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PREFACE

The geographers of the Czechoslovak Socialist Republic have prepared three special publications for the XXth International Geographical Congress:

a) A Supplement of the Journal of the Czechoslovak Geographical Society (Sborník Československé společnosti zeměpisné), volume 69; b) A special issue of the Geographical Review (Geografický časopis) of the Slovak Academy of Sciences, vol. 16; c) Acta geologica et geographica universitatis Comenianae — Geographica 4, which contains a geographic monography of the region of Košice, eastern Slovakia.

The Supplement of the Journal of the Czechoslovak Geographical Society contains, 27 articles dealing with almost all the branches of geography: 2 with cartography, 8 with geomorphology, 2 — climatology, 2 — biogeography, 2 — geography of population, 5 — urban geography, 2 geography of industry and transportation, and 2 deal with the subject of geography as a whole. One of these two articles studies the basis of the regional concept, so that the themes of the articles concern all the nine sections of the XXth Geographical Congress. However, only 8 articles deal with the themes which will be discussed preferencially in the sections.

Most of the authors of the Supplement are workers of the Geographical Institute of the Czechoslovak Academy of Sciences in Brno and of its side-line in Prague, three articles come from the Charles University in Prague, 2 from the University of Brno, and 2 from the School of Economics in Prague.

Carrying this contributions, the Czechoslovak geographers greet the XXth International Geographical Congress and wish the best success to its work, firmly believing that its sessions, helping to a better mutual knowledge of nations and countries and to a better use of the geographic milieu of all regions of the Earth, are of great importance for the future of the rapidly growing mankind.

The National Geographical Committee of Czechoslovakia

PŘEDMLUVA

Geografové Československé socialistické republiky připravili pro 20. mezinárodní geografický kongres tři speciální publikace:

a) Supplement of the Journal of the Czechoslovak geographical Society (Sborník Československé společnosti zeměpisné), svazek 69, b) zvláštní číslo Geografického časopisu Slovenské akademie věd, svazek 16, c) Acta geologica et geographica universitatis Comenianae — Geographica 4, obsahující geografickou monografii Košické oblasti.

Supplement of the Journal of the Czechoslovak geographical society obsahuje 27 příspěvků, které se týkají téměř všech geografických oborů: 2 kartografie, 8 geomorfologie, 2 klimatologie, 2 biogeografie, 2 geografie obyvatelstva, 5 geografie měst, po jednom geografie průmyslu a dopravy, 2 historické geografie a 2 se týkají geografie jako celku. Jeden z nich zkoumá podstatu regionality, takže témata našeho sborníku se týkají všech devíti sekcí 20. mezinárodního kongresu. Nicméně jen 8 článků je zaměřeno na témata, jež budou v sekcích přednostně projednávána.

Většinu článků tohoto sborníku předkládají pracovníci Geografického ústavu Československé akademie věd v Brně a jeho pobočky v Praze. Z geografických pracovišť vysokých škol 7 článků: 3 z university pražské, 2 z university brněnské a 2 z vysoké školy ekonomické v Praze.

Podávajíce tento příspěvek, pozdravují českoslovenští geografové 20. mezinárodní kongres a přejí mu co nejvíce úspěchu. Jsou přesvědčeni, že jeho jednání, směřující k lepšímu vzájemnému poznání zemí a národů a využití geografického prostředí veškerých oblastí Země, má základní význam pro budoucnost rychle rostoucího lidstva.

Národní komitét geografický ČSSR

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THE THEORY OF COMPLEXITY AND GEOGRAPHY

Teorie komplexity a geografie. — V příspěvku se soustřeďujeme na objasnění dvou významných kategorií vědeckého poznání — kategorie komplexnosti a rozmanitosti. Správné poznání charakteru a významu těchto kategorií je podle našeho názoru základem pro vypracování teorie geografie. Zároveň však tyto kategorie mají velký význam pro vědecké poznání vůbec. Sledujeme-li současnou klasifikaci věd na jedné straně a problematiku geografických a příbuzných věd na straně druhé, dojdeme k závěru, že komplexnost je obdobným základním principem vědeckého poznání jako vývoj a obecnost. V tomto příspěvku můžeme ovšem sledovat jen nejzákladnější, možno říci „vnější" problémy teorie geografie, kdežto „vnitřní" problematikou se budeme zabývat jinde.

The aim of this paper is to give an opinion of the character of two important categories of scientific knowledge — complexity and diversity — the categories which are of principal significance for the theory of geography. Just an incorrect comprehension of the content and significance of the mentioned categories is the "primary" cause of the non-unity and confusion in the theory of geography of nowadays. Owing to the limited extent of this paper, however, we are only able to follow the problems of the complex character of geography in the broadest sense of the word, which can only be a starting point for the solution of the total theoretical problematics. The "internal" questions of the theory of geography as well as the analysis of the basic literature, therefore, will be discussed elsewhere.

A. The principle of complexity as a cardinal principle of scientific knowledge

The category or the principle of complexity will be discussed first of all from the point of position of geography in the system of sciences. The classification of sciences may not be understood as a formal distribution of the extent of sciences. The main principles, classifying sciences objectively, reflect the cardinal "types" of properties of the world, and they are therefore understood as cardinal (basic) principles of scientific knowledge.

The basis for the modern classification of sciences was already given by Fr. Engels (1). The main classification principle is the determination of the evolutionary degree of the matter, which is followed by this or that science (physic — chemistry — biology — economy, etc., which we call, in the following, elementary sciences). The merit of Fr. Engels lies first of all in the fact that the Marxist science of nowadays respects the complicated character of "transitions" between individual "classical" sciences. The evolutionary viewpoint itself was not sufficient for the creation of the whole system. Of similar importance is also the classification of sciences according to the degree of universality. Only in this way is it possible to explain the special position of philosophy and then the internal differentiation of sciences too. The character of this "first" or "basic" Marxist classification of sciences is preserved also in the modern work of B. M. Kedrov (2).

From geographical papers concerned with the problem of position of geography in the system of sciences, we mention here at least the opinions of two directions of the marxist geography in the USSR — monistic and dualistic (3). It is most important for our considerations that both directions are derived from the above mentioned classification of sciences. The monists understand geography as a transient science between natural and social sciences, the dualists then divide the geography into natural and social geography (physical and economical geography).

From the aforementioned it results that up to date two basic principles of scientific knowledge have been considered or "recognized", that is universality or a "degree of universality" and development or a "degree of development". If we are to range the character of any element into the system of scientific knowledge, we must investigate internal regularities of this element, and, through comparison with others, divide the other elements into lover and higher ones with respect to development and then ascertain what the investigated element has both common and specific in comparison with others. These two principles are cardinal characteristics of each element. To each degree of universality and of development certain properties of the subject in question correspond, that is certain regularities which are not mere abstractions but properties of concrete subjects.

But are these two principles the only cardinal principles or categories o the character of the world? Let us first pay attention to what the Marxist philosophy says to the question of the abstract and the concrete. The author cites from the Marxist textbook: "... concrete knowledge reached through the senses does not catch the substance of a thing and therefore the knowledge proceeds to individual abstractions. The process of knowledge, however, does not end with the creation of these abstractions. It is necessary to obtain a concrete universal knowledge. From individual abstractions the science again returns to the concrete. But it is not a return to the concrete sensually but a reproduction of the concreate in thinking which is a higher form of knowledge (4).

But what does it mean and what character has the process "reproduction of the concrete within ones thinking"? Each science investigates not only internal regularities of the corresponding subject, but also the relations between the subject and its milieu. Science has, up to now, examined more or less only the most simple form of these relations which is the direct relations between individual subjects, examined relations, first of all, individually and recognized only integrities with a minimal "internal" diversity. This further led to the simplification of the comprehension of relations or connections in the world and leads to the non-comprehension of the principal research of the problem.

The character of the connection of each element with the rest of the world is immensely complicated. First of all the influence of other elements is various and variously significant. Mutually connected elements form various integrities — units with the character of a certain complexity. From these units new, higher integrities, more complex integrities are composed. In this manner we successively reach the highest or "complete" complex which comprises all the principal qualitative components of the world. The relation and connection between an element and the rest of the world is not expressed only by the direct and mediated relations between indvidual elements themselves but principally through external relations of more complex wholes, whose parts, the elements in question, form.

Insufficiently elaborated terminology and totally small attentiveness of the science as to the complexity, aggravate the explanation of these problematics. In scientific terminology the following concepts are enough widely spread and explained: element, component and the complex itself, which at least partially shows that the connection of each element with the rest of the world has no simple or "one-level" character (that is not only the relations between the elements themselves are in question). In reality, between the element and "complete" complex there exists not only one but a series of "partial" complexes that is of relatively independent degrees of complexity. Within the frame of the concept of "partial" complex, we understand all integrities with different degrees of complexity and we omit only the lowest and the highest degree, that is the element itself and the "complete" complex. "Gradation" of the connection between elementary knowledge nad complex knowledge, as well as the objective existence of "partial" complexes can be clearly seen on the example of "connection" of biological knowledge with geographical knowledge — biology — ecology — biogeography — natural geography — complex geography. Such "connections" of elementary sciences with complex geography is, however, the whole system.

As to "partial" complexes, such concepts as phytocoenosis, zoocoenosis, biocoenosis and natural-geographical complex, can be introduced. These are only known and observed nowadays as "partial" complexes. The results of science in the knowledge of "partial" complexes prove their objective existence and also prove that similarly as elements themselves also the complexes possess their "internal" lives. At the same time each complex in relation to its neighbourhood forms one integrity.

Each complex whole has a complicated character as it contains, besides its specific properties, also the properties of its components, that is of elements and "partial" complexes. From this results also its more complicated relative independence or less distinct "separation" from the rest of the world.

We can thus see that two poles or types of scientific knowledge exist, which is elementary and complex knowledge. Both types are not absolutely separated, but there are connected by a magnitude of transient, relatively independent degrees. Both types of knowledge are abstract. The first one is elementary abstract and the other is complex abstract, in other words it is a reproduction of the concrete within ones thinking. Complex science does not investigate the character of the world according to the units comprising the same subjects, nor according to the degree of universality or according to the degree of development, but according to the concrete units — complexes, in which the qualitatively various subjects are mutually related. The resulting character of the complex is a result of internal regularities of all corresponding elements, of their mutual relations and properties and of the relations between "partial" complexes which are contained in a given complex. With this the necessity of the simultaneous investigation of quantitative and qualitative characteristics is connected. The connection of quantitative and qualitative characteristics is much "more animated" here than in elementary sciences.

What conclusions result from the aforementioned considerations? The complication of the connection of each element with the rest of the world and "gradation" of this connection correspond to the objective existence of "partial" and "complete" complexes. This leads to the conclusion that in addition to the up to now recognized and understood basic principles of scientific knowledge that is universality and development, still the third basic principle — principle of complexity — exists. Scientific observation must investigate the character of the world not in two but in three principles and categories of knowledge, that is, according to development, universality and complexity. All three principles are cardinal principles, have a complicated character and are differentiated into a series of relatively independen degrees or levels. The followed basic principles of scientific knowledge are not only chosen abstractedly but they are a reflection of the three "types" of properties of the objectively existing material world. Each subject has on the one hand a character common with other subjects, and on the other hand a character different from other subjects. Each subject is, in comparison with others, a lower or higher form of the existence of the matter. Finally each subject is connected with the rest of the world not only "elementary" but also by means of various "partial" and "complete" complexes. The world cannot be understood only as a "direct" unity of a magnitude of subjects (or rather elements). It is necessary to comprehend the structure of this unity which corresponds to a concrete system of complexes.

B. A specific character of the subject of geography

In the subject of geography we must, first of all, respect its specific character, which is generally the valid property of the whole world in its concrete form. The fact that a variety is the most important characteristic feature of the complex and concrete observation, is best confirmed and explained in the work of J. Korčák (5). J. Korčák shows on different examples the difference between complex geography and elementary sciences, by means of statistics. Against the equality of element or against the equality of distribution of "elementary" attributes characterized by the Gauss curve, this author places here the variety of the geographical subject or geographical attributes, which is characterized by the course of a branch of hyperbola. This work almost philosophically evaluates the variety as a basic property of the world, the property of the same category as the matter equality of the world.

If we continue these considerations, we come to the conception of the unity of the world as a contradiction in the matter equality of the world and in the qualitative as well as quantitative variety in forms of the existence of matter. The variety is proper for the world as well as is the matter equality, and the contradiction of both stipulates the development of the world. The "geographical variety" corresponds to the highest development degree of the world, as here the co-existence of more qualitative elements of the world is involved. Therefore, its character is the most complicated and investigation of this character is the most difficult. More simple forms of the varieties investigate then other concrete, less complex sciences, the task of which is to explain physical substance of the variety, etc.

The variety of the world is not rigid or "constantly sole". On the contrary, what is various, cannot be investigated by abstractions only but, it is necessary to start from a concrete character and from the evolutionary comprehension of this character. In geographical observation we cannot have fixed units and scales. We can have only a whole series of graduated types of units with different transitions corresponding to different, but always concretely existing "types" of varieties. The abstract "types" of varieties are, however, important in scientific observation, but they must be compared and must again start from the concrete variety. Then they become valid at a very significant rate, for instance, in the perspective regional planning. Obviously the abstract investigating alone of the variety would be pseudoscientific, as we can construct an infinite amount of the abstract types of variety; we cannot, however, determine the category or significance of individual types without concrete observation.

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ONTOLOGICAL VALUE OF GEOGRAPHY

Ontologický význam geografie. — Zemský povrch je kromě atmosféry největší entitou vnější reality (pokud je přímo měřitelná), a proto jeho kvantitativní poměry mají základní význam i pro ontologii. Pozorujeme je v rámci cartesiánských souřadnic biometricky pojatých, jež představují nejobecnější spojení kvantity a kvality. K tomu účelu se hodí však jen individualizované útvary povrchu zemského, tedy např. ostrovy, jezera a povodí řek, pokud jsou o nich statistická data, stejně velmi vzácná a nestejně zpracovaná. Ač pozorujeme jen 10 variačních řad, všechny vykazují statistické rozložení připomínající větev hyperboly. Má tedy tvar zcela jiný než je typická pro řady biometrické. Jevy ekonomické vykazují většinou rozložení stejného typu jako fyzicko-geografické, ale vyskytují se přechody k tvaru biometrickému, jenž představuje stejnost biologického druhu. Naproti tomu variace hyperbolická je obrazem rozmanitosti a představuje nejabstraktnější vyjádření spojených protikladů ve smyslu kvantitativním.

1) Besides the atmosphere the earth's surface is by far the largest entity of outer reality as far as it can be observed and measured direct. The synthetic science of the earth's surface should therefore, more than other sciences, contribute to the ontological conception. The latter task of geography is, however, unusually difficult as the earth's surface simultaneously represents also a maximum in the qualitative point of view, it is the largest universe of all possible varieties (diversities). It is true that the atmosphere is vaster as to quantity but as to quality, infinitely poorer, as far as one has in mind relatively stable structures. In the latter sense the Sun itself is qualitatively poorer than the Earth despite his huge volume.

Considering the significant and exclusive position of the earth's surface in the world of outer reality, we will attempt, in a summary manner, at least to draw the quantitative structure of this largest known universe of varieties as far as the most simple attributes are concerned.

The biometric method (Fr. Galton, 1883) suits our task best as it attains the most general connection of the quantity category and the quality category by means of Cartesian coordinates. That is why we presume that by using this extremely abstract tool it is necessary to measure also the whole lifeless world as even within it individualized features occur. According to the nature or this subject we have to modify a little the usual conception of statistical variation and replace also the term "biometrics" with the term "variation statistics".

The statistical measuring of the earth's surface introduced A. Humboldt 1842, his geometrical conception improved K. Kořistka 1854. Following their ideas, A. Cochon-Lapparent, 1883, had construed the so called hypsometric curve which then became a generally acknowledged instrument of scientific geography. The hypsometric curve is in substance based on variation statistics, even if not stemming from the number of units, that is, individualized features.

It is, of course, true that on the earth's surface there are only few phenomena that could be considered as individualized features Islands and lakes seem as such at the first sight. But already here we face another difficulty: neither the most simple property, that is, the size, has not been measured with all units but on the territory of several countries. Another difficulty consists in the fact that the official statistics contain the latter data compiled more from the practical than the theoretical point of view. That is why frequency series have been compiled rather according to frequency than to the variation span. From the theoretical point of view, however, we should respect the values placed on axis x in the same way as the values y. That means that the length of intervals placed on axis x should be determined according to the whole variation span. This is not usually carried out with geographical series. That is why we are referred to data that do not fully suit our purpose.

2) As far as the islands are concerned, the most suitable data come from Greece, less suitable from Yougoslavia, Denmark, and two German states. As a fourth example we choose the Philippine Islands, even if their data have been gathered into only four degrees of area: they, however, represent a very extensive and natural complex of islands relatively well measured. The data have been taken from the official statistical reports so that the degrees of areas (intervals) are not equally large. That is why we cite, besides the original frequency series f, another series f_1 the values of which have been reduced (by simple arithmetical mean) to equally large intervals. The data are also not comparable because one does not know anywhere the lower limits of the minimum (0,1 hectare in Greece), and that every series comprises another number of intervals. So that we may evaluate the areas in their relation to the whole variation span, we cite in the heading of every group of islands not only the total number of units but also the area of the largest unit, the regional maximum.

a) Greece: 787 islands (larger than 0,1 hectare), maximum 8379 km^2;

Area:	under 3 —	10 —	25 —	50 —	100 —	200 and more km^2
f . . .	683	34	23	11	10	10	16
f_1 . . .	683	14,6	4,6	1,3	0,0	0,0	0,0

b) Yougoslavia: 914 islands, maximum 408 km²;

Area: under	1 —	2 —	5 —	20 —	100 and more km²	
f ...	848	9	20	20	11	6
f_1 ...	848	9	6,6	1,3	0,1	0,02

c) The two German states and Dennmark: 550 islands, maximum 7016 km²;

Area: under	2 —	5 —	10 —	25 —	50 —	100 —	200 and more km²	
f ...	464	23	19	17	4	7	2	14
f_1 ...	464	15,3	7,6	2,3	0,4	—	—	—

d) The Philippine Islands: 7083 islands, maximum 40,814 square miles;

Area: under	1 —	1000 —	10,000 and more square-miles	
f ...	6621	451	9	2
f_1 ...	6621	0,5	0,0	0,0

All these four groups of islands have been selected at random, and are relatively small except the Philippine Islands. The area has been observed according to different degrees of size; it is however important that, as far as the size of the smallest degree is concerned, the differences are quite small, they fluctuate between 1 and 3 km². The greatest differences are however in the maximum, the size fluctuates between 7016 km² (Själland) and 104,600 km² (Luzon); the Yougoslav islands are considered here together with the Greek ones. From the point of regional maximum the Philippine row is therefore the most detailed one as the lowest degree represents 1 : 40,000 variation span while with Greece 1 : 2793. We can see that as far as these geographical series are concerned, we cannot follow the biometric principle in that the number of degrees should not exceed 25.

Despite the above-mentioned discrepancies the result worked out for all four groups of islands is the same substantially. The statistical distribution of their areas is extremely asymmetrical, the relative frequency being 85, 91, 84, 94 per cent in the lowest degree. When in a graph, it shows a shape suggesting a hyperbola branch.

3) If we consider the islands as positive creations of the earth's crust in the vertical sense, then the l a k e s are negative creations of it. We shall not be surprised then that the statistical distribution of the lakes areas will be of a similar type as we have found with island. The most suitable data relate to the Latvian SSR: they include 2980 units of an area larger than 1 hectare with the maximum of 110 km² (Lubana).

Area: under	0,5 —	1,0 —	2,5 —	5,0 —	10 and more km²	
f ...	2713	133	73	32	14	15
f_1 ...	2713	133	24	6	1,4	0,0

An exceptionaly large frequency in the first degree is, no doubt, connected with the fact that a "young" glaciated plain is concerning. As an example of an older configuration, an analogous series in Yougoslavia is cited here as follows; 220 units with the maximum of 335 km².

Area:	under 0,5 —	1 —	2 —	5 —	20 and more km²
f ...	157	30	7	13	7	6
f_1 ...	157	30	3,5	2,2	0,2	0,0

The above-mentioned two series are further completed with another example relating to the area of ponds in Czechoslovakia. Though the ponds were mostly artificially created through economic activities, their area is after all determined by the shape of the terrain similarly as with the lakes; there are 16,136 units, the maximum 490 hectares;

Area:	under 5 —	10 —	50 —	100 and more hectares
f ...	8528	970	1984	998	3756
f_1 ...	8528	970	235	100	47

Also the above-mentioned examples that have been selected at random and not uniformly measured, result in an extremely asymmetrical statistical distribution. With the exception of Latvia the relative frequencies of the first degree are however no so high as with the islands; this is in connection with the fact that the length of this degree is in the relation to the maximum much larger than in the case of islands.

4) The r i v e r b a s i n s are an important example of an individualized unit of the earth's surface. They are units of a rather dynamic nature, for certain activities ocurring in them concentrate to the common axis. The river basins, differentiated from the point of only one and absolute recipient, that is, sea, are considered here as a comparable unit. The data, thus elaborated, which would simultaneously comprise the whole natural area, are available in rather a detailed compilation in Sicily; we have not succeed in getting the analogous data from Great Britain.

Neither the data from Sicily have not been elaborated enough. Only 63 of the total number of 326 river basins are cited as independent units; other smaller river basins have been gathered together to 56 wholes according to geographical coherence: it was therefore necessary to differentiate them according to the 1 : 500,000 map and measure roughly. The results have been arranged in 7 degree series the lowest degree of which represents 1 : 85 variation span with the maximum 4186 km² (Simeto).

Area:	under 50 —	100 —	200 —	300 —	400 —	500 and more km²
f ...	266	18	17	8	6	4	7
f_1 ...	266	18	8,5	4	3	2	0,1

Also this statistical distribution is extremely asymmetrical. It may be supposed that such a distribution can be found even elsewhere as the number of rivulets along the coast zone is probaby many times larger than the number of large rivers inland. The presupposition can be backed by statistical data on the length of rivers as the area of river basins depends on their length to a large extent. Full statistical data have come only from Yougoslavia. They include

1728 rivers longer than 10 km as far as they flow through the state territory entirely; maximum 940 km (Sáva).

	Length: 10 — 25	— 50	— 100	— 250	— 500	and more km
f ...	1327	290	76	29	5	1
f_1 ...	1327	174	22,8	2,9	0,3	0,0

5) Altitude differences are the basic properties of earth's surface. The gross variation series can easily be derived from hypsometric curve even if it is not based on individualized features; let us cite the data applied by J. Staszewski in 1957, only, do we reduce frequency to the same length x.

Altitude:	under 200	— 500	— 1000	— 1500	— 2000	and more m
f_1	27,8	19,7	8,5	3,9	2,6	0,2

In view of maximum 8800 m, the degree of 200 m agrees with 1/44 of the variation width. According to H. Wagner—Kossina's 1922 paper, 32,8% result for the first degree delimited in the same manner.

The statistical distribution of solid earth's surface is also of an extremely asymmetrical shape, but the lowest degree is not so dominant as in the preceding geographical series. The explanation may be found in the fact that the main features of the continental relief had been created much earlier than smaller configuration manifested by the surface of isles and lakes. During further development the altitude differences successively get reduced while the mode decreases.

6) On the basis of the above-mentioned series we presume that the size of physico-geographical units is of a statistical distribution which is extremely asymmetrical. The latter opinion is extraordinarily supported by the fact that one of the most important properties of the earth's surface, its humidity, is of a similar statistical structure. The data, of course, refer only to the total annual amount of precipitations, and have not been elaborated according to natural units but only according to 7 zones demarcated by isohyets. The data were thus published by W. D. Jones and D. S. Whitlessey, 1925, in their textbook on economic geography. They include the whole continent without Antarctis being roughly graduated by 50 cm. In respect of the maximum in Assám 1100 cm (which has been observed longer than Hawai), one degree agrees with 1/20 of the variation span.

Rainfall:	under 50,8	— 101,6	— 152,4	— 203,2	— 304,8	and more cm
f (per cent)	55	20	11	9	4	1

The first degree frequency would increase to 59,3 while decreasing to 18,1 in the second degree if Antarctis were taken into consideration. This statistical distribution of humidity is so much more remarkable that such an important characteristics of the earth's surface as temperature represents, is probably of quite a different statistical distribution. Though analogous data are not available, we can see it from extreme values —35 + 30° C. Partly, the variation is unusually narrow here when compared with humidity, partly, in view of the division into 20 classes the first degree frequency will be considerably smaller than 10 per cent. On the other hand, the warm areas (A and B as Köppen has it) cover nearly 50 per cent of the land.

One shoud appreciate the substantial difference between the two phenomena. While humidity is an exclusive product of the earth's surface, the temperature stems in an inappreciable part of the radiation the source of which is 150 million km distant. So much more we are inclined to the hypothesis that it is the "hyperbolic" statistical distribution that agrees with natural conditions on the earth's surface. We cannot however consider this as a strict law as the so called Quetelet law was in a time misunderstood. The hyperbolic form expresses rather a picture of youth which change during development even under the inorganic conditions: both the variation span and the volume of mode are getting smaller during the development.

On the other hand, the units of the organic world are characterized by a narrow variation and the statistical distribution more or less symmetrical, and the Laplace—Gauss curve may be its ideal picture. Biometrics offers a countless amount of evidence relating to it. In the variation of this type we see evidence on relative e q u a l i t y of organic species while in the variation of the hyperbolic type, extreme d i v e r s i t y of the earth's surface. We subjoin that the hyperbolic variation is the most abstract expression of united contradictions.

7) We have so far observed only the physico-geographic phenomena but, on the earth's surface, there are also striking phenomena stemming in e c o n o m i c a c t i v i t i e s. Even if the delimitation of geographical units is rather difficult here, we can neglect respective discrepancies as the variation classes are relatively broad. The economic-geographical units are generally known to possess a statistical distribution which is extremely asymmetrical with the mode in the minimum. Usual statistical data on the size of towns and settlements at all, on the size of agricultural holdings, of mining or manufacturing units or of industrial centres, can prove it. That is generally known, and we cannot cite the series in this short paper. Also the most important economic characteristics, the distribution of incomes is of such an extremely asymmetrical form in its elemental conditions, and many textbook on statisticss brings documents relating to it.

But in spite of this we cannot state that the economic-geographical units would be characterized by the same statistical distribution as the physico-geographical units. And this is simply not possible as economic-geographical processes are much faster than the physico-geographical processes.

We have so far observed only the size in its absolute value. Some of properties of economic-geographical units are being expressed by relative numbers while the structure of such rates influences the form of the statistical distribution.. It usually is of a hyperbolic form if the denominator contains a non specified part of the earth's surface as, for instance, the whole area of a district. In case both the numerator and denominator contain the number of inhabitants, the variation gets narrower, and its form becomes more or less symetrical. With the latter problems we will deal in a special paper.

Most economic-geographical statistical data concern capitalist conditions. The capitalist system to the maximum make use of diversities of the earth's surface as well as the regional unequality of the economic development. Efforts to attain the maximum of production effectiveness and its excessive concentrationon places most suitable geographically, results in a statistical distribution which is extremely asymmetrical. The socialist policy, however, attemps to balance regional economic differences, and, as far as the most important economic characteristics, the distribution of incomes, is concerned, the statistical distribution probably is rather near to the biometric form. But also in capitalist conditions one can learn that not only too small units but also too large area concentrations are not to advantage from the point of economy. That means, that even here the variation gets narrower and the mode decreases.

The main result of our research is in the thesis, that the statistical distribution of physico-geographical units is of a hyperbolic form which is, however, not always typical for the economic-geographical units. In the latter case one can see transition to a symmetrical biometric form, that is, in economic conditions the human equality prevails more and more.

We have observed very simple but fundamental properties. To evaluate them we have used one of the most general instruments of science. If the geographers expand such a research to many different properties and many countries, then they will enrich the empiric basis of the ontological knowledge of the world.

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THE GEOMORFOLOGY OF PRAGUE

Geomorfologie Prahy. — Území Prahy se rozkládá v oblasti Pražské plošiny, charakterizované převážně erozně denudačním reliéfem. Základním geomorfologickým tvarem je plošinný reliéf, který lze považovat za parovinný povrch třetihorního stáří. Ostatní povrchové tvary jsou výsledkem mladotřetihorní a kvartérní eroze a denudace, která v podloží křídy odkryla paleozoické a proterozóické horniny Barrandienu. Dnešní geomorfologický ráz území podstatně ovlivnila členitost původního předkřídového podloží. Ze zbytků mladotřetihorních limnických a fluviálních sedimentů se v reliéfu uplatňují jen zdibské písky a štěrky. Tok Vltavy provází 7 pleistocenních akumulací, v nichž autoři rozlišili akumulační a erozní povrchy. Významným prvkem reliéfu jsou akumulace spraší, uložené v několika pokryvech, které geneticky odpovídají jednotlivým pleistocenním terasám Vltavy.

