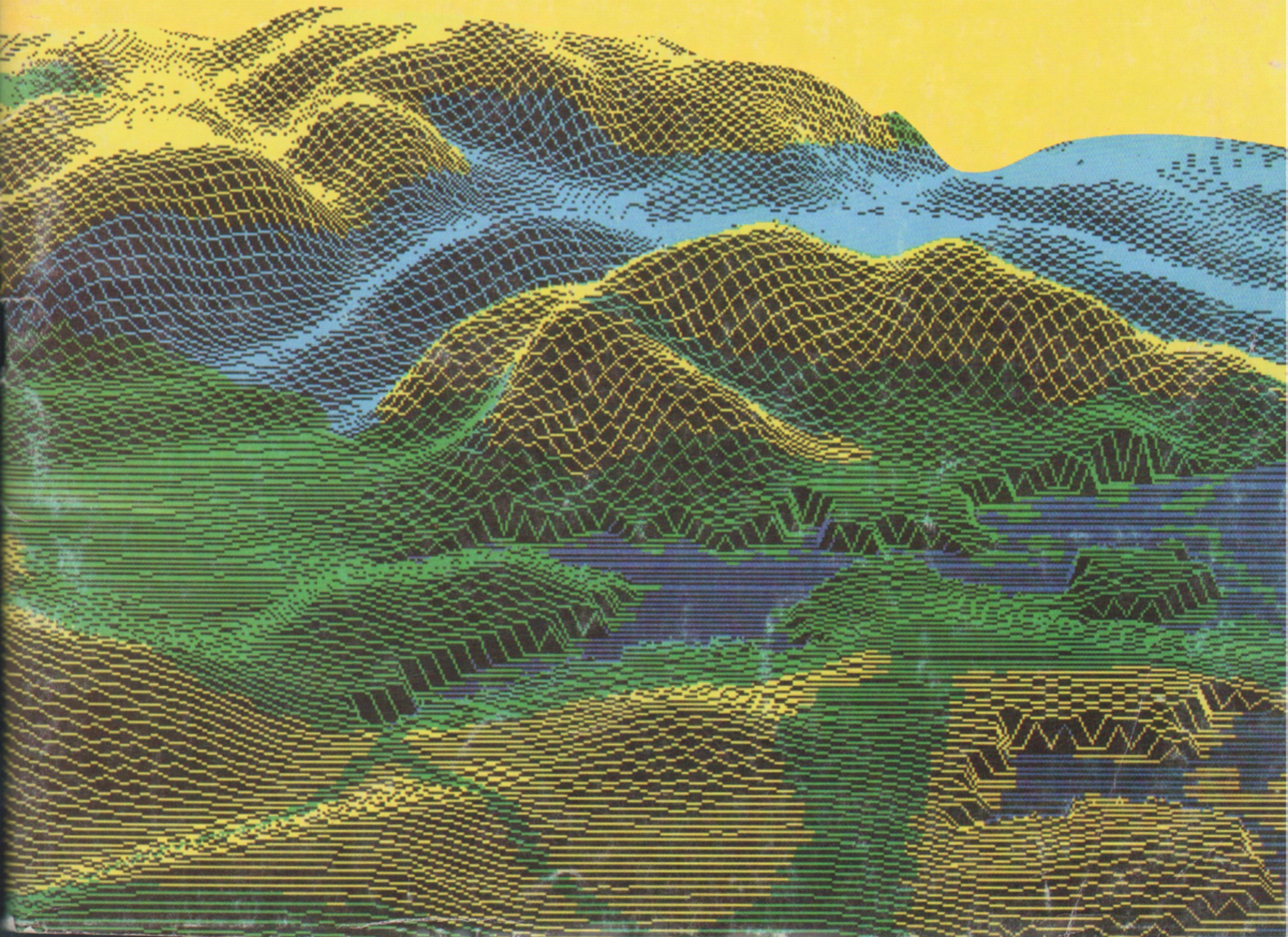
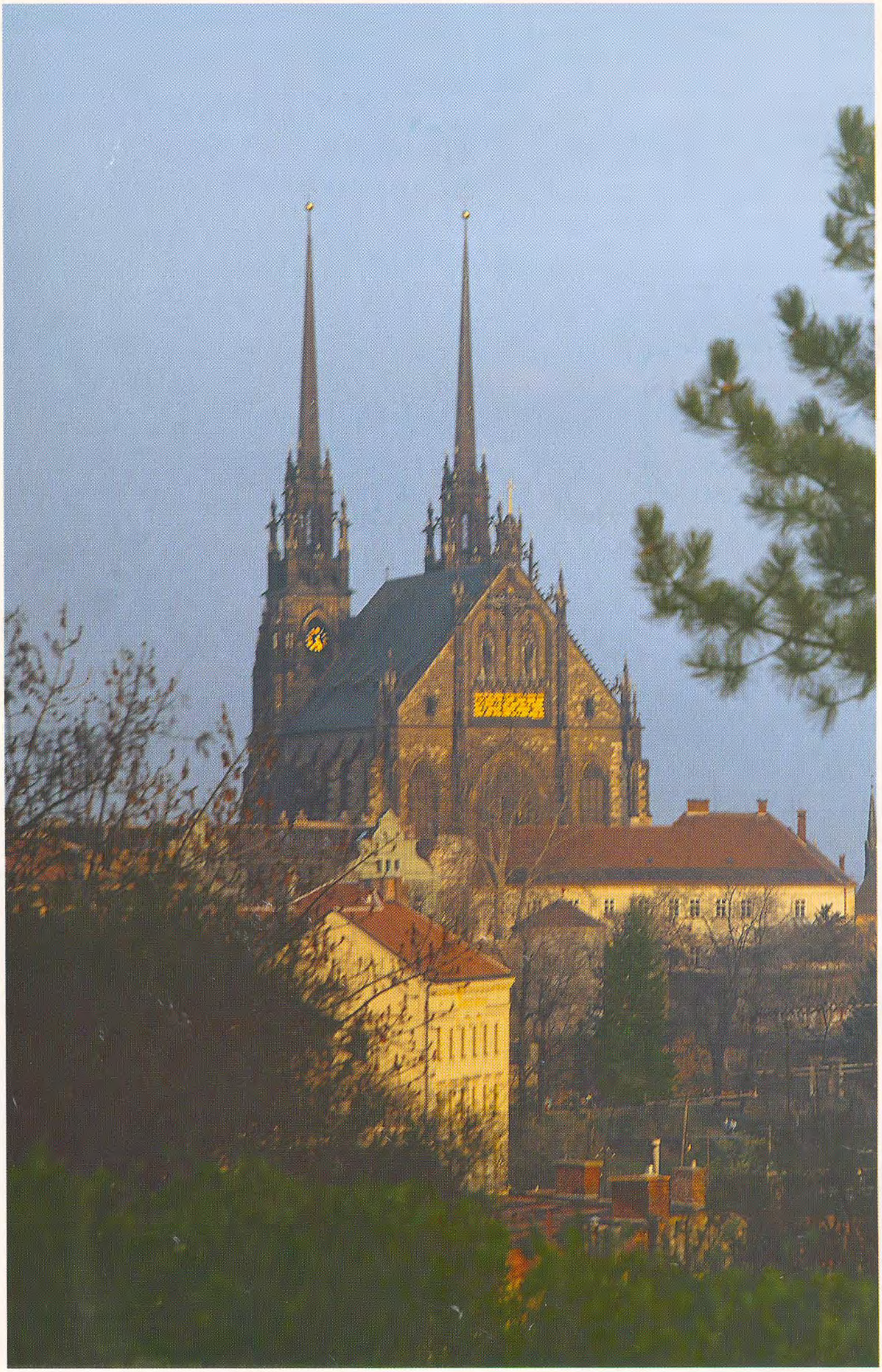
MORAVIAN GEOGRAPHICAL REPORTS

VOLUME 1 NUMBER 1,2 1993 ISSN 1210 - 8812





MORAVIAN GEOGRAPHICAL REPORTS

PRICE

Czech Republic, Slovakia 75 CZK
other countries 9.5 USD
mailing costs are counted separately
subscription (two numbers per year):
Czech Republic, Slovakia 145 CZK
other countries 17.5 USD
including mailing costs

MAILING ADDRESS

MGR, Institute of Geonics,
PO Box 29, 613 00 Brno, Czech Rep.
(fax) 42 5 578031

ISSN 1210-8812

Contents

Editorial

Jan Munzar

MORAVIAN GEOGRAPHICAL REPORTS whose first volume just appears is meant to be a professional geographical magazine openly linking up with nearly thirty years' tradition of the magazine ZPRÁVY GEOGRAFICKÉHO ÚSTAVU ČSAV (Reports of Geographical Institute of the Czechoslovak Academy of Sciences – ISSN 0587-1247) which has come to an end due to dissolution of its publisher-Geographical Institute - in 1993.

The intention to issue a new periodical was born in January 1994 at the Brno branch office of a newly established Institute of Geonics, Czech Academy of Sciences. This affiliation could provide continuity of scientific work to a team of experts from the former Geographical Institute, who were engaged mainly with environmental issues. In contrast to the original "REPORTS", new MORAVIAN GEOGRAPHICAL REPORTS (MGR) exhibit a whole range of changes of which the most visible one can be seen in language of the new periodical. With regard to its purpose, the magazine will be published in English as this is the only way how to gain regular readers and become a studied item of technical press in foreign geographical libraries. We are fully aware of the fact that success of the new periodical will also depend on linguistic standard of the texts.

A considerable change can also be seen in appearance of the magazine. The A4 format has been chosen mainly to facilitate publication of graphical, namely cartographical enclosures, which seems an important issue in a geographical journal. Similar role is played by colour cover and inner two-page spread, which should contribute to additional attractiveness of the journal. Print technologies based on computing techniques make it possible today to produce graphical standard that could never be achieved by "REPORTS". Other changes cannot be spotted at the first sight. An important novelty is cooperation with departments of geography at the faculty of natural sciences and the Paedagogic faculty of the Masaryk University in Brno as well as with the Faculties of natural sciences of the Palacký University in Olomouc and University of Ostrava. In this way, the journal will attempt at integration of Moravian academic geographers and the idea gave name to the journal, too. The concept of Morava is understood regionally, not nationally. Collaboration with geographers in Bohemia, Slovakia and in all other neighbouring countries is cordially welcomed.

At the beginning, the journal is expected to appear twice a year with its total extent being some 150-200 pages. Since the last double-issue of REPORTS OF GEOGRAPHICAL INSTITUTE OF THE CZECHOSLOVAK ACADEMY OF SCIENCES was published in 1992 (volume 29), the just born issue 1993 should be considered a bridge between the former periodical and the first regular volume of MGR. This issue is being published on the occasion of the IGU Regional Conference that will be held in Prague in August 1994. The first regular volume of MORAVIAN GEOGRAPHICAL REPORTS will be the volume of 1994.

Unlike the "REPORTS", MGR will be financed in a different way. While the "REPORTS" were fully covered from the budget of the former Geographical Institute, the MGR will operate on the basis of contributions. This means that costs are being covered from the budget of the branch office only to certain extent, the rest of income must be ensured from external sources. These income sources can be seen in sales of the journal, in advertisement activities, subsidies granted from the headquarters of the Czech Academy of Sciences and gifts from sponsors, receipts from scientific activities of the branch office. This is the reason for us to pay more attention to MGR marketing.

Publishing in MGR is opened first of all to all Moravian geographers from the Czech Academy of Sciences, universities, and other institutions which can publish their works. In addition to this, we would like to publish Moravica, ie. scientific geographical works dedicated to Moravia and its territory. Last but not least we can offer a possibility of reciprocal publishing to foreign partners of the Brno branch office of Institute of Geonics, Czech Academy of Sciences.

From the above mentioned facts we can easily deduce main objectives for publishing the MORAVIAN GEOGRAPHICAL REPORTS:

a) to facilitate publication of scientific results achieved by experts in the form that would conform to present requirements,

b) to inform the Czech and foreign professional public of a new workplace established at the Czech Academy of Sciences, engaged with geographical issues,

c) to create a basis for close cooperation of Moravian geographers in Academy, universities and in practice,

d) to facilitate continuation of literature exchange within the scope of international relations by replacing the REPORTS OF GEOGRAPHICAL INSTITUTE, with the new journal and thus improve publication possibilities for the exchange.

Success of MGR is conditioned by a whole range of factors, of course. The first of them must be sufficient amount of good standard technical papers which would reflect condition of Moravian geography. Next factor would be sufficient funds in the conditions of ever increasing printing costs. However, the MORAVIAN GEOGRAPHICAL REPORTS would never see light of the world without enthusiasm of editors who ensure technical, graphical and linguistic respects of the journal, and - of course - without proper joint work of the whole board of editors. Even here we can claim that human factor is the most important element of any effort.

We would like to wish to the newly born periodical MORAVIAN GEOGRAPHICAL REPORTS that it becomes soon a beneficial contribution among geographical journals in Central Europe, that it can contribute to learning geography of Moravia historical region, that it can join international scientific collaboration in the field of geography. The editorial board will expect response from readers to the intention of issuing this new periodical as well as to individual papers published.

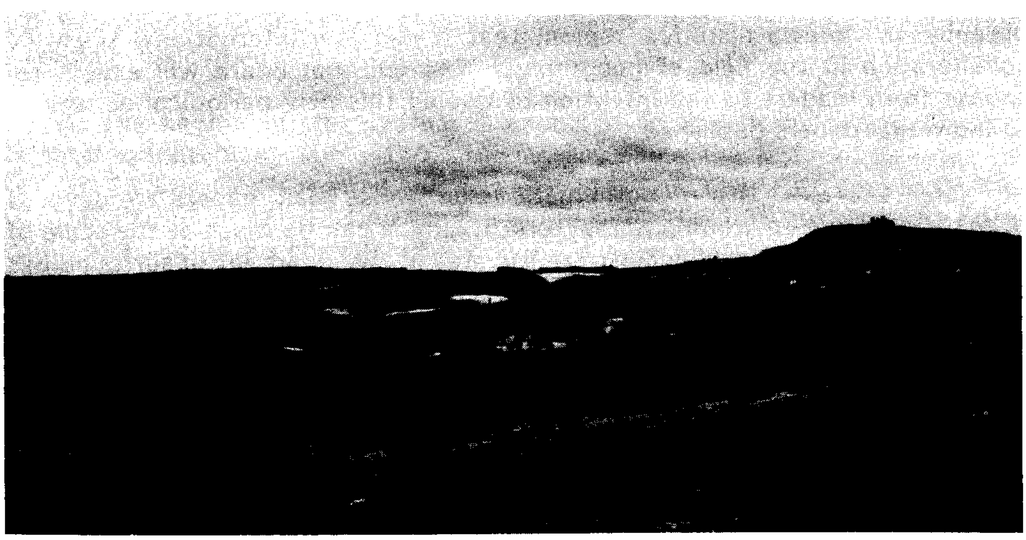
Issue 1-2/1993 is a monothematic issue whose main papers are devoted to mapping some environmental factors. Example can be maps at the scale of 1:50 000, sheet Brno, which illustrate the area in NW quadrant of surroundings of this south Moravian metropolis. Five such maps are enclosed. Our idea was that the reader of the first issue gains more than a mere text for the same price. Therefore readers will perhaps excuse the fact that the maps have not been specially made for MORAVIAN GEOGRAPHICAL REPORTS.

About Moravia and Moravian Geography

Moravia is a historical territory situated in eastern parts of the Czech Republic, the second of constituent lands of the Czech Crown (Bohemia, Moravia, Silesia). Its geopolitical position has always been favourable as Moravian Gate is the lowest point of main European watershed. The Moravian Gate represents a magnificient natural corridor which makes possible contacts with countries to the south of Danube as well as with those near Baltic Sea, and which has always meant an important trading route. As early as in the work of the greatest ancient geographer Claudian PTOLEMAIOS from the mid-2nd century, the geographic image of Moravia appeared in more details than that of Bohemia. In the 9th century, Moravia became a core of the Great Moravian Empire which was a craddle of Christianity and culture for entire East Europe. After the Empire had been disrupted by Hungarians in 907, the centre of national development had to be transferred to Bohemia.

Since the 10th century, the Moravian territory appeared very similar to its present form. Despite being always firmly connected with Bohemia, Moravia never lost its administrative independence. Margraviate of Moravia as an administrative formation within the Czech state came into existence in 1182. Eventful history of Moravia is a history of the country which was situated right on the border line between the West and East of Europe, and on the way between its North and South. This fact not only resulted in penetration of different cultural influences, but also in frequent wars and violence. Moravia has given a whole range of famous personalities to the world, of whom let us mention paedagogist Jan Amos KOMENSKÝ (Comenius), and founder of the first Czechoslovak state, and its first president Tomáš Garrigue MASARYK. In overseas countries, Moravia is sometimes being put together with the Church of Moravian Brethren, religious exiles after the Battle at Bílá Hora, followers of Jan HUS and Jan Amos KOMENSKÝ.

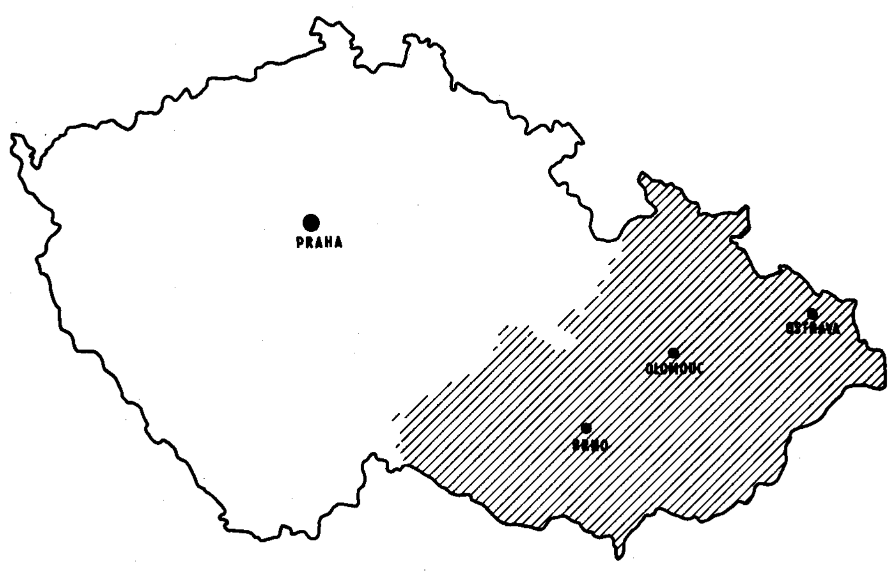
After constitution of the independent Czechoslovak Republic in 1918, Moravia was a land with area of 22 304 km^2: this represents approximately 28% of the present Czech Republic. After a system of regions had been introduced in 1949, Moravia became extinct as an administration unit, and at the territorial reform of 1960, even the historical border between Bohemia and Moravia was ignored. However, the poll survey of population, houses and flats made in 1991 as well as other symptoms indicated that historical awareness of Moravian population is still alive, and manifests itself in the sphere of culture and mentality of inhabitants. At present, there are approximately 4 million inhabitants living in Moravia. Post-revolution euphoria has given once again rise to the issue of Moravian rights, which is not presented as a problem of separation but as that of territorial self-government, though.



Pavlovské vrchy *Photo: O. Mikulík*

Moravian geography has a long-term tradition. Its beginnings and development were described in comprehensive works of František VITÁSEK (1890 – 1973). This author of the first Czech three-volume university textbook of physical geography from 1934 - 1939 has organizational deserts for development of the discipline beside his extensive scientific and paedagogic work. Right in 1945, after a forced six years break caused by closure of Czech universities by Nazis, he began with renewal of the Geographic Institute at Masaryk University in Brno. He also took part at building the geographical institute at Palacký University in Olomouc, and in 1952, when the Czechoslovak Academy of Sciences was founded, he was appointed with creation and leadership of its Cabinet for Geomorphology in Brno, which became a nucleus to the later Geographical Institute of the Czechoslovak Academy of Sciences (1963). In his works on Moravian geography, F. VITÁSEK paid attention to both the works concerning Moravian region and to research scientists who worked in Moravia and were devoted also to wider geographical issues. We can say – the field of interest, which was very close to that of our new journal.

Present Moravian geography is centred in three largest and most significant Moravian cities: Brno, Olomouc, and Ostrava. The three largest workplaces have about twenty scientific and professional workers each. Besides the Brno branch office of the Institute of Geonics, Academy of Sciences of the Czech Republic (AV ČR), it is the department of geography at the Faculty of Natural Sciences, Masaryk University, and the department of geography at the Ostrava University. The department of geography at the Paedagogic Faculty, Masaryk University, and the department of the geography at Palacký University – are smaller workplaces. Other geographers are individually engaged at further faculties and universities or other institutions where they ensure an irreplaceable geographical view of reality. The number 1/1994 of MORAVIAN GEOGRAPHICAL REPORTS will present "Orbis geographicus bohemomoravicus", from which present workplaces of the Moravian geographers will be recognisable.



Institute of Geonics, Czech Academy of Sciences, Brno Branch (its origin, structure, scope of scientific activities)

Antonín Vaishar

Introduction

The Institute of Geography of the Czech Academy of Sciences was cancelled after 30 years of its existence on 30 June, 1993 within the process of transformation. Only several scientists found new possibilities to continue in their investigations within the Academy of Sciences. They constituted the Brno branch of the new Institute of Geonics on 1 May, 1993. The headquarters of the Institute is located in the second largest Moravian town Ostrava. This part of the Institute originates in the former Institute of Mining.

Ancient seat of the Institute of Geography in the Old Brno Monastery was given back in 1990 – 1991 to the Augustinian Order of St. Thomas and only the Library continues on the Mendel's Square. The branch has obtained a pleasant house with a garden on 28, Drobného Street in the neighbourhood called Černá Pole. A smallish house on 195, Veslařská Street in another part of the city also belongs to the Institute, as well as the base in the Moravian Karst ("Salmovka" house) near the county town of Blansko.

Twenty scientists and five technicians form a team of specialists working at the branch. The list of scientists including their topical specialisations is enclosed. It is not expected that the existing number of workers would increase. Idea of the branch was based on efforts aimed at establishing a "Centre for Regional Research of Environment" launched two years ago. Not only the research programme, but also the model of management originate from that activity.

The Branch is oficially defined as a "Centre for Environmental Geography", Institute of Geonics. The main scientific programme of the Branch consists in "Regional Evaluation of the Environment under Conditions of Economic and Social Transformation". The programme consists of institutional tasks (paid from the budget), grants, implementation tasks (paid by customers) and tasks of international co-operation. The programme is managed by the Council of Programme led by dr. MIKULÍK.

