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A. Věžník

Cooperation of Soviet and Czechoslovak Geographers at Svalbard

The Norwegian Arctic archipelago Svalbard belongs to territories of considerable interest for workers in many branches of science, including geography. The archipelago is considered to be a key region for the study of the regime of glaciation in the whole Euroasian sector of the Arctic. The Institute of Geography of the Academy of Sciences, USSR, carries out broad activity there. The activity hitherto of its glaciological expedition can be divided into three periods, two of them being delimited by the years 1965—1967, 1974—1985, the third since 1986 up to the present. In the two former periods the research activities were oriented to acquiring information about the composition, regime and evolution of the glaciers of the archipelago, employing the most modern methods of geophysics and geochemistry. The most important problems were the determination of the thickness of the glaciers and the relief of the underlaying terrain by the method of radiolocation, the clarification of the structure of the glaciers and their hydrothermic situation by means of deep drillholes and a comprehensive study of the glacier core (temperature, structure, isotopic and chemical composition of ice). The regime and the evolution of the glaciation were studied in time scales from a century to 100,000 years. The result of the research activity of many years are two monographs (Troitsky, L. S., Zinger, E. M., Koryakin, V. S., Markin, V. A., Mikhaliov, V. I.: Glaciation of the Spitsbergen (Svalbard). Nauka, Moscow 1975; Glaciology of Spitsbergen, ed. by V. M. Kotljakov, Nauka, Moscow 1985). The fundamental regularities of the archipelago glaciation of the above research activities can be summarized as follows:

A. The concentration of the chief mass of glaciers into the peripheral parts of the Isle of Spitsbergen and a relatively weak development of glaciation in its central part is conditioned by the growth of the continentality of the climate, above all by the diminution of the winter precipitation and the rise of summer air temperatures, which is in connection with the regime of atmospheric circulation (prevailingly western transfer of air masses along the Iceland-Kara trough). Connected with this are also further characteristics of the glaciation, such as the distribution of the zones of accummulation, ablation, peculiarities of glacier fluctuation, etc.

B. On the basis of radio-echo sounding it was determined that the maximum thickness of valley glaciers reaches 200 m, of large mountain ice caps 350—500 m, glacier plateaus and glaciers of the plains of the island of North-East Land 600 m. The underlying beds of glaciers lie below the sea level, filling considerable parts of fjords and bays, but also of channels. Overall stores of ice at the archipelago amount to about 7,600 km³ (i.e. 30 % of the volume of glaciers on the islands of the Euroasian sector of the Arctic).

C. By deep thermal boreholes were established cold, warm and two-layer glaciers. In the latter-mentioned type the upper part is cold, the lower one warm (near the pressure thawing point of ice), containing water in the liquid state. From the inside warm and also two-layer glaciers yield water also in the course of winter, which results in the periglacial icing fields. The winter discharge from the glaciers, which is of great importance for providing water for the settlements, varies from 1 to 2 l . s^{-1} at small glaciers to 100 l . s^{-1} at large glaciers.

D. The study of the balance of the glacier mass in the period of 1975—1985 indicates a prevailingly negative balance, the same as in the whole of the 20th century, which results in the retreat of most glaciers of the archipelago. Since the beginning of the present century, the glaciated area has decreased by about 2,150 km² (i.e. by 6 %), the ice volume by about 600 km³ (i.e. by 8 %). With an overall retreat of glaciers, in about 50 glaciers, on the other hand, a remarkable advance has been observed, in which some large glaciers increased their length by 7—10 km (the Bråsvell

Glacier even by 21 km and an area of 500 km²). It was calculated that if the present conditions persist, some small valley glaciers (such as Bering and Aldegonda) would thaw altogether in 70—100 years.

E. The study of ice cores from deep drill-holes has enabled the reconstruction of climatic conditions in the course of several centuries to be made. A relatively warm climate, similar to the present one, ruled the 16th century. In the 17th—19th centuries there was a cooling in the archipelago (Little Ice Age), which resulted in a mass advance of glaciers. At the end of the 19th century warming set up which culminated in the 1920's to 1930's. The onset of glaciers was also established for the periods 7,800, 4,500 and 2,500 years ago, which is in good correlation with the colder periods established by the reconstruction of the vegetation in holocene peat-bogs. On the basis of thermoluminiscence and radiocarbon dating of old moraine and marine sediments traces of three glaciations and three marine transgressions were established in the late Pleistocene (for the last 100,000 years).