The area of Prague — the capital of Czechoslovakia — is situated in the centre of the Bohemian basin, i.e. in the north-eastern part of the Berounka hills, and extends on either bank of the lower Vltava. Most characteristic is its peneplain relief (Prague Plateau) which is due to Tertiary and Quaternary denudation and erosion processes which took place along the southern margin of the sediments of the Bohemian Cretaceous Plateau. The relief exhibits intensively folded and faulted Palaeozoic rocks of the Barrandian synclinorium whose axis runs from south-west to north-east over the southern and south-eastern outskirts of Prague. The central historical part of the town originated in a comparatively small erosion basin (Prague Basin) around the mouths of two larger right-hand tributaries of the Vltava — the Botič and the Rokytka. The relief reaches its maximum height in the western part of the map (401 m), the lowest-situated place being the surface of the Vltava near the northern margin of the map (177 m).

The oldest Proterozoic rocks (shale, gray-wacke shales, lydite) crop out to the surface on comparatively small areas in the north-west and south-east. The largest part of the Prague area is composed of Ordovician shales and quartzites; in the south-west occur Silurian and Devonian shales, diabases and limestones (predominantly on the left bank of the Vltava). In the north and south-west Ordovician and Proterozoic rocks are overlaid by almost horizontal layers of Upper-Cretaceous sandstones and marls. At present their southern border is the result of a more recent (Tertiary and Quaternary) denudation so that the relief — in the largest part of the Prague area — represents the exhumed substratum of Upper-Cretaceous sediments. From the more recent superficial deposits denudation fragments of Tertiary (most probably Miocene) gravels have been preserved on the left bank of the Vltava as well as sands and gravels of the lake type in the northern part of the map. They may be considered as Pliocene. From Quaternary sediments most important are gravel-sands of the Vltava terraces and loess occuring on larger areas west of the Vltava valley.

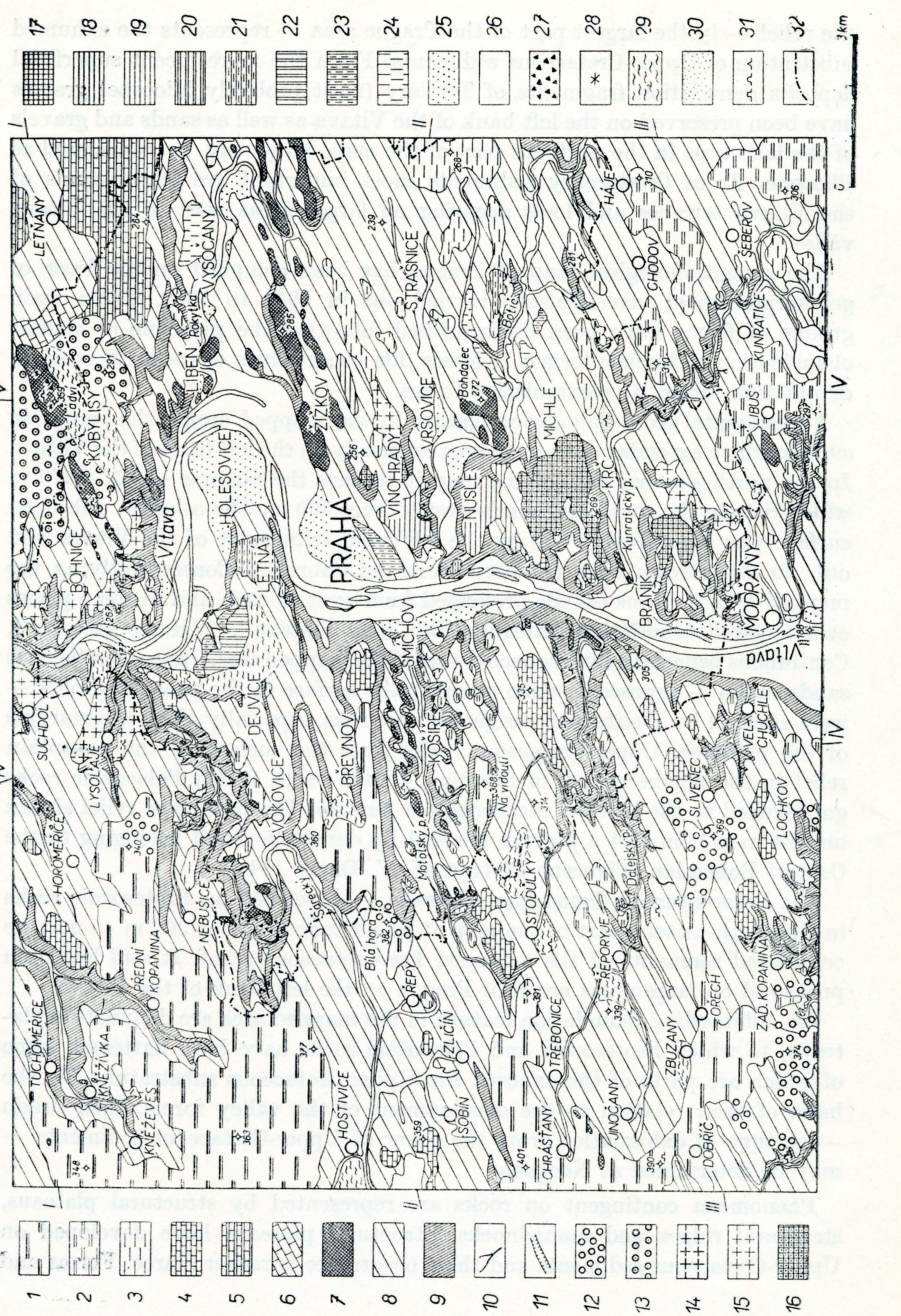
The geomorphological map of Prague has been compiled on the basis of geomorphological investigations carried out in 1958 to 1959. Three main groups of forms have been distinguished following the principle of genetic classification of surface forms: 1) forms due to structure of rocks, 2) erosion-denudation forms, 3) accumulation forms.

Fundamental geomorphological feature in the mapped area is the peneplain surface which extends over a large area especially on the left bank of the Vltava. In the north-western part of the map it reaches the altitude of 350—370 m which rises in the south and south-west to over 400 m. The original, unbroken surface was considerably cut by the left-hand tributaries of the Vltava and only in interstream areas has been preserved unbroken. Consequently, in the mapped area it forms islands prolonged from west to east, and in some places even isolated denudation plateaus ("Bílá hora Plateau", "Vidoule Plateau"). Continuous peneplain surface occurs west of the mapped area. Upper-Creataceous sandy marls — exposed in some places at the surface of the peneplain relief — were affected by Pleistocene periglacial processes, especially along the margins of the plateaus. Upper-Cretaceous rocks form the surface of the peneplain relief in the northern part of the map. In the south folded Palaeozoic rocks got levelled to the level of the peneplain surface. The peneplain relief shown on this map is in fact a plateau lowered by denudation and belonging to the Central Bohemian Oligocene Plateau (J. V. Daneš 1913).

The lower-situated denudation plateaus — developed on Proterozoic rocks in the south-eastern part of the map at an altitude of about 300 m — may be considered remnants of the exhumed Pre-Cretaceous relief. It still has been preserved on large areas north of Prague on the left bank of the Vltava.

An outstanding denudation feature in the mapped area are denudation plateaus, to which Proterozoic and Palaeozoic rocks have been flattened, some of which are parts of the exposed Pre-Upper-Cretaceous substratum. On the basis of their relation to the development of the valley forms, their origin — or time of exhumation from the cover of Upper-Cretaceous sediments — may be determined as Neogene.

Phenomena contingent on rocks are represented by structural plateaus, structural ridges and monadnocks. Structural plateaus have developed on Upper-Cretaceous sediments and their occurrence is rather scarce. Forms and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Šárecký p.
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DOBŘÍČ
ZAD. KOPANINA
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VEL. CHUCHLE
LOCHKOV

directions of structural ridges and monadnocks depend upon petrological and tectonic conditions. They occur in Proterozoic lydites, Ordovician quartzites, Silurian diabases, and Silurian and Devonian limestones. With the peneplain relief they are scarce. They occur mostly in strongly denudated areas and quite often in valleys (valley of the Motol brook). Most often they are geomorphologically quite unconspicuous. They occur mostly in zones of the Barrandian direction (south-west to north-east). In northern parts of Prague on lydite structural ridges, traces of the abrasion activity of the Upper-Cretaceous sea have been preserved in the form of surf deposits and abrasion plateaus (e.g. Ládví). In this case, old Pre-Cretaceous forms were exhumed by Tertiary and Quaternary denudation. In places, these structural ridges influenced the very geomorphological nature and development of the valleys of the Vltava tributaries (meanders of the Rokytka and Botič brooks). In the Pleistocene periglacial climate, monadnocks and structural ridges — especially those composed of lydite — were affected by intensive periglacial weathering. The result were exposed rocky masses, boulder streams and solifluction streams.

The valley of the Vltava in the mapped area is deeply cut and assymetric in profile. Its floor is comparatively narrow, widening out in the area of the Prague Basin where the river makes a large meander in Holešovice, lined with terraces. The valley runs almost directly from south to north. South of Prague the left bank is abrupt, without any terraces. It starts in an area situated higher than the oldest Quaternary terraces. On the other hand, large terraces of Old-Pleistocene age are developed south of Prague on the right bank of the Vltava. They fall down abruptly to the Vltava flood plain especially along the axis of the Barrandian syncline.

The geomorphological map of Praha.

1 — higher-situated level of denudation plateaus of Neogene age (lowered Central Bohemian Peneplain), 2 — lower-situated level of denudation plateaus of Neogene age, 3 — denudation plateaus of Pleistocene age, 4 — structural plateaus of Neogene age, 5 — structural plateaus of Pleistocene age, 6 — structural slopes, 7 — structural ridges, monadnocks, disturbed in places by Pleistocene frost weathering, 8 — backset slopes with "Dellen", 9 — abrupt slopes, 10 — erosion furrows, ravines, 11 — abandoned river beds, 12 — fragments of gravel and sand covers of Neogene age, 13 — plateau of Pliocene sands and gravels (Zdiby stage); Pleistocene terraces: 14 — terrace Ia (Lysolaje terrace of Q. Záruba), 15 — terrace Ib (Suchdol terrace), 16 — terrace IIa (Pankrác terrace), 17 — terrace IIb (Pankrác terrace), 18 — terrace IIIa (Kralupy terrace), 19 — terrace IIIb (Vinohrady terrace), 20 — terrace IVa (Letná terrace), 21 — terrace IVb (Letná terrace), 22 — terrace Va (Dejvice terrace), 23 — terrace Vb (Charles Square terrace), 24 — terrace VI (Veltrusy terrace), 25 — terrace VII (Maniny terrace), 26 — surface of valley plain; 27 — rubble and boulder streams, 28 — fragments of surf accumulations of Upper-Cretaceous age, 29 — slopes on loess drifts, 30 — slopes on drifted sands, 31 — more important quarries, loam pits, sand pits, 32 — administrative boundaries of Praha.

Left-hand tributaries of the Vltava flow predominantly from west to east. They rise in shallow depressions in the peneplain surface, cut gradually down into the substratum of Barrandian rocks along their middle and lower course, and form deep, in places canyon-like valleys. Originally, they started in the peneplain surface and flew over the Cretaceous deposits. In the course of the Late Tertiary and especially Pleistocene hollowing of the Vltava valley, they cut down epigenetically into the Palaeozoic and Proterozoic substratum of Cretaceous rocks. A typical example of epigenetic development is the valley of the Motol brook in its middle and lower reaches. It forms a wide depression, limited in the north by the margin of the peneplain ("Bílá hora" and its environment), in the south by the remnants of the structural plateau of "Vidoule". In the depression the Ordovician substratum is exposed and the Motol brook cuts across the ridges built of Drabov and Skalec quartzites and running from west-south-west to east-north-east. The brook follows transverse dislocations between the individual structural ridges. The most interesting and geomorphologically important tributary of the Vltava is the Šárecký brook which in the narrow romantic erosion valley cuts down into the resistant Proterozoic lydites, and often serves as an example of the epigenesis.

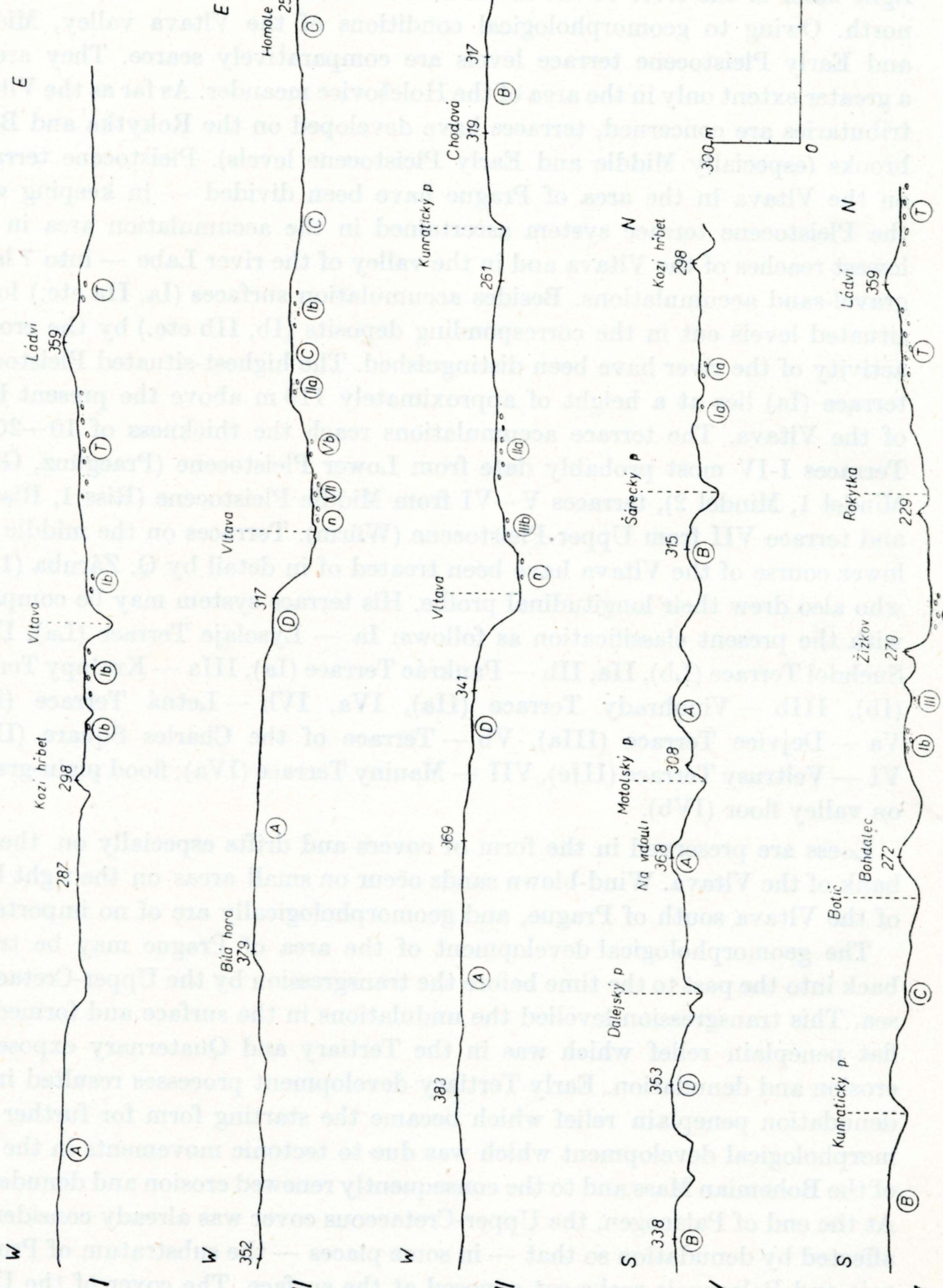
Right-hand tributaries of the Vltava display a somewhat different character owing to more advanced denudation of the area and a considerable occurrence of Quaternary terraces. The longest right-hand tributaries, the Rokytka and Botič brooks, belong to this area only with their lower courses flowing predominantly in wide valley. In places their course gets controlled by harder Ordovician rocks which they cut across (meanders of the Rokytka near Hloubětín, and of the Botič brook in Michle). The Kunratice brook in its middle reaches, before turning westwards (to the Vltava), has a typically assymetrical valley with abrupt right slope and following most probably old transverse dislocations (of Hercynian direction). Rain wash and deep erosion grooves and gorges have been developing in the slopes of deeply incised valleys.

From the oldest accumulations, denudation fragments of Tertiary (Upper Miocene) sands and gravels have been preserved. They may be well traced in the southern part of the map (Sulava) at an altitude of 355 m, i.e. 160 m above the surface of the river. They reach the thickness of about 30 m. Sands and gravels often cemented into limestones or even conglomerates occur on the left bank of the Vltava in the south-western part of the map (north of Chýnice, west of Zadní Kopanina, near Lochkov, Slivenec and Bílá Hora). They usually lie higher than the Sulava deposits and very often at the level of the surface of the peneplain. The Zdiby gravels and sands (Pliocene ?) extend as far as the north-eastern part of the map. They fill the depression between the structural ridges of Ládví and Čimice at a height of 325 m — their maximum thickness being 40 m — and occur at a lower-situated denuded level further to the north.

Terraces on the river Vltava in the area of Prague are represented by terrace accumulations. The largest terraces are Old Pleistocene terrace levels on the right bank of the river in the south and on either bank of the Vltava in the north. Owing to geomorphological conditions of the Vltava valley, Middle and Early Pleistocene terrace levels are comparatively scarce. They are of a greater extent only in the area of the Holešovice meander. As far as the Vltava tributaries are concerned, terraces have developed on the Rokytka and Botič brooks (especially Middle and Early Pleistocene levels). Pleistocene terraces on the Vltava in the area of Prague have been divided — in keeping with the Pleistocene terrace system ascertained in the accumulation area in the lowest reaches of the Vltava and in the valley of the river Labe — into 7 large gravel-sand accumulations. Besides accumulation surfaces (Ia, IIa etc.) lower situated levels cut in the corresponding deposits (Ib, IIb etc.) by the erosive activity of the river have been distinguished. The highest-situated Pleistocene terrace (Ia) lies at a height of approximately 110 m above the present level of the Vltava. The terrace accumulations reach the thickness of 10—20 m. Terraces I-IV most probably date from Lower Pleistocene (Praegünz, Günz, Mindel 1, Mindel 2), terraces V—VI from Middle Pleistocene (Riss 1, Riss 2), and terrace VII from Upper Pleistocene (Würm). Terraces on the middle and lower course of the Vltava have been treated of in detail by Q. Záruba (1942) who also drew their longitudinal profile. His terrace system may be compared with the present classification as follows: Ia — Lysolaje Terrace (La), Ib — Suchdol Terrace (Lb), IIa, IIb — Pankrác Terrace (Ia), IIIa — Kralupy Terrace (Ib), IIIb — Vinohrady Terrace (IIa), IVa, IVb — Letná Terrace (IIb), Va — Dejvice Terrace (IIIa), Vb — Terrace of the Charles Square (IIIb), VI — Veltrusy Terrace (IIIc), VII — Maniny Terrace (IVa); flood plain-gravels on valley floor (IVb).

Loess are preserved in the form of covers and drifts especially on the left bank of the Vltava. Wind-blown sands occur on small areas on the right bank of the Vltava south of Prague, and geomorphologically are of no importance.

The geomorphological development of the area of Prague may be traced back into the past to the time before the transgression by the Upper-Cretaceous sea. This transgression levelled the undulations in the surface and formed the flat peneplain relief which was in the Tertiary and Quaternary exposed to erosion and denudation. Early Tertiary development processes resulted in the denudation peneplain relief which became the starting form for further geomorphological development which was due to tectonic movements in the area of the Bohemian Mass and to the consequently renewed erosion and denudation. At the end of Palaeogen, the Upper-Cretaceous cover was already considerably affected by denudation so that — in some places — the substratum of Proterozoic and Palaeozoic rocks got exposed at the surface. The cover of the Upper Createaceous sediments influenced considerably the pattern of the drainage



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network in this area (epigenesis), although — during the cutting down of the streams into the older substratum — petrological and tectonic conditions of underlying rocks were of definite importance as well. The present geomorphological character of the region is in places influenced by the original Pre-Cretaceous substratum. As may be seen from fragments left behind after the accumulation activity of the Upper-Cretaceous sea — preserved in places on structural ridges — structural formes have not been affected too much by the Tertiary and Quaternary denudation.

Hydrographical axis and erosion basis for the development of the relief in the area of Prague is the south-north course of the Vltava. Since the very beginning of the Pleistocene no substancial changes took place in the course of the main stream. Only in the southern part of Prague, the river bed shifted in Early Pleistocene towards the west, and in the northern part of Prague a large meander was developing near Holešovice, the origin of which was due to a barrier of resistant Ordovician quartzites which made the stream shift its bed. An important factor in levelling the undulated surface are accumulation loess. It has been deposited prevailingly by western winds to form several covers corresponding genetically to individual Pleistocene terrace accumulations, except the oldest ones. Relations between accumulations of loess and terraces were studied on a classical locality in Sedlec (left bank of the Vltava) in northern part of Prague. Numerous exposures in the area of Prague as well as in the whole central Bohemia were affected by Pleistocene frost weathering (cryoturbation). The comparatively rugged and genetically varied relief offered good conditions for the origin and development of the City of Prague.

Cross-profiles to the geomorphological map of Praha. A — higher-situated level of denudation plateaus of Neogene age (lowered Central Bohemian Peneplain), B — lower-situated level of denudation plateaus of Neogene age, C — denudation plateaus of Pleistocene age, D — structural plateaus of Neogene age, T — plateau of Pliocene sands and gravels (Zdiby stage), I—VII — Pleistocene terraces (a — accumulation surface of the terrace, b — erosional surface of the terrace), n — surface of valley plain. — Příčné profily ke geomorfologické mapě Prahy. A — vyšší úroveň denudačních plošin neogenního stáří (snížená středočeská parovina), B — nižší úroveň denudačních plošin neogenního stáří, C — denudační plošiny pleistocenního stáří, D — strukturní plošiny neogenního stáří, T — plošina pliocenních písků a štěrků (zdibské stadium), I—VII — pleistocenní terasy (a — akumulační povrch terasy, b — erozní povrch terasy), n — povrch údolní nivy.

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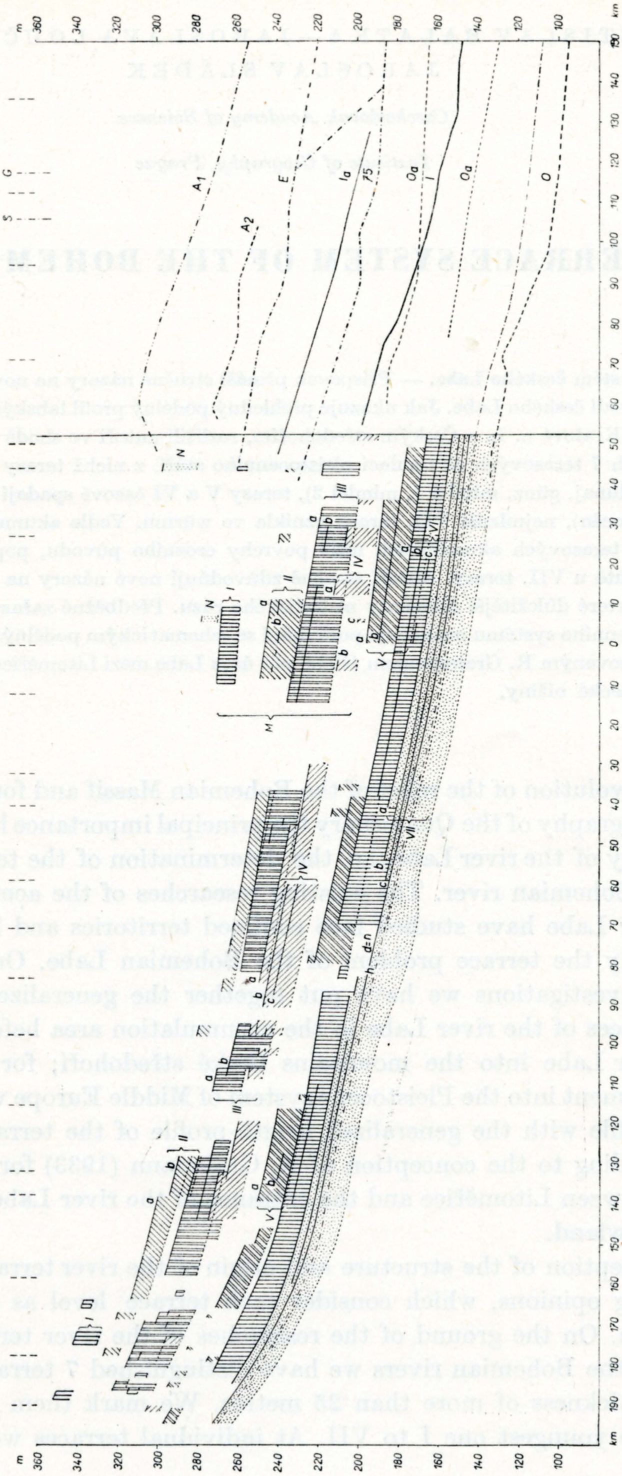
THE TERRACE SYSTEM OF THE BOHEMIAN LABE

Terasový systém českého Labe. — Příspěvek přináší stručné názory na nové pojetí terasového systému v povodí českého Labe. Jak ukazuje přehledný podélný profil labskými terasami v úseku mezi Dvorem Králové n. L. a Českým středohořím, rozlišili autoři ve shodě s poměry na jiných českých řekách 7 terasových akumulací pleistocenního stáří, z nichž terasy I až IV jsou staropleistocenní (dunaj, günz, mindel 1, mindel 2), terasy V a VI časově spadají do rissu 1 a rissu 2 (střední pleistocén), nejmladší VII. terasa vznikla ve würmu. Vedle akumulačních úrovní vytvořily se v terasových akumulacích nižší povrchy erozního původu, popř. vložené trerasy, nejlépe vyvinuté u VII. terasy. Autoři stručně zdůvodňují nové názory na genezi teras a upozorňují na některé důležitější momenty metodického rázu. Předběžné zařazení do středoevropského pleistocenního systému naznačuje porovnání se schematickým podélným profilem terasami Labe zkonstruovaným R. Grahmannem (1933) pro úsek Labe mezi Litoměřicemi a vstupem řeky do Severoněmecké nížiny.

For the evolution of the relief of the Bohemian Massif and for the recognition of the stratigraphy of the Quaternary the principal importance has the evolution of the valley of the river Labe, i.e. the determination of the terrace system of this main Bohemian river. The existing researches of the accumulation areas of the river Labe have studied face confined territories and have not solved satisfactorily the terrace problem of the Bohemian Labe. On the ground of our own investigations we have put together the generalized length-profile of the terraces of the river Labe in the accumulation area before the entrance of the river Labe into the mountains České středohoří; for the purpose of the arrangement into the Pleistocene system of Middle Europe we have compared this profile with the generalized length-profile of the terraces of the river Labe according to the conception of R. Grahmann (1933) for the river reach of Labe between Litoměřice and the entrance of the river Labe into the North German Lowland.

Our conception of the structure and origin of the river terraces differs from the existing opinions, which consider each terrace level as an independent aggradation. On the ground of the researches of the river terraces in a great number of the Bohemian rivers we have distinguished 7 terrace aggradations with the thickness of more than 25 metres. We mark them from the oldest level to the youngest one I to VII. At individual terraces we distinguish on



PIRNA
Křinice
Ploučnice
Bílina
LOVOSICE
Ohře
ROUDNICE n. L.
Vltava
NERATOVICE
Jizera
LYSÁ n. L.
NYMBURK
Cidlina
KOLÍN
TÝNEC n. L.
PŘELOUČ
Chrudimka
Loučná
Orlice
Metuje
KUKS
m
km

the one hand the aggradational surface (with index "a") representing the level of the highest sedimentation of the river deposits, on the other the lower surfaces of erosional origin (with index "b" or "c" or "d"), which are best preserved with the terraces of the Middle and Upper Pleistocene. The general number of the terrace levels of the river Labe reaches therefore more than double of the number of the terrace aggradations. This terrace system differs from the classification of the terraces of the river Vltava according to the conception of Q. Záruba (1942), which considers some erosional levels as independent terraces.