Structure of institutional programme

1. Environment Development in Regions of Various Types
Investigation is based on repeated research in model regions. Main model regions are: the Ostrava agglomeration as an example of urban and industrial region with difficult structural changes; the south Moravian region as an agricultural region with traditional culture; the Žďárské vrchy Mts. as an example of recreational region with protected landscape areas.

2. Geosystems in the Czech Republic from Environmental Viewpoint
The topic provides knowledge about environmental development in the territory of Moravia and the whole Czech Republic.

3. Environmental Studies in Urban Agglomerations and Settlement Systems
The topic is focused on urban aspects of environment. Its methodology is based on concepts of "Dwelling Environment", "Social Environment and its Perception", "Environment Evaluation of Territorial and Functional Structure of Towns" and a concept of "Town – Hinterland". The Brno agglomeration and the Ostrava agglomeration are supposed to be the main regions of interest for the study.

4. Regional Differentiation of the Quality of Life
The viewpoint of this research is social dimension of environment. Aspects of medical geography are taken into account, too.

5. Remote Sensing Methods for Landscape Use and Environment Management
The Branch intends to apply the original method of Low-Altitude Scanning among usual sensing methods.

6. Regional Information System and Environmental Cartography
A purpose-made regional information system is taken into account. It consists of statistical and graphic data. Computer maps are one of the most frequent supposed outputs from the system.

7. Programme of multilateral international co-operation "Regional Fundaments of Eco-development". The programme consists of seven topics related mostly to six basic points of the institutional programme:
- Environmental Issue in Europe,
- Ecological Aspects of Socio-Economic Transformation in Different Regions,
- Regional Environmental Problems of International Origin, Inter-regional Relationships and Barriers,
- Evaluation and Forecast of Large Technical Objects Impacts on Environment,
- Comparative Studies of Environmental Problems in Big Cities and Urban Regions,
- Regional Differentiation of Quality of Life as a Consequence of Environmental Transformation,
- Environmental Maps for Central and East Europe.

Grants, implementation tasks

Grants of the Czech Academy of Sciences, Grant Agency of the Czech Republic and Ministry of Environment were used till this time. For 1993, eight grant projects were supported with nearly 600 thousand CSK. Their structure was as follows:
- Anthropogenic Impact on Course and Character of Karst Water
- Anthropogenic Transformation of Relief and Possibilities of its Assessment
- Prognoses of Underground Water in Relation to Geographical Conditions
- Evaluation of Elements of the Karst Environment and its Positive Influence on Infant Organism
- Possibilities of Detection of Climatic Changes in Historical Period
- Complex Geomorphological Analysis of the National Park "Podyjí"

- Danger to Some Towns, Villages and Important Technical Works in the Czech Republic caused by Natural Hazards
- Development of Slopes in Periglacial Period

Some realizational tasks in total volume of about 600 thousand CSK were resolved for various customers. The most important of them were:
- Regional Study on Protected Landscape Area "Žďárské vrchy Mts." for Ministry of Economy,
- Assessment of Geomorphological Investigation on the Bohemian – Moravian Highland Mts. for Czech Energetic Enterprise,
- Physical Geographical Characteristics of Regions of Water Reservoirs Letovice, Boskovice and Těrlicko for Agency HYDROEKO.

Grants and orders covered financial requirements of the Branch to one third.

International relations

The following main goals were defined in the field of international relations:
- to renew the co-ordinational role of the Branch in multilateral scientific collaboration within the programme REGIONAL FUNDAMENTS OF ECO-DEVELOPMENT,
- to organize biennial scientific conferences CONGEO from 1995,
- to utilize the IGU Regional Conference Prague 1994 for better collaboration with IGU commissions and study groups,
- to deepen collaboration with IALE within the study group "Landscape Synthesis",
- to widen bilateral relations with geographical institutions of central and western European countries,
- to take part at international conferences held in European countries.

Collaboration with universities

Geography is one of the basic subjects of general education of population. The relation between man and nature is one of new topical aspects of the subject. It is the basis for collaboration of the Branch with universities and other schools. It is oriented to Moravian Universities – Masaryk University in Brno, Palacký University in Olomouc and University of Ostrava.

Joint activities such as CONGEO conferences and MORAVIAN GEOGRAPHICAL REPORTS are to be main stimulations for collaboration which is daily filled with usual relations in educational and personal processes as well as with processes of investigation.

Editorial activities

Aims of editorial activities of the branch are as follows:
- to crown the scientific process with publication of its results,
- to publicize a new scientific institution in scientific world,
- to achieve a possibility of exchange of scientific literature,
- to enable publishing of scientists of the branch and co-operating universities.

MORAVIAN GEOGRAPHICAL REPORTS form the base of editorial activities of the Branch. It indirectly links up with the series "ZPRÁVY" of the former Institute of Geography which ended with its 29th volume – 1992. Main differences should be seen in the fact that Moravian Geographical Reports are issued in English and in co-operation with departments of geography at Moravian Universities.

Monographs or miscellaneous will be issued mostly within the series STUDIA GEOGRAPHICA which continues from the Institute of Geography. The Institute of Geography has published 95 items of this series.

List of scientists and technical workers

RNDr. Tadeáš CZUDEK, DrSc. [1] – geomorphology,
RNDr. Kateřina ČÚZOVÁ – cartography
Ing. Jitka FICOVÁ – technical editor, graphic
RNDr. Sylvie HOFÍRKOVÁ – scientific technical services
RNDr. Mojmír HRÁDEK, CSc. – geomorphology
RNDr. Antonín IVAN, CSc. – geomorphology
RNDr. Karel KIRCHNER, CSc. – geomorphology
RNDr. Miroslav KOŽELUH, CSc. [1] – scientific information
RNDr. Hubert KŘÍŽ, DrSc. – hydrology
Ing. Jan LACINA, CSc. [1] – biogeography
RNDr. Oldřich MIKULÍK, CSc. – social geography
RNDr. Jan MUNZAR, CSc. – climatology
RNDr. Vítězslav NOVÁČEK, CSc. – remote sensing
RNDr. Stanislav ONDRÁČEK – hydrology
Ing. Jan POKORNÝ, CSc. – computer specialist
RNDr. Evžen QUITT, CSc. – climatology
Eduard SEVERA [2] – librarian
Jiří TRNKA – technical services
RNDr. Antonín VAISHAR, CSc. – human geography
Mgr. Pavel VICHEREK – population geography
RNDr. Vladimír VLČEK [1] – hydrology
RNDr. Jana ZAPLETALOVÁ, CSc. – transport and tourism geography

Address of the Branch:
613 00 Brno, P.O.Box 29, tel. (42 5) 45211901, 577123, fax. (42 5) 578031
[1] – 637 00 Brno, Veslařská 195, tel. (42 5) 336657
[2] – 603 00 Brno, Mendlovo náměstí 1, tel. (42 5) 43212028

Bodies of the branch (May 1994)

Head of the Branch: Antonín Vaishar
Member of the Academic Council of the Academy of Sciences: Mojmír Hrádek
Members of the Scientific Council of the Institute of Geonics: Antonín Ivan, Oldřich Mikulík
Council of the Scientific Programme: President Oldřich Mikulík
Editorial Board: President Jan Munzar
Commission for Scientific Education: President Antonín Ivan

There are two private associations connected with the Branch. REGIOGRAPH, Association for Regional Prosperity elaborates regional studies of various kinds, whereas Association GEOKONFIN organizes conferences and other events for the Branch.

A Brief Survey of Main Results Achieved by Institute of Geonics, Brno Branch Office, in 1993

Antonín Vaishar

The branch office in Brno came into existence on 1 May, 1993 through delimitation from the former Geographical Institute, Academy of Sciences, Czech Republic. In fact, its workers were engaged with a whole range of problems associated with liquidation of their former workplace, physical movement into the new premises as well as with formation of a new system of work at the new workplace as long as until winter months. This is why the results achieved in 1993 may seem rather modest.

Main results

The most significant outcome can be seen in a study made into the protected landscape area Žďárské vrchy (Hills) – problems of environment. (Updating some landscape segments, confrontation issues of natural environment).

The study includes an analysis of conflicts between anthropogenic activities and biotic values of the Protected Landscape Area Žďárské vrchy with special emphasis being put on ecologically important landscape segments as well as on an analysis into confrontation issues of environment. It tackles issues of the present condition of biocoenoses, anthropogenic forms of relief, erosion problems, the conflict of interests between protection of water resources and air pollution. The study is supplemented by a collection of cartographical enclosures made at a scale of 1 : 25 000 and illustrating geomorphological situation (anthropogenic forms of relief, erosion, hydrogeographical problems), biogeographical situation (skeleton of landscape ecological stability), and mesoclimatic situation. The study was made for Czech Ministry of Economy.

Other outputs — with no regard to their importance — were as follows: Geomorphological inventory of some relief forms in the National Park Podyjí (Dyje River Catchment Area).

A geomorphological inventory was made of rocky micro- and mesoformations and accumulations which came into existence namely through periglacial processes, mechanical and chemical weathering, and moving away slopes in the zone of Vranov nad Dyjí – Hardegg which is built by rocks of the Dyje river dome. Attention was also paid to basic geomorphological features of incised river meanders, defining pattern of the Dyje valley. The study was made for Czech Ministry of Environment.

Definition of environmentally susceptible areas and areas of environmental degradation in the catchment basin of Morava River.

The map includes identification of potential geomorphological hazards as well as identification of areas afflicted with severe erosion, loaded with airborn pollution substances, endangered groundwater resources, and degradation of vegetation cover. The study was ordered by Research Institute of Water Management of T.G. MASARYK.

Protection of floodplain shallow groundwater resources from negative impacts of water streams on their ampleness and namely on water quality.

The study was a part of the project named "Ensuring good standard drinking water for inhabitants" which was integrated in the complex Programme of Environmental Protection led by the Czech Ministry of Environment. It contains a report on observation of shallow subsurface watertables in the floodplain of Morava river and water situations in its relief arm, sample analyses, maps of hydroisohypes with using a mathematical model.

A set of works named Physio-geographical characteristics of some water reservoirs.

The studies tackle problems of water reservoirs at Letovice, Boskovice and Těrlicko, analyzing their physical and geographical conditions, namely characteristics of their vegetation cover as a basis to define extreme fluctuation of water level within the space of reserves and buffer zones. Contents summarize the present situation, recommended measures and suggestions for further research. The project was ordered by HYDROEKO Ltd.

Grant Projects

The following grant projects supported by the Grant Agency of the Academy of Sciences of Czech Republic were terminated in 1993:

No. 31406, Anthropogenic Activities: Their Impact on Regime and Properties of Karst Waters,

No. 31411, Anthropogenic Transformations of the Relief and Possibilities of Their Assessment,

No. 31425, Prognoses of Subsurface Water Regime as Related to Altering Geographical Conditions,

No. 31451, Evaluating the Elements of Spelaeous Environment and Their Positive Influence on Child Organism,

No. 31459, A Complex Geomorphological Analysis into Relief of the National Park Podyjí.

Foreign Relations

There were no valid agreements with workplaces in foreign countries to be passed on the Brno Branch Office from the dissolved Geographical Institute of Czech Academy of Sciences. The foreign relations are being built here practically from the beginning and are mostly based on personal contacts with abroad. A cooperation agreement has been signed with the Institute of Geography and Spatial Organization, Polish Academy of Sciences, Warsaw.

The Kiev meeting has confirmed a coordination role entrusted to the Branch Office at implementing the international programme, Regional Fundaments of Eco-development, appointing it with a task to find some legal forms for cooperating as joint workplaces. An author's original of the "Map of Landscape Use of Central Europe" for the Czech Republic, was finished within the programme (coordinator being Prof. RICHLING – Warsaw) and data gathered for the map of "Effects of political and economic transformation in Central and East Europe up to 1992", (coordinator being dr. NEFIODOVA – Moscow). Both maps are to be published by the Austrian Institute for Eastern and Southeastern Europe in 1994.

Experts from the Brno Branch Office are deeply involved in preparing the regional conference IGU 1994 in Prague by ensuring organization and contents of workshops for individual committees. The Branch Office has also started organizational work at preparing the meeting of IGU Commission "Health, Environment and Development".

Altogether eleven business trips abroad were made by fourteen workers of the Branch Office in the second half of 1993, of which 6 were to conferences held in foreign countries, 2 were study stays, and 3 concerned concrete discussions on collaboration. At the same period of time, the Brno Branch Office was visited by three foreign experts, ie. from France, People's Republic of China, and Poland.

South Moravian *Photo: O. Mikulík*

THE GEOMORPHOLOGICAL MAP OF BRNO SURROUNDINGS

Antonín Ivan – Mojmír Hrádek

Abstract

Positive development in geomorphology in the course of the last tens of years has been related to increased interest in studying formations and processes induced by man at economic exploitation of the landscape. Attention is being paid to some types of anthropogenic transformations of relief-both direct and indirect. The trend has also been reflected in geomorphological mapping, and authors of the map attempted at application of the principle in the surroundings of Brno. Decisive importance for relief formation in this area is being assigned to previous tectonic development on the margin of Hercynian platform with incorporated older units (Brunovistulicum), varied lithological rock composition and neo-tectonic movements related to collision of the platform edge with Carpathian-Pannonian blocks and rise of marginal flexure of the Bohemian Massif. The above events and features led to a mosaic of formations and relief types of which many have a unique character. Basic characteristic is presented of the relief types along with more detailed classification of their shapes including anthropogenic ones that are related to development of the town.

Shrnutí

Typy reliéfu a vybrané tvary

Pozitivní vývoj v geomorfologii posledních desetiletí je spojován se zvýšeným zájmem o výzkum tvarů a procesů vyvolaných člověkem při ekonomickém využívání krajiny. Upozorňuje se na některé typy antropogenních transformací reliéfu, přímé i nepřímé. Tato tendence nalezla odraz i v geomorfologickém mapování a bylo snahou autorů mapy uplatnit tento princip i v okolí Brna. Určující význam pro utváření reliéfu této oblasti měl předchozí tektonický vývoj na okraji hercynské platformy, do niž byly inkorporovány i jednotky starší (Brunovistulicum), pestré litologické složení hornin a neotektonické pohyby, mající souvislost s kolizí okraje platformy s karpatsko-panonskými bloky a vznikem okrajové flexury Českého masívu. Zmíněné vlastnosti a události vedly ke vzniku mozaiky tvarů a typů reliéfu, které mají řadu jedinečných rysů. Je podána základní charakteristika typů reliéfu a detailnější klasifikace jejich tvarů, včetně antropogenních, majících vztah k rozvoji města.

Key words: marginal flexure of the Bohemian Massif, Carpathian depression, West Carpathians, relief of Hercynian platform, neo-tectonic movements, basins and furrows, anthropogenic transformation of relief

1. *Introduction*

Progress in geomorphology in the last decades is characterized among others also by intensive study of man-made landforms, changes of intensity in geomorphological processes caused by man, and expansion of methods of geomorphological mapping. At present, geomorphologists participate ever more in solution of practical environmental problems and many of them are directly or indirectly related to disastrous exploitation of renewable and non-renewable natural resources. The surface of Earth as planetary source (D.R. COATES, 1981, p. 20) is damaged by activity of man very severely and it has even been proposed term of "relief pollution".

Classification of relief as a planetary resource is to a certain extent controversial. In strictly geometrical meaning the relief is thought to be a two dimensional surface on the contact between the litosphere and atmosphere (subaerial) or hydrosphere (subaquatic), and is materialized by rocks and soils. In actual cases, the existence of surface relief and relief forms is understandable only in the contex of landscape. We can visualize a landscape without atmosphere, hydrosphere and biosphere but not without the solid rock (or soil) surface and landforms.

Although practical importance of land surface and its changes due to intervention of man is quite evident, it is not yet sufficiently appreciated. Only in the last decades, anthropogenic geomorphology attempts at overcoming the existing gap in research and even some new text-books have been published. The geomorphological terms used for subaerial surface of lithosphere are relief, georelief or terrain, the last two beeing less common. In general, the relief of earth surface is–as a rule–thought to be land (as opposite to sea), or an area which is suitable for different types of human activities, rather than concrete relief forms in strictly geomorphological sense. Geomorphologists also classify the relief as mostly not renewable or non-renewable resource, but by other criteria such as morphometry, morphography, genesis and age of landforms. In practice, it is important to evaluate the relief just from the point of view of its availability for different social and economic activities, (e.g. agriculture, traffic, military purposes).

At present, man with his technology is a very important geological and in some places even dominant geomorphological agent which has assumed arrogantly rights of unlimited usage of all natural resources. Through his activities he permanently and inventively transforms the earth surface, often in opposite sense than would natural forces and processes do. No wonder that the man very often disturbs natural equilibrium and as a result he must attempt to bring more and more geological and geomorphological processes under his own control, not only exogenous but now also endogenous. To geomorphologists the present participation in solution of important environmental problems provides better professional satisfaction, but it is truth that problems of this type are not always sufficiently attractive for them. At the same time, anthropogenic changes of relief and landscape are seemingly the less urgent problems than air and water pollution and destruction of forests. On the other hand, environmental impacts of human interference into the relief are more visible and of longer duration in the landscape.

Types of human interference into the natural relief are very different and we have proposed the general term anthropogenic relief transformations (ART) for them (A. IVAN – K. KIRCHNER 1988). Two different categories of ART are distinguished. The direct ART consist in true man-made forms which originated by intentional transfer mainly of earth materials by man (quarries, open-mines, dumps, dikes, dams, canals etc.) On the other hand, the indirect ART are represented by secondary, unintentional and mostly negative effects of different human activities, which either modify intesity of existing geomorphological processes (e.g. accelerated soil erosion, landsliding after deforestation) or induce new relief forms such as subsidence depressions due to underground mining, landslides in quarries or abrasion cliffs in man-made lakes (dams).

Substantial progress in geomorphology in the last three or four decades has brought in the geomorphological mapping. Geomorphological maps can provide most exhaustive information about all aspects of relief including anthropogenic relief transformations and changes of landscape. Thus, geomorphological mapping is helping to better understanding of landscape relief, gathering more complete data bases and minimizing fashionable themes in geomorphology.

At the beginning, the geomorphological maps were compiled according to much different principles and different legends. Many national schools existed and great effort was devoted to international cooperation and unification of geomorphological map legends. This effort has been succesful mainly in cooperation concerning small-scale geomorphological maps (The International geomorphological map of Europe 1:2,5 mil.). As to large-scale geomorphological mapping, the situation is less satisfactory. The present detailed geomorphological maps are rather different and unification of their legends is more difficult. Apparently, the cooperation in construction of small-scale maps that emphasize mainly relief types or macroforms is easier. But up to now, great differences have been existing in use of this method in different countries (e.g between continental Europe and English-speaking countries).

The general and applied geomorphological maps are two basic types of these thematic maps. Both types have been constructed and prepared for scientific and practical purposes (mineral prospecting, regional planning, study of present-day geomorphological processes including natural and induced catastrophes). Discussions about different types of geomorphological maps and their importance for practice were very characteristic, especially at the initial phase of the mapping (J.P. BAKKER 1963, D.A. ST-ONGE in R.W. FAIRBRIDGE ed. 1968, J. DEMEK ed.1972). In Czech geomorphology both types of maps have been constructed, too (J. DEMEK 1969, A. IVAN 1971, M. HRÁDEK 1988). In fact, some applied geomorphological maps are very specialized (e.g. morphostructural).

2. *Geomorphology of surroundings of Brno city*

2.1 *Geological and geomorphological position of the area*

Brno area is situated at the contact of two very contrasting geological and geomorphological systems of the Czech Republic, namely that of ancient structure of the Bohemian Massif consolidated definitively during Hercynian orogeny with a much younger alpine-type structure of West Carpathians. It is the region " where the more or less subparalell Variscan and Alpine orogens with opposite vergencies are overlapping" (Z. STRÁNÍK et al. 1993).

Although the outermost part of the West Carpathians originated as a depression of Carpathian Foredeep built of weak Tertiary and Quaternary sediments, topographic contrast between the two systems is not very distinct in surroundings of Brno. The line of contact is very irregular on the map. Many promontories or even islands of basement rocks of the Bohemian Massif rise above Tertiary deposits which, on the other hand, protrude into the massif like embayment-shaped depressions. There is no doubt that Brno is situated in the area of the Bohemian Massif, but its considerable part is to be found in a depression widely opened to the Carpathian Foredeep. Foothills of the West Carpathians elevation structure built by Paleogene flysch are only 20 km to SE of Brno.

The Bohemian Massif with very heterogeneous and complex block structure is a part of the West European platform.The most eastern marginal part of massif designated as Brunovistulicum differs from other parts by its geological structure and relief evolution. Together with pre-Hercynian granitoid rocks the Paleozoic sediments (Devonian, Carboniferous and Permian) are very characteristic and take part in complicated structure of the basement. Opinions about geotectonic position of this marginal block of the Bohemian Massif have been changing substantially in the last two or three decades, partly in connection with new ideas, e.g.tectonic terranes (A. DUDEK 1980, M. SUK et al. 1984, Z. MÍSAŘ – A. DUDEK 1993). Now it is believed to be originally a part of the Fennosarmatian platform incorporated later as a strange geotectonic element into morphostructure of the Bohemian Massif.

In the post-Hercynian period, eastern part of the Bohemian Massif has become a passive margin of a platform which was gradually underthrust below the Carpathian-Pannonian plate (Z. STRÁNÍK et al. 1993). From the morphostructural point of view, the margin of Bohemian Massif is the uppermost part of a great flexure complicated by longitudinal and cross faults that descends to the Southeast and is buried by sediments of the Carpathian Foredeep and flysch nappes.

In the system of geomorphological division of Bohemian Massif its eastern marginal part in surroundings of Brno (corresponding to Brunovistulicum) belongs to the Brněnská vrchovina (Highland). This area is presented in eastern and middle part of geomorphological map. In contrast, western part of the map sheet belongs to the Českomoravská vrchovina (Highland), a huge unit built predominately by metamorphic rocks with different tectonic structure (Moravosilesicum) and relief.

2.2 *Brněnská vrchovina (Highland)*

Importance of tectonics and lithology is a deciding factor of division into low-order geomorphological units (morphostructures) in present relief of the Brněnská vrchovina (Highland). Both influences of late-Hercynian tectonic movements and post-Hercynian germanotype tectonics in relief of this very exposed marginal block of Bohemian Massif are perceptible. Reccurent marine transgressions accompanied with fossilizations and exhumations of planation surfaces in Mesozoic and Tertiary were another complicating factor in evolution of the relief.