In 1986 the Institute of Geography opened the third stage of research activities including the following topics:
— the determination of connections of the balance of glacier mass with the parameters of the atmosphere and the ice of the surrouding seas,
— the study of the internal processes in glaciers,
— the reconstruction of glacioclimatic conditions of the last 1,000 years,
— the establishment of the natural geochemical background and the degree of anthropogenic pollution of the environment on the archipelago,
— paleoglaciology of the archipelago in the Pleistocene and Holocene,
— the study of periglacial processes on the archipelago and their connection with glaciation,
— engineering-glaciological research,
— mathematical modelling of glacial processes with the objective of forecasting the development of glaciation at the beginning of the 21st century.

At the same time the expedition sees to newly carried out biogeographical and ecological research activities with the aim of elaborating a theory of operation of arctic geosystems, studies of mechanisms of renewal of arctic ecosystems affected by the activities of man, including the elaboration of recommendations for their recultivation.

These toasks were projected also to the 15-member geoecological expedition of the Institute of Geography of the Academy of Sciences, USSR, in 1988, working under Prof. E. M. Zinger (head of the expedition) and Dr. L. S. Troitsky (scientific head of the expedition), in which, besides glaciologists and geomorphologists, also specialists were represented from the branches of botany, zoology, and ecology.

In the period of 15 June to 24 August also three workers of the Department of Geography, Faculty of Science, J. E. Purkyně University, Brno, worked within the Soviet expedition. They were Asst. Prof. RNDr. Rudolf Brázdil, CSc. (climatology), Asst. Prof. RNDr. Milan Konečný, CSc. (geomorphology and cartography), and RNDr. Pavel Prošek, CSc. (climatology). The Czechoslovak part of the expedition was working under the auspices of the rector of Brno University, Prof. PhDr. Bedřich Čerešňák, CSc. The geographers from Brno linked up their work with their research activities within the Polish-Czechoslovak geographical expedition in 1985 in the region of Werenskiold Glacier (see Scripta Fac. Sci. Nat. Univ. Purk. Brun, Vol. 17, Geographia, No. 2, Brno 1987) and solved the following research topics:

A. *The study of the glacier ablation with respect to the parameters of the boundary layer of atmosphere and the energetic balance of its active surface*

In the upper part of the glacier East Grønfjord (φ = 77°52′ N, λ = 14°22′ E, H = 441 m a.s.l.) measurements and registrations of fundamental meteorological parameters and components of the energetic balance were carried out at synoptical terms. Every day the density of snow and the height of thawing were measured, which was also measured in the longitudinal and transversal profiles through the glacier. In the course of the whole period changes were followed in the structure and density of snow and the water reserve of the snow cover.

B. *The local climate of the glacier*

Besides the station in the upper part of East Grønfjord Glacier its climatic conditions were studied on the basis of data about air temperature and humidity and atmospheric precipitation on another two stations situated in the middle part of the glacier and at its terminal moraine.

C. *Climatic conditions of Barentsburg*

Climatic conditions of Barentsburg were studied on the basis of measurements at a standard meteorological station. For ascertaining the differences of the local climate of the settlement a network of 6 topoclimatic stations was built on the territory of Barentsburg at which air temperature and relative humidity were recorded. At a special station were recorded the individual components of the energetic balance and the temperature of the underlying beds of the tundra at the depths of 1, 5, 10, 15, 20 and 50 cm, the purpose of which was finding out the dependence of the dynamics of temperature changes in the underlying beds of the active tundra surface on its energetic balance.

D. *Contemporary geomorphological processes and their mapping*

The research was aimed at mapping the effect of human activities on the relief in the region with extensive mining activity and the anthropogenic influencing of present-day geomorphological processes, special attention being paid to erosion by running water, where by means of mathematical models the expected transformation of the relief were established. A map of anthropogenic transformation of the relief was made in the scale 1 : 10,000. A part of geomorphological research activities was also the study of the distribution, genesis and stages of development of hills with an ice core (the so-called pingo) in the region of Grøndalen, Grønfjorddalen and Colesdalen.