As shows the structure of the terrace system there have cooperated at the origin of the terrace surfaces the processes of aggradation and the processes of lateral erosion. The lateral erosion that leads to the widening of the valley is bound as to the processes of vertical cutting, as to the processes of aggradation. This evolution of the valley has shown itself just in the valley of the Bohemian Labe, which is built of comparatively incompetent and homogeneous rocks of Upper Cretaceous. On the contrary in those areas, which are built of more resistant rocks, the process of lateral erosion is restricted on the least degree, so that at downward cutting of the valley there is renovated more or less the width of the former valley bottom and the erosion levels can be preserved only in the rare cases. The origin of the river terraces cannot be explained by means of simple processes of vertical cutting and aggradation, what has been presumed till now.

For the construction of the terrace length-profile and for the recognition of the origin of the terraces the most important river reaches are that ones in which the complete aggradation of terrace deposits has been preserved, i.e.

The generalized length-profile of the terraces of the river Labe.

N — gravels and sands of Late Tertiary (Neogene), I to VII — Pleistocene terraces of the Bohemian Labe, a — aggradational surface of the terrace, b, c, d — erosional surface of the terrace, n — surface of valley plain, h — river level. The terraces of the river Labe according to R. Grahmann: A_1, A_2 — Pliocene terraces (rock substratum), E — terrace of Praegünz-Günz (rock substratum), 75 — problematical level (rock substratum), I — terrace of Mindel (rock substratum), I_a — gravel terrace I (aggradational level), O — terrace of Riss (rock substratum), O_a — gravel terraces O (secondary erosional levels), G — limit of Elster glaciation, S — state frontier, M — terraces of the river Vltava.

Přehledný podélný profil terasami Labe.

N — štěrky a písky mladotřetihorní (neogenní), I—VII — pleistocenní terasy českého Labe, a — akumulační povrch terasy, b, c, d — erozní povrch terasy, n — údolní niva, h — hladina řeky. Terasy Labe podle R. Grahmanna: A_1, A_2 — pliocenní terasy (skalní podloží), E — terasa praegünz-günz (skalní podloží), 75 — problematická úroveň (skalní podloží), I — terasa mindel (skalní podloží), I_a — štěrková terasa I (akumulační úroveň), O — terasa riss (skalní podloží), O_a — štěrkové terasy O (druhotné erozní úrovně), G — hranice halštrovského zalednění, S — státní hranice, M — terasy Vltavy.

the base of the terrace in its lowest level and the aggradation surface (abandoned valleys from the period of each terrace). From that point of view the situation in the accumulation area of the Bohemian Labe is especially favourable, for in consequence of the complicated evolution of the stream system in course of the Pleistocene Period many abandoned valley reaches from the periods of various terrace levels have been preserved here. Therefore in the study of the river terraces we are obliged to start with the geomorphological situation of the researched area.

The regular course of the individual terrace levels demonstrates that the evolution of the stream system and the formation of the terraces have not been substantially influenced by the Quaternary tectonic movements with the exception of a short river reach in the middle part of the valley of the Bohemian Labe under the mountains Železné hory, where the base of the youngest terrace

	Surface	Base
Gravels of Late Tertiary:		
at the foot of the mountain Říp	160	—
at Rovné and on Sovice	124	116
Pleistocene terraces:		
I	115	106
IIa	91	75
b	85	
IIIa	76	55
b	71	
IVa	60	
b	54	43
c	47	
Va	40	16
b	33	
VIa	26	
b	21	0
c	18	
VIIa	12	
b	9	—10
c	5—6	
d	3—4	

(VII) forms a clear depression in a level by 7 metres lower than the normal level of the rock substratum of this terrace. It is possible to interpret this anomaly by means of subsidence at the foot of Železné hory. In the area of the confluence of the both largest Bohemian rivers — Vltava and Labe — the terrace levels are characterised by these relative heights (in metres above the river level). (Tab. on page 34).

In the comparison of our profile of the Labe terraces with that one of R. Grahmann it follows that the course of the Pleistocene terraces does not show substantial influence of the Quaternary tectonics (even in the river reach in České středohoří and Děčínské mezihoří). Only at the Neogene level A_1 R. Grahmann supposes a divergence caused by the elevations (thrust faults) in the area of České středohoří. The Grahmann's terrace A_2 is situated in the level of the Pliocene terrace in the surroundings of Praha, his terrace E corresponds in the length-profile to the terrace I, the aggradational level of the Grahmann's terrace I corresponds to the aggradational surface of our terrace II, while the base of the Grahmann's terrace I is situated in the level of the rock substratum of our terrace III (or IV). The Grahmann's so called 75 metres

<table>
<tr><th></th><th>B. Balatka
J. Sládek
1962</th><th>Q. Záruba
1942</th><th>R. Grahmann
1933</th></tr>
<tr><td>Neogene:</td><td></td><td></td><td>A_1
A_2</td></tr>
<tr><td>Pleistocene:
Donau</td><td>I</td><td>La
Lb</td><td>E</td></tr>
<tr><td>Günz</td><td>II</td><td>Ia</td><td rowspan="2">I</td></tr>
<tr><td>Mindel 1</td><td>III</td><td>Ib
IIa</td></tr>
<tr><td>Mindel 2</td><td>IV</td><td>IIb</td><td rowspan="3">O</td></tr>
<tr><td>Riss 1</td><td>V</td><td>IIIa
IIIb</td></tr>
<tr><td>Riss 2</td><td>VI</td><td>IIIc</td></tr>
<tr><td>Würm</td><td>VII</td><td>IVa
IVb</td><td>U</td></tr>
</table>

level represents approximatively the continuation of the base of our terrace II. The aggradational surface of the Grahmann's terrace O is situated in the level of our terrace IV (or V), the lower surface of the terrace O corresponds to the aggradational surface of our terrace VI. The Grahmann's informations about the situation of the rock substratum under the contemporary level of the river Labe relate to the base of our terrace VII. From this comparison it follows that R. Grahmann supposes theoretically the large terrace aggradations at the terraces I and O (with a thickness to more than 50 metres), which have not been proved even by bore holes; therefore there are in both cases two independent terraces; that has been proved by some abandoned valley reaches in the river basin of the Bohemian Labe.

On the ground of the relation of the river terraces to the aeolian deposits, of the paleontological discoveries and after the comparison with the terrace system of the river Vltava (Q. Záruba 1942) and the lower course of the river Labe (R. Grahmann 1933) we put the terraces into the Pleistocene system in this manner. (Tab. on page 35).

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SOIL EROSION IN CZECHOSLOVAKIA

Eroze půdy v ČSSR. — Výzkum eroze půdy v ČSSR se v širším měřítku rozvíjí teprve v posledních 15—20 letech. Jeho nositeli jsou pracoviště hydrologická, agromeliorační, pedologická a geografická. Vzhledem ke značné členitosti reliéfu a velké pestrosti půd, stává se eroze půdy v ČSSR stále více předmětem studia hlavně pedologů a geomorfologů, kteří také přikročili k jejímu systematickému staničnímu pozorování. Na základě současných poznatků je možno stanovit, že na území našeho státu nejvíce působí na rozvoj splachu a stružkové eroze půdy členitost území, přívalové deště, výskyt hlinitých i hlinitopísčitých půd a porušení souvislého vegetačního krytu. Tytéž faktory spolupůsobí i při vzniku a vývoji strží. Hustota stržové sítě, především její zřetelný růst směrem z Českého masivu do Karpat, jsou však ovlivněny spolupůsobením dalších faktorů, k nimž patří intenzita neotektonických pohybů, různé druhy geologického podkladu, historický vývoj osídlení a polních cest. Eroze půdy působená větrem se projevuje v ČSSR především v nížinách na plochách s vhodnými klimatickými a pedologickými poměry, nedostatečně chráněných vegetací a na malých územích ve vysokohorských polohách.

The history of research

The research of the urgent agricultural problems of the soil erosion and the protection against it began to develop more expressively in Czechoslovakia in the last 15—20 years on the pedological, hydrological, agromeliorative and geographic working places. The pedologers and geomorphologers especially began to notice besides the proper research in the dissected and geomorphologically variegated relief of our territory the phenomena of the accelerated erosion.

When studying the origin of the earth pillars in the Plzeň area, C. Purkyně (1909), who supposed correctly the narrow and deep gullies with vertical walls to be formed by occasional water from torrential rains, noticed the erosion microforms. J. Spirhanzl (1946, 1952) studied the sheet wash and the gully erosion from the pedological point of view and he was the first, who summed up the knowledge about the water and eolian soil erosion in a complete monographic study in our country. B. Mařan and O. Lhota (1947, 1953) studied the water erosion with regard to the solving of the questions of the protection of agricultural and forest soil against the erosion. The soil denudation was studied on the small experimental fields in the Ještědské hory Mts., on the soil skeletons, and in South Moravia.

The experimental methods were introduced successively into the soil erosion research by the research workers of the chairs of hydromelioration in Praha and Brno and by the research workers of the institutes for the research of the water economics. J. Dvořák (1955) realized the experiments on small areas with the help of artificial rain, with the soil erosion and denudation; M. Holý (1955, 1956) studied the influence of the slope shapes on the sheet erosion and realized numerous laboratorial analyses of the eroded soil in the district Roudnice nad Labem. He compiled further a map of the sheet erosion for a part of the SW Bohemia.

A great iniciative for the organisation of the soil protection against erosion was shown by J. Cablík and K. Jůva, who improved the modes of the soil protection against the accelerated erosion (the high-school textbook of 1954 and 1963). V. Kozlík used in surroundings of the village Budmeřice the method of the test fields, connected with the artificial and natural watering. The acquired results were then used in the proposal of the furrowing — one of the systems of protection against the soil erosion. He followed here the point of view of the effectiveness and economy of this kind of the antierosion soil protection. D. Zachar (1958, 1960) was looking to the practical needs of the forest economics when investigating the soil erosion in more parts of Slovakia. He gave a summary of the results of the research, where he used especially the pedologic and the metric methods, in a monography.

The hydrologic methods of the erodologic research supplement well the investigations of the soil erosion in the given river basin. According to O. Dub (1955, 1956) it is possible to judge the intensity of the soil erosion on the basis of the quantity of the fluvial deposits in a certain part of the water course. The measuring of these deposits was carried out on some Slovakian rivers by D. Almer (1955), B. Nather and J. Szolgay (1958), whose results are completing the experimental material for the study of the soil erosion suitably. The measuring of the quantity of the fluvial deposits on Czech rivers was carried out by the workers of the State Hydrologic Institute in Praha.

The soil erosion being one of the geomorphologic phenomena of the slope modellation, the geomorphologic methods prove very useful at its study. These methods are used especially by the physical geographers, who investigate the accelerated erosion and who carry out even the experimental research of the sheet wash of soil on the research objects in last time. The morphometric indexes were used when the map of the density of the sheet wash pattern was elaborated in Slovakia by Š. Bučko and V. Mazúrová (1955, 1956, 1958), in Czech countries by O. Stehlík and K. Gam (1956, 1957). O. Stehlík studied even the gully erosion in South Moravia. The historical data about the soil erosion in the region of Brno were worked up by Z. Láznička (1957, 1959), who paid attention even to the recent soil erosion. J. Demek (1960), T. Czudek (1962) and J. Demek — H. Seichterová (1962) studied the sheet wash on more places of Moravia. Z. Lochman (1960) contributed to the recognition of the genesis of the erosion microforms. The gully erosion and the sheet one were studied by P. Plesník (1958) in the areas of the upper forest border in Slovakia; in contradistinction to it J. Košťálik investigated the intensity of the erosion processes on the loess soil and V. Lobotka (1955, 1963) on the flysh slopes with terraces.

In the interest of the further basic research of the soil erosion in ČSSR it is necessary to coordinate all the part investigations and to arrange them with regard to the needs of the praxis and of the theoretical development of the science of the soil protection against erosion.

The method of the map compilation

The map of the soil erosion on the territory of ČSSR gives the data of the density of the gully pattern, of the intensity of the sheet wash and of the rill soil erosion and of the intensity of the eolian erosion. The data of the density of the gully pattern were elaborated by the Geographical Institute of the Czechoslovak Academy of Sciences for the territory of the Czech countries and by the Geographical Institute of the Slovakian Academy of Sciences for the territory of Slovakia. The detailed topographic maps were used as the basic information source for the study of the density of the gully pattern. On these maps the gullies are drawn in their real shape and dimension by striking common symbols. The density of the gully pattern was established on these maps for the whole territory of ČSSR by measuring of the length of the gully cuts in squares of the territory of an area of 4 km². According to the frequency of the occurence of the values of the gully pattern on these areas, three characteristic degrees of density were settled: 1) areas with an insignificant density of the gully pattern (0,0—0,1 km/km²), 2) areas with the mean density of the gully pattern (0,1—1,0 km/km²) and 3) areas with a considerable density of the gully pattern (1,0 and more km/km²). On the basis of this scale, with regard to the total characteristic of the shape of the surface and to some typical features of its actual development, isolines of the same density of the gully pattern were drawn up for the whole territory of ČSSR by the generalization of the borders of the specific squares. The above mentioned geomorphologic studies were completed on the one hand by the confrontation of the results of the measured gully pattern on detailed topographic maps acquired for the same territory by different authors, on the other hand by the general terrain investigation of smaller areas with the typical occurrence of gullies, where the attention was paid not only to the study of the density of the gully pattern but even to the natural and cultural conditions of their development.

The data of the dislocation of the sheet wash and the rill erosion of soil were prepared by the chair of Hydromelioration of the Construction Faculty of the Czech Technical High School in Praha. The materials of the State Plan of Water Economics were used as basic information, in which the intensity of the water erosion was judged within the scope of the individual river basins on the basis of their angle of slope and of the information of the agricultural plants. The data of the State Plan of Water Economics were verified by the detailed research in the river basins of Berounka and Ploučnice. The geological, geomorphologic, pedologic, hydrologic, climatic and biological factors were evaluated here and numerous observations were carried out directly in the terrain. The investigations showed that the lists of the areas threatened by the soil erosion elaborated by the State Plan of Water Economics correspond to the reality and that they may be used safely as basic material. At the map compilation the percentage of the affecting of the agricultural soil by the water erosion in the squares of the area of 81 km² was established for the whole territory of ČSSR. The degree of threatening was determined on the basis of the ratio of the total area of the specific square to the area of the agricultural soil subjected to water erosion inside this square. The specific squares, in which less than 25 % of agricultural land are suffering water erosion, 2) the specific squares, in which 25—50 % of agricultural land are suffering water erosion, 3) specific squares in which 50—75 % of agricultural land are suffering erosion and 4) specific squares, in which more than 75 % of agricultural land are suffering water erosion, were distinguished here. By the interpolation of the borders of these squares isolines of the threatening of agricultural land by water erosion were acquired and the forested areas which are not suffering erosion were excluded of the areas limited by these isolines.

The data of the dislocation of the eolian soil erosion on the territory of ČSSR were elaborated by the chair of hydromelioration of the Construction Faculty of the Czech Technical High School in Praha on the basis of the materials of the State Plan of Water Economics acquired of the reports of the agricultural plants, of the erodological bibliography and on the basis of information of the Geographical Institute of the Slovakian Academy of Sciences, based on the evaluation of the shapes of the relief and on the basic climatic data.

Main reasons of the development of erosion phenomena in ČSSR

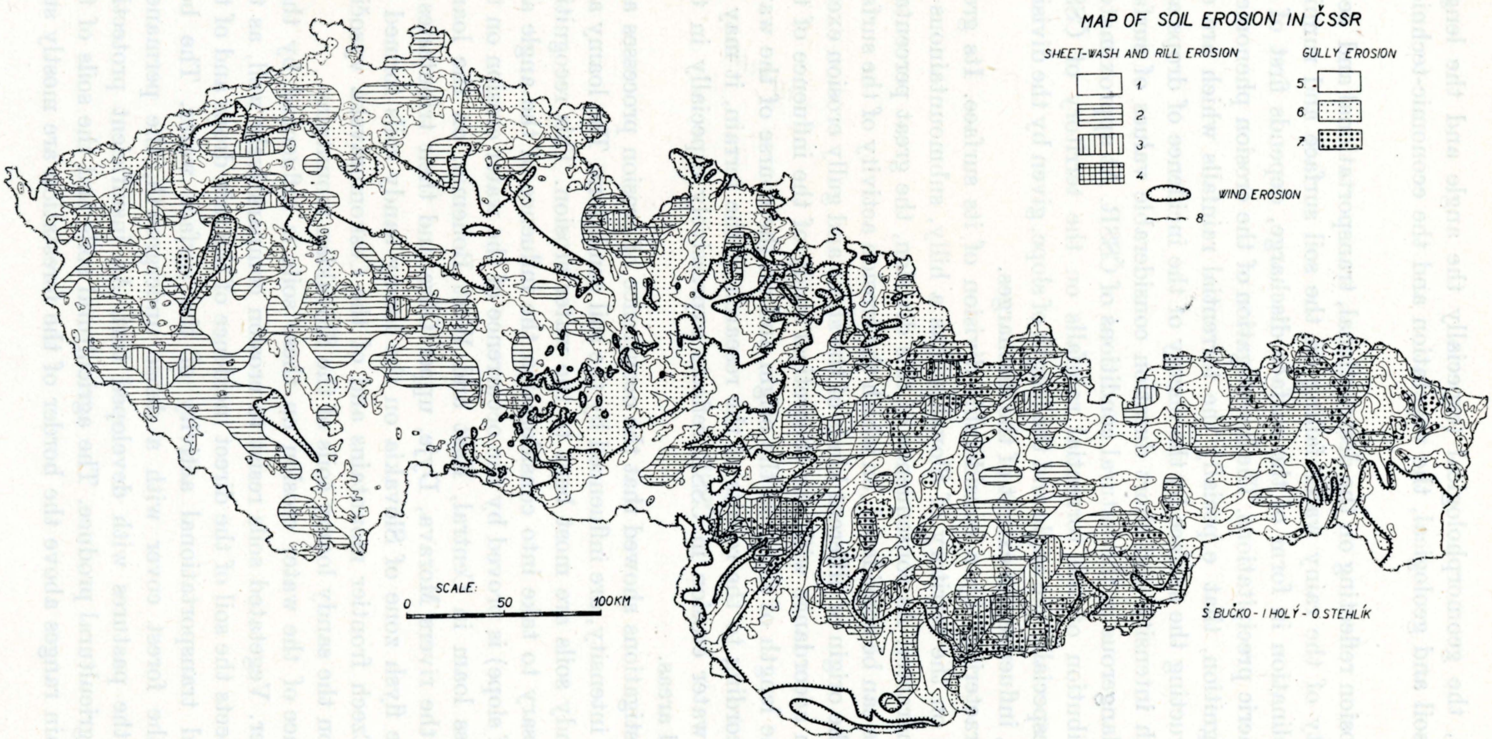
The legality of the occurrence of the water erosion is given by the mutual grouping of the erosion factors and by the influencing of their more or less expressive activity by the local conditions. The most important factors, which have to be investigated first of all in our climatic conditions, are the climatic and hydrologic, the geomorphological (especially the angle and the length of slopes), the soil and geological, the vegetation and the economic-technical ones.

The water erosion reflecting on the destructional, transportational and sedimentary activity of the rainy water falling on the soil surface and running away at its inclination in form of the surface discharge, depends first of all on the atmospheric precipitations. The investigation of the erosion phenomena led to the recognition, that e pecially the torrential rainfalls which are expressively destructing the surface by the energy of the incidence of drops and give at the high intensity and short duration considerable values of surface discharge, are dangerous in the natural conditions of ČSSR. At approximately the same distribution of the torrential rainfalls on the territory of ČSSR further factors especially the angle and the length of slope, given by the division of the territory, influence the extent of the discharges.

ČSSR is characterized by a considerable division of its surface. Its great part, especially on the territory of Slovakia, has a hilly, submountainous to mountainous character. As consequence of this division, the great percentage of soils on slopes can be considered, on which the erosion activity of the surface water causing the origin of different kinds of the sheet and gully erosion exerts its influence. In accordance with the theoretical study of the influence of the angle and of the length of slope on the origin and on the course of the water erosion and according to the results of the research in the terrain, it may be said, that the water erosion in ČSSR reflects expressively especially in the strong dissected areas.

Further investigations showed that the occurrence of erosion processes and especially their intensity, are influenced by the soil conditions. The loamy and even loamy sandy soils are most bent to the water erosion. This recognition (but it is necessary to take into consideration the influence of the angle and of the length of slope) is proved by the occurrence of the water erosion on the Pleistocene loess loam in Central, East and West Bohemia, on the loamy deposits along the rivers Morava, Dyje, upper Odra and their tributaries in Moravia, in the flysh zone of Slovakia on the loamy sandy soils formed on debris of the Czech frontier mountains and of the Českomoravská vysočina Highland and on the sandy loamy soils of the Slovakian mountains.

The occurrence of the water erosion on these soils is influenced by their vegetation cover. Vegetated soils resist to erosion comparatively well, as the vegetation protects the soil of the direct incidence of the rain drops and of the destructive and transportational activity of the surface water. The best protection is the forest cover with a dense undergrowth, the permanent meadows and the pastures with developed turf. An insufficient protection is formed by agricultural produce. The agricultural soils and the soils of the highest mountain ranges above the border of the forestation are mostly sub-



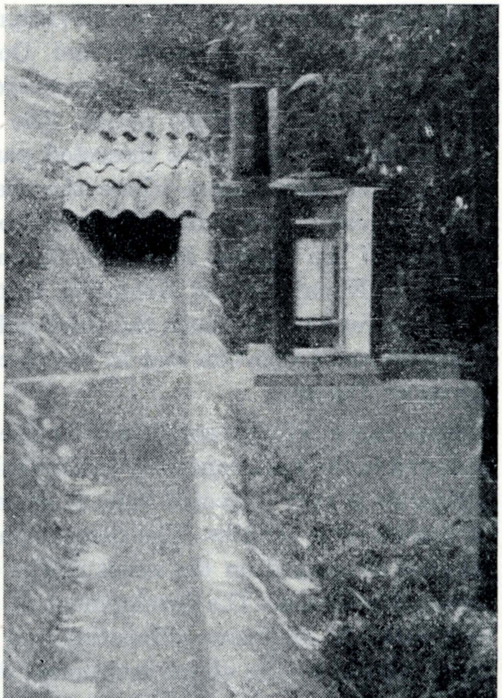
MAP OF SOIL EROSION

1. less than 25% of the area of the territory
2. 25%—50% of the area of the territory
3. 50%—75% of the area of the territory
4. more than 75% of the area of the territory
5. areas of insignificant density of the gully pattern (0—0,1 km/km^2)
6. areas of moderate up to average density of the gully pattern (0,1—1,0 km/km^2)
7. areas of intense density of the gully pattern (more than 1 km/km^2)
8. the border of the state

jected to the water erosion. This fact reflected fully on the establishment of the occurrence and of the extent of the water erosion in ČSSR.

The economic-technical conditions are of main importance for the origin of the water erosion. The water erosion occurs more expressively in areas, where the right principles of the land utilization are not adhered to, i.e. where the contour cultivation on the slope lands is not carried out, where the boundaries of water economic significance are abolished (their task is to interrupt the surface discharge down-slope) and too large acres of land are formed, where the field ways are not designed and carried out correctly, where the exceeding cultivation of woods is carried out. As these circumstances are not uniform on the territory of ČSSR and as their arrangement is planned (in some areas the necessary measures are taken), they were not included fully at the establishment of the legality of the occurrence of the water erosion.

We cannot but conclude that it may be said on the basis of the theoretical analysis of the problem and of the proving of the acquired results in the terrain and on the basis of extensive map studies, the occurrence of the water erosion in ČSSR and its dislocation to be influenced predominantly by the division of the territory and by the soil and vegetation conditions. These factors reflected very expressively in different combinations at the establishment of the legality of the occurrence of the water erosion in ČSSR and their investigation made possible to acquire a reliable basis for the compilation of the map of the water erosion.



1. Collecting concrete trough at the erosion research fields at Velké Žernoseky.
Photo M. Holý

The visible growth of the density of the gully pattern in the direction from west to east may be noticed in Czech countries. In the west part of the Czech Massif the greatest gully density is concentrated in the areas consisting of rocks of the Permian and Cretaceous period, where the kaolinic and arcosis sandstones are subjected to the destruction by the running water. The greatest gully concentrations are found near the village Plasy, north of the town Plzeň and in the space among the towns Rakovník, Louny and Žatec, further between the towns Litoměřice and Liberec and north of the town Náchod. On a considerable area but in a smaller concentration, the gullies appear in the foothills of the Krkonoše Mts., Orlické hory Mts. and on the Českomoravská vrchovina Highland. The origin of these gullies is conditioned especially by the Holocene deepening of the water courses, which even the vertical erosion of the occasional water flows in the valley heads filled up with Pleistocene sediments, is connected with. The reasons of the development of the gullies in the highlands and mountaineous countries of the east margin of the Czech Massif in Moravia and Silesia are similar; the greater activity of the erosion processes is caused here by the greater intensity of the young tectonic movements.

In the zone of the Subcarpathian depressions the loess covers and the loose or a little consolidated sediments of Quaternary and of the late Tertiary offer very suitable conditions for the development of the gullies. The gully development in the Dyjskosvratecký and Dolnomoravský úval was considerably supported by people, as these areas are exploited agriculturally very intensively since the Neolithic period. The greatest concentration of the gullies can be found in the more dissected parts of the graben between the towns Znojmo and Brno, from where the area proceeds along the margin of the Českomoravská vrchovina Highland to the town Boskovice and along the SE foot of the Central Moravian Carpathians among the towns Kyjov, Uh. Hradiště, Napajedla and Kroměříž. In the space of the Moravian gate and of the Ostravská pánev Basin the thick gully pattern was formed on the deposits of the glacial formation and in the thick loess loam covers especially east of the town Ostrava.

Even more suitable conditions for the development of the gully erosion can be found in the flysh zone of West Carpathians. The surface of the hillylands and highlands is very dissected here, it has a considerable relief energy and slopes of considerable lengths. The deep loamy sandy regolith and the solifluction mantles developed on the zones of the claystones which occupy large areas during Pleistocene. The development of the agriculture was closely connected here with the extensive afforesting and with the clearance of the land in the relief formed by the above mentioned deep regolith. It is therefore possible to find almost everywhere in the space of the outer Carpathians large areas with a relatively dense pattern of gully incisions and also the greates gully agglomerations reaching in extreme cases the values of more than 4 km/km^2. The greatest gully concentrations can be found in the Těšínská pahorkatina Hillyland, among the towns Frýdek, Č. Těšín and Ostrava, further in the valley head of the river Ostravice and in the valley head of the river Rožnovská Bečva.

The different intensity of the erosion processes is caused in Slovakia especially by the geomorphologic character of the relief, by the petrographical properties of the rocks and the soils developed on them, by the meteorologic and anthropogenous factors. To the contrary of the Czech countries the relief of Slovakia is with regard to the west Carpathian mountain system very strongly dissected and it has slopes of a great angle. Even the processes of the accelerated erosion show due to it marks of a considerable freshness and intensity.

The prevailing part of the Slovakian territory is occupied by the mountain relief, in which the proper higher massifs, the lower foothills, highlands and hilly lands differ one from another morphologically. The massifs formed by the hard flysh crystalline and volcanic rocks, with the relatively well preserved coherent forests, are characterized by the insignificant gully erosion (the gully density being smaller than 0,1 km/km^2). The considerably afforested foothills, highlands and hilly lands consisting of the relatively less resistant rocks (claystones, shales, crushed dolomites, tuffs and agglomerates) have much more favourable conditions for the gully erosion. The dense gully pattern (0,5—2,0 km/km^2) developed in the hilly lands (Myjavská pahorkatina) especially and on the highlands of the flysh (Kysucká vrchovina, Podbeskydská vrchovina, Šarišská vrchovina, Ondavská vrchovina with the exception of the central part) and of the volcanic zone (Krupinská vrchovina, Fiľakovská vrchovina Highlands). Smaller enclaves with the expressive and fresh gully and rill erosion can be found in the foothills of the mountain massifs of the crystalline (chtelnicko-šípkovské podhůří Malých Karpat, lúčanské a kalnické podhůří Podvážského Inovce, podhůří Gmerského rudohoří) and of the volcanic zone (the foothills Vihorlat and Popričný, the foot layers of the Slánské Mts). The gently modelled forms of these orographic wholes supported the colonization of this territory by peasants and by herdsmen even in the middle ages, but especially in the 15th and 16th century during the so called Valachian colonization. The slope fields, the elementary free grazing, the field ways running down slope and other motives caused the intensive gully erosion on the middle up to strongly inclined slopes (5—20°) and on the a little resistant substratum.