The Brněnská vrchovina (Highland) consists of three geomorphological units: Boskovická brázda (Furrow), Bobravská vrchovina (Highland) and Drahanská vrchovina (Highland).

a) The Boskovická brázda (Furrow) is a narrow tectonic depression wide only 5 – 7 km which coincides with a very old deep Boskovice - Diedendorf fault near the contact of Brunovistulicum with Moravosilesicum (Z. MÍSAŘ – A. DUDEK, 1993). The depression originated as a late-Hercynian halfgraben of NNE-SSW direction which was filled with Upper Carboniferous and Lower Permian continental deposits, in some places with coal seams.

Present topography of the furrow characterized by small basins (with rests of Miocene marine sediments) separated by low hilly thresholds has resulted from differential erosion and tectonic remobilization in Tertiary. Due to this fact, the topographic depression in not so wide as the original graben structure. Another interesting phenomenon is drainage across the depression.

The largest partial basin in surroundigs of the town of Tišnov is situated at the crossing of Boskovická brázda (Furrow) and Železnohorský zlom (Fault) from NW-SE. In this basin isolated subsided blocks of Devonian limestones are interpreted as fossil karst inselbergs by V.PANOŠ (1964).

b) The Bobravská vrchovina (Highland) eastwards of the Boskovická brázda (Furrow) is characterized by block-faulted relief (horsts and grabens). Prevailing rocks are deeply eroded and intensively tectonized granites and granodiorites of the Brno Massif with narrow metabazite zones of N-S direction. The oldest sediments resting unconformably on the igneous rocks are Lower Devonian basal clastics of Old Red type. They are downfaulted into granites or metabazites.

The tectonic block-faulted relief with many small horsts and grabens in the Bobravská vrchovina (Highland) is very unusual in the Bohemian Massif and its origin is much discussed both in geological and geomorphological literature (J. KREJČÍ 1964, 1968).

In the most western part of the Bobravská vrchovina (Highland), east of the Boskovická brázda (Furrow) there is an assymetrical horst of Lipovská vrchovina (Highland, 478 m) up to 5 km wide. Remainders of planation surface on the top with low inselbergs are distinctly inclined to the East. Very interesting forms crossing the fault blocks are deep gorges of rivers of Svratka and Bobrava.

The most interesting part of the Bobravská vrchovina (Highland) is a not properly individualized complex morphostructure of the Brno Basin (A. IVAN 1993, M. HRÁDEK 1989, 1991). From the point of view of morphostructural analysis, the Brno Basin is a double graben with a central horst zone of S-N direction. The basin is up to 15 km wide in the S and has composite triangle-shaped groundplan determined by five important tectonic directions (NW-SE, SSW-NNE, N-S, W-E and SW-NE). Among five low-order morphostructures of the basin, there are two assymetric grabens, two partial basins and a middle, inner elevation zone of horst blocks with the highest point at 485 m above sea level. The floodplain of Svratka river in Brno is at the altitude of 200 m.

The Brno Basin is inner part of the Nesvačilka Graben originated probably in Mesozoic. This very important cross structure complicates the buried marginal flexure of the Bohemian Massif and is filled with Jurassic carbonates and Paleogene pellites up to some thousands metres thick. The graben is also interpreted as submarine canyon or aulacogen actively eroded in Paleogene. This was the route through which sediments from the Bohemian Massif were transported into Carpathian geosyncline (F. PÍCHA 1977, F. PÍCHA, E. HANZLÍKOVÁ, J. CAHELOVÁ 1978). This development was probably finished only in Miocene by formation of flysch overthrusts in the Carpathians and migration of foredeep towards the Bohemian Massif. Important rivers draining very planated Bohemian Massif probably debouched into estuary predisposed by the Nesvačilka Graben.

The Brno Basin is separated by a low threshold from the Tišnov Basin (part of the Boskovická brázda Furrow) northwest of Brno and towards SE it widely opens into the Carpathian Foredeep, geomorphological unit of Dyjsko-svratecký úval (Graben).

Thickness of Miocene sediments (mainly Lower Badenian sands and clays) in the Brno Basin is usually 100 - 200 m, in deeper parts near contact with the Carpathian Foredeep perhaps up to 500 m. Thus, high differences of basement surface in area of the Brno Basin can be more than 700 m.

Dating of block movements is a very complex issue and many contradictory ideas have been published. Neotectonic movements probably interferred with Miocene marine transgressions, but pre-Badenian sedimentary record was mostly destroyed. Our opinion is that the block tectonics was active before, in the course and also after the transgressions. After the last regression in Lower Badenian subaerial differential erosion gradually evacuated weak sediments and exhumed the rest of pre-faulting planation surface on uplifted blocks. Some small blocks were remodelled into inselbergs. Owing to deep subaerial erosion, small tectonic blocks of Jurassic limestone are visible too as karst inselbergs on the bottom of Brno Basin (e.g. Stránská skála).

c) East and North of the Brno Basin there is the third, greatest geomorphological unit of Brněnská vrchovina (Highland), the Drahanská vrchovina (Highland). Only its westernmost part built of granitoid rock is on the map. North of Brno downfaulted resistant Lower Devonian conglomerates form a narrow synclinal ridge above the planation surface on granite. Top of the ridge is the highest point in the surroundigs of Brno and also of the map sheet (Babí lom 562 m).

East of the deep gorge of Svitava river, which is about 30 km long, there is a large and more interesting part of the Drahanská vrchovina (Highland) built of mainly folded Paleozoic sediments, Devonian limestones (Moravian Karst) and Lower Carboniferous graywacks, slates and conglomerates (Variscan flysch). Intense Hercynian tectogenesis was followed by deep denudation and planation. The post-Hercynian planation surface (Triassic ?) cut both resistant and weak folded rocks. Intensive tropical weathering of Devonian limestones in Mesozoic is demonstrated by deep fossil karst depressions (more than 100 m) filled with weathering products (Jurassic,Cretaceous ?). The remnants of Upper Cretaceous fresh-water and marine sediments (Cenomanian, Turonian) are preserved in the Blansko Graben in northeastern corner of the map.

Neotectonic dome-like structures characterized by a typically deformed planation surface are very interesting forms in the Drahanská vrchovina - Highland (M. HRÁDEK – A. IVAN, 1974). Very instructive example of this type structure is the Soběšická klenba (Dome) in the northern part north of Brno, analysed in detail by J. KREJČÍ (1964).

2.3 Českomoravská vrchovina (Highland)

Only a small eastern marginal part of the Českomoravská vrchovina (Highland) is presented in the map. From the geological point of view, this is Svratecká klenba (Dome), one of the most controversial structures in the Bohemian Massif. Here the conception of alpine type Hercynian tectonics was postulated at the beginning of this century. This conception of thrusting of older Moldanubicum over younger Moravicum was later rejected by many authors but new research confirms its general correctness (J. JAROŠ – Z. MÍSAŘ 1974). Later, the conception has been modified considerably by J. JAROŠ (1992). In his opinion the Moravicum is also nappe, thrusted over the Brunovistulicum. After deep erosion the Svratka Dome "may even represent a double tectonic window". In core of the dome the very resistant two mica augen gneiss (Bíteš gneiss) belonging to the Moravicum, as same as slightly tectonized and less resistant Svratka granite (Brunovistulicum) are truncated with little regard for lithology or structure. Phyllites and limestones are characteristic for pheripheral parts of the dome.

Geomorphological division of this part of the Českomoravská vrchovina (Highland) west of Brno includes the Bítešská vrchovina (Highland). A relatively flat relief with extensive, well preserved planation surface and deep narrow but broadly-spaced river valleys are most striking features especially in the centre of dome (Krajina 515 m). The longterm subaerial denudation is demonstrated by more than 100 m deep kaolines near village Lažánky (M. KUŽVART 1965) and also by fossil karst phenomena. The position of remnants of planation surface together with radial drainage pattern indicates neotectonic remobilization of ancient dome (M. HRÁDEK – A. IVAN 1974).

3. Anthropogenic relief transformations (ART)

Heterogeneous relief and geological structure have offered all main types of building materials directly in Brno in the past. Thus, together with plenty of sands, gravels, clays and loess, it was possible to mine at this place not only different types of bulding stones such as granite, diorite, diabase and sandstone, but also Jurassic and Devonian limestones. But aesthetic and environmental aspects as well as requirements as to quality of raw materials resulted in gradual ceasation of mining activities and their restriction to some suburbs at first, and later out in the country. The most disturbing effect on landscape aesthetics is evident in mining of limestone. Large quarries in Devonian limestone are in the northeastern part of Brno in southern tip of Moravian Karst and in the area of geomorphological map in the Tišnov Basin, where exploitation at the hill Čebínka in the 60's particularly destroyed very important botanical and geomorpological localities. In the paper of V. NOVÁČEK (1983) 85 mining places are mentioned in the area NW of Brno identical with the geomorphological map. But many loess-pits and gravel-pits mined out in the past were reclaimed and their localization is possible according to old maps or archives. Most mining forms were also used for waste deposition and damage of relief is not obvious in the present landscape. The relief of horst and grabens suppress impression of intensive urbanization but on the other hand represents a very complicating factor of traffic (J. KARÁSEK 1986).

Position of the town on the bottom of basin has caused that new settlements have been built mainly in the higher relief. At present, differences between the lowest and highest parts of the town are more than 200 m. The complicated topography contributes to very fragmentary and polyfunctional land-use. Even very steep slopes are terraced for building or agricultural purposes.

As to indirect ART the most interesting forms are induced abrasion cliffs and beaches along the shore of Brno dam (J.LINHART 1964). Abrasion activity and retreat of cliffs continue up to now, more than fifty years after building of the dam. Accelerated soil erosion (mainly rills and gullies) and minor induced landslides are another indirect ART.

4. *Geomorphological map of relief types and some important forms*

The aim of geomorphological map of Brno surroundings is to give a true picture of relief and simultaneously intimate the main environmental geomorphological problems not only to geomorphologists but also to other specialists. Legend of the map lacks specialized terminology. Data about age of forms are ommited, too. Unfortunately, quality of the topographic base is rather poor, especially when compared to military topographic maps (confidential in the time of field mapping in 1988-9). Merely these oversimplified and purposely "anthropogenic" deformed maps (available "only for internal use of state authorities and socialist organizations") were approved for publishing at that time.

The presented geomorphological map is of a rather general type and takes into cosideration some forms important from the point of view of environmental geomorphology (valuable preserved forms and anthropogenic forms), too. Our opinion is that the maps of relief types provide more lucid information about the relief. The most important information about relief type and its origin is expressed by colour (e.g. deep brown designates denuded relief of dissected highland). Intention of colour scale consits in plasticity of the map to come close to reality. Importance of some anthropogenic forms is stressed by red colour. Types of hachure supply additional information mainly about genesis or geomorphological processes.

Author's address

RNDr. Antonín Ivan, CSc.
Institute of Geonics, Czech Academy of Sciences, Branch Office Brno,
Drobného 28, CZ-602 00 BRNO, CZECH REPUBLIC

RNDr. Mojmír Hrádek, CSc.
Institute of Goenics, Czech Academy of Sciences, Branch Office Brno,
Drobného 28, CZ-602 00 BRNO, CZECH REPUBLIC

Reviewer

Doc. dr. Jaromír Karásek, CSc.

References

BAKKER, J. P. (1963): Different types of geomorphological maps. Problems of geomorphological mapping.Geographical studies, 46, p. 13 – 22, Warszawa.

BÍNA, J.– Folk, Č. (1983): Geoekologie brněnské aglomerace.Studia geographica 83, GGÚ ČSAV, Brno, 362 pp.

COATES, D. R. (1981): Environmental geology. Wiley, New York, 701 pp.

DEMEK, J. (1969): Podrobná obecná geomorfologická mapa 1 : 25 000 (List Dolní Kounice). Studia geographica 1, p. 139-148, Brno.

DEMEK, J. ed. (1972): Manual of detailed geomorphological mapping. Academia, Praha, 344 pp.

DUDEK, A. (1980): The crystalline basement block of the Outer Carpathians in Moravia: Bruno-Vistulicum. Rozpr. Čs. Akademie věd, Ř. mat. přír., 90, 8, p. 1 – 85, Praha.

FAIRBRIDGE, R. W. ed. (1968): Encyclopedia of Geomorphology. Reinhold, New York, 1295 pp.

HRÁDEK, M. (1988): Some examples of applied geomorphological maps from Czechoslovakia. Z. Geomorph. N. F., Suppl.-Bd. 68, p. 189 – 203, Berlin-Stuttgart.

HRÁDEK, M. (1989): Význam miocénu Kamenného vrchu pro poznání tektonického vývoje Brněnské kotliny. Miscellanea micropaleontologica IV, 9, p. 121 – 132, Hodonín.

HRÁDEK, M. (1991): Geomorfologická analýza Brněnské kotliny. Sborník referátů z geografického symposia (ed. V. Novák), Brno, p. 117 – 128.

HRÁDEK, M. – Ivan, A. (1974): Neotektonické vrásno-zlomové morfostruktury v širším okolí Brna. Sborník ČSSZ, 59, p. 249 – 257, Praha.

IVAN, A. (1971): Applied geomorphological map of the Pisárky Basin in Brno. Studia geographica 21, p. 33 – 49, Brno.

IVAN, A. (1979): Příspěvek k problematice antropogenní modelace na území města Brna. Zprávy GGÚ ČSAV, 16, p. 118 – 126, Brno.

IVAN, A. (1992): Brněnská kotlina - dvojitý prolom se středním pásmem hrásťových ker: problémy vymezení a geneze. Zprávy GGÚ ČSAV, 29, p. 7 – 46, Brno.

IVAN, A. – KIRCHNER, K. (1988): Study of anthropogenic relief transformations in the Institute of Geography: main results, tasks and perspective. Sborník prací 15, p. 35 – 46, Brno.

JAROŠ, J. – MÍSAŘ, Z. (1974): Deckenbau der Svratka-Kuppel und seine Bedeutung für das geodynamische Modell der Böhmische Masse. Sbor. geol. věd, Geol., 26, p. 69 – 82, Praha.

JAROŠ, J. (1992): The nappe structure in the Svratka dome. Proc. Conf. Bohemian Massif. Czech Geol. Survey, p. 137 – 140, Praha.

KARÁSEK, J. (1986): Geotechnická charakteristika tras elektrické rychlodráhy v Brně. Sborník prací 12, p. 49 – 52, Brno.

KREJČÍ, J. (1964): Reliéf brněnského prostoru. Folia přír. fak. UJEP v Brně, Geographia, 1, Brno. 123 pp.

KREJČÍ, J. (1968): Das Relief der weiteren Umgebung von Brünn und seine Entwicklung mit besonderer Berücksichtigung des Mährischen Karst. Mitt. d. Geogr. Ges. Wien, 110, p. 38 – 54, Wien.

KUŽVART, M. (1965): Geologické poměry moravskoslezských kaolinů. Sbor. geol. věd, LG, 6, p. 87 – 146, Praha.

LINHART, J. (1964): Regime of the water level and shore development of the dam reservoirs. Journ.Czechoslovak Geogr. Soc, Suppl. to 20. Int. Geogr. Congress London, p. 67 – 76, Praha.

MÍSAŘ, Z. – DUDEK, A. (1993): Some critical events in the geological history of eastern margin of the Bohemian Massif. Journal of the Czech Geological Society, 38, p. 9 – 20, Praha.

NOVÁČEK, V. (1983): Kamenolomy, hliniště a pískoviště v SZ okolí Brna. Sborník prací 1, p. 215 – 228, Brno.

PANOŠ, V. (1964): Der Urkarst im Ostflügel der Böhmische Masse. Z. Geomorph., N.F., 8, p. 105 – 162, Berlin-Stuttgart.

PÍCHA, F. (1977): Tektonika litosférických desek, sedimentační prostory a geneze uhlovodíků. Věstník ÚÚG, 52, p. 171 – 180, Praha.

PÍCHA, F. – HANZLÍKOVÁ, E. – CAHELOVÁ, J. (1978): Fossil submarine canyons of the Tethyan margins of the Bohemian Massif in southern Moravia. Věstník ÚÚG, 53, p. 257 – 272, Praha.

STRÁNÍK, Z. et al. (1993): The contact of the North European Epivariscan Platform with the Western Carpathians. Journal of the Czech Geological Society. 38, p. 21 – 29, Praha.

SUK, M. et al.(1984): Geological history of the territory of the Czech Socialist Republic. Academia, Praha, 396 pp.

Explanations to the map – Appendix No. 1

Relief types:

1-4 Dissected highlands
1 - with remnants of subhorizontal planation surface
2 - with remnants of dome-like deformed planation surface
3 - with remnants of inclined planation surface
4 - with preponderance of slopes

5-7 Gently undulated higlands
5 - with remnats of subhorizontal planation surface
6 - with remnants of inclined planation surface
7 - with preponderance of slopes

8 - dissected hilly land with remnants of subhorizontal planation surface
9 - erosion-denudation relief of foothills (piedmont hilly land)

10-12 hilly land in basins
10 - with erosion-denudation relief
11 - with erosion-accumulation relief
12 - built of loess
13 - riverine basins with erosion-accumulation relief

Selected forms
14 - floodplains
15 - inselbergs and knobs in basins
16 - structural ridges and knobs in elevated position
17 - solifluction cover and talus
18 - tors
19 - gorges
20 - saddles
21 - caves
22 - margins of elevated mezoforms connected with faults
23 - fossil weathering crust
24 - slopes disturbed by gully erosion
25 - great active open-mine
26 - small active open-mine
27 - great inactive open-mine
28 - small inactive open-mine
29 - abrasion processes in man-made lake
30 - agricultural terraces
31 - dumps of waste
32 - waste in inactive open-mine
33 - significant view-point
34 - distinct boundary of forms or relief types
35 - undistinct boundary of forms or relief types

Babí lom *Photo: K. Kirchner*

THE SKELETON OF LANDSCAPE ECOLOGICAL STABILITY

Jan Lacina

Abstract

Ecological stability of the landscape, which depends mainly on the condition of biotic component, namely vegetation has been disturbed in vast territories by long-term intensification of anthropogenic activities. At present efforts directed to restoration of ecological stability the most important task consists in defining and registration of all natural and near-natural ecosystems which have been preserved in the cultural landscape. These ecologically significant landscape segments which are further divided into ecologically significant landscape elements, districts, regions and ecologically important line communities by spatial and structural criteria, form the skeleton of landscape ecological stability. Since the formations in question are often represented only by isolated isles of biodiversity, their present network should be completed and provided with proper interconnection. Thus, the skeleton of landscape ecological stability becomes a basis for creating functional regional systems of ecological stability of the landscape.

Shrnutí

Kostra ekologické stability

Dlouhodobou intenzifikací antropogenních aktivit byla na rozsáhlých územích narušena ekologická stabilita krajiny, která je závislá na stavu biotické složky, zejména vegetace. Při současných snahách o obnovu ekologické stability je prvořadým úkolem vymezit a registrovat všechny přirozené a přírodě blízké ekosystémy, které se v kulturní krajině zachovaly. Tyto ekologicky významné segmenty krajiny, které podle prostorově strukturních kritérií dělíme na ekologicky významné krajinné prvky, celky, oblasti a ekologicky významná liniová společenstva, tvoří kostru ekologické stability krajiny. Protože se často jedná jen o izolované ostrovy biodiverzity, je třeba jejich současnou síť doplnit a propojit. Kostra ekologické stability je tak základem pro vytváření fungujících územních systémů ekologické stability krajiny.

Key words: ecologically significant landscape segments, skeleton of landscape ecological stability, regional systems of ecological stability of the landscape

1. *Introduction*

Anthropogenic factors, significantly forming the landscape in Central Europe for many centuries, have led to gradual transformation and at many places even to devastation of natural ecosystems. Ecological stability of the landscape has thus been seriously disturbed, ie. the ecological systems have lost their capacity to resist disturbing influences by means of self-regulation processes occuring in them. It is known that the ecological landscape stability depends on the condition of biotic component. It is therefore necessary that a certain proportion of natural biocoenoses remains preserved even within the cultural landscape, which would represent, if possible, complete diversity of species (biodiversity) of certain landscape. The natural ecosystems should be evenly distributed in the landscape, and form a really functional system.

The natural ecosystems in cultural landscape have been preserved mainly on extreme sites which cannot be subject to intensive utilization. Their network in the landscape is thus usually insufficient and unevenly distributed. This is why the ecological network must be artificially renewed in landscape types under strong anthropogenic impact.

An impuls for biogeographical research directed towards building of the landscape ecological network is the equilibrium theory of island biogeography (McARTHUR, WILSON - 1967). In the Czech Republic, the methodological procedure of landscape biogeographical differentiation has been worked out with using the interpretation of geobiocoenoses. Definition of the skeleton of landscape ecological stability has been set up as one of its major tasks (BUČEK, LACINA – 1977, 1979a, 1979b, 1984). A methodological procedure of creation regional systems of landscape ecological stability (LÖW et al. – 1984) was developed at building a functioning ecological network in cooperation of a multidisciplinary team of natural scientists and planners, which is being discussed and precised in these days.

2. *Fundamental concepts and methodological procedure of defining the skeleton of landscape ecological stability*

The skeleton of ecological stability is a set of presently existing ecologically important landscape segments. Ecologically important are those segments of the landscape, which are either formed by ecosystems with relatively higher ecological stability or in which these play a dominant role. They are distinguished by permanent character of biota and by ecological conditions enabling existence of species appurtenant to landscape natural gene-pool.

The ecologically important landscape segments can be formed by natural biocoenoses which are typical of certain biogeographical areas, or by biocoenoses whose condition and development are conditioned by anthropogenic activities. The first group includes mostly remains of forest stands with natural forest tree species composition, the second group is composed of mainly various types of derelict lands, meadows with prevailing naturally growing species and ponds.

By spatial and structural criteria (size and shape, degree of homogeneity of ecological conditions, and present condition of biocoenoses) the ecologically important landscape segments divide into:

- ecologically important landscape elements,
- ecologically important landscape districts,
- ecologically important landscape regions,
- ecologically important line communities.

By their biogeographical significance (degree of biological diversity, representativeness and unique character of communities, incidence of rare and endangered species and communities) the ecologically important landscape segments further divide into those of:

- local importance
- regional importance
- supra-regional importance
- provincial importance
- biospherical importance.

Ecologically important element is a small area (usually of 100 m^2 up to 10 hectares) with homogeneous ecological conditions which usually include only one community type. Among elements we find for example a residual deciduous forest stand amongst pure coniferous stands, a wetland meadow with spring area amongst cultural meadows and fields, a small pond with riparian communities, an isolated rock with natural vegetation, a group of trees or even an isolated sizeable solitary tree amidst the rural landscape with no forests at all.