Besides fulfilling the above research activities the members of the expedition carried out geographical research between the settlements of Barentsburg and Longyearbyen and in the region of Pyramiden. By means of the research flights by helicopters, the Brno geographers also got acquainted with the central and the northern parts of the Isle of Spitsbergen and the Isle of Barents, making extensive photodocumentation material. For Czechoslovak TV Brno material for three thematic popular-scientific films was made. The participants of the expedition handed over, on behalf of the Rector of J. E. Purkyně University, Prof. Dr. Bedřich Čerešňák, CSc., a commemorative medals of the University to the 200th anniversary of J. E. Purkyně's birthday, to the director of the Geographical Institute in Moscow, the corresponding member of the Academy of Sciences, USSR, Prof. V. M. Kotljakov, to the Norwegian Governor of Svalbard, Mr. L. Eldring, to the Soviet Consule at Barentsburg, Mr. A. P. Romanov, and further official persons. The geoecological expedition was the first ever cooperation of Soviet and Czechoslovak geographers in the research of the Arctic.

R. Brázdil, M. Konečný, P. Prošek

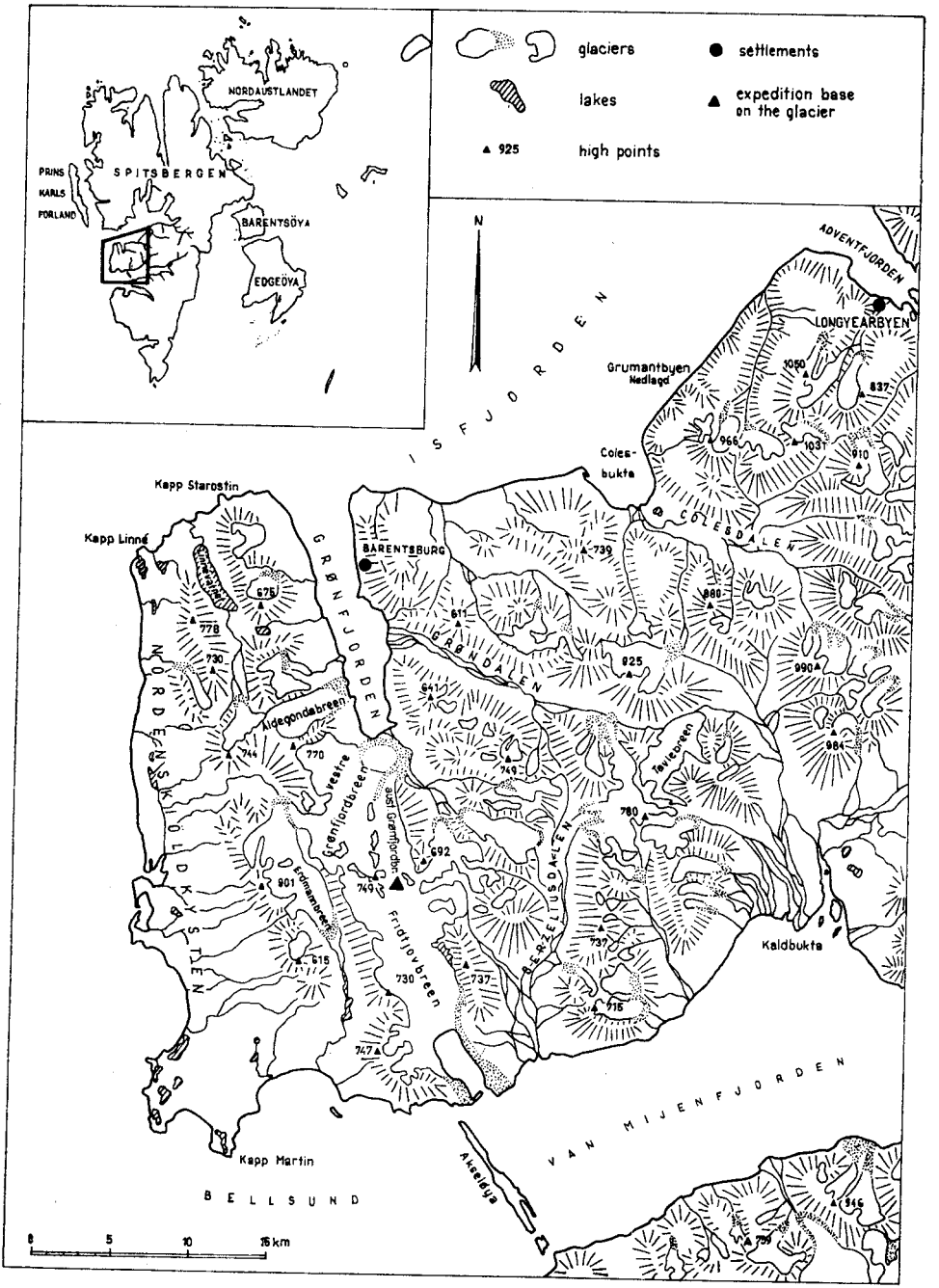

Fig. 1. Schematic map of the Nordenskiöld Land between Isfjorden and Bellsund

Fig. 2. An overall view of the glacier East Grønfjord, separated by the median moraine and Hallandkammen crest from the glacier lake and the glacier West Grønfjord (extreme right). In the left part of the picture part of the crest Siljeströmkammen