Numerous anthropogenous motives for the accelerated erosion occur due to the dense colonization even in the basin-shaped relief, but with regard to the different natural factors (less rainfalls, smaller expressiveness of the relief) the gully erosion is in the majority of the basins less intensive than in the hilly lands and highlands of the moutain relief. The dense gully pattern (1,0—4,0 km/ /km^2) developed on the loose Neogene and Quaternary rocks (volcanic agglomerates, sandy gravels of Neogene formations, loess loams and rough Deluvial mantles) and on the relatively long slopes of the higher hilly lands of the Horní Nitra, Ipola and Košice basins.

The intensive processes of the gully erosion pass in the higher hilly lands of the Neogene plateaus of the lowland relief in which the various economic activity of people can be observed especially since the middle ages. The little resistant loose rocks of the substratum, the loess loamy soils and the long slopes influenced the development of the dense gully pattern in the NW, N and NE part of the Podunajská nížina Lowland and of the S part of the Východoslovenská nížina Lowland. The greatest density (more than 2,0 km/km^2) of the gully pattern developed on the border of the higher hilly lands with the submountainous steps.

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DEVELOPMENT OF THE SURFACE OF LEVELLING IN THE BOHEMIAN MASS WITH SPECIAL REFERENCE TO THE NÍZKÝ JESENÍK MTS.

Vývoj zarovnaného povrchu v Českém masivu se zvláštním zřetelem k Nízkému Jeseníku. — Zarovnaný povrch se v oblasti Nízkého Jeseníku vyvíjel během dlouhého období, a to v závislosti na klimatických změnách a tektonických pohybech. Každý soubor geomorfologických procesů vlastní té či oné klimamorfogenetické oblasti se ve své době projevil v jeho tvářnosti a přispěl k jeho polygenetičnosti. Zatímco neotektonické pohyby způsobily vznik vesměs velkých ker, vyvolaly erozně-denudační procesy v pliocénu na těchto krách vznik malých stupňů plošin, které jsou příznačné pro rozvodní partie území Nízkého Jeseníku. Výsledkem odnosu v pliocénu bylo značné snížení a zmenšení plochy starého zarovnaného povrchu, které bylo od místa k místu značně různé a záviselo na hloubce bazální zvětrávací plochy a místních geomorfologických poměrech, a vedlo ke vzniku dnešní stupňoviny plošin. Svým založením je zarovnaný povrch starý, svou dnešní tvářností však mladý. Pliocenní modelace dosáhla takových rozměrů, že mu vtiskla jeho dnešní základní rysy.

V závěru práce jsou stručně naznačeny některé problémy zarovnaného povrchu v celém Českém masivu. Autor zdůrazňuje, že v této oblasti nelze mluvit o tzv. oligocenní parovině, která byla mladšími geomorfologickými procesy již rozrušena.

Introduction

During the last years a still greater attention was paid in Czechoslovakia to the origin of the planations on the watershed parts of the terrain. These planations cut the surface of the differently resistant rocks and are one of the basic elements of the relief of the Bohemian Mass. They occur in various altitudes even within the scope of the same geomorphologic region. The solution of their genesis and age is a considerably complicated problem for the time being. They are opinions namely, that in some areas these are altiplanation terraces, plains of abrasion, pediments, or most often, that the planations are relicts of the originally uniform Oligocene peneplain uplifted by tectonic movements and broken into blocks, or finally, that two up to three surfaces of levelling of different age are found on the territory of the Bohemian Mass.

Genesis and age of the surface of levelling in the Nízký Jeseník Mts.

The Nízký Jeseník Mts. occupy the most eastern part of the Sudetic Mountains; they reach their greatest altitudes in W (up to 809 m) and are slowly sloping towards east generally (altitudes of about 320 m). They are separated from the environs by mostly expressive slopes. The summit level of the Nízký Jeseník Mts. is formed by the moderately undulate surface, represented by planations and widely rounded watershed ridges. The planations level the surface of folded and differently resistant Culm and Devonian rocks, consisting predominantly of greywackes and schists. They are either nearly even, (especially in the east part of the territory — angle often less than 1°), slightly undulate, or they are sloping slowly in one direction. The most often differences in height are 10 up to 30 m among the near planations, less often up to 100 m and even more. The planations are separated by valleys, flat passes and slopes. The low slopes are denudated considerably and they have not the marks of the young fault-slopes (V. Panoš 1962). Their direction varies very often and their length like the length of the planations does not usually surpass 1 km. Elsewhere (less often) high, long slopes reaching the height of about 100 m and being parallel with some of the marginal faultslopes of the Nízký Jeseník Mts. are concerned. These slopes are often founded on tectonic lines, along which the vertical movements of the area had a different intensity on both sides of the fault line. We meet consequently in the investigated area with expressive steps of planations on the watershed of the streams (fig. 1, 2). The subsidence of the altitude of the planations towards east is not fluent everywhere. Cases are found, where the planation lying west of the adjoining one, is lower than the east one. But on the whole the subsidence of the height of the planations towards east and also towards the marginal slopes is very distinct. On the planations the basal layers of the Tertiary weathering products and the Quaternary products of weathering can be found (fig. 3). For the solution of the genesis and of the age of the planations, the fact is of importance on one side, that on some of them the products of the Tertiary weathering are missing and only the weathered material formed during the Quaternary

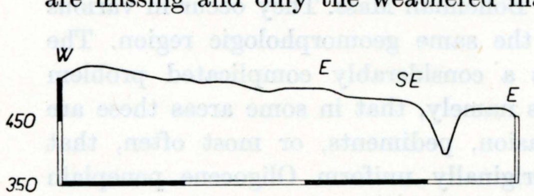

Fig. 1 Planations on Culm greywackes, north of the village Vrchy in the Nízký Jeseník Mts.

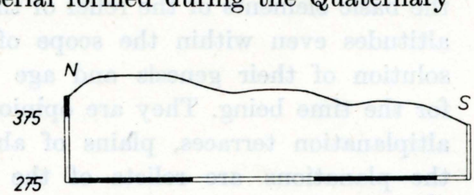

Fig. 2 Planations (built predominantly of Culm schists) on the watershed between the streams Děrenský potok and Gručovka, north of the village Děrné in the Nízký Jeseník Mts.

is found here, on the other side the occurrence of the marine sediments in valleys and of the correlate sediments of Pliocene age in the area of the Hornomoravský úval (Upper Moravian Graben).

The planations in the Nízký Jeseník Mts. have consequently all marks of the destruction forms created during the long development. They are the components of the surface of levelling. Its development can be followed by the geomorphologic methods since Tertiary and especially since the Lower Tortonian.

The present investigations show, that even before the Lower Tortonian sea transgression there was in the Nízký Jeseník Mts. on the watershed parts of the terrain a flat surface with thick products of weathering which was during the further development modelled to such an extent, that it is not possible to speak in this area today about a surface of Oligocene age. From the fact, that the planations have not the marks of the forms created by the marine erosion (to compare with J. Krejčí 1944) and from the geological knowledge about the Lower Tortonian transgression (I. Cicha—J. Paulík—J. Tejkal 1957, I. Cicha 1961) follows, that the system of the marine-cut terraces does not occur here. During the transgression, the sea abraded in the products of weathering and during the regression especially in its own sediments. Only in the narrow stripe close by the Moravian Gate the abrasion could in the first phase of the Lower Tortonian transgression reach even the rock substratum of the fossil weathered material. During the transgression the intense modellation of the old surface came to pass, which reflected first of all by the removal of a great part of the fossil products of weathering. It is not out of the question that on suitable places the removal of all or nearly all old products of weathering could occur, which caused a considerably surface lowering.

After the regression of the Lower Tortonian sea caused by the uplifting of the Nízký Jeseník Mts. (I. Cicha 1961) the weathering and the removal of the weathered material in sub-aerial conditions continued. This removal caused especially by the sheet-wash (J. Büdel 1957 and others) reached a considerable

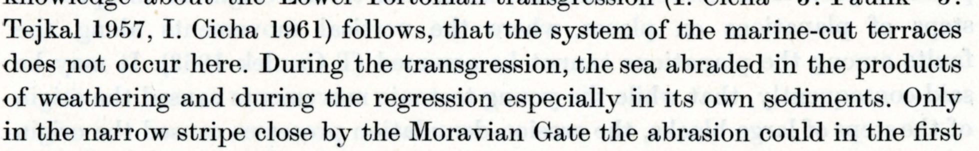

Fig. 3 Weathered material on the planation at the east margin of the town Vítkov in the Nízký Jeseník Mts. 1 — brownish - grey softly sandy humus loam with solitary fragments of Culm greywackes (Holocene soil), 2 — yellowish-brown softly sandy greyspeckled loam, strongly sandy on base, with solitary fragments of Culm greywackes and well rounded quartz-stones (Quaternary), 3 — angular fragments of Culm greywackes mixed with sandy loam, formed by the frost weathering (Pleistocene), 4 — greyish-white up to white kaolinic weathered Culm greywackes (Neogene), 5 — ochre yellow, rusty and greyish-green slightly loamy up to loamy sand with solitary strongly weathered rounded fragments of Culm greywackes — weathered greywackes formed in the warm climate (Neogene), 6 — slightly weathered greywackes (Culm).

intensity and culminated during the Upper Pliocene. On the elevations of the basal surface, which is considerably undulate, (J. Büdel 1957 and others) the removal of nearly all, or on some places even of all products of weathering set in, while in the depressions of the basal surface on the watershed of the streams and in some lower parts of the terrain only their upper layers were removed. The considerable lowering of the old surface of levelling (founded during the long period before the Tortonian), can be considered as the result of the removal in Pliocene, but in no case this removal reached the base level. This may be claimed especially, because the Lower Tortonian sediments which are found on more places in a thickness of more than 20 m, could not occur in the valleys in the given case. The extent of the lowering of the ground surface depended not only on the depth of the basal surface (given especially by the local geological conditions), but on the local geomorphological conditions too. Therefore the extent of the lowering of the surface of levelling was from place to place considerably different, which led to the origin of the present steps of planations on places, where the vertical movements along the faults among the planations cannot be assumed (T. Czudek 1963). It may be said consequently, that while the young tectonic movements caused the origin of the steps of large blocks, the erosion-denudation processes caused the origin of small steps of planations during the Pliocene period, which are characteristic for the whole described area. The intensive removal during Pliocene caused also, that in the cold periods of Pleistocene the less weathered Culm and Devonian rocks on the planations, especially on numerous places of the elevations of the basal surface, were within reach of the intense periglacial weathering. This weathering caused the origin of the coarse-grained rock fragments mixed with loams and the further decomposition of the Tertiary weathered mantle. In the middle parts of the nearly even planations the cryoturbation was acting intensively and the solifluction did not occur. But the solifluction affected together with the sheet wash on the tilted, more undulate planations and in the marginal parts of the nearly even planations. The wind was an important denudation factor on all planations at that time. But the surface lowering of the planations during Quaternary was in comparison with that of the Pliocene period considerably smaller (T. Czudek 1963).

According to the present state of research it may be said in conclusion, the surface of levelling to have developed in the Nízký Jeseník Mts. during a long period in dependance on climatic changes and tectonic movements. Every system of the geomorphological processes proper to this or to that climamorphogenetic region, had at its time certain effects on its shape and contributed to its polygenetic topography. But the Pliocene modellation of the old surface of levelling (the lowering and diminution of its area) which culminated in the Upper Pliocene, reached in the Nízký Jeseník Mts. such an extent, that it impressed to it its present basal feature.

Some problems of the surface of levelling in the Bohemian Mass

In the area of the Bohemian Mass the expressive planations on the watershed parts of the terrain levelling the rocks of different age and of different resistance are known already long. These are parts of the surface of levelling, which is situated in the individual geomorphologic areas in different altitudes (e.g. the Krušné hory Mts., the Slavkovský les Mts., the Hrubý and Nízký Jeseník Mts.); the differences in height of the ground surface being at a relatively short distance even more than 500 m. Even within the scope of the same geomorphologic unit the differences in height are among the planations on some places greater than 100 m. This surface got its present appearance in most geomorphologic units by a very intensive modellation as late as in Pliocene, so that we do not meet in the area of the Bohemian Mass with the Oligocene surface (the so called Oligocene peneplain), which has been desintegrated by the younger geomorphologic processes. While the old surface of levelling was broken into large blocks by the neotectonic movements, which operated even inside the geomorphologic units, the erosion-denudation processes during the Pliocene period caused on them the origin of the steps of planations (with small differences in height among the planations), characteristic for the watershed parts of the erosion relief of the Bohemian Mass. The surface of levelling of the Bohemian Mass developed during a long period in different climamorphogenetic regions. On the base of the present state of research it can be said, that it has in many areas of the Bohemian Mass rather the marks of a peneplain than of a pediplain, resp. of a system of pediments. But the pediments occur locally at the foot of some marginal slopes, below the Quaternary talus.

As for the effect of the marine resp. lake erosion on the development of the surface of levelling of some areas of the Bohemian Mass it may be said, that this geomorphologic process did not form the marine-cut terraces in an areally larger region. But the abrasion had a considerable influence on the modellation of the relief.

The problem of the so called Pre-Cretaceous surface of levelling and of the occurrence of two or three surfaces of levelling in the Bohemian Mass is very complicated for the time being. In all probability in some cases, e.g. in the area consisting of the Miocene and Pliocene sediments and along some larger streams the local surfaces of levelling were formed, which are as for their origin younger than the surface of levelling e.g. of the Krušné hory Mts., the Českomoravská vrchovina Highland, the Nízký Jeseník Mts., the Drahanská vrchovina Highland.

The surface of levelling had in most areas roughly the same features as it has today already before Quaternary (E. Neef 1955 and others). But it went on modelling in the periglacial conditions of Pleistocene especially. This modellation reflected on the one hand by its moderate lowering (e.g. the Nízký Jeseník Mts., the Drahanská vrchovina Highland, the Slavkovský les Mts., the Tepelská vrchovina Highland), on the other hand in some areas by the origin of the altiplanation terraces (for instance the Hrubý Jeseník Mts., the Rychlebské hory Mts.) which occur below the frost-riven cliffs and in vicinity of some tors (fig. 4). The tors got, however in some areas (especially in the granite ones) due to the removal of the weathered material (D. L. Linton 1955) to the surface already during the Tertiary period or in some cases at least partly as late as in Pleistocene owing to the down-wearing of the ground surface. It is possible to speak in the vicinity of these tors about the more or less exhumed basal surface (B. P. Ruxton—L. Berry 1959) and not about the altiplanation terraces, developing by the more or less parallel retreat of the frost-riven cliffs (R. S. Waters 1962 and others) or it can be spoken in certain cases about the combination of both these surfaces.

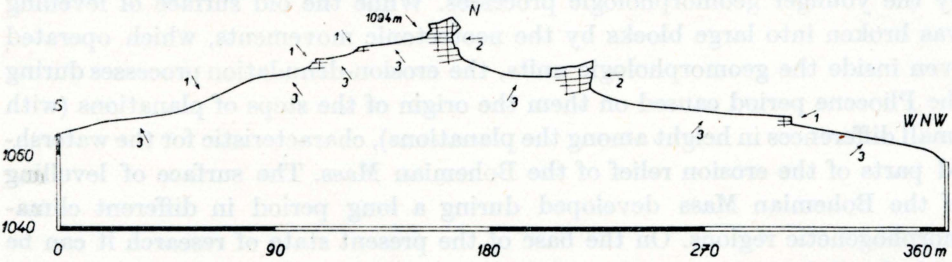

Fig. 4 Frost-riven cliffs (1), tors (2) and altiplanation terraces (3) in the summit part of the Hill Žárový vrch, WSW of the town Vrbno p. Pradědem in the Hrubý Jeseník Mts., which are according to J. Skácel petrographically built by alternating layers of chloritic migmatites and orthogneisses. (Measured by J. Vařeka, J. Malínek, T. Czudek).

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ALTIPLANATION TERRACES IN CZECHOSLOVAKIA AND THEIR ORIGIN

Kryoplanační terasy v Československu a jejich vznik. — Kryoplanační terasy byly v Československu popsány v posledních letech především z oblastí se značnou výškovou členitostí (Šumava, Sudety, Žďárské vrchy, hornatiny Vnějších Karpat). Jsou to zřetelné terasy na svazích, které mají většinou sklon 3—11° a jsou navzájem oddělené příkřejšími, často svislými úseky. Dosahují délky až přes 2 km a šířky několika desítek až stovek metrů. Jsou zaříznuty do skalního podloží. V některých případech sečou vrstvy, v jiných probíhají rovnoběžně s vrstevními plochami. Jejich vznik souvisí s periglaciálními pochody v pleistocénu. Vyvíjely se rovnoběžným ustupováním příkřejších úseků (mrazových srubů) na svazích. Materiál oddělený z mrazových srubů byl dále dopravován soliflukcí a splachem po povrchu teras, které byly těmito pochody dále modelovány. Protnutím kryoplanačních teras na protilehlých svazích byly místy rozrušeny zbytky terciérních zarovnaných povrchů a vznikly zarovnané povrchy vrcholů a rozvodních hřbetů kvarterního stáří.

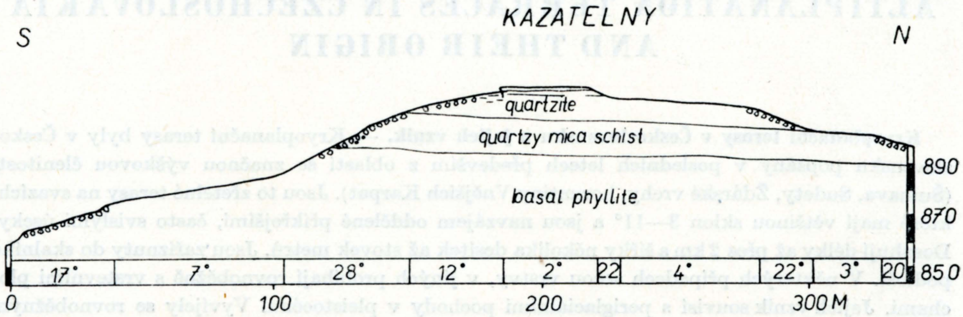
Introduction

Altiplanation terraces were recognized at first by H. M. Eakin (1916) in Central Alaska (Yukon-Koyukuk Region). H. M. Eakin termed them and described them as flat areas several square rods to hundreds of acres in extent, fronted by scarps a few feet to hundreds of feet in height (1916, pp. 77—78). The research workers of the Geographical Institute of the Czechoslovak Academy of Sciences (V. Panoš 1960, 1961, O. Stehlík 1960, T. Czudek—J. Demek 1961, T. Czudek—J. Demek—O. Stehlík 1961) were the first, who found the altiplanation terraces in the Czechoslovak landscape. This paper gives a summary of the results acquired in the Bohemian Highland and in the Flysh Zone of the Carpathians.

Characteristic of altiplanation terraces in Czechoslovakia

Altiplanation terraces occur in Czechoslovakia most often in regions with a high relief, in which long hillsides and narrow watershed-ridges are prevailing (Šumava Mts., Sudety Mts., some parts of the Českomoravská vrchovina

Highland, sandstone mountain ranges of the Flysh Zone of the Carpathians, etc.). Slopes are often expressively stepped in these areas and tors are found on the summits of ridges. Gently sloping treads of 3—11° inclination and moderately steep to vertical risers alternate on the stepped hillsides (profiles No. 1, 2, 3). The flatter, gently sloping treads have the shape of terraces. The terraces pass on hillsides either coherently on a distance of some hundreds of



1. Profile of the Kazatelny Ridge near the village Rejvíz in the Hrubý Jeseník Mts. Measured by J. Demek, geological structure according to J. Skácel.

2. Profile of the Malinská skála Hill near the village Milovy on the Českomoravská vrchovina Highland. Measured by J. Vařeka.

metres, or they are dying out and beginning again. The width of the terraces is usually of some tenths of metres and is always smaller than their length. The terraces on hillsides use to have an inclination of about 6°. The summit terraces have smaller declivities (1—3°). Besides the inclination in the direction of the total angle of slope, the terraces are often inclined even in their longitudinal direction. The terraces occur individually on hillsides or some steps of terraces are developed at another time (profiles No. 1,3, 6).

The steeper inclined slope parts, which are backed by the individual terraces, have a different appearance. Less expressive are the steps covered by soil and vegetation, whose declivity varies about 16—24°. Steeper scarps veneered by angular talus blocks are projecting more expressively. In some cases these steps are formed by large angular blocks weighing many tons (profile No. 2).

The steps formed by rock walls are most expressive. The rock walls consisting of solid rock use to have angular forms. The height of the walls varies from 2,5 m (profile No. 1) to 20—25 m. Most often they are 5—10 m in height. At the foot of the rock walls talus are found consisting of angular rock fragments having often a considerable size. The angle of talus reaches in some places 39° (profile No. 5) and is drawing near to the angle of repose for its component

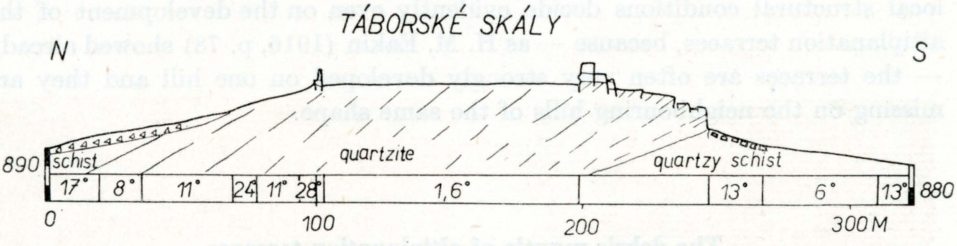
1. Frost-riven cliff in two-mica granite on the hill Tisá skála near the town Golčův Jeníkov in Českomoravská vrchovina Highland. At the foot of the frost-riven cliff the talus composed by angular rock fragments can be found. Photo J. Demek.

material. In other cases we do not find any rock fragments at the foot of the rock cliffs and the foot is sharp, even then, when the extensive denudation of the rock cliff is evident of its whole appearance. The foots of such walls use to be moderately undermined and the walls are usually overhanging. In some cases the material accumulated in the shape of a not high rampart can be found below the overhanging wall in a certain distance of its foot. The length of the rock cliff is different. The longiest rock cliffs were described up to this time in the Hrubý Jeseník Mts. (R. Netopil 1956, pp. 95), where they are to 2 km long and in the Moravskoslezské Beskydy Mts. (length round 1,5 km). But steeper back slopes are found on these benches most often, on which vertical rock cliffs with sections formed by angular talus blocks and even with soil mantled and vegetated steps alternate (for instance the 480 m long and on average 25 m high step on the mountain ridge Táborské skály in the Hrubý Jeseník Mts.). It should be noted, that the marginal scarps of the higher terraces on stepped slopes are generally as steep as the scarps of the lower terraces. The benches are developed on hillsides facing all cardinal points and in various altitudes (in the described area from 200 to 1,400 m above the sea level).

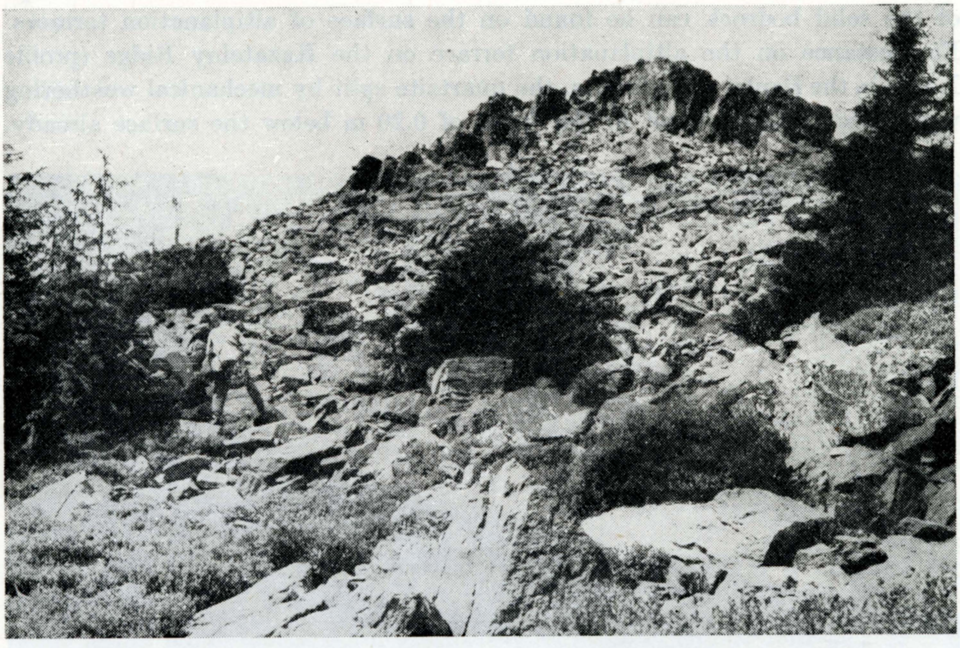
2. Frost-riven cliff in gneiss in the valley of the right tributary of Rokytná-River near the village Horní Kounice in the Českomoravská vrchovina Highland. At the foot of the frost-riven cliff the block- stream can be found. Photo O. Bárta.

Structural relations

It is obvious from the evidence furnished by various exposures that the terraces are cut in solid rock. They are developed in all sorts of rocks, but they are found in some ones more often, in others less often. The altiplanation terraces occur seldom in coarse grained intrusive igneous rocks, especially in granites or syenites. They are developed most often on slopes consisting of quartzite, phyllite and sandstone. They can be found especially on places, where rocks more or less resistant to the macrogelivation alternate. In the Hrubý Jeseník Mts. they are for instance often developed in places, where quartzite with mica schist and phyllite alternate (profiles No. 1, 3).



3. Profile of the Táborské skály Ridge near the town Zlaté Hory in the Hrubý Jeseník Mts. Measured by J. Vařeka and J. Demek, geological structure according to J. Skácel.



3. Castle koppie Ztracená skála in Hrubý Jeseník Mts. At the foot a considerable talus created by angular fragments of quartzite is developed. Photo J. Demek.

In some cases the surface of the altiplanation terraces is parallel with the inclination of the beds (profile No. 1). Especially in the horizontal differently resistant rocks of the Bohemian Plateau and in some areas of the Carpathian Flysh Zone (O. Stehlík 1960, p. 47) the origin of the altiplanation terraces is closely related to the origin of the structural terraces. At another time the terraces are cutting the folded or tilted beds evidently (profile No. 3). The most expressive rock walls are developed on the fronts of the strata or of the cleavage. The jointing of rocks and especially the vertical joints are of main importance for the origin of the free-face. The steeper sections can have even in the same rocks due to local conditions a different appearance. The local structural conditions decide evidently even on the development of the altiplanation terraces, because — as H. M. Eakin (1916, p. 78) showed already — the terraces are often very strongly developed on one hill and they are missing on the neighbouring hills of the same shape.

The debris mantle of altiplanation terraces

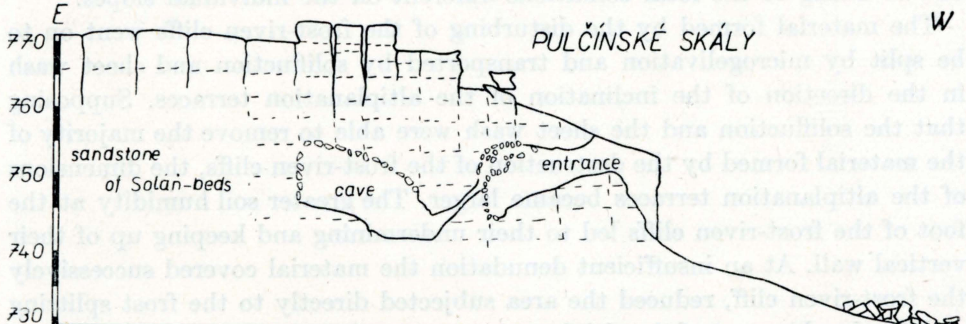
The debris mantle of altiplanation terraces is different. In some cases outcrops of the solid bedrock can be found on the surface of altiplanation terraces. For instance on the altiplanation terrace on the Kazatelny Ridge (profile No. 1) in the Hrubý Jeseník Mts. the quartzite split by mechanical weathering was found in the test pit in the depth of 0,20 m below the surface already.

4. Altiplanation terraces on the summit of the Táborské skály-Ridge in Hrubý Jeseník Mts., which are separated by an expressive step. Photo J. Demek.