Ecologically important landscape district is a more extensive area (usually of 10 to 1000 hectares) where diverse ecological conditions facilitate existence of more community types. Characteristic complexes are for example incised valleys of upper and lower river reaches with forest, rock and wetland communities. Within the complex, there is a whole range of ecologically important elements. This appears useful namely in the cases when the individual elements differ from each other by methods and desirable intensity of protection and management.

Ecologically important landscape region is a large area (usually of above 1000 hectares), distinguished by diverse ecological conditions as well as by diversity of communities among which ecologically stable natural communities and near-natural communities are prevailing. The ecologically important landscape regions include not only the majority of protected landscape areas, but also a whole range of extensive areas with prevailing forests of natural composition of forest tree species and meadow communities rich in species. Very important are pond areas with typical mosaic of aquatic, wetland and terrestrial communities. Within the landscape region, it is always useful to define smaller territories with pronounced different communities as ecologically important landscape elements or complexes.

Ecologically important line communities are specific formations of the cultural landscape: they have a narrow and oblong shape and are characteristic by prevailing proportion of transition marginal biocoenoses (ecotones). They are formed by grass-herbaceous or woody vegetation, by breaking blocks of fields and meadows or forest monocultures. The densiest network of line communities in our cultural landscape are formed by riparian stands in which continuous natural biocoenoses of alder, willow and ash with undergrowth of wetland and hydrophilous plant species reach in many a case the length of several kilometers. Shorter but no less important are the line communities on remains of balks, agrarian terraces and stone walls. The important line communities include also alleys and tree avenues of autochtonous broadleaved trees (especially lime, maple, oak, rarely also beech, in some landscapes birch and European mountain ash). Ecologically less important are line communities formed by introduced tree species such as poplar provenances, horse chestnut, black locust, etc.

This spatial structural classification is used at assessing present condition of the landscape, at defining the skeleton of ecological stability. It has appeared that at least locally important landscape elements and line communities which request and deserve improved management and protection can be found and defined in practically any area.

The skeleton of ecological stability is defined on the basis of comparison between the natural (potential) and present condition of ecosystems in the landscape. It is first of all remains of natural communities with the highest ecological stability, which are to be defined. In the biogeographical province of Central European deciduous forests this applies mainly to remains of forest stands with species composition corresponding to the natural one. In agricultural landscape these include namely various types of derelict lands (both dry and wet) which are characteristic of high diversity of species. The intensively exploited rural and urbanized landscape usually lacks sufficient amount of residual ecosystems with high ecological stability. Therefore it is necessary to apply here a principle of relative choice. The skeleton of ecological stability in these cases includes also those parts of the landscape, which are less valuable in terms of ecological stability - such as locust grove amidst the field agricultural landscape, or park with a certain proportion of autochthonous tree species located in the middle of the town. Even these anthropogenically conditioned landscape segments enable existence of at least some species belonging to natural gene-pool of the landscape.

Definition of ecologically important landscape segments which form the skeleton of ecological stability is made by means of terrain biogeographical research. Biogeographical mapping of the present condition of biocoenoses can be either selective or full-area. At selective mapping the biogeographical research concentrates only to areas of ecological importance, of which many are well known from older literature such as materials documenting state nature protection. More suitable appears to be full-area mapping of current condition of the vegetation to detailed scales (1 : 10 000 and greater). Advantage of the full-area mapping is the fact that the skeleton of ecological stability can be defined much more precisely and in more details.

Types of contemporary landscape can be defined by representation and distribution of current vegetation in the landscape. Attention is also being paid to relief types as well as to representation and arrangement of water streams and water areas. The types of contemporary landscape include areas with the same kind and intensity of anthropogenic activities which exhibit the same consequences within natural conditions of the given type. Basic types of the contemporary cultural landscape in Central Europe are as follows: urbanized landscape, agricultural landscape, agricultural-forest landscape and forest landscape. These general types are differentiated in more details by representation and distribution of actual types of current vegetation (e.g. in fields, meadows, vineyards, broadleaved forests, parks, etc.) into sub-types. The sub-types of contemporary landscape differ from each other by their functional importance, and also by their relative degree of ecological stability. The individual sub-types of contemporary landscape differ also in representation and distribution of ecologically important landscape segments. Thus the full-area definition of types and sub-types of contemporary landscape provides a good knowledge of specific places where the ecological network must be primarily renewed.

3. *Map contents and its assessment*

Example for defining the skeleton of ecological stability in maps of medium scales (1 : 50 000) was found in an area which includes northern part of BRNO and its surroundings. This area is markedly differentiated both by natural conditions and by intensity of anthropogenic influence.

The map illustrates 4 types of contemporary landscape with 16 sub-types, the types being distinguished by colours and their sub-types by figures. The greatest representation in the mapped area is that of agricultural-forest landscape, the second place is being occupied by forest landscape and the third one by urban landscape. The least representation is that of agricultural landscape. In a table, the landscape sub-types are allocated to altitudinal vegetation zones as well as to trophic and hydric series. A scale is applied to assess their anthropogenic load, relative degree of ecological stability and functional importance in terms of production, water-management, soil preservation, recreation and biosphere protection. Aesthethic qualities are differentiated in a similar way.

There are altogether 133 ecologically important landscape segments defined on this full-area base, which can be distinguished by colours used to illustrate types of existing communities (water, wetland, grass, xerotemorphile, forest deciduous, parks, etc.). Their biogeographical significance (local, regional and supra-regional) is expressed by thickness of the demarcation line. Shortening in front of the name designates the spatio-structural category of ecologically important landscape segment (element, district, region, line community) or the type of protected landscape area. It is apparent from the map that the highest number of ecologically important landscape segments in the given territory can be defined within forest ecosystems, lesser number in meadow ecosystems and only exceptionally in wetland and water ecosystems. The urban area of BRNO can boast of a significant representation of ecologically important park segments. The majority of defined segments is of local and regional biogeographical importance, only some of them are of supra-regional significance. Quite striking is the fact that in the time when the map was made (1990) only 30 of the mentioned 133 ecologically important landscape segments were provided legislative protection.

4. *Conclusion*

The map of the above conception is expected to provide sufficient knowledge about differentiation of the contemporary landscape by representation and distribution of current vegetation types, which also indicate a certain intensity of anthropogenic influence as well as a certain relative degree of landscape ecological stability. The map should demarcate all parts of the landscape, which are of primary significance for preservation of biodiversity and landscape ecological stability. This means that it would not be enough to only illustrate-as it seems a rule in similar maps-exclusively the areas protected by legislation. Distribution of the existing skeleton of landscape ecological stability in the area under study indicates that there will be differences in demands imposed on creation functional territorial systems of ecological stability within various subtypes of contemporary landscape. It follows from the map also that some parts of the landscape will have to be preferrably eliminated from considerations on intensive anthropogenic exploitation (urbanization, intensive forest management, intensive agricultural production, mining of mineral resources and parent rocks, etc.). These are the reasons which should make the map of "The Skeleton of Ecological Stability", one of important basic documents for any decision-making concerning regional developments.

Since 1990, when the described map was designed, both the methodology of defining the skeleton of ecological stability and actual knowledge of illustrated area have been improved with tens of other ecologically important landscape segments having been defined on the basis of full-area mapping procedures. The new Act on protection of nature and landscape, issued in 1992, defines new categories of particularly protected areas. In this sense, the map calls for integration of topical changes.

Author's address

Ing. Jan Lacina
Institute of Geonics, Czech Academy of Sciences, Branch Office Brno,
Drobného 28, CZ-602 00 BRNO, CZECH REPUBLIC

Reviewer

RNDr. Jaroslav Vašátko, CSc.

References

BUČEK, A. – LACINA, J. (1977): Hodnocení biogeografických poměrů CHKO Žďárské vrchy. (Assessing biogeographical situation of the protected landscape area Žďárské vrchy.) Zprávy GgÚ Brno, 14, No. 2/3, p. 21 – 57.

BUČEK, A .– LACINA, J. (1979): Biogeografická diferenciace krajiny jako jeden z ekologických podkladů pro územní plánování. (Biogeographical landscape differentiation as one of ecological source materials for area planning.) Územní plánování a urbanismus, 6, No. 6, p. 382 – 387.

BUČEK, A. – LACINA, J. (1979): Utilization of biogeographical differentiation for protection and formation of landscape. In: Proc.Vth.Int.Symp. on Problems of Ecol.Landscape Research. Stará Lesná - the High Tatras, p. 329 – 338.

BUČEK, A. – LACINA, J. (1984): Biogeografický přístup k vytváření územních systémů ekologické stability krajiny. (Biogeographical approach to the formation of landscape ecological stability regional systems.) Zprávy GgÚ ČSAV Brno, 21, No. 4, p. 27 – 36.

LÖW, J. et al. (1984): Zásady pro vymezování a navrhování územních systémů ekologické stability krajiny v územně plánovací projekci. (Principles for defining and designing regional systems of landscape ecological stability at planning regional development.) Brno, Agroprojekt 53 pp.

McARTHUR, R. H. – WILSON, E. O. (1967): The theory of island biogeography. Princeton Univ. Press, Pinceton 203 pp.

Explanations to the map - Appendix No. 2

The map reflects types and sub-types of the contemporary landscape. The tables provide an overall view of the types and characteristics of their functions, ecological stability, anthropogenic effects and aesthetic qualities. All these items constitute the skeleton of ecological stability. The ecological stability is a complex of all important current ecological segments of the landscape. They are distinguished by phytocoenoses and biogeographic significance.

Types of the present landscape:

1 – Urban landscape: 1.1 Residential landscape in depressions and uplands, 1.2 Residential and industrial landscape in depressions, 1.3 Residential and forest landscape in uplands, 1.4 Recreational and forest landscape in river valleys. 2 – Agricultural landscape: 2.1 Cropland in depressions, 2.2 Cropland on flat ridges of uplands and highlands, 2.3 Cropland with riparian stands in broad river and stream floodplains. 3 – Agricultural-Forest landscape: 3.1 Combined cropland and forest with prevailing deciduous forests (oak, hornbeam) and with upland orchards, 3.2 Combined cropland and forest with prevailing coniferous forests (pine, Norway spruce) and orchards in broken uplands and highlands, 3.3 Combined cropland and forest with pine and mixed forest stands and steppe derelict land in the uplands devastated by limestone mining, 3.4 Combined cropland and forest with Norway spruce stands and upland meadows, 3.5 Combined cropland and forest with mixed forest stands in the flat karst uplands. 4 – Forest landscape: 4.1 Deciduous forests (oak, hornbeam, beech) in broken uplands and highlands, 4.2 Mixed forests (pine, Norway spruce, larch, oak, hornbeam, beech) in uplands and highlands, 4.3 pine forests in broken uplands and highlands, 4.4 Norway spruce forests in broken uplands and highlands. 5 – Landscape type limits, 6 – Landscape sub-type limits, 7 – numerical designation of landscape sub-types.

Ecologically important landscape segments:

8 – Boundaries of ecologically important landscape elements and districts of local biogeographic significance, 9 – ditto of regional importance, 10 – ditto of supra-regional importance, 11 – Boundaries of ecologically important landscape regions of local biogeographic significance, 12 – ditto of regional importance, 13 – ditto of supra-regional importance, 14 – Ecologically important line communities of local biogeographic significance, 15 – ditto of regional importance, 16 – ditto of supra-regional importance.

Community types in ecologically important landscape segments:

17 – Aquatic, 18 – Wetland, 19 – Mesophyte grasslands, 20 – Hydrophilous grasslands, 21 – Xerophylic and thermophylic grasslands, 22 – Saxicolous, 23 – Forest deciduous, 24 – Forest floodplain, 25 – Forest coniferous-deciduous, 26 – Forest coniferous, 27 – Forest-steppe, 28 – Parks.

Used abbreviations:

EVKP – Ecologically important landscape element,
EVKC – Ecologically important landscape district,
EVKO – Ecologically important landscape region,
EVLS – Ecologically important line community,
CHKO – Protected landscape area,
KO – Rest area,
SPR – National nature preserve,
CHPV – Protected natural formation,
CHPZ – Protected parks and gardens.

Explanations to the table assessment of present landscape types:

STK – Number of landscape sub-type, VS – Altitudinal vegetation zone: 1 - oak, 2 - beech, 3 - oak-beech, 4 - beech, 5 - fir-beech, TR – Trophic series: A/B Oligotrophic-mesotrophic, B Mesotrophic, B/C Mesotrophic-Nitrophilic, B/D Mesotrophic-Calciphilous, HR – Hydric series: n - normal, o - restricted, z - water logged, AO – Intensity of anthropogenic impacts, ES – Degree of ecological stability. Evaluation of functions: PZ – Agricultural production, PL – Forest production, V – Water management, P – Soil protection, R – Recreation, BO – Biological protection, EK – Aesthetic qualities.

The scale expresses the following meaning or condition:

0-none (not evaluated), 1 – very low, 2 – low, 3 – medium, 4 – high, 5 – very high.

Lednice *Photo: O. Mikulík*

LAND USE MAP

Miroslav Koželuh

Abstract

A land use mapping method based on the interpretation of satellite imagery is described in the paper. From various processes applied to obtain the information on parcelation and thematic contents of land use map, visual interpretation of multispectral false colour composite (FCC) of LANDSAT TM was used. Practical applicability of the method was verified by construction of a land use map at a scale of 1 : 50 000 from southern Moravia.

Shrnutí

Formy využití ploch

Informace o prostorovém rozmístění jednotlivých forem využití půdy je užitečná pro řadu oborů lidské činnosti. Její fixace v mapě má nevýhodu v poměrně rychlé ztrátě aktuálnosti. Při obnově, příp. tvorbě nových map tohoto druhu je proto velmi efektivní využití metod dálkového průzkumu Země.

Materiály dálkového průzkumu Země lze zpracovávat dvěma cestami v závislosti na druhu dat. V případě použití obrazových záznamů na magnetickém médiu je optimální vyhodnocovat informace dálkového průzkumu Země v digitální formě metodami počítačové interpretace. Druhý způsob spočívá ve využití obrazové informace ve formě fotografického snímku a interpretační postupy mají vizuálně-analogový charakter.

V článku je prezentována jednoduchá a levná metoda tvorby map využití půdy, vycházející z druhého způsobu, založená na vizuální interpretaci družicových snímků. Při konstrukci map tohoto druhu je základním úkolem přiřadit do zákresu hranic jednotlivých forem využití půdy (síť parcel) vlastní tématický obsah - t.j. aktuální způsob využití dané plochy. Informace o parcelaci i tématické náplni parcel je v popisované metodě získávána interpretací barevných syntéz (FCC), zhotovených z vizualizovaných multispektrálních obrazových záznamů LANDSAT Thematic Mapper.

Jako hlavního interpretačního znaku se využívá tónu snímku v jednotlivých částech elektromagnetického spektra, který určuje výslednou barvu studovaného jevu na barevné syntéze. V případě standartní syntézy je potom možné identifikovat objekty na základě jejich barvy. Standartizace barevné syntézy zahrnuje volbu spektrálních pásem, z nichž se syntéza sestavuje a výběr barev, přiřazených zvoleným spektrálním pásmům. Pro zhotovení mapy využití ploch byla na základě experimentování vybrána kombinace 3., 4. a 5. kanálu LANDSAT Thematic Mapper.

Praktická použitelnost metody byla ověřena na konstrukci mapy využití půdy v měřítku 1 : 50 000 z území severně od Brna. Byly rozlišeny tyto základní formy využití půdy: sídla a urbanizované plochy, zemědělské plochy, lesní plochy, vodní plochy, devastované a neplodné plochy. Tyto třídy byly dále podrobněji členěny na les listnatý, smíšený, jehličnatý, zemědělské plochy s vegetací a bez vegetace, atd. Mapa byla sestavena výhradně z dat dálkového průzkumu Země, bez použití nedistančních informací.

Key words: land use mapping, remote sensing, false colour composite

1. *Introduction*

The information about land use and spatial distribution of individual components of land cover is useful for many branches of human activities. Its fixation in the map work is disadvantageous due to a comparatively rapid loss of relevance. In Czech conditions, up-dating the content of such maps by classic methods does not guarantee sufficient operativeness irrespective of considerable financial demands.

In this situation, it is possible to use methods of remote sensing for compilation or up-dating of the map content of this kind. Application of the remote sensing methods has a long-term tradition in this field, and it is also possible to say that the expertise has exhibited the greatest possible spread as aerial and satellite surveys, thus representing the most complete and most up-to-date source of information for these purposes thanks to time and spatial homogeneity. High standard has been achieved in evaluating the present situation of land use from image satellite recordings, obtained by satellites for research into natural resources (LANDSAT, SPOT) inclusive automated processing methods using computer techniques. It is mentioned in literature that with the help of photographs it is possible to determine the land use five times quicker than the classic methods (field mapping).

2. *Methodology*

Two ways can be adopted in evaluating the land use and generally in any specialized interpretation of remote sensing materials as related to the form of image information. In the case of using the CCT (computer compatible tape) recordings, it is optimum to process the remote sensing information in a digital form by methods of computer interpretation. The other way consists in using image-information in the form of photographic picture and methods of interpretation are of visual-analogous character. Choice of variant depends mainly on equipment with processing technique, less then on the form of remote sensing material source.

In the process of mapping the forms of land use, the main task is to include the proper thematic content, ie. the way of given land use, in the network of plots or other chosen division of the territory under study. At resolving this task by means of remote sensing which includes both satellite and aerial photographs, it is useful to apply a method based on interpretation of false colour composites, formed from multispectral images, and their evaluation from the viewpoint of spatial distribution of individual land use forms. By its complex conception of the studied reality with a possibility of observing spatial links and relations, this method is close to geographic approach to landscape sphere and moreover, represents consistent utilization of merits of a wide spectral engagement of multispectral information.

The main interpretation symbol used is tone of image in individual sections of electromagnetic spectrum, which determined the resulting colour of studied phenomenon on the false colour composite. The composites are created by combining individual zonal images and colours allocated to them optically or electronically by instruments called multispectral synthetisers or projectors. The resulting colour image is evaluated visually. Objects can be identified on the basis of their colour provided that we are familiar with meanings of these colours, ie. if we have an interpretation key for the given type of composite.

Should such an interpretation key, based on colours, have a wider applicability, it is necessary to work out a standard procedure of creating a colour composite, which would ensure reproducibility of results. Respecting this principle in the case of a image from unknown area will then enable correct interpretation of the image on the basis of knowledge of colour meanings, and in the case of a time sequence of composites from the same territory to deduce changes and processes which take place in the landscape on the basis of changed colours.

Standardization of the process of creating a colour composite should include selection of spectral zones of which the composite is made, including the choice of negative or positive version and that of colours allocated to the chosen spectral zones.

The choice of spectral zones for a composite aims at achieving a maximum number of colour scale tones on the colour composite, which makes it possible to differentiate the greatest number of phenomena possible. With attention being directed to just a certain phenomenon or an object, it is important for the observed phenomenon or the colour composite to be distinguished from its surroundings as much as possible. Profound knowledge of spectral characteristics of the observed phenomena, especially of the values of reflection in individual spectral zones, is very useful. As to the choice of colours for individual spectral zones, the decisive criterion can again be seen in the demand of maximum colour contrast and perhaps also aesthetic sense of the colour composite processor.

At observing the above mentioned preconditions, it can be stated that colours representing the corresponding elements on the colour composite are typical of the given element, which then can be identified on their basis. This fact is made use of at compiling intepretation keys with whose help the given composite type can be interpreted. The situation is somewhat complicated by a great number of colour tones that can be found on the composites. With regard to the fact that the number of items in the interpretation key is limited, it is necessary in the process of interpretation to associate the tones of colours into groups which correspond to individual items of the key.

Practical solution of compiling the land use map issue made use of the false colour composite made from image recording of LANDSAT 5, scene no. 190/26 of the 10 May, 1987. The false colour composite was compiled by combining the channels TM3, TM4 and TM5 in such a way that the result of visual interpretation of land use forms could be transferred directly into the scale and projection of the used bottom map. The methodology of preparing a geometrically correct false colour composite was described by the author in great detail (KOŽELUH 1993).

The Basic map of the CSFR in the scale of 1 : 50 000, sheet 24-32 BRNO was chosen as the bottom map.

In the first stage of compiling the map in the scale of 1 : 50 000 from the area situated NW of Brno, borders of individual forms of land use (system of plots) were brought out from the composite onto transparent foil not only in agricultural plots but also in forests. The clue at depicting the boundaries consisted in colour changes of individual objects and in all line elements observable on the composite including the system of rivers and contours of water areas. No other auxiliary information of non-distance origin was used at doing this, which means that the parcelation reflects actual condition of landscape area structure at the date of scanning. Comparison of the parcelation diagramme with the map reveals an number of inaccuracies, namely at illustrating the ground plan of forest areas and even more so in settlements as well as in the course of communications and bank lines of waters. On the other hand, a generally known fact has been confirmed about a relatively exact reflection of the system of rivers in our maps. Not all the errors can be ascribed to generalization process at compiling the map.

In addition to the mentioned information for correction and more accurate compilation of maps, delineation of plots provides a qualitatively new information which is missing in common maps. This particularly applies to the possibility of determining the course of forest generic structure borders within forest complexes, and distribution of agricultural land to areas with uniform management - strips of land.

After the delineation of plots had been made, which is a rather difficult and time consuming stage of land use map compilation by the described method, the following step consisted in filling the system of plots with thematic information about the use of areas, obtained through visual interpretation of colour composites. A number of mutually different forms of land use that can be interpreted from the composite depends-through the mediation of criterion-on distinguishing capacity of the composite and determines extent of the land use map legend.

The map legend includes following items:

- urban areas (with residential and industrial functions)
- agricultural land with vegetation incl. permanent grass cover
- agricultural land without vegetation (ploughed land)
- forest land with prevailing coniferous stands
- forest land with mixed stands
- forest land with prevailing deciduous stands
- forest land denudated by felling (clear cut areas)
- devastated areas (quarries)
- water areas

Categories of permanent grass cover, orchards, hop-fields and vineyards are usually marked off in classic land use maps as an integral part of lands used for agricultural purposes. These forms of land use cannot be identified from satellite data of the given scale, because in their spectral manifestation they merge with other objects (permanent grass covers with agricultural land covered with vegetation, orchards and vineyards as related to the date of vegetation survey either with bare land or even with deciduous forest). For this reason, classification of the agricultural land into two sub-categories (with and without vegetation) was used in the map legend.