Fig. 3. View of the summit part of the glacier East Grønfjord. To the extreme right is the snow-covered peak Marcussenfjellet (749 m a.s.l.), at the background the individual peaks of the Ytterdalsegga

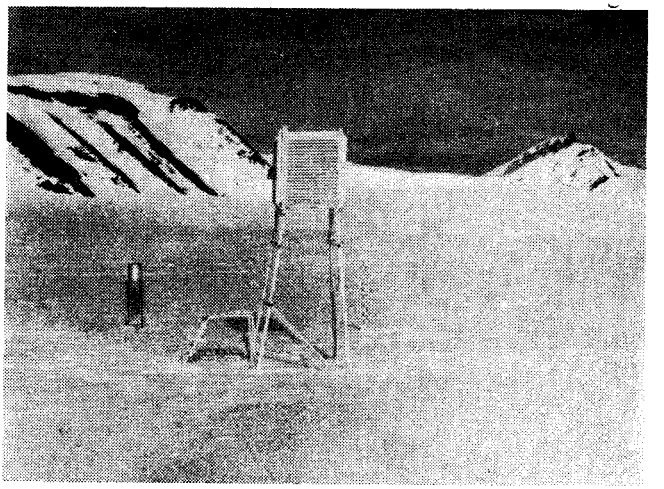

Fig. 4. The basic meteorological station in the highest part of East Grønfjord Glacier

Fig. 5. The edge part of the ice cap Jotunfonna near Pyramiden

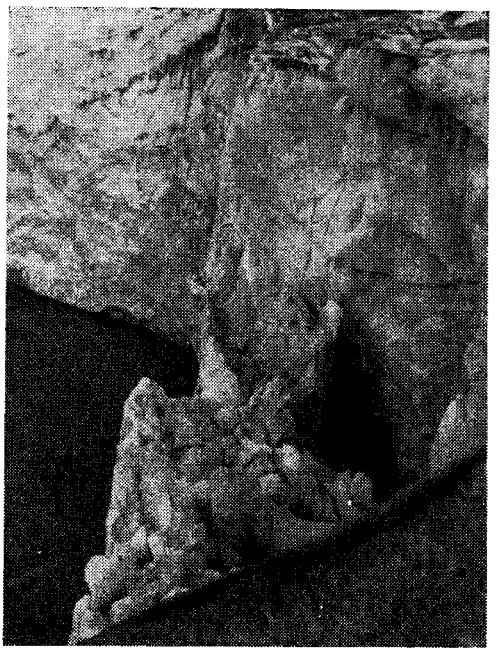

Fig. 6. The edge part of the Nordenskiöld Glacier with pieces of ice breaking away

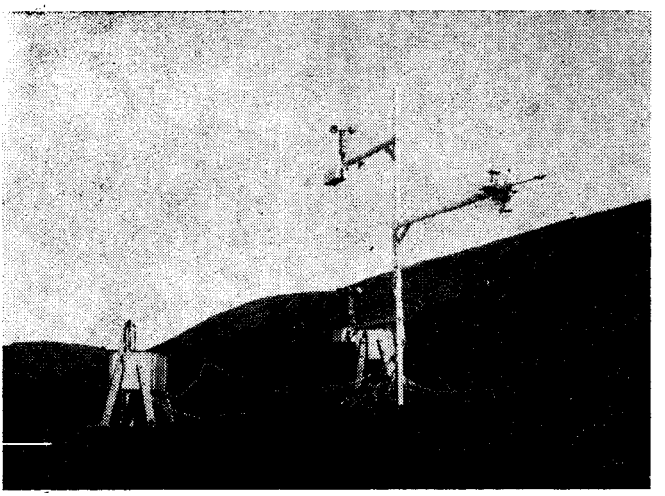

Fig. 7. The station for measuring the radiation balance and its components and for profile measurements of air temperature and wind speed at the tundra surface at Barentsburg