In contradistinction to it the terraces on the north slope of the Malínská skála Hill on the Českomoravská vrchovina Highland (profile No. 2) are covered by an at least 3 m thick layer of block waste. Other test pits showed the terraces to be covered by rock fragments mixed with sandy loam. Even in close vicinity of the cliff angular rock fragments were often lying loosely in the sandy loam. Some of them were situated diagonally up to vertically. There is no sign of stratification in this material. In some sandstones of the Bohemian Plateau and of Carpathians the non-stratified loose up to loamy sand created by the direct disintegration of sandstones forms the mantle of the terraces. In some cases the sorting of the material by frost (for instance in the Hrubý Jeseník Mts. — M. Prosová, 1954, pp. 8—11) can be observed on the terraces.

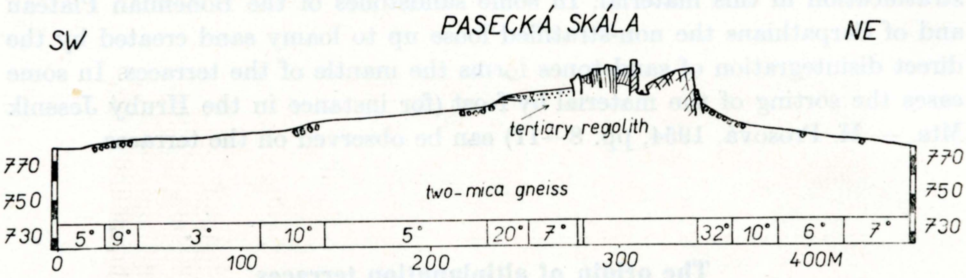
The origin of altiplanation terraces

The origin of the altiplanation terraces is connected with intensive periglacial processes passing on the territory of Czechoslovakia during the cold periods of Pleistocene. The intense frost weathering disturbed the massive rocks on slopes and summits to the depth of 10—40 m (profile No. 4). The frost weathering passed more quickly on places of the greater slope humidity or in the vicinity of undulations, in which the snow kept up longer. As soon



4. Profile of the Pulčínské skály Ridge near the village Pulčín in the Javorníky Mts. Measured by J. Vařeka.

as the weathering processes reached the solid bedrock, the initial terraces began to develop. The initial terraces were formed in places of the break of slope most often, where the solid bedrock was situated near the surface, or where its outcrops could be found. The steeper section formed by the cutting of the initial terrace into the slope, retreated parallelly and so the not large steps were enlarged into altiplanation terraces. The parallel back-wearing was caused by the separating of blocks due to the opening of the vertical joints. In favourable conditions the steeper section got the shape of a frost-riven cliff, i.e. of a vertical up to overhanging rock wall, which was intensively modelled by congelifraction. The frost-riven cliffs have owing to the separating of blocks not seldom a step-like shape in the upper part (profile No. 3). They

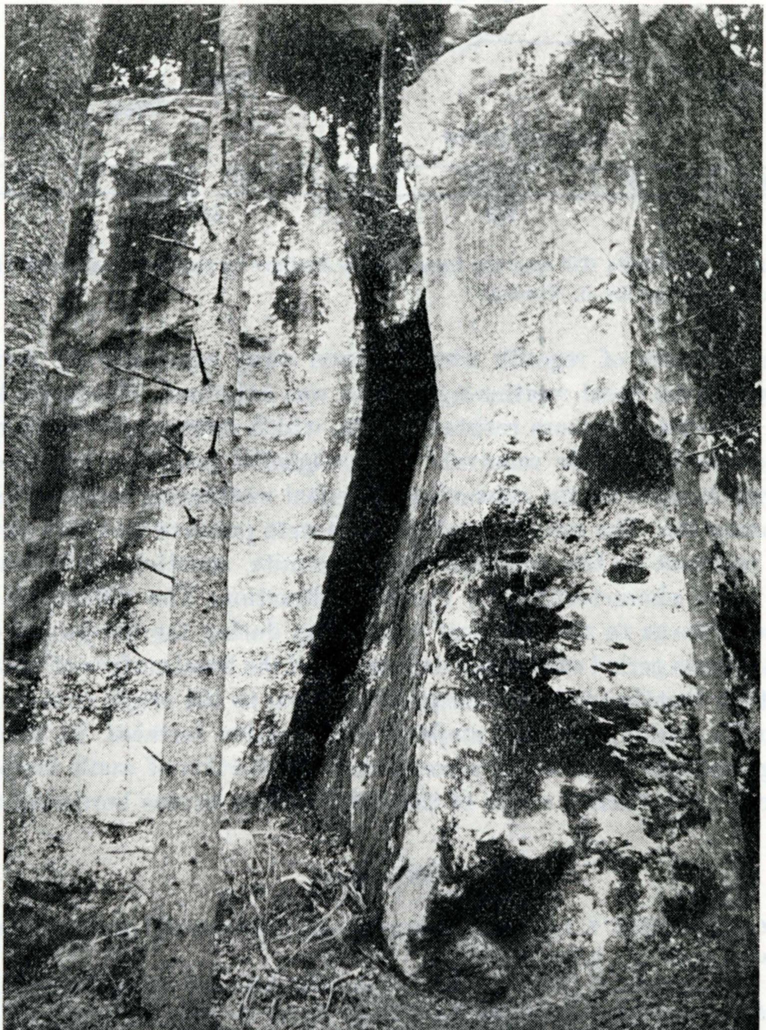


5. Profile of the Pasecká skála Hill near the village Kadov on the Českomoravská vrchovina Highland. Measured by J. Vařeka and J. Demek.

did not retreat with the same velocity in all their parts. The proofs of their back-wearing can be found in form of differently shaped tors in front of the frost-riven cliffs. The origin of the altiplanation terraces does not depend on the erosion basis. The terraces can develop in various heights and their number can be owing to the local conditions different on the individual slopes.

The material formed by the disturbing of the frost-riven cliffs went on to be split by microgelivation and transported by solifluction and sheet wash in the direction of the inclination of the altiplanation terraces. Supposing that the solifluction and the sheet wash were able to remove the majority of the material formed by the destruction of the frost-riven cliffs, the dimensions of the altiplanation terraces became larger. The greater soil humidity at the foot of the frost-riven cliffs led to their undermining and keeping up of their vertical wall. At an insufficient denudation the material covered successively the frost-riven cliff, reduced the area subjected directly to the frost splitting and the development of the altiplanation terraces became slower, till it stopped entirely, even in the same climatic conditions (T. Czudek—J. Demek 1961, pp. 58). In the climax of the cold periods of Pleistocene the frost splitting passed, while in the transition phases the material was sliding down the layer saturated with water between the melting active bed and the perma-frost. The melting snow moisted the material mowing even at very gentle inclinations (1—2°).

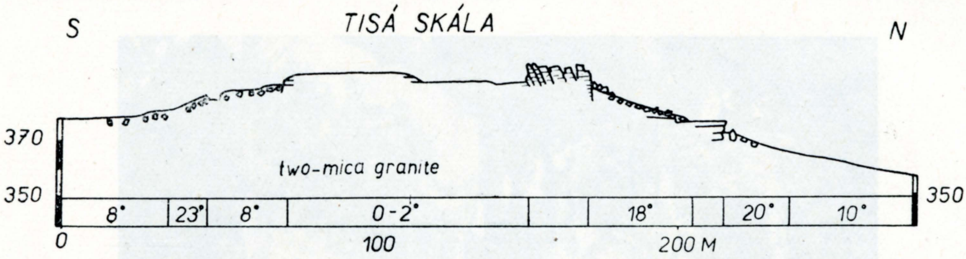
The parallel retreat of the frost-riven cliffs on the opposite slopes of one hill or ridge caused successively their crossing and the disintegration of the older topographic surface. It is necessary to explain in this way some flats on the summits of the ridges of an angle of 1—3°, above which angular tors are towering sharply. The tors and rocks have various forms and the degree of their disintegration is different. It is possible to compose a whole row of development from the extensive castle koppies over tors to the heaps of angular blocks, which are the last stage of the disintegration of these rock forms (T. Czudek—J. Demek 1961, pp. 58). The inclination of the flat summits is then further reduced by the frost weathering and by the solifluction. The forms considered as parts of the Tertiary peneplain are according to the new



5. Frost-riven cliff in flysh-sandstones in Pulčínské skály in Javorníky Mts. In the middle part of the photo the entrance in the considerable fissure cave can be found. Photo J. Demek.

investigations very young (of the Middle up to the Upper Pleistocene).

The investigations in the Bohemian Highland showed at the same time, that it is not possible to explain all flat summits on which castle-koppies and tors are rising, by the cryoplanation. The test pits on some of these summits at the foot of the castle koppies and tors reached the regolith of the hot-humid climate of Tertiary (profil No. 5). It can be assumed, these flat summits to be a part of the Paleogene surface of levelling of the Bohemian Highland, of



6. Profile of the Tisá skála Hill near the town Golčův Jeníkov on the Českomoravská vrchovina Highland. Measured by J. Vařeka.

which thick layers of regolith were stripped away especially by periglacial processes and the basal weathering surface was exhumed. The castle koppies and tors are then the more resistant parts, which were preserved in regolith and exhumated by their removal. The periglacial processes modelled then these forms created by the subsurface chemical weathering more or less after their exhumation. The initial rounded forms were preserved on tors consisting of rocks resistant to the macrogelivation (granite, syenite), while others got angular forms characteristic for the congelifraction. The differences in the resistance of rocks to the chemical weathering during the hot-humid climate of the Paleogene period caused the undulation of the basal surface of weathering and led then together with the irregular removal to the origin of steps on the flat summits, looking like the steps of altiplanation terraces. In some cases the periglacial processes led to a considerable reduction of castle koppies and to the origin of a narrow stripe of the altiplanation terrace bordering the tor.

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REGIME OF THE WATER LEVEL AND SHORE DEVELOPMENT OF THE DAM RESERVOIRS

Režim hladiny a vývoj břehů přehradních nádrží. — Na údolních nádržích jsou vzájemné vztahy mezi hydrologickými procesy na vlastních nádržích a geomorfologickými procesy na jejich březích. Procesy probíhající na povrchu vlastní nádrže závisí na režimu její vodní hladiny a mohou vyvolat značné a rychlé změny na pobřeží. Tyto změny zase zpětně působí na vodní režim nádrže. Intenzita procesů mění se v závislosti na různých podmínkách geografických, geologických, geomorfologických a hydrometeorologických a souvisí s manipulačním řádem a hospodařením vodou na té které přehradě. Na základě grafikonu četnosti výskytu vodních stavů lze na zaměřeném příčném údolním profilu posoudit intenzitu abraze a vypočítat objem abradovaného materiálu, kterým byl zanesen užitkový prostor nádrže. Podle výsledků několikaletého výzkumu a na základě studia změn na březích nádrží existujících, je možno sestavit prognozu vývoje břehů u nádrží plánovaných, což je pro projektanty a budovatele dalších přehrad neocenitelné.

The dams and the large dam reservoirs, the building of which made great progress all over the world especially during the last years, change the natural environments to a great extent.

The water forms together with the milieu a dialectic unity and it is not possible to study them separately. Therefore there is a very close correlation between the geomorphology and the hydrologic investigations (O. Dub 1957).

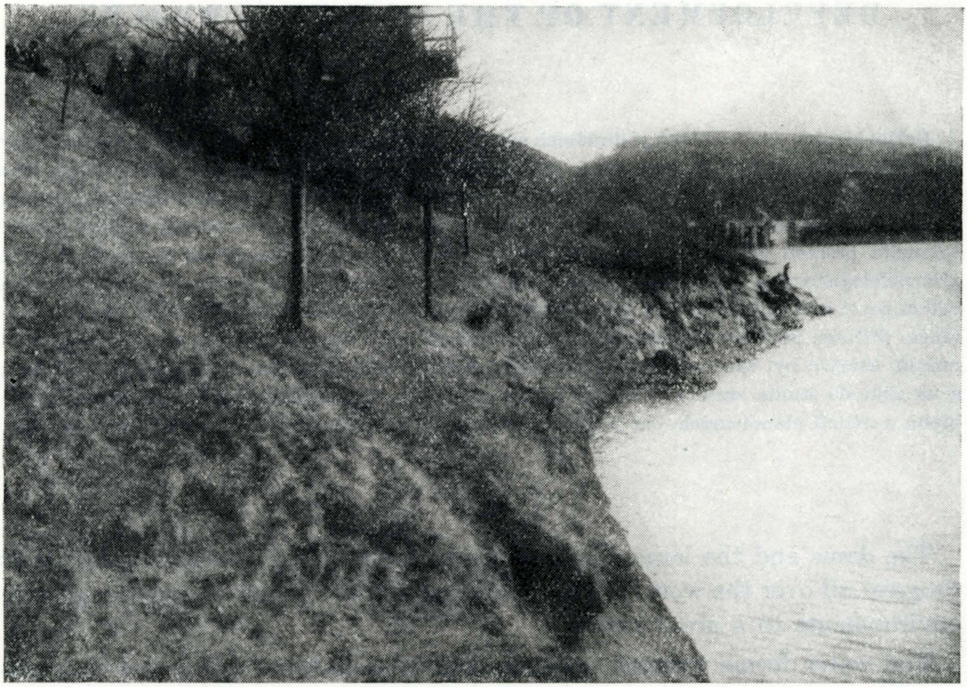
On the dam reservoirs there are mutual relations between the processes on the reservoirs on one side and the processes on their shores on the other side. The processes on the surface of the reservoir depend on the regime of its water level and cause considerable and quick changes on the shore. These changes affect the water regime of the reservoir retrospectively. The mutual activity and the intensity of the different processes does not appear on every reservoir in the same way nor on all its places. They change in dependence on the different geographic, geologic, geomorphologic and hydrometeorologic conditions and they depend on the manipulation order and on the water system of this or that dam.

The regime of the water level consists of a series of factors, which the oscillation of the water level and the changes caused by the wind activity, by the flow and by the freezing of the water level, belong to.

The oscillation of the water level depends on the general balance equation of the reservoir:

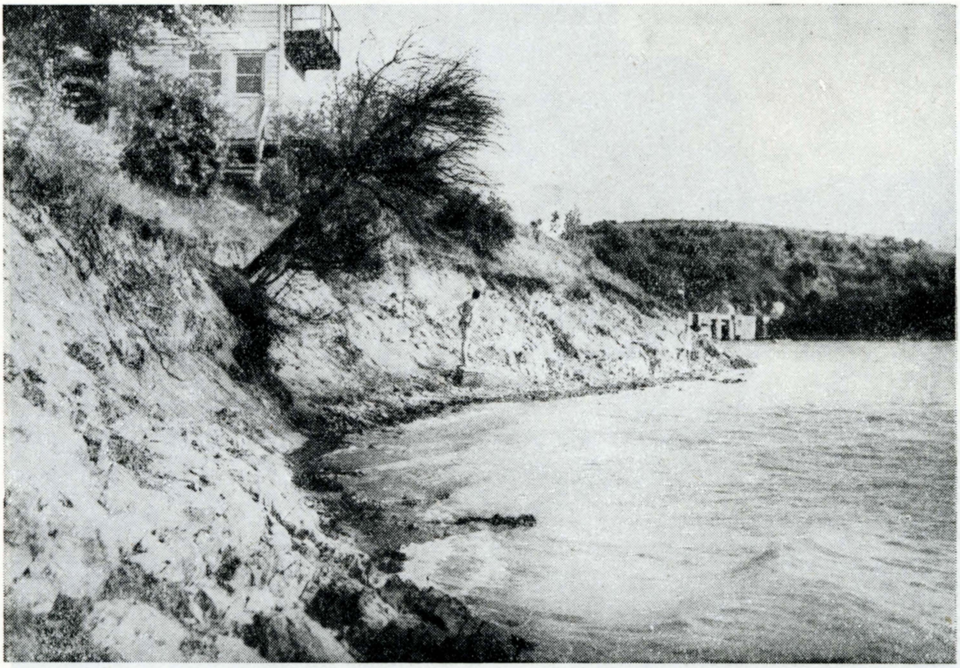
$$V_p + P + S + W_z + L + K = O + W_k + E + L_v + V_k\,,$$

where V_p means the capacity of the reservoir on the beginning of the balanced period, P the water quantity, which flowed into the reservoir, S the quantity



1 Shore abrasion on the Kníničky-dam near Brno. State in 1958.

of the precipitations fallen down on the water surface, W_z the water quantity returned by the sluice into the reservoir, L the melting ice and snow, K the quantity of moisture formed by the condensation on the reservoir surface, O the water quantity flown away through the turbines, by the dewatering orifice and over the dam, W_k the water quantity delivered to the water gangs and channels, E the evaporation of the free water surface, L_v the water volume in ice, V_k the final capacity of the reservoir. The members of this equation form on one hand the decisive factors, on the other hand the supplementary ones. The supplementary factors, e.g. the condensation, can be neglected due to their smaller importance. The infiltration in the inflow and discharge is not mentioned separately, though the ground water inflow may be of importance in some reservoirs. At dam reservoirs with the seasonal storage the water plane reaches the same level every year, at the reservoirs with the carryover storage the maximum level can be even some meters below the normal backwater. The amplitude of the oscillation of the water plane varies usually about 2—3 m reaching in a series of cases 6—7 m and cases were established in Czechoslovakia, where the draw-down was up to 15 m (J. Linhart 1956) during one year. By the building of the cascade of dams on one water course, the oscillation



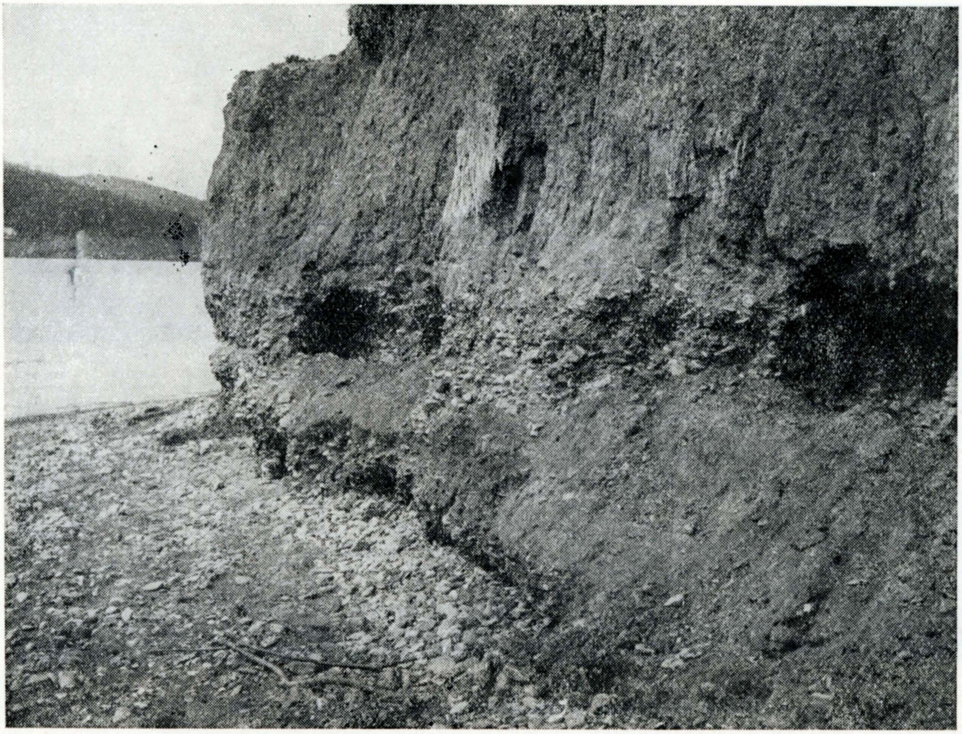
2 The same part of the shore as on the fig. 1, in 1963.

of the water level became in the water reservoirs downstream considerably more moderate.

In addition to the oscillations of the water level caused by the water balance of the reservoir, the oscillation conditioned by the more considerable difference of the atmospheric pressures in the various parts of the reservoir can occur in larger reservoirs. These are rhythmical oscillative movements at which the whole water plane passes from the horizontal position to the tilted one, alternately on one and the other side (seiches).

To the changes caused on the water level by the wind activity the wave motion belongs first of all. Its intensity depends on the force and on the duration of the wind, on the length of the free water plane on which the wind wave may take a run and on the depth of the reservoir. On large basins in SSSR wind waves were observed during strong storms surpassing 2,5 m in height

(A. V. Živago—K. O. Lange 1959) and on the reservoirs in ČSSR the author registered at a very strong wind (6—8 Beauf.) the height of waves up to 1,5 m. The steepness of the waves given by the ratio of their height to their length is on the large dam lakes greater than on the sea, but their period is considerably smaller than on the sea. The wind causes besides the wave motion even the water mass movement near the shore. In the direction of the wind, the flow develops

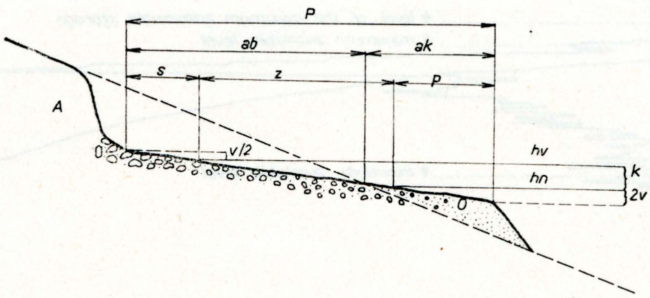


3 Niches in the abrasion cliff in the gravel terrace with a loess cover on the Kníničky-dam.

near the surface and causes at movements towards the shore a flow of an opposite direction on the bottom. The shore being plain and flat, the coarseness at the bottom is in relation to the depth of the water considerable, the velocity decreases at the bottom and therefore the inflow to the shore is greater than the discharge, water is accumulating here and the water level raises. It is the other way round, when the wind blows from the shore, when the greater discharge cannot be compensated by the slowed up inflow and therefore the water level is sinking at the shore. On the dam reservoir of Rybina in SSSR a difference in height of the water level at the west and east shore was established to be even 1 m (J. Linhart 1961a), when the wind was strong.

The changes caused by the water flow reflect only in the upper part of the reservoir and exceptionally even in the middle one, which will have only at greater inundations the character of a river.

The changes connected with the origin and the end of the coherent ice cover in the basin depend on its geographical position, on the atmospheric conditions and on the physical properties of water. The surface of the water level freezes from the shore towards the centre of the reservoir. The thickness of the ice



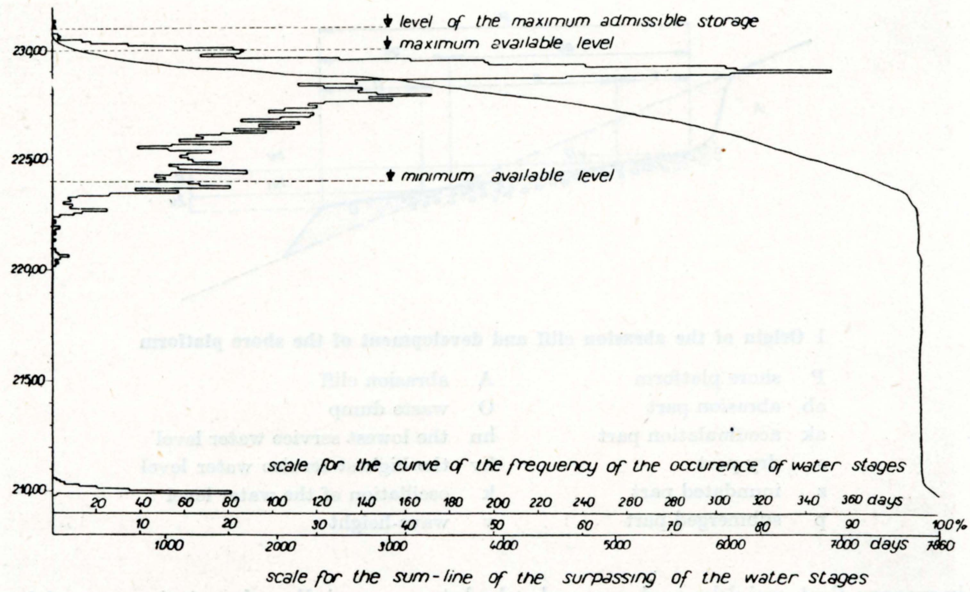
1 Origin of the abrasion cliff and development of the shore platform

P	shore platform	A	abrasion cliff
ab	abrasion part	O	waste dump
ak	accumulation part	hn	the lowest service water level
s	dry part	hv	the highest service water level
z	inundated part	k	oscillation of the water level
p	submerged part	v	wave-height

increases first quickly and more slowly later, especially when it is covered by a layer of snow, which has a small conductivity of heat. According to the observations, the solid ice cover in the reservoir lasts about a fortnight longer than in the flowing river below the dam. The greatest thicknesses of the ice cover on the dam reservoirs in ČSSR were measured in the value of 70 up to 100 cm (S. Kratochvíl 1961).

After the filling of the dam reservoir the remodelling of the original valley slopes and of the bottom begins. The earths are saturated by water, their real weight decreases by the effect of the uplift pressure, but their load above the water level does not change. Due to the change of the equilibrium the old already calmed landslides on the valley slope can be enlivered. By the oscillation and the persistence of the water plane on a certain level the system of step-like abrasion terraces is formed. They do not keep long in loose soils, for they are washed out by water at the iterative rise of the water level. At a sudden drawdown the fine parts of the soil use to be washed out of the slope to the bottom of the reservoir and the change of the physical properties, the disturbance of the stability of the shores and the landslides set in.

The results of the existing research showed that the main factor of modelling is the waved water level of the reservoir. The steep shores are wavecut and the abrasion cliffs are formed on them. If they consist of less resistant rocks, they are retreating relatively quickly and leave an abrasion terrace sloping gently to the water level; of this terrace a larger or narrower shore platform successively develops. The shore retreats most quickly in loess loams. On the large dam reservoirs in SSSR the back-wearing of the abrasion cliffs up to

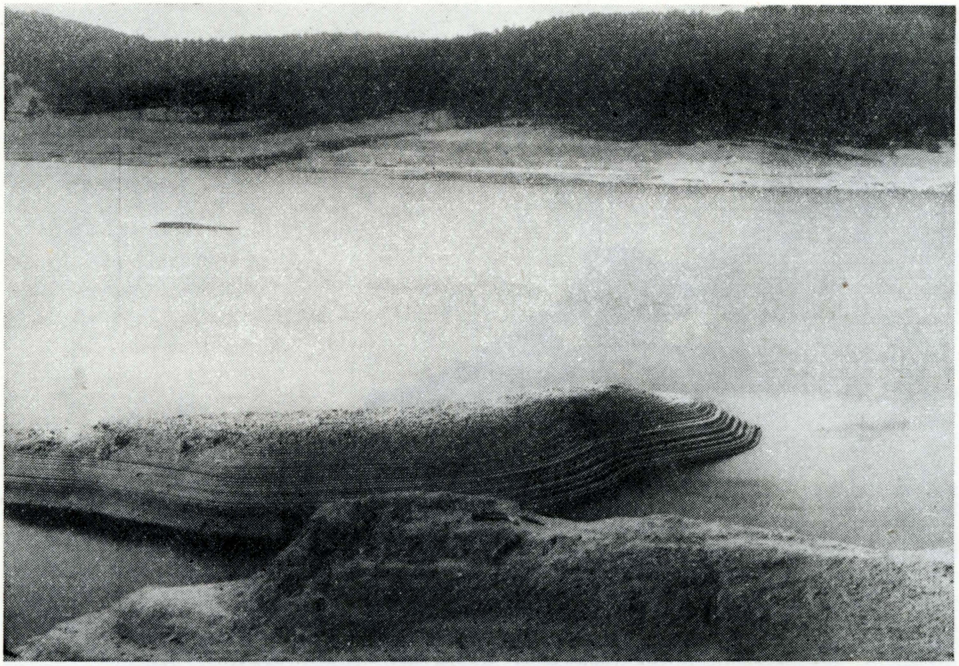


2 Water basin of the Kníničky-dam near the town Brno

Curve of the frequency of the occurrence of water stages and the sum-line of their surpassing from 25. 6. 1940 till 31. 12. 1961

100 m in one year was established in the first phase after their filling (S. L. Vendrov 1953) and the height of these cliffs reached up to 20 m. On the dams in ČSSR e.g. on the Kníničky dam on the river Svratka near the town Brno, the shore retreats in sections formed by terrace gravel with loess in the overlying rock on average yearly by 1 m. The initial quicker retreat got slower, from the filling of the basin the 25. 6. 1940 till 31. 12. 1961, that is in 7860 days, the shore retreated here on some places by 22 m. On the base of the graphic frequency chart of the occurrence of the water stages and of the establishment of their duration of surpassing, it is possible to judge on the measured profile the abrasion intensity and to compute the volume of the abraded material, which caused the aggradation of the useful capacity of the reservoir. The building of the dam on the upper Svratka river in Vír was finished in 1957 and the water passage was improved so, that in the basin of the Kníničky dam

on the middle Svratka river the most frequent level of the water plane increased from the altitude 227,90 to the height 228,90. This means, the shores to be now disturbed most often by the effect of the wave activity in a stripe situated by 1 m higher than it was before. In the measured profile the upper part of the shore over the height 228,90 in the years 1958—1961 retreated by 3,5 m and 14 m^3 of loess were abraded here on one running meter of loess.