Colours depicting the individual forms of land use follow out of WLUS (The World Land Use Survey) recommendations.

3. *Discussion of results*

The land use map is enclosed in appendix. It was compiled by methodology described in the previous chapter, exclusively on the basis of satellite image interpretation, with no other supporting information.

The mapped area is distinguished by variety of land use forms composition. At linking up to the relief, expected localization of the individual land use forms can be corroborated. Elevated parts of the territory are covered with forests which-by estimate-occupy half an area of the map sheet. In terms of forest tree species composition, the category of forest, further divides into three basic forms: coniferous, deciduous and mixed forests. Representation of these sub-categories is rather uniform, and pronounced dominance of the coniferous forest, which is common in the regions west of the area under study and is represented by Norway spruce pure stands, cannot be seen here. Apparently, as to interpretation of these forest classes, a certain percentage of inaccuracy must be expected. Plausibility of the interpretation cannot be verified (except for a round made right in the field) since the information on species composition of the forest is not available in any map of these scales.

There are further areas demarcated within the forest land, which have been devastated by felling that used clear cutting methods. Here, attention is deserved by a large unstocked area between Ostrovačice and Žebětín. Shortly before the image was made, the area had been massively deforested to enable construction of a racing track for automobiles and motorcycles (Masaryk Racing Track). Localities of mineral mining industries such as big quarries near Čebín, Lažánky and Tišnov have also been shown as devastated areas.

Areas and settlements used for agricultural purposes are situated in lower and flatter parts of the relief. Beside the SE map quadrant which is practically filled with urban areas of BRNO, Blansko, Tišnov and Kuřim, the remaining part of the area under study exhibits housings of rural type. Success of intepretation of settlements depends on character of these residences. Urban-type settlements with a high proportion of inorganic surfaces such as roofs, buildings, communications, can be interpreted without any difficulties. On the other hand, rural settlements with a high proportion of vegetation do not provide sufficient contrast to their surroundings, which can make their identification impossible in practice. It is obvious from the map that it is mainly boundaries of settlements at places where they merge into open landscape, which are sometimes not delineated in full agreement with ground plan of the bottom.

Areas used for agricultural purposes, which cover the flat relief in depressions can well indicate for example the course of Boskovice ridge in the map. In the composite, agricultural land was manifested in the whole range of colour tones in dependence on the proportion of green and non-green components of active surface, ie. on the level of land cover with vegetation. The map legend included only the two extreme conditions: agricultural land with vegetation and without vegetation, transient cases being included in one or the other class according to the proportion of vegetation and bare land.

4. *Conclusion*

The land use maps provide valuable information about actual condition of landscape sphere. They find particular application in territorial decision-making activities of administrative bodies, being at the same time one of essential elements of the GIS databases. Their compilation and up-dating with the use of remotely sensed data appears to be effective from both financial and time viewpoints.

The method used for compilation of land use map on the sheet 24-32 BRNO (ie. visual interpretation of colour composites) has been proven suitable for workplaces with no available instrumentation for digital processing of image information. It is based on human factor and makes full use of experience from interpreting colour composites.

Value of the map is a product of its time (1988) and of the fact that no other non-image informations were used for its compilation. The "genuine" approach of remote sensing at creating maps of this kind has already been surpassed, and utilization of all available data (including terrain survey to verify interpretation of critical localities) facilitates to compile the land use maps by means of remote sensing image material, whose legend contains up to three times the amount of items when compared with this map.

Author's address

RNDr. Miroslav Koželuh, CSc.
Institute of Geonics, Czech Academy of Sciences, Branch Office Brno,
Drobného 28, CZ-602 00 BRNO, CZECH REPUBLIC

Reviewer

RNDr. Vítězslav Nováček, CSc.

References

KOŽELUH, M. (1993): Mapování využití půdy z družicových snímků. Sborník ČGS, 98, 3, p. 170-178. Praha.

Explanations to the map - Appendix No. 3

(the numbers correspond to numbers in the legend of enclosed map)

1 – urban areas (with residential and industrial functions)
2 – agricultural land with vegetation incl. permanent grass cover
3 – agricultural land without vegetation (ploughed land)
4 – forest land with prevailing coniferous stands
5 – forest land with mixed stands
6 – forest land with prevailing deciduous stands
7 – forest land denudated by felling (clear cut areas)
8 – devastated areas (quarries)
9 – water areas
10 – water streams
11 – important roads
12 – boundaries of land use forms

Pavlov *Photo: O. Mikulík*

HUMAN IMPACT ON NATURAL ENVIRONMENT

Antonín Vaishar

Abstract

The map records spatial differentiation of anthropogenic impacts on (natural) environment. The authors attempted at finding, quantification and localization of typical environmental impacts of individual social and economic human activities on environment. Classified are areas according to their methods of use as well as individual sources of air and water pollution. Model example is an area northwest of Brno, which is represented by typical mosaic of land use in the background of capital.

Shrnutí

Vliv socioekonomických aktivit na životní prostředí

Mapa zachycuje prostorovou diferenciaci vlivů člověka na (přírodní) prostředí. Autoři se snažili najít, kvantifikovat a lokalizovat typické environmentální vlivy jednotlivých sociálních a ekonomických aktivit na životní prostředí. Hodnocena jsou území podle způsobu využití a jednotlivé zdroje znečištění ovzduší a vody. Modelovým příkladem je území severozápadně od města Brna, které je reprezentováno typickou mozaikou využití země v zázemí velkoměsta.

Key words: human impact on environment, land use, Brno surroundings

1. *Introduction*

Main idea of the map [1] consisted in an illustration of impacts of human activities on (natural) environment. The chosen scale facilitated detailed expression of individual phenomena. The chosen area in the background of urban agglomeration enabled to grasp a wide range of relationships between the human activities and condition of environment.

In spite of the fact that the mentioned relationships are theoretically very well known, their cartographic intepretation requires precise localization and if possible, also quantification. However, in many a case this is not so simple. It is not possible to measure all impacts at all places and at all times. This is why the individual values must often be estimated or converted. The estimates are usually based on generalization of previous experience. Nevertheless, sometimes a concrete case may be beyond this common experience. Therefore, maximum verification of obtained results is desirable.

First of all, the map presents spatial image. However, the spatial concept does not mean a mere distribution of phenomena, but also their interrelationships. It is therefore not only visual demonstration of these phenomena that is in question, but also an opportunity to learn more about mutual links and contexts of individual anthropogenic effects on environment.

The system of evaluation is entered by resources of different nature and different spatial organization. These may be classified for example by branches of national economy. In a structure like this, we would speak of impacts caused by agriculture, forest management, industry, transport, recreation, residences. Individual interactions are of point, linear or areal character. This is important from the viewpoint of choice for cartographic illustration. No less important is, however, position of the evaluation since changes in comprehension of spatial character may result in changes of quality.

A typical example of such a phenomenon is local heating. Individual house fire-boxes are usually negligible sources of air pollution. However, concentration of several hundreds or even thousands of local fire-boxes may present a greater danger than one big pollutor and apart from this, the one big pollutor can be measured, fined and has a chance to implement technological measures unlike the large amount of local sources. This explains significance of spatial character of

[1] The map was worked out by the team of following authors: Evžen QUITT, Oldřich MIKULÍK, Antonín VAISHAR, Kateřina ČÚZOVÁ, Miroslav KUNDRATA, Jan LACINA, Jaroslav UNGERMAN, Vladimír VLČEK, Jana ZAPLETALOVÁ

individual relationships. An optimum expression of such a spatial character of individual relationships is a map.

2. *Relationships between Man and (Natural) Environment*

Definitions and explanation notes to individual relationships are arranged according to the map legend.

2.1 Urbanized areas

Urbanized areas are considered to be continual areas built up with dwelling houses and accompanied with appurtenant infrastructure. These areas are characterized by types of the dwelling houses as well as by technical equipment and engagement of flats. Basic categories of dwelling buildings in Moravian conditions are family houses and blocks of flats. Country settlements are typically known by their family houses of either traditional character with remainders of rural production function, or by those of urban villa types.

Structure of dwelling houses in urban settlements is more complex. There are usually housing estates of family houses of various ages and types (villas of the highest social status, houses in block configuration of garden neighbourhoods, road town outskirts with row family houses of low social status), housing estates of apartment houses (burgher houses of central and suburban quarters for middle class population, lower social status blocks of flats in workers, outskirts, the so called socialist architecture, ie. originally brick and later prefab structures culminating in "settlements"), as well as mixed housing estates.

Various types of the dwelling houses impact environment to different extent. Significant difference can be seen between family houses and blocks of flats. The relationship between character of the built-up estate and its impact on natural environment can be quantified only with difficulties, and it also depends on configuration of the built-up area, character of topography, original natural environment, etc.

Quality of flats is represented by structure of flats in individual categories of technical equipment. There are following four categories of flats distinguished in the Czech Republic: I – flats with complete technical equipment including bathroom and toilet and with central heating, II – flats with complete technical equipment without central heating, III – flats without bathroom or without toilet, IV – flats without bathroom and without toilet. Occupation of flats was assessed according to criteria of dwelling area per capita, and number of persons per a dwelling room larger than 8 square meters.

Final quality indicator and flat occupation were defined on the basis of the above three indices. The index is to certain extent exceptional in this map as it represents one of characteristics of social environment. However, quality of flats is related to perception of environment by their inhabitants.

Enormously differentiated appears to be the structure of home and housing resources in Brno. In the period between two world wars, Brno was one of the cities in Europe, which followed progressive urban trends. The structure of houses and flats naturally reflects in environmental values of dwelling.

2.2 Production area

Activities of production industries were specified and localized within production areas. This applied mainly to industrial localities, mining areas and built-up areas of agricultural production. Existing maps and topographic surveys were used as a basis in order to verify them. Sense of detaching the production areas consisted in localization of possible sources of environmental problems rather than their specification or quantification which is a subject of other legenda sections.

2.3 Recreational area

Mission of recreational facilities in an area consists in improvement of environment in the region. However, when exceeding certain limits, recreation may also lead to devastation of the area. This applies in particular for overloaded areas which include near surroundings of the cities.

The map illustrates two types of recreational areas. The first of them are chalet settlements, garden colonies, areas used for recreation. This category includes also urban parks. In reality, the mentioned group of objects is considerably heterogeneous both in terms of recreational significance and in terms of environmental consequences. Differences are seen for example in different ratios of active and passive recreation, in different intensity of area utilization, different carrying capacity of the area, different infrastructure. Some chalet settlements with greater number of objects, of not always proper architectonic solution which allows high concentration on a relatively limited area, may produce similar critical problems (waste, social conflicts) as towns - but with incomparably worse infrastructure. Some recreational areas may become zones of reduced safety for population due to criminality. At other places, the increased motion of holiday-makers may result in direct devastation of both vegetation and topography. Generally viewed, however, occurence of these recreational facilities should indicate areas where at least some phenomena exhibit positive influence on environment.

It is useful to realize that recreation in cottages, gardens and weekend houses represented not only a very frequent type of recreation in the past regime, but also one of a few expressions of individual ownership. In addition, it played an important role at self-supplies with vegetables and fruits. Therefore, garden colonies represent a relatively intensive productional utillization of the area.

Another type of recreational areas are sport facilities which serve active recreation and - from the viewpoint of environment - behave usually as facilities of tertiary sector. Among other, these areas can produce temporary noise disturbances from time to time (motor tracks, football stadiums).

2.4 Forests

Forest areas are characterized by two groups of indices. The first of them tell much about the degree of transformation of forest tree species composition as compared to potencial condition. It is in fact a comparison of present representation of individual forest tree species with original natural structure. With regard to the fact that the natural structure of forest corresponds with natural conditions, it is possible to judge - from the degree of its transformation - on the relationship of present forest to environment. It is assumed that severely transformed forest stands can much worse resist atacks of anthropogenic activities and cannot fulfil non-wood-producing functions to full extent, whose sense consists in maintaining ecological stability in the landscape. We would like to point out that the discussed issue includes only composition of forest tree species, not forest appearance and character of management applied in the forest. According to the mentioned criterion, forests were differentiated by their tree species composition as follows:

- forests very little transformed,
- forests little transformed,
- forests transformed,
- forests heavily transformed.

In addition to the fact that forest management takes a certain part in influencing environment as one of the human activities, the forest as a natural landscape element is affected by condition of environment. One of the most pronounced impacts can be seen in consequences caused by air pollution. According to the degree of damage and danger to forest stands represented by air pollution, classification of forests was illustrated as follows:

- forests with low signs of damage,
- forests with lower and medium damage,
- forests with severe and very severe damage,
- dying and died forests.

Very essential is also a non-wood-producing ecological function of the forest. Urban forests provide a possibility of compensating unfavourable characteristics of urban environment. In the northern half-circle of Brno surroundings extensive forest stands form a so called "green horse shoe" which is a very beneficial element for environment of town inhabitants.

Damage to forests belongs among important indicators of disturbed natural environment, namely air pollution. Significant is also a fact that this indicator is relatively very sensitive to transfer of air pollutants often at great distances.

2.5 Rural areas

In conditions of Central Europe, rural areas represent the most visible element of natural environment degradation. Total transformation of the original biota is further intensified by consequences caused by used agrotechnical methods whose range is relatively wide from pollution of environment with chemical preparations, mechanical damage due to employed machinery up to opening extensive areas to water and wind erosion.

With regard to the fact that data needed for an analysis into impacts of chemization in agricultural production onto deterioration of natural environment are hardly obtainable in the chosen scale, the map includes mainly phenomena related to erosion processes. Danger of erosion to soils is expressed qualitatively, by two more or less contradictory categories: arable land protected from erosion by turf, and arable land with prevailing accumulation and transport processes.

The methodology of analyzing the degree of water and wind erosion hazard to soils is based on confrontation of natural potential (resistance against changes) with anthropic pressure (KUNDRATA 1988). Arable land with prevailing erosion and denudation processes was divided into three categories by intensity of the phenomenon:

- low intensity,
- high intensity,
- very high intensity.

In addition to this classification, plots of arable land which are exposed to very heavy wind erosion formed a special group.

2.6 *Animal production facilities*

In contrast to the non-point character of environment devastation by plant production, pollution of environment by animal production is of purely point nature. Heart of the matter consists in the fact that the majority of large-scale facilities in which a considerable part of livestock was kept during the period under study were built with technology for processing wastes in the form of liquid slurry. This technology has been proved to have an extremely negative impact on pollution of natural environment. The large-scale facilities of animal production were divided in the map according to employed technological process into litter, slurry, and combined facilities. In the latter case, share of both mentioned technologies was illustrated.

Values of a so called population equivalent of pollution were allocated to individual point sources of pollution from animal production, the value being defined as wastes produced by human residence of a given number of inhabitants. This quantitative classification has five categories, and extremes range between thousands and ten thousands of inhabitants.

2.7 *Solid waste dumps*

Solid waste landfills are identified in the map with the waste being mostly either communal or mixed. Localization of the dumps was made on the basis of existing records which were then combined with terrain survey. According to regime of their operation, the dumps were classified into controlled dumps, ie. landfills with approved regime complying with environmental principles and knowledge, approved dumps, ie.landfills approved to certain provisions but with no controlled regime, and wild dumps, ie. illegal landfills.

2.8 *Impacts of traffic*

Negative effects of traffic are the first of line sources to environmental problems entered in the map. Factors taken into consideration were air pollutants and noise. Data were obtained from information on counting road traffic, whose results not only register numbers of passing vehicles along various road sections, but also composition of the vehicle flow of which the most interesting part for us was the rate of passing trucks, especially heavy lorries. The mentioned data were converted according to existing formulas into negative effects of traffic, valid for individual sections of selected roads.

Air pollution was expressed in $kg \cdot km^{-1}$ in three categories while noise was recorded in dB/A in four categories. Obviously, this expression can apply only to road sections which were measured at counting the traffic. It is assumable that it was first of all road sections with higher traffic load that were counted. Therefore, with a certain exaggeration, we can assume that uncounted road sections fall into the next category - least damaging the natural environment.

2.9 *Air pollutants*

This item of legenda to our map illustrates point sources of air pollution with noxes whose occurrence is currently measured in Czech conditions. It is dust, sulphur dioxide and carbon monoxide. Data were obtained from registers of air pollutors recorded in registers of REZZO information system, operated by TERPLAN Prague. Sources of dust air pollution are mentioned in two categories as to their significance: less important sources of dust air pollution (1000-3000 MT noxious substances per year), and sources of dust air pollution important from the super-regional point of view (beyond 3000 MT noxious substances per year). In addition to this, there is a special marking for important sources of sulphur dioxide immissions (beyond 2000 MT per year) and carbon monoxide (beyond 3000 MT per year). Production rates of air pollutants from non-point sources such as local heating of residences are mentioned in another item of legenda.

2.10 *Water pollution and waste water treatment*

The first of parameters expressing consequences of environment pollution is the index of water stream polution. In the Czech Republic we have four categories to indicate cleanliness of water streams. The categorization has been a result to complex characteristic of water streams, which included oxygen regime (BOD_5), basic chemical composition and special indices. Values of the index are principally related to pollution sources and their localization as well as to 355-day water passage $Q355_d$. Category I represents clean water, category II polluted water, category III heavily polluted water, and category IV water which has been very heavily polluted. Water of the categories III and IV is usually not usable for most of purposes. In addition to the categories of water cleanliness this item includes also localization of waste water treatment plants.

2.11 *Air polluted regions*

Another index to show consequences of natural environment pollution can be seen in air polluted regions. Air pollution with sulphur dioxide and with flying dust was taken into account at their demarcation. Data were obtained partly through measurements, partly through estimates made on the basis of localization and character of the sources, relief articulation and dominating wind direction. Average annual values in $\mu g \cdot m^{-3}$ were calculated for 1981 – 1988.

Cartographically the air polluted regions were demarcated by means of isolines which reflected identical level of pollution and were graduated by $10\,\mu g \cdot m^{-3}$. The highest tolerable concentrations in sulphur dioxide and flying dust were $60\,\mu g \cdot m^{-3}$ and $40\,\mu g \cdot m^{-3}$, respectively.

2.12 *Production of residential wastes*

Wastes from residences were calculated on the basis of numbers of inhabitants and individual characteristics related to technologies of waste formation. This applies to air pollution and its connection with methods of heating flats where the decisive role is played by availability of gas. This kind of air pollution is naturally considerably increased during the heating season. Method of heating plays an important role also in terms of amount and sorts of solid communal wastes which differ - on the top of it all - by the degree of urbanization of the residence. Resulting values of waste production were expressed by a triad of numbers, recorded under the name of residence. In the City of Brno, the calculation was made for individual neighbourhoods.

2.13 *Method of using water areas*

A complementary characteristic in the map is the method of using water areas, marked with a letter. Legenda of the map distinguishes utilization for protection, water management, agricultural purposes, livestock keeping purposes, recreational purposes and swimming pools. Admitted is a multi-purpose use of water reservoirs.

3. *Disturbance to natural environment in NW surroundings of Brno*

Northwestern surroundings of Brno are situated at a counter direction to prevailing winds and at a counter direction to water streams from the city. Theoretically, this ought to be a relatively advantageous position. However, it is necessary to consider that the locality is known by numerous anthropogenic activities which are more or less bound to Brno. First of all, there are many engineering and other plants of the Brno industrial agglomeration, which are localized in Blansko, Adamov, Kuřim, and partly also at Tišnov. The landscape is massively disturbed by lime stone mining near Čebín. The most important recreational area for town inhabitants is situated around the dam reservoir Kníničky and in adjacent wood complexes which can also be found northwest of Brno. West of Brno, there is the Boskovice furrow which spreads along north-southern direction and is intensively used for agricultural purposes, while highway D1 spreads along eastwestern direction. Road traffic massively disturbs also a corridor along the road no. 43 (E461) in Svitavy direction.

A sheet of the map illustrates the northwestern section of the city of Brno itself. It is mainly dwelling parts and infrastructure while industrial zones are situated to the East and South of the town. Nevertheless, several large factories of engineering, electrotechnical, chemical, food, and building material industries as well as an important traffic corridor can be found even in the northwestern section.

The area situated to northwest of Brno is considerably differentiated in terms of physical geography. There are both forested ridges to be found here, which are relatively stable in ecological terms and inversion basins and breaks which are loaded with concentration of inhabitants, their activities and traffic corridors. Utilization of the area is then defined by topography and other natural conditions.

The area is relatively densely inhabited, particularly along major communications. However, there are also relatively extensive forest complexes here which can be found in the western and northern outskirts of Brno. Large amount of small residences can be found on the western margin of the map within the articulated topography of Křižanov Uplands.

The above rough characteristic of mosaic utilization of the area indicates that in the area under study there is a whole range of much diversed sources of disturbance to natural environment. However, diversed are also natural conditions and their greater or lesser capacity of absorbing the disturbance. All this then results in alternation of environmentally good quality areas which to certain extent can improve environment for inhabitants in Brno, with territories which are massively devastated by different forms of human activities.

4. *Conclusion*

Compared with the majority of other maps in the submitted collection 1 : 50 000, the map describing effects of socio-economic activities on the landscape is much more exacting with diversity of its problems. Its construction requires joint work of many experts in various partial geographical disciplines. Its results may sometimes look trivial because they illustrate generally obvious things. However, it is necessary to take into account that localization of problems concerning individual sources of disturbance to natural environment, similarly as attempts at their evaluation at such a large scalecannot be called simple in any case.

The above discussed complexity of the issue and organizational demands for processing of results present pronounced limits to application of illustrated problems in other regions. On the other hand, however, it is exactly this diversity that can provide a great field of action for fantasy of a cartographer who is thus free to create rich combinations of map elements which will ever better express contents of cartographical information.

In fact, sense of the map consists in interpretation of land use with emphasis being put on active human factor. Ambitions of the map should be seen in its capacity to form a basis for strategy towards sustainable development of the concrete region.

There is no doubt that similar maps must be made. Their minimum benefit consists in the fact that a relatively considerable number of environmental problems in concrete region can be recorded. These records are then an important helping hand at decision-making of local and regional councils and authorities, or possibly also an orientation starting point for ordering detail studies.

Author's address

RNDr. Antonín Vaishar, CSc.
Institute of Geonics, Czech Academy of Sciences, Branch Office Brno,
Drobného 28, CZ-602 00 BRNO, CZECH REPUBLIC

Reviewer

Doc. dr. Alois Hynek, CSc.

References

KUNDRATA, M. (1988): Geographical evaluation of current (topical) anthropogenic changes of soils. In: Some aspects of geographical evaluation of the condition and development of environment in CSR. Geographical Institute, Czechoslovak Academy of Sciences Brno, p. 23 – 29.