4 Steps of the abrasion terraces on the Batak-dam in Bulgaria developed in the sandy banks by the sinking of the water level in 1962.

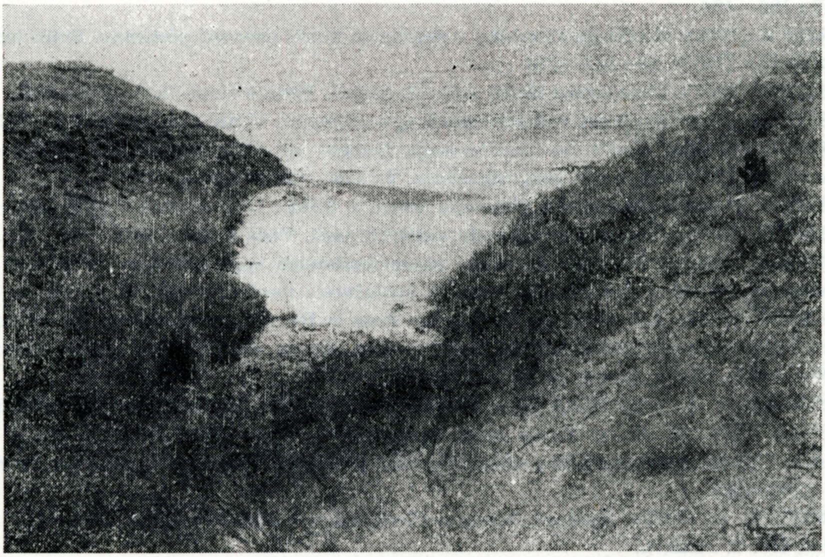
The height of the waterlevel 228,90 was reached or surpassed in the whole period of observation (1940—1961) during 353 days and the whole half of this value falls on the last 4 years. The retreat of the abrasion cliffs will stop, as soon as they will get out of the reach of the waves, the power of which is suppressed on the shore platform growing below the cliffs. The wave activity is then limited only on the abrasion and the levelling of the inundated and submerged surface of this platform. The depth at which the waves begin to modell the bottom more considerably and at the same time to lose their power, equals the double wave-height (V. P. Zenkovič 1946). The correctness of this fact was confirmed by the research, for the depth of the margin of the submerged part of the sandy shore platform is equal to the double height of the wave. It may be seen, that the waves do not affect the greater depth of the bottom.

The shore platform begins consequently in the depth equal to the double height of the wave below the lowerst service water level and it has its end below the abrasion cliff in the height equalling approximately the half of the wave-height above the most frequent service water level. The wave activity continues then on the shore platform by the classification of the material so, that the coarser material remains in its upper part and in the direction to the basin

5 Roots of the stubs stripped by the effect of the swell in the slope débris on the shore of the Orava-dam.

it grows finer and finer. On the gulf shore the abrasion passes more intensively on the capes. The abraded material is deposited by the waves on the margin of the cape, where the sandy beach grows successively. At the opposite direction of the wind the beach grows even on the second side of the cape, they become allied after a certain time and the cape changes into a liman closed by the beach. The vegetation seizes on it successively and so the shore line gets levelled gradually.

The lateral erosion observed in the upper part of the reservoir due to the effect of the running water contributes to the destruction of the shore. The



6 Development of sandy beaches and limans on the shore of the Cimljansk-dam in Soviet Union. All photographs by Jaroslav Linhart.

destructive effect is increased by the frazil ice during the spring melting and by the floating blocks of ice.

On the base of the long range observations and of the study of the changes on the shores of the existing reservoirs, it is possible to elaborate the prognosis of the development of the shores of the planned basins, what is of great importance for the projectors and for the builders of further dams.

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DYNAMIC ASPECTS OF THE URBAN CLIMATE

Dynamické aspekty městského podnebí. — Klimatologie měst je jednou z významných disciplin v současné době se formující geografie měst. Zatím je převážně věnována pozornost městskému mezoklimatu a urbanistické bioklimatologii. Je však nutno ve větší míře rozvíjet i metody zpracování makroklimatologických charakteristik městského klimatu, na něž by mohly navazovat mezoklimatologické a bioklimatologické charakteristiky a dojít tak ke komplexnímu obrazu klimatu jednotlivých měst a k vyčerpávajícímu zevšeobecnění tohoto problému.

Vhodnou cestou k tomu je studium větrných poměrů, teploty vzduchu, vlhkosti vzduchu, oblačnosti a síly (rychlosti) větru při jednotlivých, zejména převládajících směrech větrů v souvislosti s výskytem synoptických typů. Jsou-li takové analýze podrobena meteorologická pozorování všech částí města, můžeme dojít k cenným a zcela novým výsledkům z hlediska teoretického i praktického.

V článku je podána ukázka takového rozboru a hlavní výsledky jsou podány v tabulkách.

Urban climatology is one of the important disciplines of the growing science of urban geography. Up to the present the study of urban climate has been developing mostly outside the proper framework of geography as an independent branch of climatology, that is to say, partly as the subject-matter of local climatology (mesoclimatology), partly as the subject-matter of urbanistic bioclimatology.

The study of urban climate is concerned essentially with two fundamental aspects of research, and at present less attention is being paid to the macroclimatological aspects of the problem than to its local climatological (mesoclimatological) and microclimatological aspects. Thus for instance an attempt has already been made to classify the local climate of towns into types according to the local climatological regime conditioned by the character of the built-up area, the orientation of streets and squares etc. (E. Quitt).

Climatological studies of this kind are, no doubt, valuable not only from the theoretical, geographical point of view, but also as contributing important basic information for urbanistic and building practice. They are particularly important in view of the steadily growing concentration of town population and the perspective of the concentration of country population in future due to the advancing industrialisation of agricultural production.

When evaluating the local climate or microclimate of towns, we cannot do so with full responsibility unless we take into account macroclimatological condition and synoptic aspects of the climate. These are the most essential factors, particularly as regards the purity of urban atmosphere. Macroclimatological conditions in connection with the type of synoptic situation, and among these especially the direction and force (velocity) of wind, the temperature of the air, air humidity and cloudiness are most important for the planning or reconstruction of modern towns which should be in harmony or in a sort of equilibrium with the physiographical and economico-geographical conditions of the region in which the towns are situated. In most cases up till now the macroclimate of towns has been evaluated rather formally according to the characteristics obtained by so-called classical methods. Therefore in this study I should like to demonstrate on the example of Brno one of the possible applications of dynamic climatological characteristics in the evaluation of urban climate. To obtain the dynamic characteristics of macroclimatological conditions in Brno I have used the synoptic typing of M. Konček and F. Rein which is sufficiently well described in literature (F. Rein, M. Konček, M. Nosek).

The substance of dynamic climatological characteristics lies in that the description of climatic elements is not bound by the calendar interval, which, if used, serves only as a secondary parameter; it is always related to some dynamic parameter. In our case synoptic types are employed as the principal dynamic parameter.

If we ascertain the frequency of occurence of individual synoptic types, we can on the basis of individual means or other estimated characteristics for these types express an opinion which type contributes essentially to the formation of the certain climatic character of the given place, and also what temperature, humidity etc. are typical of the given place. Moreover, it is possible to take into consideration simultaneously the whole complex of the meteorological properties of the given synoptic type. Characteristics thus obtained have then a synoptic climatological value.

An important fact is, moreover, that we can also find out the percentage of infrequently occurring types and the manner of their climatological manifestation; this is important for our problem in the case that the values thus estimated differ considerably from the average conditions.

An estimate of the share of various synoptic types in the formation of Central European climate is illustrated in Table I compiled for the seasons of the year for the period 1950/1959.

In the annual mean a substantial contribution to the formation of our climate is shared by the following eight synoptic types listed in the order of their frequency of occurence (cf. Table I): Wc, H, SWc_1, NWc, Bc, Wa, Cc, Ec. The share of the other types is relatively small. A more significant characteristic is the occurrence of synoptic types in different seasons of the year. In this respect, even some of those types whose average annual frequency is small become more significant. Such are the types NEc, Nc, NEa, Ea, SEa and SWc_2 in spring, the types SEa and Sa in autumn, and types Wcs, Ea, SWc_2 in winter.

In general, the synoptic types can be divided into three groups: the first group contains constant types which occur during the whole year, in all months; fluctuation in their occurrence is insignificant. They are: SWc_1, Bc, NWc.

Table I

Relative frequencies of occurrence of synoptic types (in %) after the catalogue of M. Konček and Fr. Rein (2). Compiled by M. Nosek.

Synoptic Type	Spring	Summer	Autumn	Winter	Year
Wc	10,1	13,8	10,9	19,9	13,7
H	10,8	14,6	16,9	9,4	13,0
SWc_1	9,4	9,5	8,9	8,2	9,0
NWc	8,0	7,5	10,1	9,7	8,8
Bc	8,6	9,0	9,3	7,1	8,5
Wa	2,7	12,8	6,5	4,4	6,7
Cc	6,4	6,7	4,5	6,4	6,0
Ec	6,0	2,5	3,0	7,3	4,6
Ea	4,8	3,0	2,2	3,9	3,4
SWc_2	4,2	2,7	2,6	3,7	3,3
SEa	4,4	0,1	5,4	3,0	3,2
NEc	5,5	3,4	1,4	2,1	3,1
NEa	4,8	3,0	2,4	1,5	3,0
NWa	3,3	2,0	3,5	3,0	2,9
Nc	5,0	2,8	1,2	1,5	2,6
Wcs	0,8	1,3	4,1	3,9	2,5
SWa	2,4	1,5	2,8	3,1	2,5
Sa	2,1	0,2	3,9	1,8	2,0
O	0,7	3,6	0,4	0,1	1,2

The second group, characterised by a marked annual variation of occurrence, comprises the types H, Wc, Cc, O, Ec, Wa, Ea, NEa, SEa, Sa. The third group comprises types with variable frequency of occurrencein course of the year, but without clearly marked annual variation. They are the following: NWa, SWa, Wcs, SWc_2, NEc and Nc.

It can be said that the synoptic types are essentially characterised by a certain character of circulation, by cyclonic or anticyclonic activity and by certain values of climatic elements.

Air circulation elements of climatic conditions and climatological characteristics connected with them are of the greatest importance for evaluating urban climate.

Therefore very valuable information concerning urban climate can be obtained from wind-roses, especially if these are oriented on the most important climatic elements. Table II gives such wind-roses for Brno, for the seasons of the year. As evident from this table, the north-west wind direction prevails most markedly in all seasons of the year while the second prevailing wind direction is from south-east. The frequency of the later direction increases

Table II.

Wind-roses of the seasons of the year in Brno in the period 1950/59 showing air temperature — T, relative air humidity — U, cloudiness — N, and wind force in °B — ff. Frequency of directions in $^{0}/_{00}$ — F.

	N	NE	E	SE	S	SW	W	NW	O
Spring									
T	4,9	7,9	11,3	10,1	18,9	11,3	9,5	8,1	5,7
U	71,1	69,5	62,1	68,6	62,0	66,9	68,1	72,1	86,8
N	3,8	6,1	5,3	5,4	8,0	6,2	6,5	5,6	5,5
ff	1,8	1,9	2,4	2,1	2,5	2,0	2,0	2,0	0,0
F	7	62	2	269	1	28	34	575	22
Summer									
T	19,6	18,6	21,7	20,8	22,7	20,6	18,3	18,3	18,6
U	62,4	79,0	64,6	70,1	76,0	68,0	74,2	75,3	80,1
N	3,3	4,0	3,9	4,6	7,1	5,9	6,1	5,9	4,2
ff	2,0	1,8	1,9	1,9	1,8	2,1	2,4	2,0	0,0
F	5	36	5	229	4	44	57	589	31
Autumn									
T	6,2	8,3	13,2	9,4	17,0	9,7	10,6	8,3	6,3
U	89,6	84,8	72,3	80,1	54,0	84,1	71,5	71,8	90,1
N	5,6	6,1	2,3	5,9	0,0	5,7	6,6	6,0	4,7
ff	2,0	1,8	2,3	2,1	1,0	1,8	2,1	1,9	0,0
F	7	49	4	344	1	37	40	496	22
Winter									
T	—2,9	—1,7	—2,8	—0,2	.	2,4	0,8	—1,2	—4,6
U	71,2	81.5	82,0	85,1	.	88,9	80,1	83,3	88,8
N	7,2	6,4	4,8	7,8	.	8,3	8,9	7,4	6,7
ff	2,6	1,8	2,2	2,1	.	1,6	2,2	1,9	0,0
F	4	55	1	342	.	24	26	524	14
Year									
ff	2,1	1,8	2,2	2,1	1,3	1,9	2,2	1,9	0,0
F	6	51	3	296	2	33	40	546	23

a little in autumn and winter, while the frequency of the north-west wind direction slightly decreases in the same seasons of the year. The other wind directions are strongly suppressed which clearly reflects the influence of the terrain configuration of the Pisárky valley on the slope of which the meteorological station analysed in our study is situated.

The prolongation and opennes of this valley to the south is one of the main causes of the wind-rose deformation of low-lying ground winds.

When we follow the results given in Table II we find, for instance, that highest air temperatures are registered if the wind direction is south, but climatologically this fact is of little significance, since the frequency of occurrence of this wind direction is very small. On the other hand, of climatological importance are the values obtained during the occurrence of the two beforementioned prevailling wind directions; we may conclude that in all seasons of the year the temperatures are higher when the winds are from south-east, than they are when the winds are north-west. Relative air humidity and cloudiness are greater in spring and summer if winds are north-west than if they are south-east, in autumn and winter, on the contrary, they are greater in the case of south-east winds than they are in the case of north-west winds.

The problem is different when we try to find the respective shares of various synoptic types in this or that wind direction. Table III illustrates these shares in $^0/_{00}$ for the seasons of the year. This table makes it clear that, in essence, all synoptic types may have a share in the two prevailling wind directions; it all depends on the concrete individual situations, i.e. in which part of the cyclone or anticyclone system the given place is situated, and how the actual air flow may be deformed by the relief of the considered place.

From this point of view the climatic characteristics of wind-roses given in Table II which look very simple must in fact produce very complicated effects.

The order of sequence and importance in which individual types take share in the two prevailing wind directions and the character of their climatological effect are shown in Table IV. This table makes it also clear how the climatic characteristics of individual synoptic types vary under different wind directions. Thus, for instance, in spring with the synoptic type of anticyclone over Central Europe (H) if the wind comes from north-west the temperature is only by +0,1° C higher than is the mean of the season of the year, if the winds are from south-east it is higher by +0,8° C, in summer there is no difference between them, in the case of north-west wind direction it is lower by —0,2° C, of south-east wind direction by —0,3° C colder than is the mean of this seson. In autumn this type is considerably colder when the wind is north-west direction than when it is south-east, in winter with north-west wind it is warmer by +0,3° C, with south-east wind colder by —2,1° C than is the mean in winter.

Table III.

Frequency of wind directions in $^0/_{00}$ according to synoptic types and seasons of the year in Brno. Period 1950/59.

Synoptic type	N	NE	E	SE	S	SW	W	NW	Calm	Total
Spring										
Nc	.	1	.	4	.	.	3	42	1	51
NEc	.	4	.	5	.	.	.	45	.	54
Ec	1	5	1	15	.	1	2	32	1	58
SWc										
SWc_1	.	4	.	51	.	4	2	31	2	94
SWc_2	.	4	.	20	.	1	2	12	2	41
Wcs	.	1	.	.	.	2	.	4	2	9
Wc	.	6	.	17	.	4	7	63	3	100
NWc	.	2	.	2	.	2	7	66	1	80
Bc	1	5	.	29	.	4	7	36	1	83
Cc	1	2	.	19	.	2	1	40	.	65
O	1	1	.	1	.	.	.	3	1	7
H	1	4	.	27	.	3	1	70	3	109
NEa	1	8	1	3	.	.	1	34	1	49
Ea	.	11	.	14	.	1	.	21	1	48
SEa	.	2	.	32	.	1	.	8	1	44
Sa	.	.	.	17	.	.	.	4	.	21
Swa	1	1	.	7	.	1	1	13	1	25
Wa	.	1	.	4	.	2	.	21	.	28
NWa	.	.	.	2	.	.	1	30	1	34
Summer										
Nc	1	1	.	1	.	.	1	22	1	27
NEc	.	1	.	5	.	1	3	22	1	33
Ec	1	2	.	5	.	1	1	16	.	26
SWc_1	.	2	.	43	1	4	6	36	5	97
SWc_2	.	.	.	9	.	1	1	13	1	25
Wcs	.	1	.	1	.	1	1	8	1	13
Wc	.	3	1	29	1	10	9	84	2	139
NWc	1	1	.	3	.	2	6	61	1	75
Bc	.	3	.	22	.	4	4	56	2	91
Cc	.	4	1	20	2	3	5	31	3	69
O	.	1	.	10	.	4	.	20	1	36
H	.	4	1	38	.	7	5	88	3	146
NEa	.	.	.	4	.	1	.	18	2	25
Ea	.	6	1	11	.	.	.	12	.	30
SEa	.	.	.	1	.	.	.	1	.	2
Sa	1	.	1	1	.	.	.	.	1	4
SWa	.	.	.	6	.	1	1	7	1	16
Wa	1	6	.	20	.	3	13	79	5	127
NWa	.	1	.	.	.	1	1	15	1	19

Synoptic type	N	NE	E	SE	S	SW	W	NW	Calm	Total
Autumn										
Nc	.	1	.	.	.	.	.	10	.	11
NEc	1	2	.	4	.	.	.	8	.	15
Ec	.	2	.	4	.	2	1	21	.	30
SWc_1	.	3	.	58	.	2	1	25	2	91
SWc_2	.	1	1	11	.	2	1	11	1	28
Wcs	.	2	.	11	.	1	4	24	.	42
Wc	.	6	2	28	.	9	11	50	4	110
NWc	1	3	.	7	.	4	8	78	1	102
Bc	1	5	.	35	.	2	3	44	2	92
Cc	2	2	.	13	.	3	.	24	1	45
O	.	.	.	.	.	.	.	4	.	4
H	1	4	1	69	.	5	4	78	6	168
NEa	.	1	.	2	.	.	.	13	1	17
Ea	.	6	.	4	.	2	.	10	.	22
SEa	.	2	.	32	.	.	.	19	1	54
Sa	.	1	.	33	.	.	.	4	1	39
SWa	.	2	.	17	.	.	.	8	1	28
Wa	1	4	.	14	.	4	5	37	1	66
NWa	.	2	.	2	.	2	2	28	.	36
Winter										
Nc	.	1	.	1	.	.	.	14	.	16
NEc	.	2	.	1	.	.	.	18	.	21
Ec	1	7	.	20	.	1	1	43	2	75
SWc_1	.	1	.	56	.	2	2	19	1	81
SWc_2	.	.	.	27	.	1	.	10	.	38
Wcs	.	3	.	11	.	3	.	20	2	39
Wc	.	13	.	71	.	9	11	93	1	198
NWc	.	4	.	10	.	.	7	74	2	97
Bc	.	4	.	19	.	2	.	44	2	71
Cc	1	1	.	22	.	1	2	36	2	65
O	.	.	.	1	.	.	.	.	.	1
H	.	5	.	29	.	2	1	57	1	95
NEa	2	2	.	.	.	.	.	12	.	16
Ea	.	5	1	9	.	1	1	19	.	36
SEa	.	2	.	24	.	.	.	3	.	29
Sa	.	.	.	13	.	.	.	3	1	17
SWa	.	2	.	23	.	.	.	6	.	31
Wa	.	3	11	11	.	2	1	28	.	45
NWa	.	.	.	3	.	.	1	25	.	29

Table IV.

Deviations of air temperature (dT), relative humidity (dU), cloudiness (dN) and wind-force (dff) directions — NW (F) and SE (F) in the seasons of the year in Brno for the period 1950/59. The occurrence of all wind directions. Synoptic types with frequency of less than 20 $^0/_{00}$ are given

SPRING

Wind direction											
NW						SE					
F	ST	dT	dU	dN	dff	F	ST	dT	dU	dN	dff
70	H	+0,1	— 6,5	+0,8	+0,1	51	SWc_1	+1,7	+ 3,3	+1,3	+0,2
66	NWc	—8,8	+ 0,7	+1,3	+0,3	32	SEa	+0,4	— 2,7	—1,2	+0,8
63	Wc	+1,7	— 0,6	+1,1	+0,4	29	Bc	+3,7	+ 3,7	+1,3	+0,2
45	NEc	—2,3	+ 3,5	+1,6	+0,2	27	H	+0,8	— 5,2	—3,1	—0,3
42	Nc	—2,8	— 1,8	+0,6	+0,5	20	SWc_2	+3,7	+ 1,5	—0,7	—0,1
40	Cc	+0,5	+22,9	+4,4	0,0	19	Cc	+0,6	+10,3	+3,1	+0,1
36	Bc	+2,9	—14,3	+1,3	+0,4	17	Wc	+0,1	+ 4,6	—0,1	+0,1
34	NEa	—5,3	— 6,2	—0,4	+0,2	17	Sa	—1,2	+ 2,9	—2,8	+0,1
32	Ec	—0,7	+ 1,0	+1,3	+0,2						
31	SWc_1	+1,3	+10,3	+2,0	—0,3						
30	NWa	—1,1	— 9,0	—1,9	+0,2						
21	Ea	+1,6	— 5,8	—1,6	0,0						
21	Wa	+0,8	— 9,5	—0,5	—0,1						

SUMMER

Wind direction											
NW						SE					
F	ST	dT	dU	dN	dff	F	ST	dT	dU	dN	dff
88	H	—0,3	+ 5,5	—2,7	—0,1	43	SWc_1	+1,3	— 1,4	—0,2	+0,2
84	Wc	—0,3	— 0,7	—0,1	0,0	38	H	—0,2	— 4,7	—2,7	—0,2
79	Wa	+0,6	— 3,2	—1,2	—0,1	29	Wc	—1,0	+ 3,7	+1,5	—0,1
61	NWc	—1,9	— 0,9	—0,1	+0,2	22	Bc	+0,1	+ 0,3	+0,4	+0,2
56	Bc	—0,6	+ 5,0	+1,3	+0,1	20	Cc	—1,7	+ 6,5	+1,6	0,0
36	SWc_1	+1,0	— 3,3	—0,3	0,0	20	Wa	+1,0	+ 1,8	—0,9	+0,1
31	Cc	—2,3	+11,0	+2,8	+0,1						
22	Nc	—1,7	— 2,0	+0,9	+0,2						
22	NEc	+0,5	+ 0,1	—0,1	+0,1						
20	O	+1,4	— 2,3	—1,3	—0,2						

from the means corresponding to the given direction of the wind for the two prevailing wind share of individual synoptic types (ST) in the given wind direction is expressed in $^0/_{00}$: of the total exceptionally only. The table is compiled according to the following scheme: F ST dT dU dN dff.

AUTUMN

Wind direction											
NW						SE					
F	ST	dT	dU	dN	dff	F	ST	dT	dU	dN	dff
78	H	+0,6	+ 8,5	—1,6	0,0	69	H	—0,2	—0,7	—1,8	—0,3
78	NWc	—0,1	+ 6,8	+1,3	+0,3	58	SEc_1	+2,3	+1,1	+1,3	+0,1
50	Wc	+0,9	+ 8,6	+1,2	+0,3	35	Bc	+1,8	+7,1	+2,9	—0,2
44	Bc	+1,5	+15,3	+2,7	+0,2	33	Sa	+1,5	—1,3	0,0	+0,6
36	Wa	+0,8	+22,2	—0,5	—0,2	31	SEa	—0,2	—4,3	—1,3	+0,3
28	NWa	+0,1	+ 6,2	+0,4	+0,2	28	Wc	0,0	+7,9	+1,9	—0,4
25	Ec	—0,3	+11,0	+0,4	+0,1	17	SWa	—0,3	+0,3	—1,6	0,0
24	Wcs	—0,8	+16,1	+1,9	+0,2						
24	Cc	+0,2	+13,8	+2,4	+0,1						
21	Ec	+0,3	+11,0	+0,4	+0,1						
20	SEa	+0,3	+ 6,8	—2,0	—0,1						

WINTER

Wind direction											
NW						SE					
F	ST	dT	dU	dN	dff	F	ST	dT	dU	dN	dff
93	Wc	+3,1	— 1,3	0,0	+0,1	71	Wc	+13,	+3,6	+1,0	—0,2
74	NWc	+2,6	— 3,0	+0,4	+0,6	56	SWc_1	+4,0	+2,3	+1,4	+0,2
57	H	+0,3	— 0,6	—1,8	0,0	29	H	—2,1	+0,1	—1,0	—0,3
44	Bc	+0,2	0,0	+0,7	—0,1	27	SWc_2	+0,8	+7,5	+1,4	—0,1
43	Ec	—1,9	— 2,9	+0,8	+0,1	24	SEa	—5,2	—7,0	—1,7	+0,3
36	Cc	+3,7	+ 6,5	+1,6	—0,1	23	SWa	—2,2	+5,1	+0,2	+0,2
28	Wa	+2,4	+ 0,8	—1,4	—0,1	22	Cc	+1,6	+4,3	+1,3	0,0
35	NWa	—1,8	— 6,6	—1,4	+0,6	20	Ec	—1,2	+2,1	+1,4	+0,1
20	Wcs	+2,2	— 3,4	—1,2	+0,6	19	Bc	+2,4	+2,4	+1,8	+0,4
19	Ea	—4,0	— 5,1	+0,7	—0,1						
19	SWc_1	+2,3	+ 3,2	+1,7	+0,3						
18	NEc	—1,6	—11,8	+1,2	+0,6						

It is evident that these characteristics acquire their full meaning only if we analyse in this way the data of meteorological stations in those parts of the town which are distinct topographically, expositionally and urbanistically. In this way only can we in a fully exhaustive and synthetic manner define the meaning of the weatherside and the leeward side of the town and form an idea of its wind system and its connections with the total urban climatological regime.

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DEVELOPMENT OF KARST CANYON SIDES IN MILD HUMID CLIMATE

(According to Field Observations Made in Moravian Karst)

Vývoj svahů krasových kaňonů v mírném humidním klimatu (podle pozorování v Moravském krasu). — Erozní prohloubení paleogenních úvalovitých údolí, podmíněné výkyvy klimatu a nápory saxonského orogénu v burdigalu a ve svrchním helvetu, vytvořilo hluboké krasové kaňony Moravského krasu. Jejich původní příkré svahy byly rozčleněny po odnosu tortonských výplní v stupňovité lišty i izolované skály a rozevřely se tak, že nemají v příčném profilu tvar „V" nýbrž tvar rytířského erbu. Způsobuje to nerovnoměrné zvětrávání svahových ploch ve vertikálním směru, čímž horní části zůstávají příkré a ke dnu kaňonu se při rostoucím konkávním prohnutí jejich sklon snižuje. Přítomnost mocných holocenních a recentních sutí na lištách svědčí, že jde o proces vývoje svahů v mírném humidním klimatu, působící v závislosti na struktuře karbonátů. Projevil se již ve svrchním pliocénu a v teplých obdobích pleistocénu. Důležitými složkami tohoto procesu jsou exposice svahu, rozdíly v denní teplotě, insolace a voda mrznoucí v puklinách, podmiňující silnou tvorbu sutí s izolačním účinkem na pohřbené části svahů.

The Central European karst regions display several distinguishable landscape forms and correlative sediments belonging to the different types of the fossil and recent climate. Consequently they appear to be convenient for the evidence of the intricate morphogenetic and morphographic relations turning out among the older and younger landscape features in dependence on the climate changes. The results of the field observations being made on the dry canyon sides in the Moravian Karst (Czechoslovakia) may be a contribution to the acquaintance with the slope development especially in the mild humid climate.

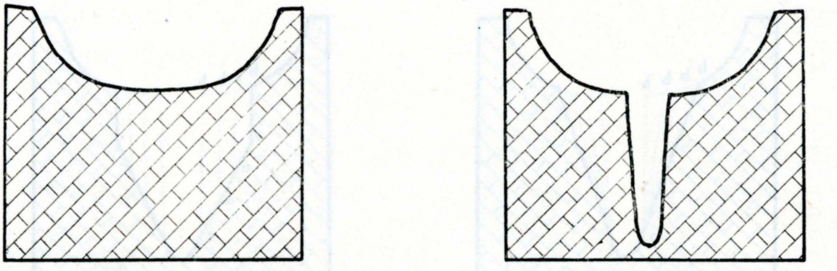
The Moravian Karst is the largest outcrop of the well faulted and dislocated Devonian limestones in the eastern part of the Bohemian Mass. The limestones are surrounded by the silicates from all sides and their layers are levelled at several niveaus. The different type, the age and the belonging mesoforms of those surfaces of levelling were determined newly through the Mesozoic, Tertiary and Quarternary sediments and weathering products (V. Panoš, 1961, 1963). The surfaces of levelling are divided by the valley pattern, which cuts up the carbonates and the silicates rather uniformly. The polycyclic valley development depends on the climatic changes as well as on the crustal movements and doming of the Bohemian Mass in the foreland of the Carpathian fore-deep during the Paleogene-Neogene stages of the Saxonic orogene.

The oldest of the present valley forms, i.e. the relatively shallow dry vallies and the valley-like depressions displaying the very typical dish-like cross-section and the flat gradient curve being often not uniform yet, originated in the upper part of the Paleogene at least (V. Panoš, 1961, 1962). The valley sides are widely concave in the lower parts, but they become to be steeper upwards, so that the valleys are separated of the surrounding surfaces of levelling rather distinctly. Some valley sections at the border of the limestone region were remodelled by the lateral erosion and corrosion of the allogene water courses into the marginal valley-poljes (semipoljes) at the close of the Paleogene, the bottoms of which were cut up by the deep blind valleys at the close of the Neogene and filled up by the fluvial deposits in the Lower Pleistocene. The karst pediplanation as well as the process of the slope-peeling cause the retreat of the undermined limestone slopes at the level of the sedimentary surface up to present time (V. Panoš, 1957, 1962).

The striking incisions interfere in the shallow valleys at the different distances of the marginal valley-poljes and alter for the deep dry canyons with the steep and irregular gradient curve. The karst canyons pass nearly without any morphographical changes into the deep valleys being cut into the silicates. Some strong karst springs appearing in the lower sections of the karst canyons feed the tributaries of the Svitava-River. The karst canyons and the valleys in their continuation were cut into the bottoms of the Paleogene valley forms during the Lower Miocene. The deepening finished before the Lower Tortonian sea transgression already and the karst canyons became to be dry owing to the advanced karstification by the successive and relatively great sinking of the level of erosion (V. Panoš, 1961, 1962). The Lower Tortonian marine sediments were cleared out of the upper and middle canyon sections during the Pliocene, but nevertheless they persist in the lowest sections of some canyons under the Pleistocene fluvial and slope deposits up to present time (V.Schütznerová-Havelková, 1958). There are hundreds of caves being arranged at some distinct levels above and under the present canyon bottoms.

Some short sections of the canyon sides display the high vertical scarps extending from the canyon bottoms to the parting edge of the Paleogene valley bottom relics. The cross-sections of those constricted parts of the canyons look like the high and very narrow capital letter "U" with the upper dish-like cross-section of the Paleogene valley. These canyon sections are concerned as the relics of the original forms of the deep narrow karst gorges being cut into the Paleogene valley pattern (V. Panoš, 1961).

However the canyon sides are rather open yet in the majority of their sections. They consist of several differently inclined, even or gently concave surfaces of the clastic rock waste (a melange of the coarse and fine debris in variable proportions). These inclined planes are divided by the unevenly high, steep or overhanging scarps at different levels. Sometimes the inclined debris slopes occupy nearly the whole plane of the canyon side. Somewhere the scarps are divided into the isolated rocks projecting along the canyon on the inclined debris slope. Mostly the debris-mantles cover the forms of the rock substratum. The burried forms of the slope appear like the variably large and irregurarly inclined benches being cut in the plane of the limestone slope. The benches are arranged in the variably high steps. The join of the frontal edges of the individual benches appears in the valley cross-section like a curve being gently concave at the canyon bottom but becomming straighter and steeper



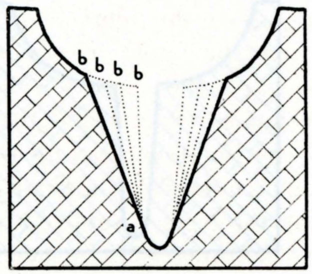
1 2

Fig. 1 — Cross-section of dish-like Paleogene valley.
Fig. 2 — Cross-section of Paleogene valley and of originally "U" shaped Lower Miocene karst gorge.

upwards and passing nearly fluently in the vertical line, which is determined by the frontal plane of the uppermost marginal scarps. Consequently the cross-sections of the canyons and of the older shallow valleys display some similar features, whereby the benched canyon cross-section looks like the escutcheon or armorial bearing (V. Panoš, 1961) and it differs by it from the "V" shaped cross-section of the valleys in other than carbonatic structures.

Generally the features of the open karst canyon sections have to be suggested as the fossil fluvial-erosive cyclic forms of the valley sides being transformed by the younger processes. The intensity of the disintegration of the original karst gorge sides culminated as late as their deepening was interrupted. The benched slopes have been explained usually as the periglacial forms of the cold Pleistocene periods, i.e. as the altiplanation terraces and frost-riven cliffs with the production of the congelifract and with its soliflual transportation (e.g. J. Birot, 1956, etc). Though the periglacial processes did disintegrate the older landscape forms of the Moravian Karst, moreover the activity of some other than periglacial processes follows of the debris slope analysis. Besides the angular fine-grained debris of the proved periglacial origin there is a lot of the clayey corroded coarse waste belonging to the warmer humid periods. Such debris overlies the Lower Tortonian marine deposits, the Pleistocene fluvial sediments and the Subatlantic travertines. It interbeds fluently or finger-likely in the Pleistocene fluvial deposits and in the Holocene cave-floor sediments containing the Neolitic and Middle Ages cultural horizons very often. Consequently such debris must be suggested as the product of the several prae-, inter- and post-Pleistocene warmer humid periods (V. Panoš, 1957, 1961). The Holocene origin of the waste was proved in the number of other Czechoslovakian karst regions not only by the stratigraphic but also by the paleontologic methods (V. Ložek, 1963, etc.).

Basing on the field observations and using some experiences of H. Mortensen



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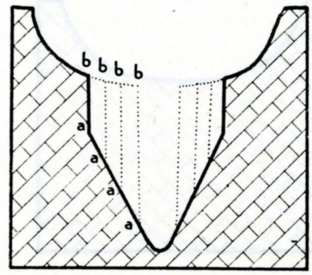

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Fig. 3 — Schematic development of "V" shaped valley with supposed down-wearing slopes (according to E. Richter).

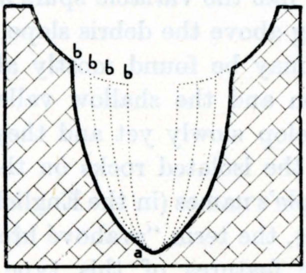
Fig. 4 — Schematic development of "V" shaped valley with supposed back-wearing slopes and debris slopes (according to W. Penck).

(1960) it may be possible to explain the strange cross-section of the karst canyon sides by the unequal breaking of the slope equilibrium. Of course any explanation must take account of the variable structure of the well faulted and fissured limestones, which encouraged the differential action of the erosional processes depending on the climate. However the stability of the slope is not uniform on the whole slope plane in the vertical direction, when even the structure would be homogene. The weathered zone of the free face in the upper parts of the slope breaks down more easily than the weathered zone in the lower parts can do. Consequently the lower parts of the slope reach the higher grade of weathering as it is evident by the variable corrosive and mechanical widening of the cleavage fissures at the individual levels of the observed canyon sides. Few open joints only appear in the solid limestone of the free face, whereas the rocks in the lower part of the slope display the cubic cleavage or platy parting. The rare open joints limit the certain blocks of the weathered limestones, which separate slowly of the free face and break down. Hereby the new and new zones of the solid limestones have been exposed to the action of the exogene processes. Moreover the fragments originating in the fallen blocks and covering the lower parts of the slope help to slack up the process of weathering. Consequently the nearly equal value of the maximal angle of stability in the upper parts of the steep canyon sides has been reduced successively in the direction to the canyon bottom. In this manner the benches being covered usually by the debris originate on the karst gorge sides and the valley cross-section obtains by the successive opening the typical features akin to the escutcheon.

The free face does not develop even in the horizontal direction along the canyon sides uniformly. The less jointed zones of the limestones resist the weathering and keep the high grade of stability for a long time. They separate of the surrounding free face at the beginning like the variable spurs and later like the completely isolated rock masses rising above the debris slope. Having somewhere the height of about 40 m they may be found mostly along the destructed parting edge between the canyon and the shallow valley sides. Being once separated the rock masses develop slowly yet and they persist on the slope for a very long time. Because the isolated rocks on the valley sides have been indicated by the various people's names (in the English papers e.g. stacks, rock-bastions, buttresses, tors etc), the term "svahové hřebenáče" (the valley side cliffs) is proposed for the features of this type by the author.

Moreover the slope stability is controlled by the climate. The principal factors appear to be the exposition, the insolation and the water freeezing in joints. The upper parts of the permanently naked slopes are exposed to the intense activity of the day-night temperature changes, which appear to be the most important agent in the present climatic conditions. The amplitude of temperature reaches there its day-night value even more than of 30° C. The lower parts of slopes, especially those in the N—S passing canyon sections, are insolated either for a short time at noon only or not in the least. Consequently there the temperature oscillations are smaller than in the upper parts of the slopes being exposed to the insolation for a longer time during the day. Among the valley sides displaying the similar structural characteristics the slopes facing south are destructed and opened more than are the opposite ones. The water freezing in the fissures owing to the day-night temperature changes attacks the limestones very intensively in the present climatic conditions, as may be seen of a number of blocks falling free to the canyon bottom very often. On the contrary the debris, as well as the vegetation, are very important for the reduction of the temperature amplitude. The underground ice persists in the interstices among the components of the clayey-stony debris up to the close of May usually. The creating underground ice heaves the fragments on the debris slope indeed, but because of its slow melting or sublimation no distinct gravitation movements — except the subsidence — appear in the debris. The more intense movements appear in the debris covers being undermined by the water sources at the foot. The componental movements in the debris-mantle down the slope display the catastrophic velocity in the observed canyons, when the debris contains a lot of the clayey admixture having the function of the slippery devices after the debris was all wet. The debris masses move even on the slightly inclined benches like the little debris-avalanches to the canyon bottom sometimes at heavy rains.

Consequently it may be concluded, that the karst canyon sides in the Moravian Karst display in the present stage of development neither the features akin to the uniformly inclined planes of the down-wearing slope (as it is suggested by E. Richter, 1900, O. Lehmann, 1933, H. Lehmann, 1954, a.o.) nor to



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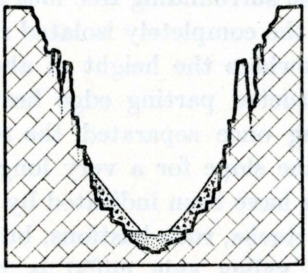

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Fig. 5 — Ideal cross-section of escutcheon-like karst canyon developing in mild humid climate.
Fig. 6 — Real cross-section of karst canyon in Moravian Karst in present development.

the intricate form consisting of the back-wearing and successively lowered free faces and of the oblique, by debris covered rock planes (according to the conception of W. Penck, 1924). The ascertained opening and benching of the originally more or less vertical sides of the dry karst gorges depends on the mild humid climate generally. This development started already in the mild humid periods at the close of the Tertiary, carried on in the transitional warmer humid periods of the Pleistocene interglacials and interstadials and reaches its climax in the Postglacial warmer and humid forestal climate as well as in the present mild humid climate inclinating slightly to the continentality and being characterized by the warmer summer and autumn and by the colder spring and winter with the changing precipitations. The carbonates appear to be the less resistant rocks in the climate of those types.

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TO THE CONTENTS OF THE BIOGEOGRAPHIC MAP

(New Methods of the Biogeographic Cartography)

Nové metody biogeografické kartografie. — S rozvojem poznání prostorového rozšíření organismů a jejich společenstev se rozvíjelo i jejich znázornění na mapovém podkladě. Rozšíření taxonů bylo znázorňováno různými metodami: bodovou jako nejpřesnější, obvodovou, paprsčitou a mřížovou. Zvláštní pozornost zasluhuje metoda A. Jakubskiho pro vymezení počtu taxonomických jednotek (isospecie, isogeny apod.). Rozšíření rostlinných společenstev zachycují u nás dosud pouze geobotanické mapy, vypracované metodou R. Mikyšky. Zvláštní pozornost zasluhuje mapa skupin lesních typů podle Al. Zlatníka (1959) pro území Slovenska. Jeho mapovací jednotky mají již v podstatě biogeocenologický a biogeografický ráz. Naše biogeografické mapy malých měřítek vycházejí z fysiognomicky nápadných forem reliefu. Organická společenstva zachycujeme v sukcessivních diagramech od přirozených možných organokomplexů až po společenstva antropicky podmíněná. U map malých měřítek vycházíme z rekonstrukce přirozené možné vegetace (na subatlantikum) a mapy doplňujeme sukcesivními diagramy celých organokomplexů.

Together with the development of the recognition of the space distribution of organisms and their communities even their drawing on the base of a map developed. To the oldest biogeographic maps belong those which drew the distribution of individual taxons by the dot-method, being used up to his time as the most exact one. By the application of this method the method of district-line and t' e areal one developed which showed the distribution of the taxons either by a district line or by the covering of the area colonized by a taxon, with colour, haching etc. It was possible to draw the distribution of some taxons at the same time. At a higher number of taxons it was necessary to use instead of dots either the symbols or the signs; similarly like at the district-line method, several types of lines and so the map stops to be synoptic. Both methods may be used at the maps of large scales and of the small ones. Besides these methods we meet in the biogeographic maps even with the so called radial method and the grating one. The first type of the map is used frequently for the drawing of the penetrating of the taxons from the area of continuous distribution into new areas which they did not live in up to this time, so for instance the penetrating of the East European taxons to the west or the penetrating of agricultural damagers into new areas, etc. The grating method is as the qualitative and quantitative one used especially in the last time for the catching of the distribution of two species the areals of which are bordering on each other in the given area. The map is divided by this method into a system of "grates" which limit a certain area. By the statistical method the quantitative representation of both taxons is established in the area of every square, and their number is drawn in % in the middle of every square by a sector. So we get the image of the region, divided by grates into small square areas, in every of them being a circle with the percentual representation of both taxons. This circle method is used frequently even in the economic geography. From the historical point of view the maps of A. Jakubski (1926) in which the author united by isolines the areas with the same number of taxonomic units (the so called isospecies, isogens, isofamilies, etc.) are interesting. The maps of the Polish zoogeographers help to solve the developmental zoogeographic problems.

Another type are the maps of the distribution of whole organic communities. These are practically only the maps of vegetal communities, while the maps of the animal ones have not been compiled up to this time (comp. with Waibel 1913). The maps of vegetal communities became the base of the geobotanic and forestry mapping and they found many applications in climatology, pedology, economic geography and in a series of practical branches. Numerous the so called reconstruction geobotanic maps and forestry maps show the areal distribution not of the real natural vegetation but of the possible one, the reconstruction of the natural vegetation being from the bionomic and chronologic (to a certain period) point of view on the base of the present state very difficult and often impossible practically. To this group even the geobotanic maps of Czechoslovakia belong which have been mapped in the scale 1 : 75.000 (Bohemia and Moravia); of these maps, maps with a scale of 1 : 200.000 were compiled then for the Czech countries and with a scale 1 : 50.000 for Slovakia. But they do not offer the momentary (present) image of the vegetation and they omit quite comprehensibly the animal component of the community. The Al. Zlatník's map of the groups of forestal types, that appeared for the whole territory of Slovakia (1959) occupies a special position. The units used for the purpose of mapping, have in their substance yet a biogeocenologic and biogeographic character. The basic unit of the typology in the biogeocenologic conception is the forestal type as the complex of natural stadia and of stadia changed differently by the human being. All their degrees of development are seized further on a certain type of permanent conditions, which belong to each other from the point of view of development. These relations are attested scientifically with the aid of parallel areas, bordering on each other and of distant areas which belong to the same type of permanent conditions according to all existing biogeocenologic conditions. The base of indication is first of all the vegetal component of the biogeocenosis, that is its synusiae and even the individual important indication vegetal species. The forestal types are united into complexes indicated as groups of forestal types. The forestal types belonging to the group, belong to a single vegetation degree and to one of the four rows. The row A is indicated by the dominance of oligotrophic vegetal types, the row B with a substancial participation up to dominance of eutrophic species without the presence or with an unimportant participation of nitrophilous and heminitrophilous species and without participation of proper calciphilous resp. calcicolous species. The row C is characterized by the dominance or the abundant participation of nitrophilous and heminitrophilous species, the row D of calciphilous and calcicolous species on humus-carbonate soils. The biogeocenoses influenced by the higher underground water level or caused expressively by alternating moistening are united into groups, belonging to the oligotrophic complex "a" and to the eutrophic complex "c". The groups of forestal types and the superior vegetation degrees and complexes influenced by the special types of the regime of the ground water are according to the composition of the vegetation inductively and indicatively derived units of higher order, which may be mapped in a gross scale and which affect in different areas by a remarkable association. As for the florogenetic and in general the biochorologic point of view different variations of all units of different degrees are indicated as their geographic variations (A. Zlatník in lit.). The classification of the forestal vegetation into 8 high-degrees (the oak, oak-beech, beech, fir-beech, pine-beech-fir, pine and stunted fir-grade) corresponds to the biogeographic conception too. Even these maps omit comprehensibly on the one side the non forestal area, on the other side the animal component.

Contrary to these maps based on the mapping of the individual taxons or their communities and which are biologic maps, it is necessary to base the vegetation-geographic, zoologo-geographic and biogeographic ones on the fundamental structural units of the region. These basic structural units of the geographic region are understood in a single complex, i.e. physically, biologically and anthropically, the attention in biogeographic maps being paid first of all to the organic communities (organokomplexes), which are characteristic as for the space for a certain unit of the region. They differ in this from the phytogeographic, zoogeographic and geobotanic maps showing on their maps the chorologically remarkable taxons or even their communities. The basic biogeographic unit is supposed to be the Sukačev's (1947) biogeocenosis, accomplishing the claims of the complete gographic conception and joins the abiotic factors (relief, soil, clima) with the organic ones (vegetation and fauna). For reasons of the geographic analysis the biogeocenosis is divided into the phytogeocenosis, which is the base of the vegetation-geographic maps and the zoogeocenosis, forming the base of the zoologo-geographic maps. By the synthesis of both geocenoses we got the biogeocenosis, which is the base of biogeographic maps.

At the maps of large scales (1 : 25.000 and 1 : 50.000) we use at the bio-

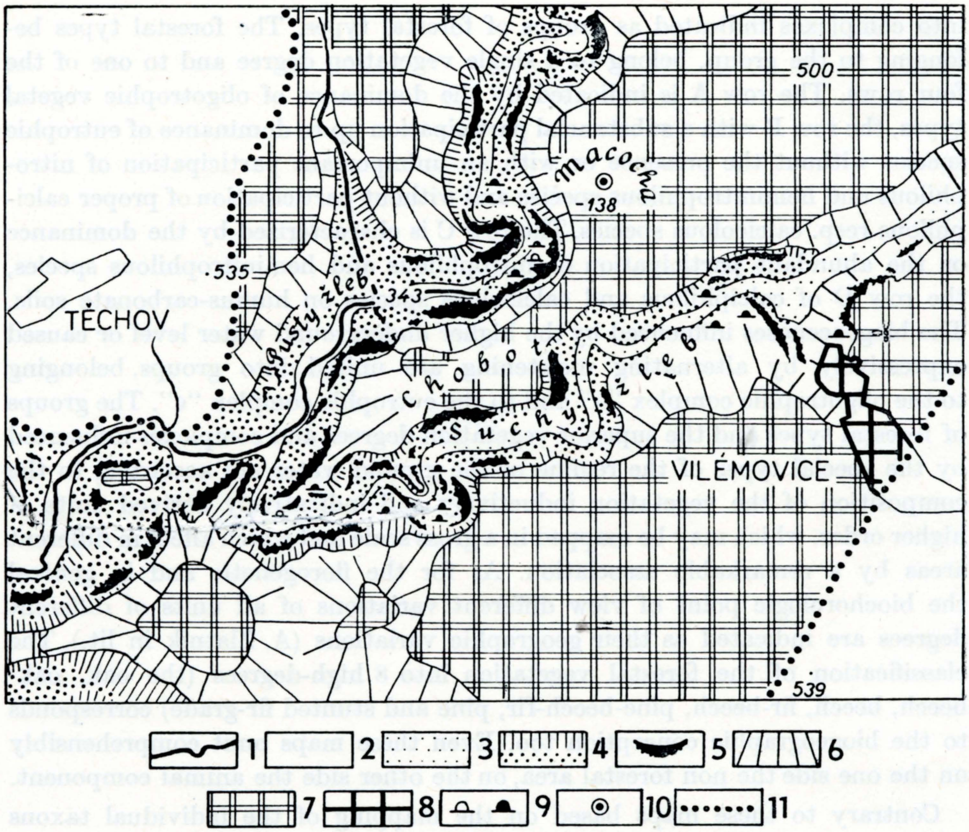

Fig. No. 1. Moravian Karst. Example of biogeographic maps of large scales.
Explanations: Biogeocenoses 1) of a submontaineous torrent in inverse position, 2) of a flood-plain with a water-stream in inverse position, 3) of a flood-plain without a water-stream in inverse position, 4) of steep rocks (vertical slope-lines) partly covered with compacted and uncompacted products of weathering (dotted), 5) of rocks, 6) of loamy gentle slopes, 7) karst plains with deeper soils, 8) of settlement units, 9) of lightened and unlightened caves, 10) of the Macocha chasm, 11) border of the area of Devonian limestones (the area of the Moravian Karst).

geographic mapping of small areas the basic forms of the relief, which are under given conditions of all landscape elements as for the morphologic and physiognomical point of view most striking (rocks, debris slopes, plateaus, canyons, etc.). On these forms of the relief may be shown not only the actual state of the biogeocenosis but even by the reconstruction method the natural state of the organokomplexes to a certain period. Both stadia of reconstruction and the present state of the organokomplexes are as for the genetic point of view closely bound. Besides this, even the anthropic factor influences often in very short-time intervals the features of the organokomplexes of certain relief forms by its activity (cutting down of the forest, clearing, etc.).

rise of humidity ⟶

Substratum

coniferous monocultures'b.

poor secondary atypical organokomplexes of the monocultural wood with a disturbed stratification (the vegetation and bushy zone is missing often) without forestal molluscs and with a very impoverished macrozooedafon (the rainworms are missing often) — few small terrestrial mammals

the yoke-elm woods'b organokomplexes of the meso- upto xeromorphous wood with a poor macrozooedafon without thermophile molluscs (Zebrina detrita is missing)

xeromorphic bushes'b. covers of cornel tree, hawthorn with thermophile molluscs (Helicodonta obvoluta and Helix pomatia) with the steppe mollusc Zebrina detrita in the ground zone (E:).

xeromorphic biogeocenoses

pillow moss without meso- up to hygrophilous grass with thermophile molluscs (species of the fam. Pupilidae)

Rock and débris without the developed soil profile ⟶ initial stage of the rendzina soil with forest liter and row humus ⇢ degradated soils often with a podsol horizon, a little aerated and tight

⟶ natural development ⇢ anthropic influence

Diagram No. 1. Moravian Karst: scarps partly covered with consolidated or non consolidated débris. Part: sunny débris. (Example of successive diagram of biogeographic maps of large scales). See the map No. 1., explanation No. 4.

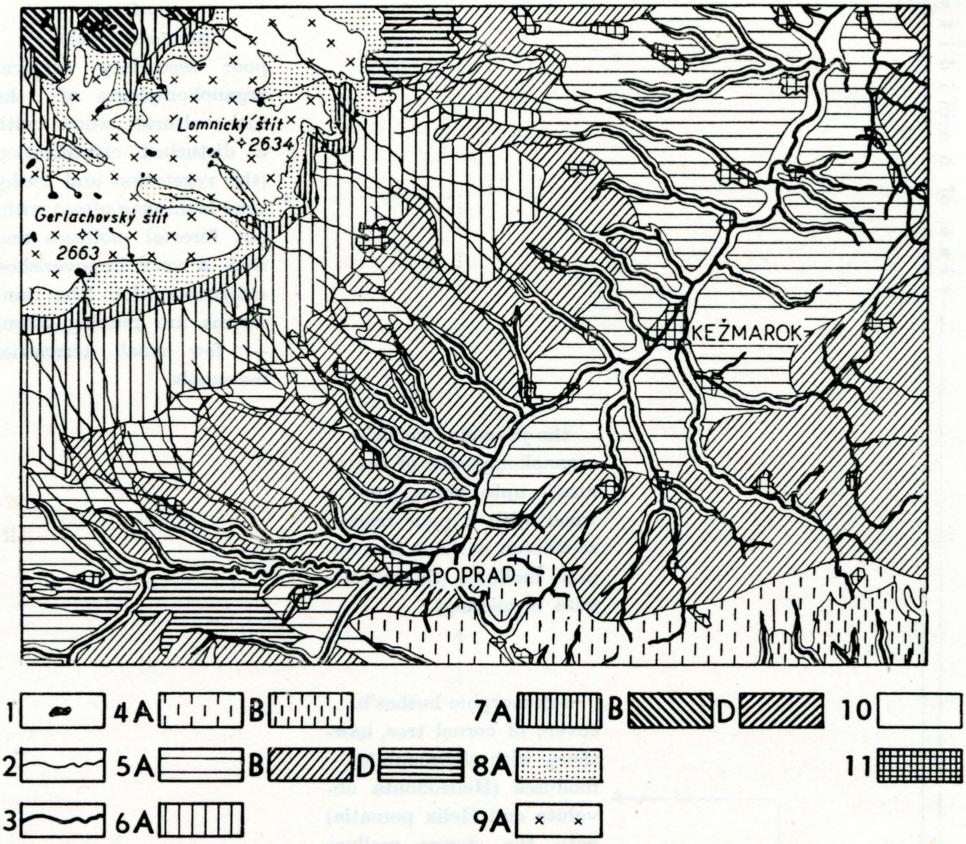

Fig. No. 2. East part of the High Tatra Mts., the Poprad-Basin and the west part of the Levoča mountain range. Example of biogeographic maps of small scales.
Explanations: Water organokomplexes 1) of high mountaineous lakes, 2) of high mountaineous and mountaineous torrents, 3) of submontaineous torrents; Terrestrial ones 4) of oak-beech-degree: A) oak-beech-groves (higher degree), B) oak-beech-groves, 5) of fir-beech degree: A) fir-spruce-beech grove (lower degree), B) fir-beech grove, D) dealpin beech-grove, 6) of spruce-beech-fir degree: A) fir spruce-grove (higher degree), 7) of spruce degree: A) larch spruce-grove, B) maple spruce-grove, D) beech spruce-grove (higher degree), 8) dwarf-pine degree: A) dwarf-pine-groves, 9) of alpine mountaineous degree: A) on unnutricious bases, 10) flood plains with Saliceto-Alnetum and Alnetum incanae, 11) organokomplexes of settlement unites.
Degrees 4—10 according to the classification by Al. Zlatník (1959); the rows A, B, D according to Al. Zlatník on acidiphilous (A) upto calciphilous, neutro- upto alcalophilous (limestone) soils (D).

Schwickerath (1954) tried to express this dynamics in the organokomplexes in the vegetation geography, who elaborated the method of the dynamically comprehended rings (Gesellschaftsring) for the individual basic forms of the relief. The Schwickerath's method has been applied in our biogeographic maps with the difference, that the maps are based instead of on phytocenoses on whole biogeocenoses, beginning from the basic possible natural biogeographic unit (biogeocenosis) upto the climax stadium of the biogeocenosis of the given form of the relief and of the anthropically conditioned unit (fields, pasture-grounds, monocultures etc.). Besides the organokomplexes even the soil succession is shown here. The solitary although geobiologically important taxons are not shown here therefore, while the vegetation and the fauna in their succession from the lovest biogeocenosis up to the highest possible natural and anthropically conditioned organokomplexes are shown here. This method has not been used yet in the biogeographic maps. This method seems to be the correct one, as this geographic vectorial drawing of the geographic analysis of the community outlines the aim to fix not only the optimum conditions of association, but even its geographic variability on the physiognomically striking form of the relief. By this method the territory of the Moravian Karst (Fig. No. 1) in the scale 1 : 25.000 is mapped, which is geologically homogenous (devonian limestones) and geomorphologically very heterogenous (deep canyons, sink-holes, tors and spurs, etc.), what conditions even the heterogenity of the association rings of the individul basic forms of the relief (diagram No. 1), i.e. from our point of view of the lowest structural units. In the legend and in the description of the map we base on the opinion pointed out correctly by R. Gradmann (1919 : 23) already, that the specification of the individual communities shall be adequate, in the mother-tongue and only then, if we do not subsist on our own terminology, the Latin terms shall be used. At the continental biogeocenoses the primary factor is comprehensibly the vegetation. On the contrary in water streams and in caves (in the karst territory) the first position belongs to the animal component of the biogeocenosis. When elaborating the animal association rings we meet with problems following from the fact, that the animal is not so definite and the zoocenologic methods are in the beginnings only. The biogeographic maps compiled in such a way complete suitably the geomorphologic and pedologic maps of the investigated territory.