Explanations to the map - Appendix No.4

Urban areas
Quality and occupation of flats: 1 – very good, 2 – good, 3 – medium, 4 – poor, 5 – very poor.
Type of houses: 6 – Family houses, 7 – Blocks of flats, 8 – Combined.

Production facilities
9 – Industrial, 10 – Mining, 11 – Agricultural.

Recreational areas
12 – Recreational areas with weekend houses, allotment gardens, 13 – Sports areas.

Forests
Forest tree species structure changes as related to the natural status: 14 – Very slightly changed, 15 – Slightly changed, 16 – Medium changed, 17 – Severy changed. Air pollution impacts on forests: 18 – Slight, 19 – Medium, 20 – Strong, 21 – Decaying forests.

Agricultural areas
Soils exposed to erosion: 22 – Soils partly protected by plant cover, 23 – Arable lands characterized by accummulation and transport processes. Soil damage by erosion: 24 – Low, 25 – Heavy, 26 – Very heavy, 27 – Damage caused by severe wind erosion.

Rural animal production facilities
(assessed by population equivalent) 28 – Below 2000, 29 – 2000 to 5000, 30 – 5000 to 10000, 31 – 10000 to 25000, 32 – Beyond 25000, 33 – With litter technology, 34 – With semi-liquid and liquid manure technologies, 35 – With combined technologies.

Solid Waste deposits
36 – Controlled, 37 – Tolerated, 38 – Illegal.

Negative impacts of traffic
Polluting gases ($kg \cdot km^{-1}$ per day): 39 – Less than 100, 40 – 101 to 200, 41 – Beyond 201. Mean equivalent noise level in dB(A): 42 – Less than 65, 43 – 65.1 to 70.0, 44 – Beyond 70.1.

Air pollution
46 – Little source of dust pollution (1000–3000 MT per year), 47 – Source of dust pollution important from the regional point of view (beyond 3000 MT per year), 48 – Important source of sulphur dioxide (beyond 2000 MT per year), 49 – Important source of carbon monoxide (beyond 3000 MT per year).

Water pollution and cleaning facilities
Water quality classes: 50 – First class, 51 – Second class, 52 – Third class, 53 – Fourth class, 54 – Waste water cleaning plant.

Regional air pollution
Air pollution by SO_2 ($\mu g \cdot m^{-3}$): 55 – Measured annual mean concentration values in 1981-1988 (MAC $= 60\,\mu g \cdot m^{-3}$), 56 – Expected air pollution. Air pollution caused by dust in $\mu g \cdot m^{-3}$): 57 – Measured annual mean concentration values in 1981 – 1988 (MAC $= 40\,\mu g \cdot m^{-3}$): 58 – Expected annual mean concentration.

Urban waste production (red marked numerical code)

	SO_2 MT per yr	Waste water MT BOD_5 per yr	Solid urban waste MT per yr
0	less than 1	less than 1	less than 17
1	1.1 – 2	1.1 – 2.3	18 – 34
2	2.1 – 4	2.4 – 5.3	35 – 68
3	4.1 – 8	5.4 – 12.2	69 – 136
4	8.1 – 16	12.3 – 28.0	137 – 272
5	16.1 – 32	28.1 – 61.6	273 – 544
6	32.1 – 64	61.7 – 134.5	545 – 1088
7	64.1 – 128	135.5 – 298.0	1089 – 2176
8	128.1 – 256	298.1 – 655.5	2177 – 4352
9	beyond 256.1	beyond 655.6	beyond 4353

Function of water areas
O – nature protection, V – water management, Z – irrigation, C – fish production, R – recreationa

GENERAL AND DETAILED TOPOCLIMATIC MAPPING FOR PURPOSES OF ENVIRONMENT PROTECTION

Evžen Quitt

Abstract

Detailed topoclimatic maps at the scale of 1 : 50 000 can illustrate a whole range of processes occuring in surface and lower parts of the boundary layer of atmosphere. Typical climatic situation was assumed at quantifying extent, intensity and frequency of these processes, under which the topoclimate can fully develop. Basis for compilation of the map consists of 8 registers of an information system with data in digital form for units 100 × 100 m.

Shrnutí

Topoklimatická mapa

Podrobné topoklimatické mapy v měřítku 1 : 50 000 zobrazují celý komplex procesů v přízemí a spodní části mezní vrstvy ovzduší. Při kvantifikaci rozlohy, intenzity a četnosti těchto procesů se předpokládala typická povětrnostní situace za níž se může topoklima plně rozvinout. Podkladem pro sestavení mapy je 8 registrů informačního systému s daty v digitální podobě pro jednotky 100 × 100 m.

Key words: topoclimatic map, boundary layer of atmosphere, information system

Since the mid-50's, topoclimatic surveys were made by Geographical Institute in various parts of the country, mainly in connection with building large technological facilities. Their major objective consisted in quantification of effects of different types of active surface and different relief forms on processes occuring in the surface and boundary layers of atmosphere. It is namely exactly here where topoclimatic situation can most influence dispersion of atmospherical admixtures.

Experience from the research resulted in establishment of a geographical information system for purposes of environment protection in the 70's. After having been filled with data, the information system was employed at topoclimatic mapping of territory of entire Czechoslovakia at the scale of 1 : 500 000. The country was divided into a network of squares 1 × 1 km for each of them we derived basic characteristics about articulation of topography and its forms, both physical and biological properties of the surface, surface exposure to cardinal points, its inclination and moisture conditions. The information unit area of 1 km^2 fully corresponded to the scale of this topoclimatic map (1 : 500 000 up to 1 : 200 000). Incidentally, size of the information unit was very close to data gained from remote sensing by meteorological satellites. These data can namely be used for modelling processes occuring in the lower part of boundary layer of atmosphere. The information system has made it possible to apply regional approach at studying the topoclimatic processes. By entering the data of prognostic character, we could further develop ideas on possible changes of topoclimate in the near future, which would be caused by anthropogenic activities.

Application of this information system gave rise to an easy-to-survey topoclimatic map of the Czech Republic at a scale of 1 : 500 000, later then to a map of air pollution published in Atlas of Environment and Population Health at a scale of 1 : 1 000 000, and a map of topoclimatic types of Central Europe at a scale of 1 : 1 500 000, which was published in Austria in 1992 as a part of the Atlas of Eastern and Southeastern Europe.

Linking up with the Collection of geological and purpose maps of natural resources worked out and published in the end of the 80's at the Central Geological Institute in Prague, methodology was worked out of compilation of a Collection of geographical maps of environment in the Czech

Republic at a scale of 1 : 50 000. Compiled were sample sheets of basic map of CSR 24-32 BRNO and 34-22 Hodonín including topoclimatic maps. In the enclosed sample collection we also bring the topoclimatic map of Brno surroundings (Appendix No. 5).

The topoclimatic map at a scale of 1 : 50 000 illustrates a whole range of processes occuring in the surface and lower parts of boundary layer of atmosphere. These processes participate to the decisive extent at distribution of air pollutants and this is the reason why knowledge of their spatial distribution is necessary for assessment of air pollution situation at the level of regions, districts and individual localities. It is also needed for dispersion studies made into existing or planned sources of air pollution at curbing area and building plans for investment development of municipalities in which evaluation of the issue of atmosphere protection follows out from the Act on Environment. In advanced countries, similar documents can be seen at local city councils where they provide a basis for decision-making about larger investment projects.

The topoclimatic map can quantify intensity, duration or frequency of processes occuring in typical climatic situations within the surface and lower parts of boundary layer of atmosphere. Special attention is being paid to phenomena which are most important in terms of their participation at distribution of air pollutants:

- thermic causes of turbulence,
- dynamic causes of turbulence,
- size and duration of vortex movements,
- variability of wind vector with height,
- pre-requisites for confluence and difluence of streamlines,
- possibility to support catabatic run-off of cooled air from slopes,
- intensity of ventilation,
- frequency of temperature inversions,
- duration of temperature inversions,
- intensity of temperature inversions.

This quantification of topoclimatic processes will facilitate assessment of their effects onto dispersion potential of atmospheric admixtures exactly in the atmosphere layer which is most important for health condition of the population, natural landscape components or depositions of heterogeneous substances in ecosystems.

Definition of atmospheric admixtures dispersion potential in the surface and lower parts of boundary layer of atmosphere is therefore a starting point for synthetic studies of processes that take place here under typical climatic conditions. This is an essential part of dispersion studies, which cannot be neglected. At calculating the expected measure of air pollution, these studies can namely be based on very simplified inputs that characterize atmospherical processes. Regarding the used input data and methodology of calculation, the mathematical model is not capable of grasping a whole range of processes of primary importance, which can markedly participate at modification of air pollution characteristics stated in the dispersion study. Topoclimatic valuation of processes affecting dispersion of atmospherical admixtures in the surface layer of atmosphere form therefore a very essential basis for correct interpretation of data included in these dispersion studies.

It seems therefore entirely unrealistic to work out standpoints to erection of large technological plants without appropriate knowledge of distribution of processes in the lower part of boundary layer of atmosphere and their quantification, and thus to fulfil fundamental requirements of the Law no. 17/92 Gaz. on environment. Data contained in the topoclimatic map will thus facilitate not only finalization of the dispersion studies up to the condition applicable for ecological and technical practice, but namely guidance of area and development plans for investment development in municipalities.

The eight information databank systems in digital form for information units of 100 × 100 m serve as a base for compilation of detailed topoclimatic maps at a scale of 1 : 50 000 (but also that of 1 : 25 000). The databank registers in question are as follows:

1) Macroclimatic characteristic providing a survey on distribution of selected 25 most important data (mean air temperature in January, April, July and October, average number of tropical days t_{max} 30 °C and more, summer days t_{max} 25 °C and more, frost days t_{min} −0.1 °C and less, ice days t_{max} −0.1 °C and less, days with severe frosts t_{min} −10.1 °C and less, arctic days t_{max} −10.0 °C and less, and the number of days with average temperature 10 °C and more. The number of days with average temperature 0 °C and more ensured at 80% and the date of onset and end of the period, temperature sums of days with temperatures 5 °C and more, and then 10 °C ensured at 80% are next data. Precipitation regime was characterized by totals for growing period and winter period, number of days

with precipitation 1 mm and more and 10 mm and more, number of days with snow cover 1–20 cm, 21–40 cm, and thicker than 41 cm. The macroclimatic characteristic was closed with the number of clear and clouded days – see Fig. 1.

2) Arrangement of inversion areas and quantification of duration, frequency and intensity of local inversions – see Fig. 2.

3) Possibilities of development and degree of catabatic processes intensity (cooled air run-off from slopes with consequential accummulation in concave forms of the relief) – see Fig. 3.

4) Amount of sun radiation and its management – see Fig. 4.

5) Locations with altered air moisture content – see Fig. 5.

6) Distribution of ventilation intensity in the main or possibly also second prevailing wind direction – see Fig. 6.

7) Synthetizing index of atmospheric admixtures dispersion negative potential – see Fig. 7.

8) Synthetizing index of atmospheric admixtures dispersion positive potential – see Fig. 8.

These registers of information system serve not only for compilation of detailed topoclimatic maps, but they also assist at explaining local differences in deposition of heterogeneous substances, at considerations on possible dislocation of annoying odours from large agricultural plants specialized in livestock production or chemical factories, at resolving issues of the most suitable routing and design of road, railway and water communications, at building large hydrotechnical works, and particularly at assessing distribution possibilities of air pollution sources.

Author's address

RNDr. Evžen Quitt, CSc.
Institute of Geonics, Czech Academy of Sciences, Branch Office Brno,
Drobného 28, CZ-602 00 BRNO, CZECH REPUBLIC

Reviewer

RNDr. Alois Matoušek, CSc.

References

QUITT, E. (1971): Climatic regions of Czechoslovakia, Studia Geographica No. 16, Brno, 74 pp.

QUITT, E. (1972): Beitrag zur Methode der mesoklimatischen Rayonization. Acta fak. rerum. nat. univ. comenianae V, Bratislava, p. 151 – 157.

QUITT, E. (1979): Pograničnyj i prizemnyj sloj atmosfery v kartografičeskoj projekcii. In: Some problems from forest bioclimatology, microclimatology and urban climate. Práce a štúdie no. 23, Hydrometeorological Institute Bratislava, p. 124 – 136.

QUITT, E.(1981): Der Einfluss geographischer Faktoren auf die Gestaltung der Grund- und bodennahen Schicht der Atmosphaere. Pettermanns Geographische Mitteilungen 1, Gotha, p. 21 – 29.

QUITT, E. (1983): Potentielle Voraussetzungen der Gestaltung der atmosphaerischer Grundschicht als Unterlage der mesoklimatischen Rayonisation des ČSSR. Zeszyty Naukowe Uniw. Jagiel., Prace Geograficzne 57, Krakow, p. 133 – 140.

QUITT, E. (1989): Geografické přístupy k modelování procesů ve spodní části mezní vrstvy ovzduší (Geographical approaches to modelling processes in the lower part of marginal layer of atmosphere). In: Numerické modely v meteorologii. UFA ČSAV, Harrachov, p. 171 – 178.

QUITT, E. (1990): Methods, results and perspectives of topoclimatological mapping in Czechoslovakia. In: Problems of contemporary topoclimatology. IG i PZ, Warsaw, p. 19 – 27.

QUITT, E. (1992): Air pollution. In: Atlas of environment and population health in ČSFR, Brno-Prague.

QUITT, E. (1992): Topoklimatische Typen in Mitteleuropa. In: Atlas Ost- und Suedeuropa, Vienna,

Explanations to the graphical output

Figure 1-A sample of graphical output from information system in the vicinity of Polička, providing macroclimatic characteristic of the area (Quitt 1971).

Y – mildly temperate climatic area MT 3
V – cold climatic area CH 7

Figure 2-A sample of graphical output from information system, showing distribution of inversion positions.

A – Vertically very thin temperature inversions (amidst the valley, several meters above active surface), occuring occasionally only at night with insignificant temperature differences against the open area.
B – Vertically very thin temperature inversions, occuring sometimes even at day time with significant temperature differences against the open area.
C – Vertically thick temperature inversions afflicting about a third of the valley profile, occuring frequently also at the day time, with pronounced temperature differences against the open area.

Figure 3-A sample of graphical output from the register informing about possibilities of catabatic process development.

A – Catabatic run-off of cool air from slopes, preconditioned to transfer atmospherical admixtures and odours to lower altitudes.
B – Very pronounced catabatic run-off of large volumes of cool air from slopes, accompanied by intensive transfer of atmospheric admixtures to lower altitudes.
C – Massive catabatic processes supported by character and inclination of active surface with great area of cool air collection district.
Z – Trajectory of concentrated micro-advective transfer of accumulated cool air matters.

Figure 4-A sample of graphical output from the register of information system on distribution of locations with altered air humidity.

A – Increased values of namely absolute air humidity, caused by the character of active surface and aquiferation of sub-surface layers. Pre-conditions for increased occurence of fog by up to 20%. Favourable conditions for incidence of hydrophilic plant communities as well as for rise of hydromorphic soils.
B – Increased values of both absolute and relative air humidity content, influenced mainly by catabatic processes and by position at the bottom of inversion valleys. Increased frequency of fogs by 20% and more.
C – Increased values of both absolute and relative air humidity content, influenced-beside the active surface with aquifer sub-surface layers-also by catabatic processes and decreased minimum temperatures on the bottom of inversion valleys. Pronounced increase in fogs (up to 40%). Favourable conditions for hydrophilic plant communities and rise of hydromorphic soils.

Figure 5-A sample of graphical output from information system providing characteristic of solar radiation amount and its management.

A – Less irradiated areas (96% in January as well as in annual average and less solar irradiation when compared with horizontal plane). Massive decrease in temperature maximums. Micro-advective circulation under conditions of suitable temperature contrasts. Snow cover duration longer by more than 20%.
B – Well irradiated areas (120–150% in January, 111–120% annual average solar irradiation when compared with plains). Higher temperature maximums support formation of micro-advective air transfers. Snow cover duration shorter by more than 20%.

C – Well irradiated areas (as above) but with active surface formed by forest. Intensity of micro-advective processes suppressed. In coniferous forest stands-snow cover life shorter only by 10%.
G – Normally irradiated areas, with regard to urban surface with higher average temperatures by up to 0.5 °C, temperature maximums higher by about 1.5 °C, duration of snow cover shorter by 20% and more.

Figure 6-A sample of graphical output from information system on distribution of aeration intensity and wind field dislocation.

B – Locations with highly increased frequency of dead calm (over 30% cases) with very weak aeration and thus low dispersion of atmospherical admixtures.
P – Locations with medium effective aeration at the level of peak plain.
H – Windward locations with WNW dominating wind directions and heavy aeration.
D – Windward locations with the second main wind direction from SSE and with heavy aeration.
K – Pronounced control-to-confluence of streamlines with main prevailing wind direction from WNW.
Z – Pronounced control-to-confluence of streamlines with the second main prevailing wind direction from SSE.

Figure 7-A sample of graphical output of negative potential index of atmospheric admixture dispersion.

A – From time to time, slightly reduced capacity for dispersion of atmospheric admixtures, derived from incidence of occasional weak temperature inversions and low total values of solar radiation.
B – Reduced capacity for dispersion of atmospheric admixtures, derived namely from the incidence of weak temperature inversions occuring mainly in combination with increased frequency of calm.
C – Low capacity for dispersion of atmospheric admixtures, based on frequent-in comparison to the previous stage more intensive-temperature inversions which last for longer part of the day in the cold part of the year.
E – Very low capacity for dispersion of atmospheric admixtures, caused by frequent temperature inversions which can last more days, and by increased frequency of calm.

Figure 8-A sample of graphical output for index of positive potential of atmospheric admixtures dispersion.

G – Slightly increased pre-conditions for dispersion of atmospheric admixtures, supported namely by micro-advective processes of by more intensive aeration.
H – Increased capacity for dispersion of atmospheric admixtures, derived from very pronounced catabatic processes and intensive aeration.
I – Good pre-condition for dispersion of atmospheric admixtures, given by very heavy and efficient aeration.

Fig. 1 - General and Detailed Topoclimatic Mapping

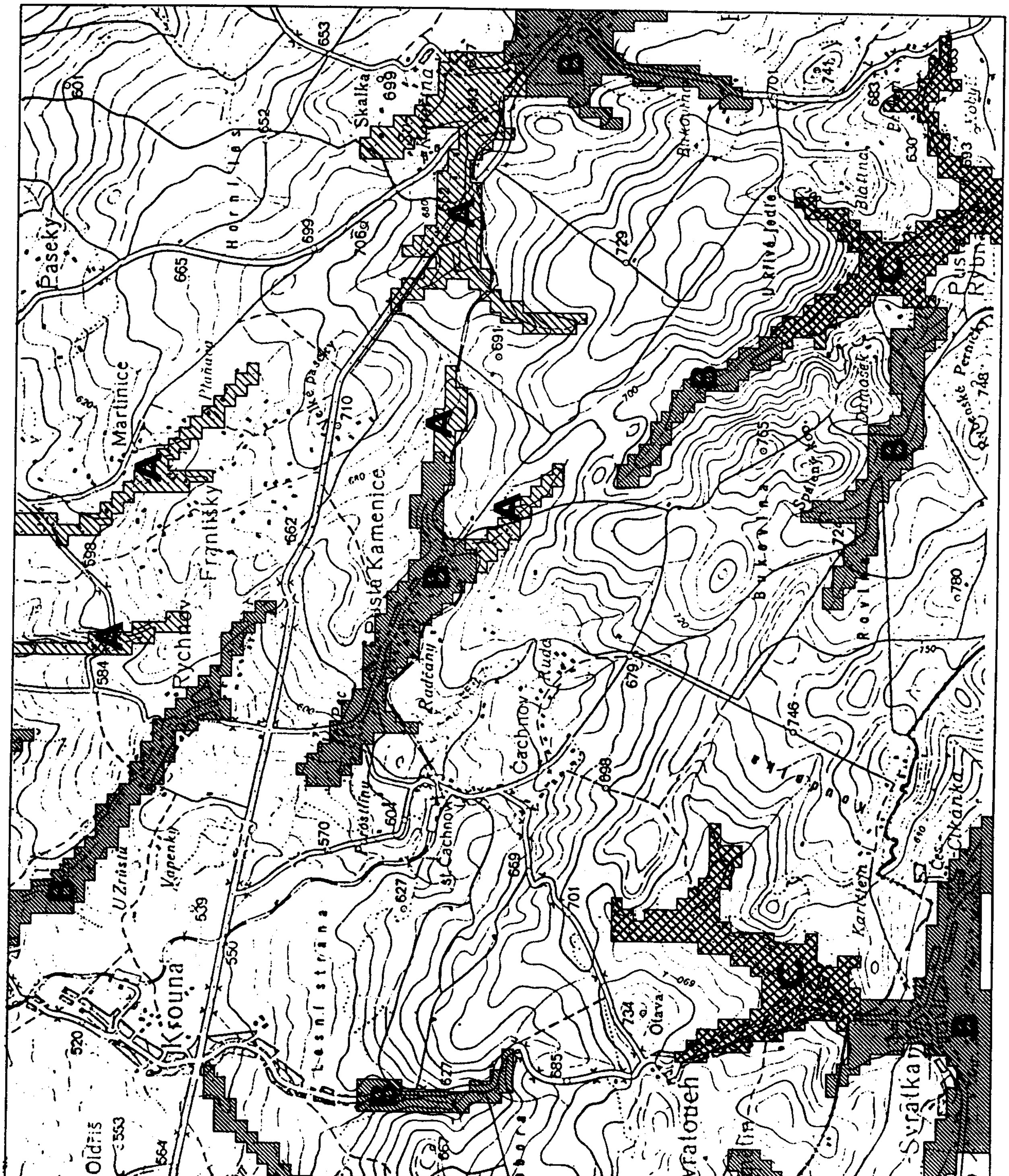


Fig. 2 - General and Detailed Topoclimatic Mapping

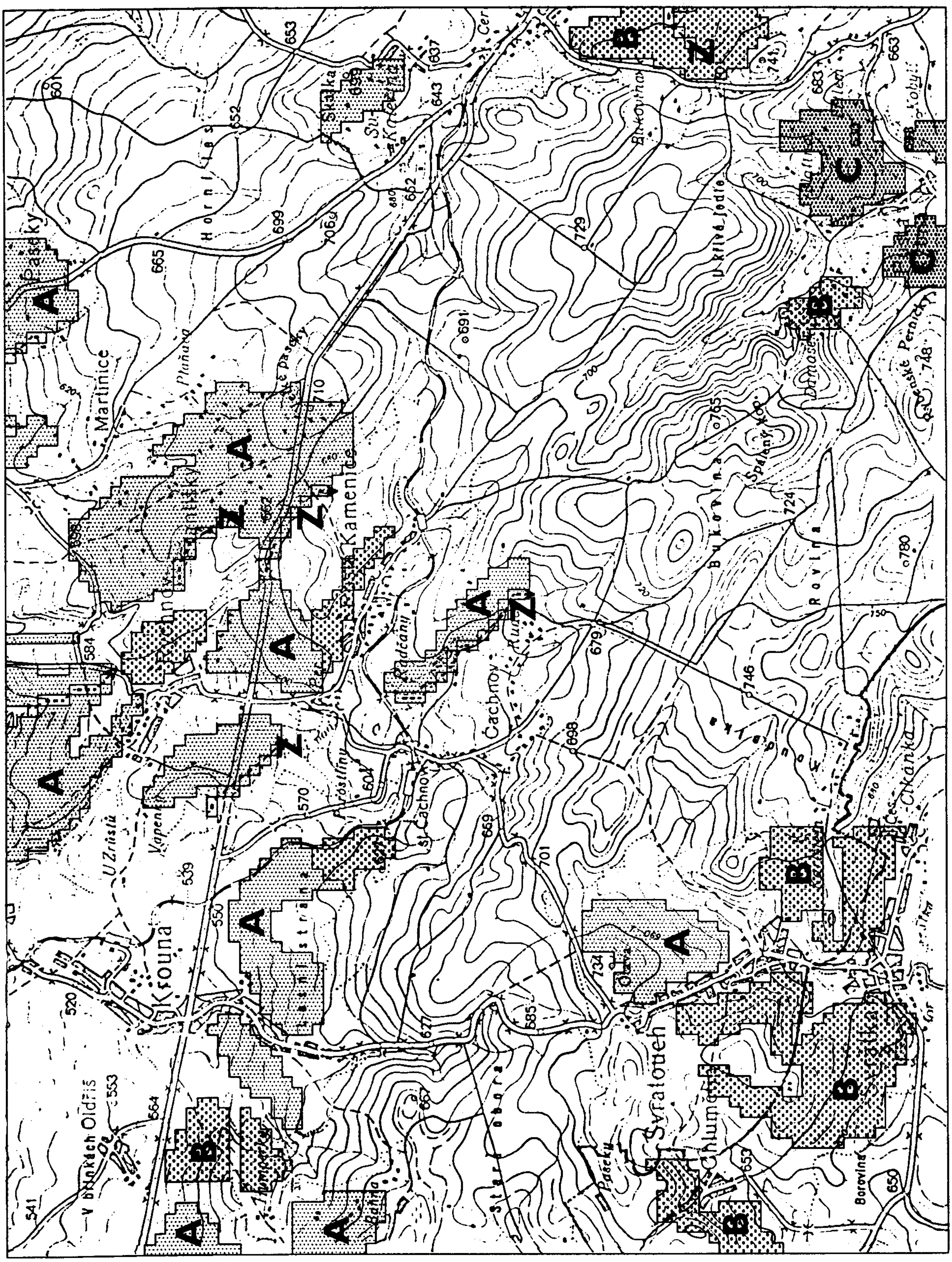


Fig. 3 - General and Detailed Topoclimatic Mapping

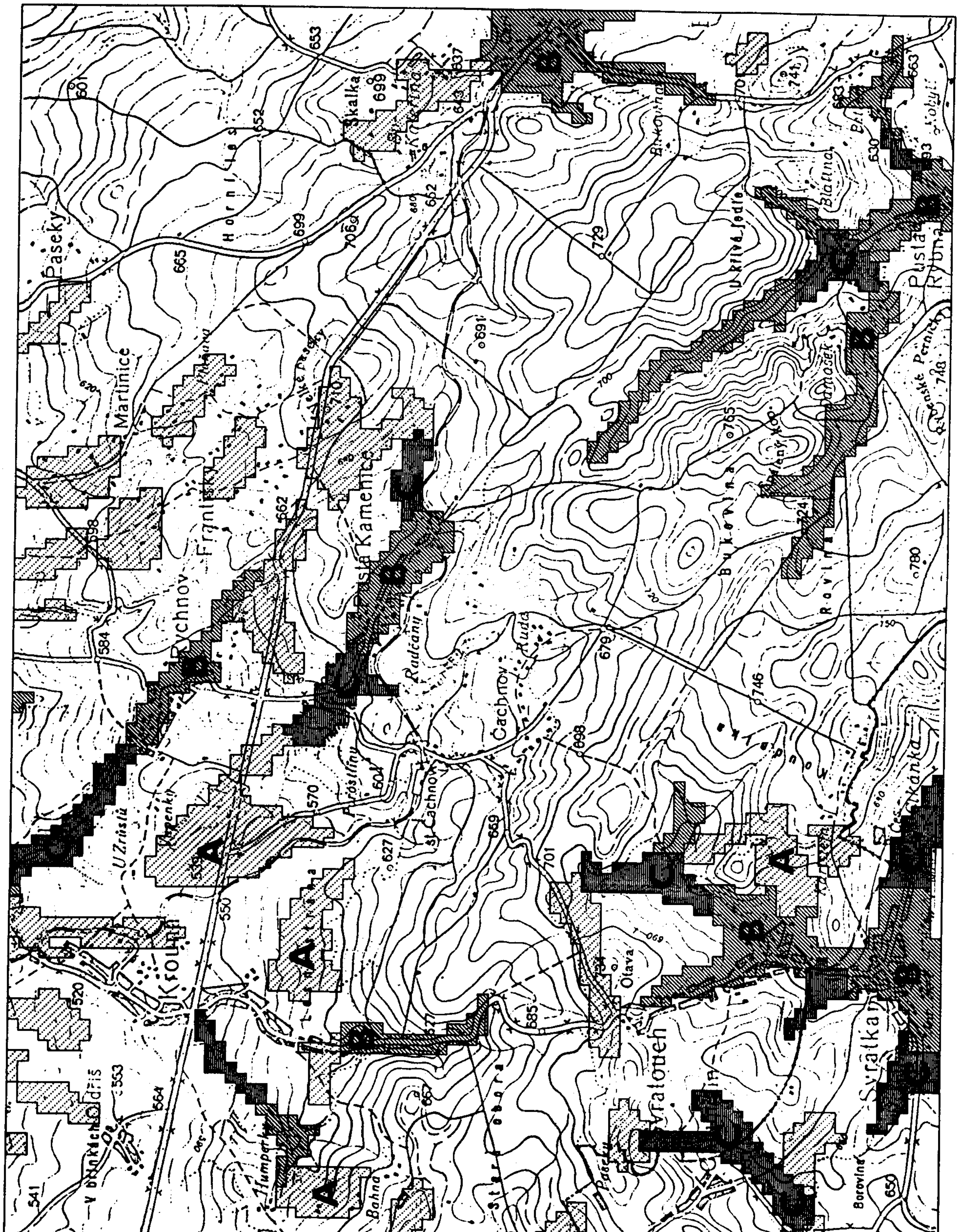


Fig. 4 - General and Detailed Topoclimatic Mapping

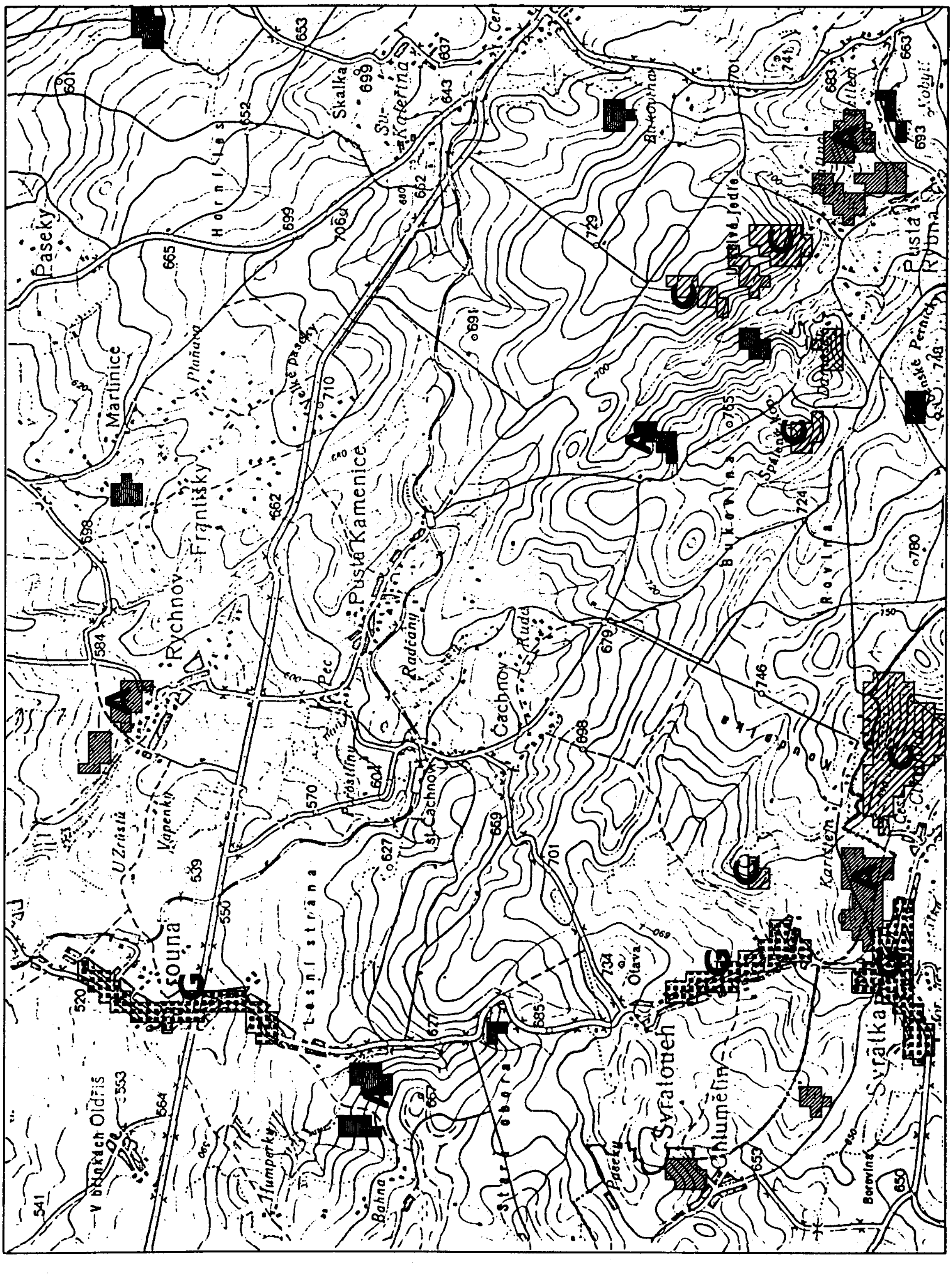


Fig. 5 - General and Detailed Topoclimatic Mapping

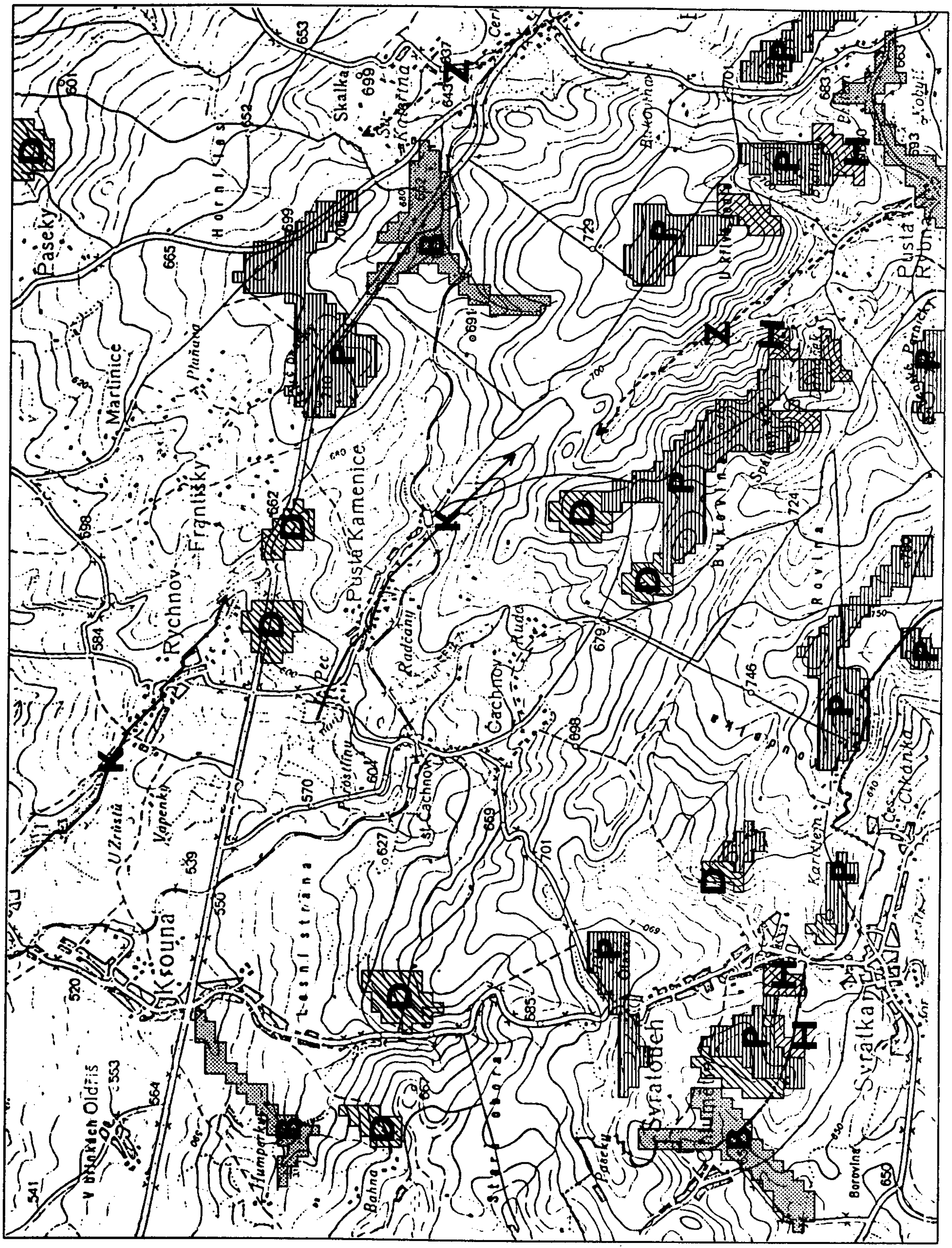


Fig. 6 - General and Detailed Topoclimatic Mapping

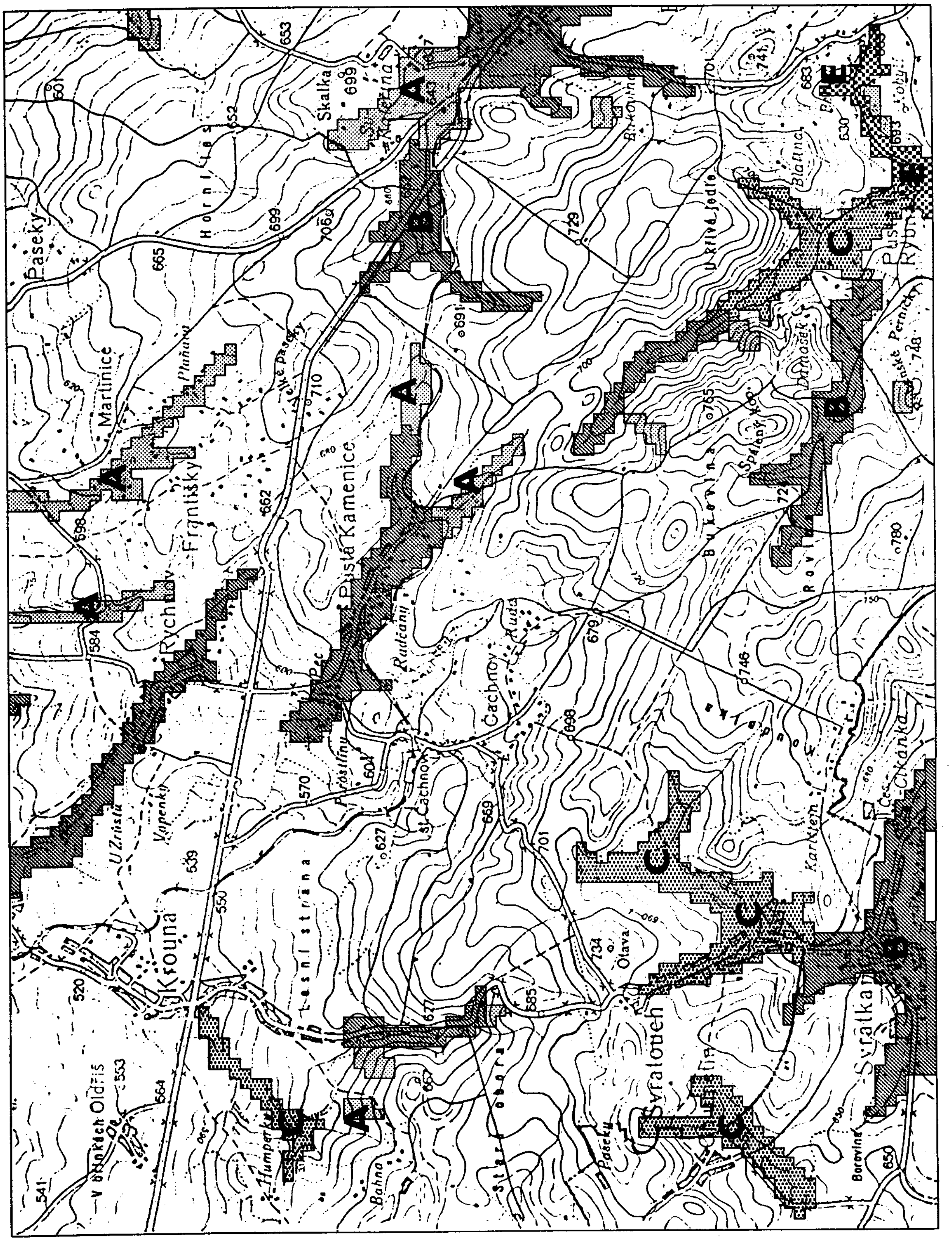


Fig. 7 - General and Detailed Topoclimatic Mapping

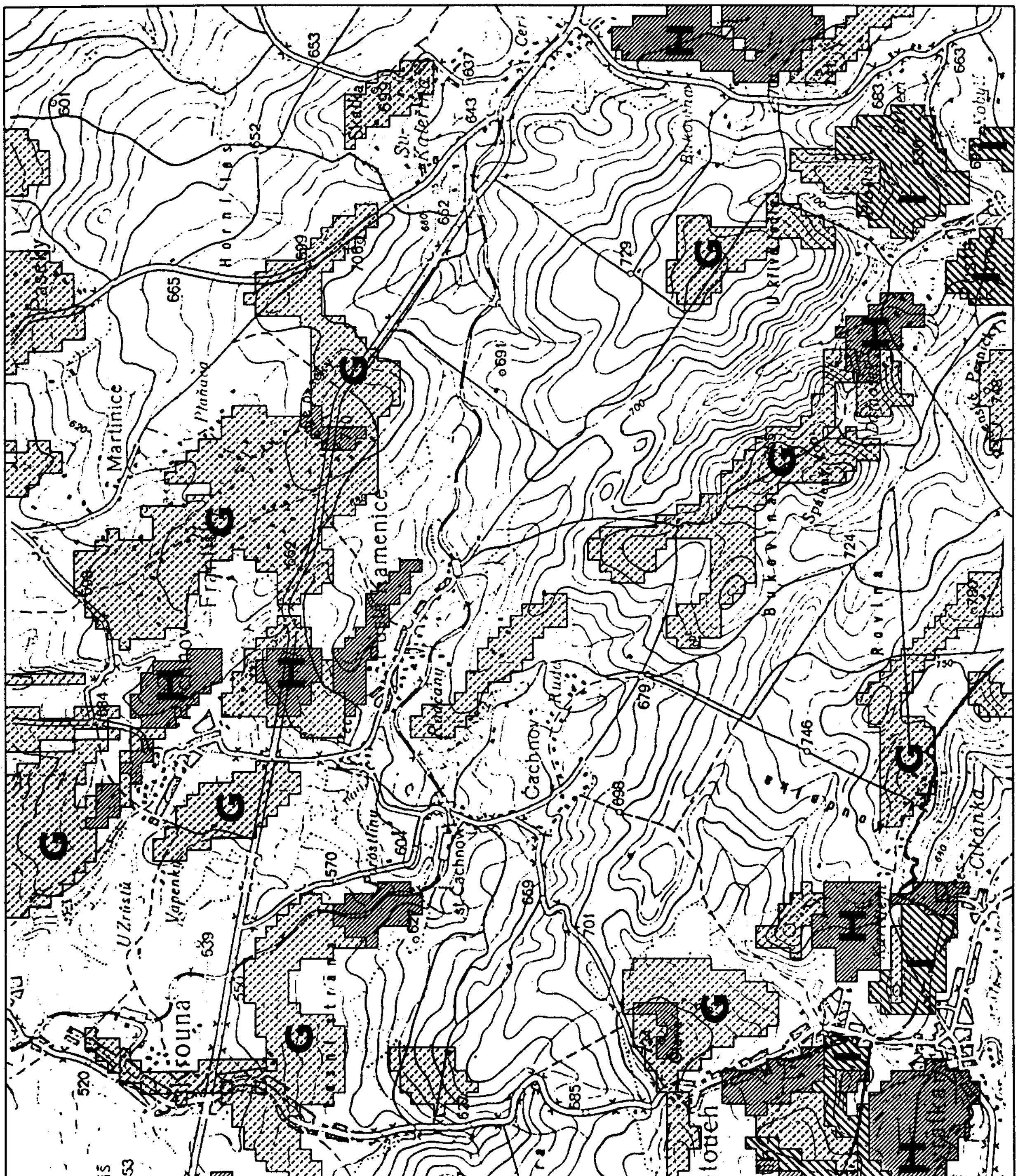


Fig. 8 - General and Detailed Topoclimatic Mapping

Explanations to the Topoclimatic Map of the Brno Surroundings - Appendix No. 5

Topoclimate of Hilly Lands

1 - topoclimate of peak parts distinctly protruding above the surroundings, 2 - topoclimate of convex formations merging with the surroundings (peak plane), 3 - ditto with the low loose housing, 4 - topoclimate of slopes under very good solar irradiation, 5 - ditto with a possibility of pronounced catabatic flow, 6 - topoclimate of slopes under normal solar irradiation, 7 - ditto with the low loose housing, 8 - ditto with a possibility of pronounced catabatic flow, 9 - topoclimate of slopes under minor solar irradiation, 10 - ditto with a possibility of pronounced catabatic flow, 11 - topoclimate of deeply incised valleys, 12 - ditto with the low loose housing, 13 - topoclimate of indented formations with local temperature inversions, 14 - ditto with the low loose housing, 15 - topoclimate of indented formations with weak local temperature inversions, 16 - ditto with the low loose housing, 17 - ditto highly urbanized with the high housing, 18 - ditto affected by extensive water areas.

Topoclimate of Highlands

19 - topoclimate of peak parts distinctly protruding above the surroundings, 20 - topoclimate of convex formations merging with the surroundings (peak plane), 21 - ditto with the low loose housing, 22 - topoclimate of slopes under very good solar irradiation, 23 - ditto with a possibility of pronounced catabatic flow, 24 - topoclimate of slopes under normal solar irradiation, 25 - ditto with the low loose housing, 26 - ditto with a possibility of pronounced catabatic flow, 27 - topoclimate of slopes under minor solar irradiation, 28 - ditto with a possibility of pronounced catabatic flow, 29 - topoclimate of deeply incised valleys, 30 - ditto with the low loose housing, 31 - topoclimate of indented formations with pronounced local temperature inversions, 32 - ditto with the low loose housing, 33 - topoclimate of indented formations with less pronounced local temperature inversions, 34 - ditto with the low loose housing.

Effects on processes and characteristics of some climatic elements of ground layer of the atmosphere in individual types of topoclimate

Climatic characteristic in boundary layer of different topoclimate types

1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	1	1	1	1	4	1	3	3	3	3	2-3	3-4
2	1-2	1	1	1-2	1	3-4	1	3	3	3	3	3	3
3	2-3	1	1	2	2	2-3	1	3-4	3-4	2-3	3	2-3	3
4	2	2	2	3	2-3	2-3	1	4	3	2	2-3	2	4
5	2	3	2	3	2-3	2-3	1	4	3-4	2	3	2	4
6	2	2	1-2	2-3	2	2-3	1	3	3	3	3	3	3
7	2-3	1-2	1-2	3	2-3	2	1	3-4	3-4	2-3	3	2-3	3
8	2	3	1-2	2-3	2	2-3	1	3	3-4	3	3	3	3
9	2	2	1	2	1-2	2-3	1	2	2-3	3-4	3-4	4	2
10	2	3	1	2	1-2	2-3	1	2	3	3-4	3-4	4	2
11	3-4	1	1	2-3	2-3	1-2	3	2	2	4	4	4	2
12	4	1	1	3	2	1	2-3	2-3	2-3	3-4	4	3-4	2
13	3	1	1	2-3	1-2	2	2-3	3-4	2	3	3-4	3	3
14	3-4	1	1	3	2-3	1-2	2	3-4	2-3	2-3	3-4	2-3	3
15	2-3	1	1	2	1-2	2-3	2	3	2-3	3	3	3	3
16	3	1	1	3	2-3	2	1-2	3-4	3	2-3	3	2-3	3
17	4	1	1	4	4	1	1	4-5	4-5	1-2	2	1	4-5
18	2	1	1	1	3	3	1-2	2	3-4	4	4	3	2
19	1	1	1	1	1	4-5	1	3	3	3	3	2-3	4
20	1-2	1	1	1-2	1	3-4	1	3	3	3	3	3	3
21	2-3	1	1	2	2	2-3	1	3-4	3-4	2-3	3	2-3	3
22	2-3	3	3	3	3	2-3	1	4	3	2	2-3	2	4
23	2-3	4	3	3	3	2-3	1	4	3-4	2	3	2	4
24	2-3	3	2-3	2-3	2	2-3	1	3	3	3	3	3	3
25	3	2-3	3	3	2-3	2	1	3-4	3-4	2-3	3	2-3	3
26	2-3	4	2-3	2-3	2	2-3	1	3	3-4	3	3	3	3
27	2-3	3	1	2	1-2	2-3	1	2	2-3	4	3-4	4-5	2
28	2-3	4	1	2	1-2	2-3	1	2	3	4	3-4	4-5	2
29	4	1	1	2-3	3-4	1-2	3-4	1-2	2	4-5	4	4-5	1-2
30	4	1	1	3	3	1	3	2	2-3	4	4	4	2
31	3-4	1	1	2-3	2	2	4	3-4	1-2	3	4	3-4	3
32	4	1	1	3	3	1-2	3-4	3-4	2	2-3	4	3	3
33	3	1	1	2-3	1-2	2-3	2-3	3	2-3	3	3-4	3	3
34	3-4	1	1	3	2-3	2	2	3-4	3	2-3	3-4	2-3	3

1 - number of legend item in the map, 2 - altitude-related variability of wind vector in the lower part of atmosphere boundary layer, 3 - intensity of catabatic flow under the radiation type of weather, 4 - intensity of anabatic flow under the radiation type of weather, 5 - intensity of vortex flow, 6 - vertical movements in the atmosphere, 7 - intensity of aeration, 8 - pre-conditions for occurrence of local air temperature inversions, 9 - maximum air temperature under the radiation type of weather, 10 - minimum air temperature under the radiation type of weather, 11 - relative air humidity by day, 12 - relative air humidity at night, 13 - duration of snow cover, 14 - evaporation.

Classification criteria

1 absent, negligible, severely reduced
2 weak, low, reduced
3 medium, normal
4 strong, high, increased
5 very strong, very high, severely increased

Surroundings of the Brno water reservoir *Photo: K. Kirchner*

Use of the Environment and Resulting Problems in Central and East Europe

Oldřich Mikulík

The map scale of 1 : 3 000 000 required a high degree of generalization, and the density of information already achieved made it necessary to leave out some characteristics although they were well documented and would have lent themselves to inclusion.

The environmental situation described by the maps and text reflects the problems between 1985 and 1989. It must be hoped that the political and economic upheaval in the formerly socialist countries, particularly the events of 1989/90, will change for the better attitudes of the political bodies and the population with regard to environment and hence also to the poor environmental situation as such. Some countries are already taking consistent steps, in others only discussions are under way. Everywhere, the resolution of ecological problems is being felt as a vital concern, and green movements and green parties are emerging. Accessibility of formerly confidential environmental data makes it easier to find solution to environmental problems. Introduction of market economics and taxes for resource use as well as promotion of small and medium-sized companies will result in major structural changes in most economies and enterprises. However, negative effects must also be expected. All these developments together go to underline the importance of environmental research and the mapping of its findings, which may elucidate the interrelationships between various forms of resource use and the resulting problems.

As a major challenge for future policies and economic activities environmental management must strive to conserve natural resources as the basis of a prosperous society, to safeguard the environment as a pre-requisite for human survival and to protect nature in order to preserve our genetic heritage. Man-made environmental change turns into a problem when it makes it more difficult or impossible to pursue traditional uses of resources or when it no longer allows the continuous use of resources and methods hitherto employed.

Impairment of environmental quality as a whole as well as quantitative and/or qualitative impairment of the natural resources are criteria for identification of the problems. Impairment is determined in terms of the extent to which the components of the natural world have been changed and their relative ability to fulfil their socio-economic functions remains intact.

When looking at environmental management, we must also analyse what economic sectors and regions are using what resources as well as look at the intensity of resource exploitation. This is important because in most cases, solution ofthe problem will require economic steps. In this process we must quite generally look at not only reducing the impact on nature, but also to change the sectoral and territorial structure of resource use so that it is more adequate to natural situation.

International nature of environmental problems calls for continued mapping in Central, East and South East Europe and extension of this activity to the western part of the Continent in the shape of a uniform map of the environmental situation in Europe. A team of international experts with long-standing experience both in the methodology and in the practical field work as well as the Laboratory for the Regional Research on Environment in Brno allow us to do just that.

Activities of the Laboratory were interrupted by cancellation of the Institute of Geography. New possibilities to continue in its work are looking for within the Institute of Geonics, Academy of Sciences of the Czech Republic.

We acknowledge cooperation of the following scientists: Tatyana NEFEDOVA (former Soviet Union), editor-in-chief for the manuscripts, was responsible for harmonizing various national contributions. Oldřich MIKULÍK (former Czechoslovakia), László BASSA (Hungary) and Joanna PLIT (Poland), together with the editor-in- chief, formerd the editorial team. National data and manuscripts were compiled by D. DONTCHEV, M. ILIEVA, M. JORDANOVA and St. VELEV (all Bulgarian), K. ČÚZOVÁ, A. VAISHAR (both former Czechoslovakia), G. SCHÖNFELDER (former GDR), M. ŠPES (former Yugoslavia), L. BASSA (Hungary), E. TOMASI (Austria), J. PLIT (Poland), E. ZAVOIANU (Romania), T. NEFEDOVA and I. VOLKOVA (both former Soviet Union).

Consultants were A. IVAN, K. KIRCHNER, H. KŘÍŽ, M. KUNDRATA, J. LACINA, E. QUITT, St. ŘEHÁK, J. UNGERMAN, V. VLČEK and J. VYSTOUPIL (all former Czechoslovakia); E. BENEDICT and H. HERMANN (former GDR); H. HOJESKI, H. NOWAK and K. SCHWAIGER (Austria); A.S. KOSTROWICKI (Poland); I. GORLENKO, I. KANCEBOVSKAYA, N. KAZANSKAYA, F. KOZLOVSKII, M. KRYLOV, L. RUDENKO, T. RUNOVA, A. SUSHTCHEVSKII, A. TREYVIŠ, Yu. VEDENIN and B. ZIMIN (all former Soviet Union).

The following institutions provided the financial and organizational basis for the research: Institute of Geography of the Bulgarian Academy of Sciences, Sofia; Institute of Geography of the Czechoslovak Academy of Sciences, Brno; Institute of Geography and Geo-Ecology, Leipzig, Martin Luther University, Halle; Institute of Geography of University Ljubljana; Institute of Geography of the Hungarian Academy of Sciences, Budapest; Austrian Institute of East and South-East European Studies, Vienna; Institute of Geography and Spatial Organization of the Polish Academy of Sciences, Warsaw; Institute of Geography of the Soviet Academy of Sciences, Moscow.

Organization and coordination of manuscript edition was in responsibility of the Laboratory for Regional Research of Environment in Brno.

Data were moreover provided by the following institutions: Federal Agency for Agriculture, Vienna; Federal Forestry Research Centre, Vienna; International Institute of Applied Systems Analysis, Laxenburg (Austria); Austrian Central Bureau of Statistics – Department of Environment, Vienna; Federal Agency for Environment, Vienna; Central Institute of Meteorology and Geodynamics, Vienna; Institute of Geography of the Romanian Academy of Sciences, Bucharest; Laboratory for Soil and Hydrology, State University of Moscow; Central Research Institute for Urban Planning at the State Committee on Construction of the Soviet Union, Moscow.

Elena OLESHKEVITCH was responsible for cartographic presentation of the entire map manuscript.

T. RUNOVA as an editor of the entire manuscript, T. NEFEDOVA and J. PLIT as authors of the synoptic parts, as well as D. DONTCHEV (Bulgaria), O. MIKULÍK (former Czechoslovakia), M. ŠPES (former Yugoslavia),

L. BASSA (Hungary), E. TOMASI (Austria), J. PLIT (Poland), P. DEICA and I. ZAVOIANU (Romania), T. NEFEDOVA (former Soviet Union, but also covering the former GDR) as authors of national contributions.

The maps and texts were revised by the editorial team of the Atlas of East and SouthEast Europe. Head of the team: P. JORDAN. Review of contents: P. JORDAN, E. TOMASI. Review of cartography: F. PARTL, K. SCHAPPELWEIN. The maps were produced at the Institute of Cartography and Reproduction Technologies at the Technical University of Vienna under F. KELNHOFER, for the Austrian Institute of East and South-East European Studies. The text were produced at the Austrian Institute of East and South-East European Studies.

The two-sheet map on the environmental situation, edited by the Austrian Institute of East and Sout-East European Studies in conjunction with the Laboratory for the Regional Research on Environment in Brno, are only part of a more comprehensive map project under way at the Institute of Geography of the Academy of Sciences in Moscow. The above map will show, at a 1:2500000 scale, the section depicted on the maps of the Atlas of East and SouthEast Europe as well as the entire European Soviet Union as far as the Urals.

Cartographic reasons have made it necessary to divide the subject of "Use of the Environment and Resulting Problems" into two parts and, hence, into two maps. The Map A ("Use of the Environment") shows resource use, while the Map B ("Environmental Problems") is devoted to ecological problems.

Map A depicts the types and intensities of natural resource exploitation. Areas under agricultural and silvicultural use as well as little-used areas are shown in areal colours. Areas with a small-scale combination of farming, grassland and woods are grouped as a separate type of use, essentially for reasons of the scale (second line of the legend matrix).

Agricultural use is moreover subdivided according to intensities through colour shading. In order to determine intensities, such characteristics as "percentage of agricultural land", "livestock", use of "commercial fertilizer" and crop yields were used so as to express specialization and productivity and hence the impact of agriculture on the soil. Statistical standardization was used to translate into a synthetic parameter the characteristic data, which were available for the entire area by administrative units of comparable size.

Industrial use of resources is shown on the map by columns for industrial locations with a minimum of 1 000 employees in one of the documented sectors. Height of the column indicates potential impact of the industries on environment (air, water, soil) in a given location. The subdivision into coloured segments highlights the relative contribution of individual sectors (incl. energy production). Extent of the environmental impact was determined by multiplication of the number of employees per industrial sector by an "ecological coefficient" weighting environmental damage caused by an industry according to experiences applying to the entire area. Following "ecological coefficients" were used for the individual sectors of industry: processing of non-ferrous metals 15, chemical industries and petroleum refining 10 – 15 (depending on the type of production), fuel and power production 3 – 10 (depending on the kind of heating), lumber and paper production 1 – 10, iron works 5, mechanical engineering 1, food processing 1, production of building materials 0.7. Since this method does not take into account technological improvements to reduce the environmental impact of individual industrial enterprises, it does not always (particularly in Austria) indicate actual emissions of an industrial location although it does provide an overall picture of the structure and distribution of industrial pollution.

Environmental impact of mining is represented by a two-size triangle. Nuclear power plants are classified as a potential threat to the environment and are thus shown in full, divided into power plants in operation and power plants under construction.

Impact of human settlements on the environment is shown by means of circles proportionate to the number of inhabitants. Solely settlements with more than 50 000 inhabitants are included, smaller communities being depicted only if they are home to major industries or if other emission sources are potential major polluters.

Since tourism and recreation pose a variety of threats to the environment (traffic, sewage, ski runs, trails, etc.), which are usually in addition to other uses already existing, areas with a flourishing tourist sector of travelling and recreational areas around large cities are identified by a grid superimposed on the colours depicting spatial use. They are essentially distinguished by such characteritics as arrivals, overnight stays, traffic density.

Map B shows the kinds of environmental problems occurring. Damage or disturbance to natural resources (soil degradation, damage to forests, lack of water) is shown through a variety of spatial grids.

The damage to soil and forests, caused essentially by inadequate methods of cultivation, is divided into a nearly critical and a critical stage: the former signifies diminishing quality and productivity of resources. Here, the strict control of exploitation would be required. In the critical stage, the extent of damage already inflicted, no longer allows exploitation of a particular resource in the way it has hitherto been applied. The grid for water scarcity identifies areas with limited availability of water caused either by natural and/or anthropogenic factors; it refers to both quantity and quality of water as well as to surfacewater and groundwater.

The large-scale spread of air pollutants (determined on the basis of such indicators as sulphur dioxide, dust, nitrogen oxides) is classified according to "low" (corresponding to "normal air"), "increases", "high", and "very high concentrations" by a succession of yellowish areal colours. Sulphur dioxide (SO_2) is chief indicator because it is the only air pollutant for which data of international comparability are available throughout the entire area. Other indicators such as mostly dust and/or nitrogen oxides (NO_X) were used only at higher concentrations so as to highlight regional and local air pollution peaks more clearly. Forest damage as a result of air pollution is not differentiated according to severity; it is depicted mostly around emission sources. Not included is forest damage caused by long-distance transport of air pollutants, because there is not enough material yet on the long-term cross-frontier effects. Air pollution in larger settlements is caused not only by industrial but also by domestic and traffic-related emissions. Moreover, local meteorology plays quite a significant role. Thus, air pollution in larger settlements sometimes differs substantially from long-range air pollution levels. Like the Map A, Map B shows all settlements with more than 50,000 inhabitants plus those settlements which are major air polluters themselves (immissions) because of large industrial enterprises or other causes.

Pollution of rivers, lakes and coastal waters is identified by coloured bands. Criteria for evaluating water quality are based on classifications differing from country to country in some cases (depending on whether chemical and/or biological criteria are considered). For rivers, the width of coloured bands corresponds to the stream width.

Larger areas with considerable damage caused by strip or underground mining and with at least heavy air and water pollution brought about by mining and industry are identified as areas of massive environmental devastation. The area contaminated by the Chernobyl nuclear disaster (1986) is in the same class with these, for the one accident only. Representation is based on measurements of Caesium – 137, a chief contaminant outside the 30-kilometer zone.

The map was published by the Institute for East and South-East European Studies in Vienna in 1992. It is available at this institution.

Meteorological Dictionary in Six Languages in the Czech Republic

Jan Munzar

"Geographical concept are the nuts and bolts of the discipline, essential for the progress and the means for communication among scholars and nations", wrote professor E. MEYNEN as a motto to German version of the International Geographical Glossary (IGU-CIGT 1985). MEYNEN's words are surely also valid in the case of concepts from other disciplines inclusive the ones of meteorology and climatology.

A year before the Regional Conference 1994 of IGU was held in Prague, the "Meterorological Explanatory and Terminological Dictionary" was issued in this town thanks to financial support from the Ministry of Environment of the Czech Republic – a work that had no analogy within neighbouring countries in Central Europe at that time. Although explications are in the Czech language, the dictionary is being indicated as a six language one because as many as six foreign language equivalents are being presented at individual entries: Czech, Slovak, English, French, German, and Russian. Together with separate, alphabetically arranged indices in Slovak, English, French, German and Russian languages, the new dictionary can be used for both passive and active translation.

Let us mention that the German version of the IGU Dictionary is equipped with equivalents in 7 languages: German, English, Spanish, French, Italian, Japanese, and Russian-but it has no linguistic indices, which makes its use for translation rather difficult. It is only possible to compare the German, English and French equivalents within the areas of individual geographical specializations.

As far as the number of entries is concerned, the IGU geographical dictionary explicates 2400 terms of which 118 are deviced for the section of climatology. The new Czech meteorological dictionary contains the total of 4111 entries (arranged by substantives), of which 3222 are explanatory and

889 of cross-reference meaning. A relatively large number of terms explained relates to the fact that the new dictionary is the first meteorological dictionary ever issued in the Czech Republic. Therefore, it does not only include terms used at present time, but it also attempts at registration of the national meteorological terminology in its entire development. It is true that the core of the dictionary consists in explanations of professional terms, but it includes also terms which are semantically incorrect, unsuitable, slang or folk words. In this sense it is analogous to the French-English Dictionary from meteorology and climatology by G.O. VILLENEUVE (1980).

As to terminological and explicative aspects, the Dictionary covers meteorology and climatology in their entire scope, and partly contains even necessary terms from physics, geography, geology and other scientific disciplines, should they be from spheres contacting meteorology or have wide application in meteorology. The terms used today markedly differ from those which are either obsolete or incorrect. Therefore, function of the presented Dictionary is to considerable extent directive because no terminological norms have been issued yet in Czechoslovakia nor in its two succession states.

Creation of the dictionary was a long-time affair. The original idea became realistic only after 1980 thanks to the new initiative of Dr. Karel KRŠKA in the Czechoslovak Meteorological Society. A team of voluntary Czech and Slovak experts from all major fields of meteorology and climatology was set up, which means that after internal reviews were made, the total number of 37 authors took part in resulting form of the work.

It is necessary to point out that the presented Dictionary brings Czech and Slovak terminologies side by side for the very first time at all. The hitherto editorial practice in Czech and Slovak meteorology usually used either Czech or Slovak monographs, text books, manuals or articles, because the two Slavonic languages are very close to each other and are commonly understood by both nationalities. This gave rise to occasional terminological equivocations in less transparent terms with different lexical basis, especially at lessons. The systematic work on Dictionary was accomplished by page proof reading in May 1991. It may be called a paradox that due to the publisher's delay caused by economic reasons, the Dictionary became a contribution to Czech and Slovak mutuality too late: only after disintegration of the Czech and Slovak Federative Republic on 31 December, 1992.

It is a valuable piece of work which undoubtedly contributes to "comeback" of the Czech Republic into Europe, and therefore can be fully recommended to anybody. Distributor of the Dictionary is the Library of Czech Hydrometeorological Institute, Na Šabatce 17, CZ-143 06 PRAGUE 4 – Komořany, where those who are interested can turn to.

References

IGU – Commission International Geographical Terminology (1985): International Geographical Glossary. Deutsche Ausgabe, editor E. Meynen. Stuttgart, Franz Steiner Verlag, 1479 pp.

One language dictionary of meteorological terminology (with entries in Slovak, English, German, French, and Russian). Prague, Academia and Ministry of Environment, Czech Republic 1993, 594 pp.

VILLENEUVE, G.O.: Glossaire de météorologie et de climatologie. Deuxieme edition. Quebec, Les Presses de l'Université Laval, 1980, 651 pp.

1919 - 1994

75

UNIVERSITAS
MASARYKIANA
BRUNENSIS

The jubilee Year of Masaryk University was opened with a ceremonial meeting of the members of the university on January 27, 1994, the eve of the passage of the act which established this, the second largest university in the Czech Republic.

During the course of this anniversary year, many scientific, educational, cultural, and sporting events of both local and international significance have been and will be held. Our efforts are not only to commemorate the anniversary of the founding of our university, but also to present this institution of higher education to the general public and demonstrate this university's unique role in the education of future generations and in the development of science, education, and culture.

The climax of the Year of Masaryk University will be an international conference and celebration held in honour of the jubilee of Masaryk University. These two events will take place at the beginning of November 1994.

Please accept our invitation to participate in these most special days in the Year of Masaryk University.

Dr Eduard Schmidt Chancellor