The biogeographic maps of small scales (1 : 200.000 and less) are compiled in a similar manner. According to this method even the biogeographic map for the National Atlas of Czechoslovakia has been compiled. The base is the reconstruction map of the possible natural vegetation of the forestal types according to Al. Zlatník, that, as has been shown before, corresponds best to the biogeocenologic and also the biogeographic conception (Fig. No. 2). The basic units are here the vegetation degrees with the rows A—D, reconstructed even on the non forestal area in the Subatlantic period, i.e. in the period, that has not been influenced by the man. The group of the forestal types is given first of all by the qualitative and quantitative combination of the species of woody plants in the main synusiae in the original state of the forest during the actual climate, i.e. for the Subatlantic period. It is attested and proved

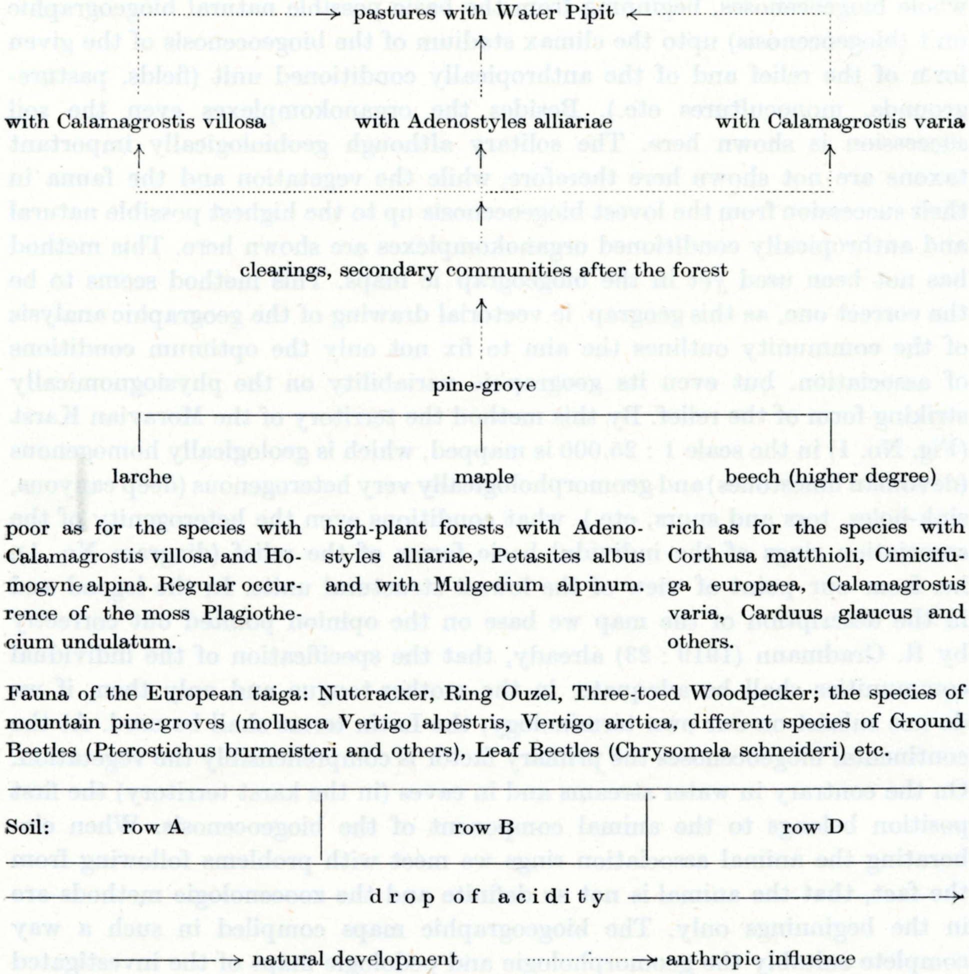

Diagram No. 2. East part of the High Tatra Mts., the Poprad-Basin and the west part of the Levoča mountain range. (Example of the successive diagram of biogeographic maps of small scales). See map No. 2., explanation No. 7.

according to the relicts of the most natural preserved forests and according to the archives documents. The maps are completed with brief succession diagrams (diagram No. 2), showing the complex of the types of the possible and anthropically conditioned biogeocenoses in the given degree. The general character of the map and of the accompanying mark clue represented here by the successive diagrams, has the character of other gographic thematic maps and it differs from them in the dynamic conception of the chained successive processes, which pass constantly in the geographic landscape.

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METHOD OF THE ESTABLISHMENT OF MESOCLIMATIC REGIONS IN TOWNS

Metody mezoklimatické rajonizace měst. — Na základě sedmiletého průzkumu mezoklimatu Brna bylo přikročeno k jeho rajonisaci. Bylo vymezeno celkem 9 hlavních typů a 6 podtypů odlišujících se vzájemně od sebe nižší nebo vyšší průměrnou teplotou či vlhkostí, intensitou poklesu teploty ve večerních hodinách, rychlostí vzestupu teploty v ranních hodinách, velikostí denních extrémních teplot i vlhkosti. Rajonisace byla provedena pro 4 skupiny synoptických typů. Každá z těchto skupin synoptických typů umožňuje vznik a vývoj podobného druhu městského klimatu. Bylo zjištěno, že k vývoji podobných mezoklimatických poměrů ve městě dochází za typů Wa, Ea, H, částečně Wc, Wcs, SWa, SWc_1, SWc_2. Druhou skupinu tvoří typy NEa, SEa a část typů NWa, Sa, SWa. Do třetí skupiny byly zařazeny typy NWc, Nc, NEc, Ec a část typů NWa, Sa, BC, CC, SWc_1 a SWc_2. Ve čtvrté skupině jsou čáti typů Wc, Wcs, SWc_1, SWc_2, BC a CC. Z četnosti jednotlivých synoptických typů zařazených do 4 hlavních skupin můžeme pak stanovit i přibližnou četnost výskytu jednotlivých druhů městského mezoklimatu.

Since 1955 numerous mesoclimatic investigations for the purpose of the improvement of the knowledge of the town climate and of the establishment of the mesoclimatic regions were carried out in the town Brno and its surroundings. The prevailing part of the research of the temperature and of the humidity of the atmosphere was carried out by the system of measuring drives; the motor-car, the motor-cycle or the tram were used as means of communication (2, 3, 4) here. The measuring was carried out with an electric resistance thermometer or with a psychrometer during the drive. On certain synoptic situations a series of data about the temperature and humidity conditions of Brno in the individual day and year periods was acquired, during the 7 years of the research.

Some synoptic situations enable the origin and the development of a similar type of the mesoclimate. These situations may be consequently united in some groups according to their prevailing influence on the climatic conditions of the town. The situations with similar radiation conditions, diurnal amplitude of atmospheric temperature and humidity, intensity resp. direction of wind and other phenomena (e.g. fog, precipitation) were united. So for instance the development of similar mesoclimatic conditions occurs in the town during the situations Wa, Ea, H, partly Wc, Wcs, SWa, SWc with a light breeze or during the calm and with clear sky. At the situations Wa, Wc, Wcs and SWc certain differences in humidity conditions described further in the characteristics of the individual mesoclimatic types can be noticed. The situations NEa, SEa and a part of the situations NWa, Sa, SWa with the fine up to half-fine weather, with strong sometimes moderate wind may be arranged in the second group. At this group only the situation NWa differs from the other ones in the humidity conditions. The situations NWc, Nc, NEc, Ec and that part of the situations NWa, Sa, BC, CC, SWc having the cloudy up to overcast and windy weather, belong to the third group. The situation Ec differs from the whole group in the humidity conditions. The situations Wc, Wcs, SWc, BC and CC belong to the fourth group, which is characterized by the overcast but calm weather.

It is necessary to remark, that the investigations of the temperature and humidity conditions were not carried out with the same accuracy at all situations. The conditions at the situations of the I. and the II. group were studied most thoroughly, while some situations of the groups III and IV were not checked by investigations perfectly.

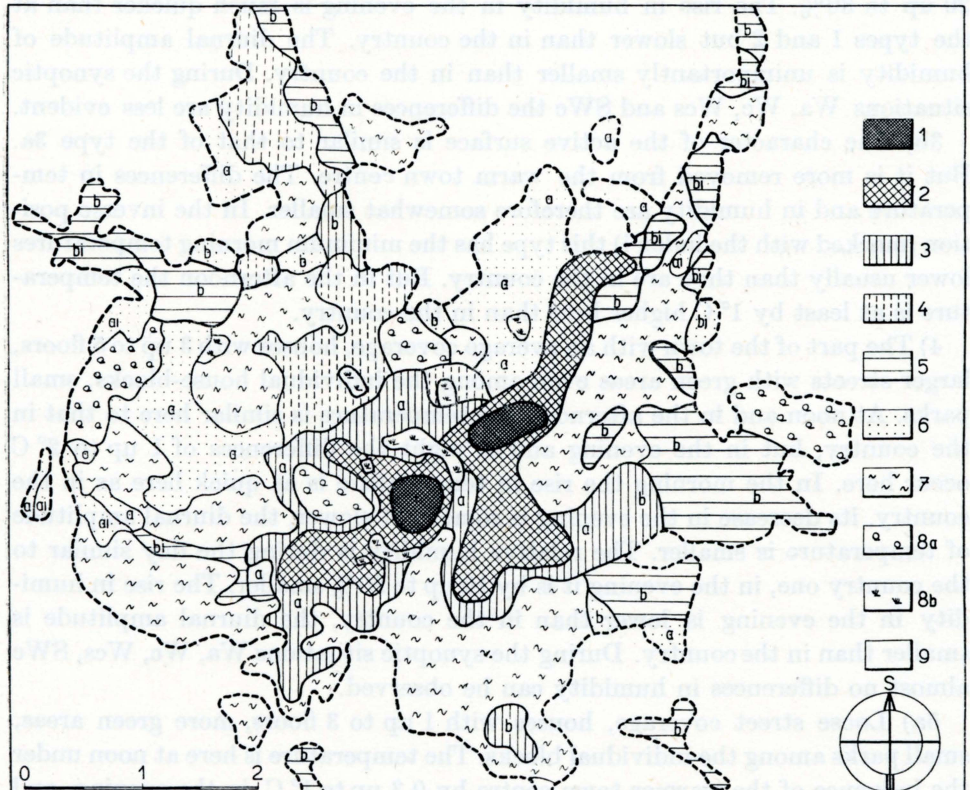
On the base of the extensive climatic investigations carried out in Brno, it was possible to begin with the establishment of the mesoclimatic regions of the town. There were defined 9 main types and 4 subtypes, differing one from another in the lower or higher temperature or humidity, in the intensity of the fall of temperature in the evening, in the speed of the rise of temperature in the morning, in the size of the extreme diurnal temperature and humidity.

But the mesoclimate could not been studied with the same accuracy in the whole town Brno. Such a research would involve high financial expenses, many measuring instruments and many workmen realizing the measurements. Therefore I applied to the study of the mesoclimate of some parts of the town Brno, in which the most mesoclimatic specialities occur. The dependence of the temperature and humidity conditions on the density and on the character of the coverage, on the height of the buildings, on the width of the streets, on the kind of vegetation, on the size of the green areas in the town etc., was stated. These results enabled then to compile the map of the mesoclimatic regions even on places, where the investigations were not carried out, or where their number was small. The most differentiated mesoclimatic conditions (of all 13 types and subtypes) occur comprehensibly under synoptic situations of the group I. Then it is possible to distinguish:

1) The densely built up centre of the town with narrow streets and houses with 5 up to 6 floors. This is the relatively warmest part of Brno. In the forenoon the temperature is the same or often even lower here (in summer) than in the open country, at night the temperature is by 1 up to 3° C higher here. The diurnal amplitude of temperature is considerably smaller than in the country, the temperature fall in the evening and the rise in temperature in the morning are slow. The relative humidity is on average by 15% lower during the day and

by 20 up to 30% lower in the evening than in the country. The decrease in humidity in the morning and its rise in the evening is much slower than out of town, its diurnal amplitude being smaller. The differences in humidity are less evident during the situations Wa, We, Wes and SWe.

2) The centre of the town with dense development, without green areas, with narrow and large streets, with houses with 4 up to 6 floors. During the



day, especially in the forenoon, the temperature is higher here than at the type 1, but at night it is a little lower (by some tenth of °C). The diurnal amplitude of temperature is substantially smaller than in the country but greater, than at the type 1. The nightly decrease and the rise in temperature in the morning are slow, but quicker than at the type 1. During the day the relative humidity is the same or higher here than at the type 1. But in the evening the difference reaches in comparison with the country at the most 20%. The decrease in humidity in the morning and its rise in the evening are distinctly quicker than at the type 1. During the synoptic situations Wa, Wc, Wcs and SWc the differences in humidity are less evident.

3a) The part of the town with the average coverage, larger streets, with the lack of green areas, with houses with 3 up to 5 floors. This type uses to be constantly warmer than the open country. In summer in the afternoon by 0,5° C (in the forenoon somewhat less) and in the evening by 1 up to 2° C. The diurnal amplitude of temperature is accordingly somewhat smaller than in the country but substantially greater than at the types 1 and 2. The relative humidity is during the day by 15 up to 25% lower here, in the evening then by 20 up to 30%. The rise in humidity in the evening is much quicker than at the types 1 and 2 but slower than in the country. The diurnal amplitude of humidity is unimportantly smaller than in the country. During the synoptic situations Wa, Wc, Wcs and SWc the differences in humidity are less evident.

3b) The character of the active surface is similar to that of the type 3a. But it is more removed from the warm town centre. The differences in temperature and in humidity are therefore somewhat smaller. In the inverse position (marked with the index i) this type has the minimum morning temperatures lower usually than they are in the country. But in the afternoon the temperature is at least by 1° C higher here than in the country.

4) The part of the town with an average coverage, houses with 3 up to 5 floors, larger streets with green areas even among the individual house-blocks, small parks. At noon and in the afternoon the temperature is similar here to that in the country, but in the evening and at night the differences of 1 up to 2° C occur here. In the morning the rise in temperature is as quick here as in the country, its decrease in the evening is somewhat slower, the diurnal amplitude of temperature is smaller. The relative humidity is during the day similar to the country one, in the evening it is by 10 up to 20% smaller. The rise in humidity in the evening is lower than in the country, the diurnal amplitude is smaller than in the country. During the synoptic situations Wa, Wc, Wcs, SWc almost no differences in humidity can be observed.

5a) Loose street coverage, houses with 1 up to 3 floors, more green areas, small parks among the individual blocks. The temperature is here at noon under the influence of the warmer town centre by 0,3 up to 1° C, in the evening, and by 1 up to 2° C in the morning, higher than in the country. The diurnal amplitude is somewhat smaller here than in the country, the rise in temperature is quicker in the morning than at the type 3. The relative humidity is in the morning similar to the country one, during the day by 5 up to 10%, in the evening by 10 up to 20% smaller, the rise in humidity is slow in the evening. During the situations Wa, Wc, Wcs, SWc the differences in humidity do not occur.

5b) Character of the coverage like at the type 5a, only without the possibility of the influence of the warm centre of the town. During the day the temperature is similar to the country one, in the evening it is higher by up to 1° C. The differences in temperature between the country and this coverage are smaller in winter than in summer. The diurnal amplitude of temperature is somewhat smaller than in the country. This type has in inverse positions (marked by the index i) especially during the cold periods of the year, lower minimum temperature, frequent fogs and a higher atmospheric humidity.

6a) Villa-coverage within green areas. The temperature conditions are during the day similar to the country ones, the temperature is by 0,3° C higher here in the evening. The velocity of the rise in temperature in the morning and of its decrease in the evening and the humidity conditions are similar to the country ones. This type is in inverse positions characterized by lower minimum temperature, higher atmospheric humidity and more frequent fogs.

6b) Block-coverage (3 up to 6 floors) within green areas, the minimum distance of the individual blocks being 100 m. This type has the temperature conditions similar to these of the type 6a with the exception, that the temperature is here at noon by up to 0,5° C and in the afternoon by some tenth of °C higher than in the country. The relative atmospheric humidity is the same here as in the country. This type is characterized in inverse positions (marked by the index i) by lower temperatures, higher atmospheric humidity and more frequent fogs.

7) Spaces built up with more extensive industrial plants or other equipments (exhibition ground, railway station, trackage). The mesoclimate is influenced strongly by the character of the active surface and even by the heat emitted by these plants. The mesoclimatic characteristics cannot be fixed accurately due to their heterogeneity, to their size and to their situation.

8a) Tree parks the mesoclimate of which depends on their area and position with regard to the town (near or far of the centre). It may be said in general, that near the centre the temperatures are by 0,3 up to 0,8° C lower here during the warm periods of the year, in the evening then by 0,5 up to 1,2 °C lower than in the built up part. The decrease in temperature in the evening is somewhat slower here than in the country, but perceptibly quicker than in the built up parts. The relative humidity is by up to 20% greater here in the morning than in the centre, during the day by up to 15% greater.

8b) Grass parks without high verdure are at noon during the warm season by up to 0,4° C colder, in the evening by 0,6 up to 1,5° C colder than the densely built up centre of the town. The decrease in temperature in the evening and its rise in the morning is as intensive as in the country. The relative humidity is somewhat smaller here than at parks with the high tree verdure.

9) Fields, meadows and gardens with the mesoclimate which is not influenced by the coverage. They are in inverse positions marked by the index i, on slopes facing south with higher average temperatures then by the index t.

The similar establishment of mesoclimatic regions of the town Brno is carried out at the remaining 3 groups of synoptic situations only with the difference, that many of the mesoclimatic types do not reflect more expressively in them and therefore they are omitted or included into the other types.

The approximate frequency of the occurrence of the individual types of the town-mesoclimate is stated on the base of the frequency of the individual synoptic situations arranged into the 4 main groups.

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THE VEGETATIVE INVERSION ON THE EXAMPLE OF THE MORAVIAN KARST

Vegetační inverze na příkladu Moravského krasu. — Vegetační inverze vzniká jako důsledek dlouhodobé inverze tam, kde chlad, vlhko a stín během celého roku převládá nad teplem, suchem a slunečním svitem. V důsledku rozmanitého utváření reliéfu zasahují inverzní vlivy v oblasti Moravského krasu do různých výšek. Směrem ode dna ubývá chladné a vlhké složky inverze a přibývá složky suché a teplé, která dosahuje maxima na hranách horních okrajů skalních stěn. V místech exponovaných k severu zasahují inverzní vlivy až k hranám skalních stěn a ještě výše, vliv inverze při této expozici je zastřen. Inverze se velmi zřetelně projevuje v nástupu fenofází. Dalším projevem inverze je bohatá fruktifikace mechů, zajímavý je v Moravském krasu výskyt prealpinských a dealpinských prvků a horských druhů. Moravský kras tvoří samostatné květenné území kryté svéráznou vegetací, jevící vztahy k vápencovým obvodům Karpat bohatým zastoupením rostlinných prvků horské povahy.

The vegetable associations influence very considerably the character of the landscape and they use often to be one of the decisive factors for the distinction of various areas. It is first of all necessary to pay attention to the soil base — which uses to be the decisive factor — as to one of the factors conditioning the occurrence of the individual vegetable associations or of certain kinds of plants. A very rich flora covers the territories with the base of limestone character and therefore they are a very grateful topic of the biogeographic observations. The limestone areas form expressive karst regions, many of which occur even on the European continent. Recently even the detailed biogeographic investigation of one of the karst areas of Czechoslovakia, of the Moravian Karst, is carried out. The first results of observations showed some characteristic and very interesting factors having an important influence on the vegetation cover in this area.

This paper treats of one of these factors, of the vegetative inversion.

It is necessary first of all to devote some words to the position and to the relief of the investigated area. The territory of the Moravian Karst lies northward of the town Brno, on the south and SW of the Drahanská vrchovina Highland, roughly among the towns Boskovice, Blansko, and Brno. It occupies the area of about 74,6 square kilometres. The geological base of the investigated karst area is formed by Upper Devonian limestones.

Into the apparently monotonous landscape the canyons Pustý žleb and

Suchý žleb are cut, reaching the average depth of 150 m. The further canyon called Pustý or Syrový žleb is flown through in some sections by the river Punkva sinking in many places into underground spaces and emerging in other places. The Suchý žleb is waterless. The most known place of the Moravian Karst is the Macocha-chasm, 138,4 m in depth. Approximately on the half of its bottom and walls the sun does not shine the whole year, similarly like on other places in the canyons. There is a constant shade and cold there. On the contrary on the sunny valley spurs numerous thermophile kinds seized forming isolated islets in the middle of extensive beech-fir woods. We meet here on small distances with vegetative contrasts — in the valleys with numerous kinds of mountain character, on the sunny spurs with thermophile elements of steppe character. This inverted stratification is called inversion.

Besides the relief and warmth inversion, which can be divided into the short-range and long-range one, we know the inversion of the vegetative zones, which can be found as the consequence of the long range warmth inversion on places, where the cold, the dampness and the shade are predominating during the whole year over the warmth, the dryness and the sunshine.

Owing to the various forming of the relief (rock-steps, rock walls, debris), to the different width of the canyon valleys, to the differences in exposure, to the declivity and depth of the canyons, the influences of the inversion reach different altitudes. It may be said on the whole that upwards from the bottom the cold and humid component of the inversion decreases and the dry and warm one increases, reaching its maximum on the edges of the upper margin of the rock walls. Higher, on the surface of levelling, the vegetation is developed in harmony with the height above sea level of the surface of levelling. These are beech-fir covers, which are today, especially in their northern part, considerably changed by human intervention into fir and pine-tree monocultures.

On the bottom of the canyons and of the chasm the associations of mountain character can be found, some sorts of which are growing in Carpathians, e.g. Cortusa sibirica, Phyllitis scolopendrium and others. On the contrary on the upper margins of the rock walls thermophile associations are prevailing, some sorts of which reach in the Moravian Karst locally their northern boundaries of occurrence, e.g. Cornus mas, Anemone silvestris, Prunus fruticosa, Stipa joannis, Stipa stenophylla, Lithospermum purpureo-coeruleum and others.

On places facing north the influences of inversion reach the edges of the rock walls and still higher. At this exposure the influence of the inversion is screened. It appears in the vegetation covers which are searching for cold, dampness and shade, in strongly mossy associations of the type Seslerietum muscosum.

On the bottom of the Pustý žleb the river Punkva flows in the narrowed sections, or only a road leads there, in the larger ones there is a narrow stripe of a river flat. On some places the plantcovers of the Petasitetum albi, elsewhere the fragments of the humider facies of the yoke-elm wood with mountain elements occupied smaller or larger areas. The extremely shaded lower parts of the rock walls are covered by the greyish-blue dustlike covers of the leprous stages of the lichens and by the ochreous lichen Blastenia ochracea. The shaded rocks belong in their lower parts to the moss associations of the societies Neckerion, Thamnion and Seligerion. Above these the spurs and rock steps are occupied by the association Seslerietum muscosum, passing over upwards into a beech-fir wood (Abieto-Fagetum). Inasmuch as debris are reaching the bottoms of the canyons, they are either not overgrown or covered by forest and rock moss with the prevailing kinds Hylocomium splendens and Rhytidiadelphus triquetrus. In the further stage of stabilisation the debris are covered by the association Seslerietum muscosum. The debris use sometimes to be overgrown with woods, which belong to the association Acereto-Fraxinetum with several facies according to the prevailing sorts: urticetosum, lunarietosum, asperuletosum, festucetosum silvaticae. The vegetable aspect appears to us in this manner at the exposure towards north.

At the southern aspect the associations are developed differently. The lowest parts of the rock walls in the narrowed sections of the canyons, in semi-shade, are overgrown with the dry association belonging to the society Neckerion, with the association Camptothecium philippeanum, Anomodon viticulosus. To this association the vegetation cover of the whole surface of the walls belongs. The rock-steps and terraces are covered by the association Seslerio-Festucetum duriusculae. On the upper edges of the rock walls influenced extremely by the insolation the previous association passes over into the association of the thermophile bushy cover of Corneto-Quercetum and on free surfaces into the association Brachypodietum pinnati. Higher the debris forest (Querceto-Carpinetum melicetosum uniflorae) links on to. The vertical rock walls exposed fully to the sun, are overgrown with thermophile moss and lichens of the society Grimmion tergestinae. The rock walls watered by the soaking water, are covered by dark stripes of aerophytic Cyanophiceae. The spurs sprinkled by the water dripping from the rock-shelters, on which birds are reposing and enriching it with nitrogenous matter, are covered with orange-yellow lichens of the species Caloplaca. They form typical nitrophilous associations, striking by the orange-yellow covers.

The inversion can be observed very well in the setting in of the phenophases. In the cold, dampness and shade of the canyon valleys the individual phenophases are setting in with a considerable delay. So for instance we observed on the bottom of the Suchý žleb the Carpinus betulus with rolled up leaves, while it was in full bloom above on the sunny spurs. It was similarly even with the other woody plants. The delay was observed even in the setting in and in the beginning of the flowering, in the ripening of the fruits, etc.

A further expression of the inversion the rich fructification of mosses is, even of those, which use to be sterile. The extreme dampness and the cold lasting the greater part of the vegetative period, cause the fertility of the following sorts: Ditrichum flexicaule, Ctenidium molluscum, Hylocomium splendens, Rhytidiadelphus triquetrus. More often the fruitful sorts of Neckera crispa, Anomodon viticulosus, Camptothecium philippeanum can be found.

The occurrence of the praealpine and dealpine elements, both having their origin in the limestone foot-hills of the European high mountains is very interesting in the Moravian Karst. The praealpini are at home on the warm and dry limestone foot-hills of the Alps and Carpathians, the dealpini on the contrary on the cold and humid positions of the subalpine and alpine zone. They got to the lower positions and consequently even to the Moravian Karst with the proceeding glacier. After the deglaciation they conformed to the life conditions in lower positions, the praealpini in the dry ones, the dealpini in the humid and cold ones.

Of the praealpini of the Moravian Karst Allium montanum, Alyssum saxatile, Berberis vulgaris, Biscutella laevigata, Cirsium eriophorum, Cyclamen europaeum, Libanotis pyreneica etc. can be found.

To the important dealpini of the Moravian Karst Asplenium viride, Cimicifuga europaea, Cortusa sibirica, Saxifraga aizoon, Sesleria calcarea, Phyllitis scolopendrium and a whole series of mosses and lichens belong.

A further speciality of the flora of the Moravian Karst is the abundant occurrence of the mountain kinds, which are at home in the higher positions of the Českomoravská vysočina Highland and of the Jeseníky Mts. They have there suitable life conditions in the inverse positions, in the deeply cut canyons. The occurrence of the mountain sorts in lower positions is specified as the demountain phenomenon, the plants then as demountain elements. The occurrence of two sorts, Athyrium distentifolium and Lycopodium selago, which are at home in the Jeseníky Mts. in the park-like forest above 1250 m and in the Tatra Mts. in the stunted-fir zone in 1500—1800 m was established in the Moravian Karst too. Of the sorts being at home in the mountain pine-tree woods (1000—1250 m) Chaerophyllum hirsutum, Ribes alpinum, Sambucus racemosa and some others occur in the investigated area.

A very numerous group is formed by the sorts belonging to the zone of the beech-fir forests and being at home in the altitudes of 700—1000 m: Bromus ramosus ssp. benekenii, Circaea alpina, Corallorhiza trifida, Dentaria bulbifera, Polystichum lobatum etc.

The Moravian Karst forms an independent area of flora covered by a characteristic vegetation, showing relations to the limestone areas of Carpathians by the rich representation of the vegetable elements of mountain character; the flora differs here substantially from the flora of the Drahanská vrchovina Highland and from the area of the coherent occurrence of the thermophile plants, which are ceasing to appear most typically on the southern border of the Moravian Karst, on the southern slopes of the Hády near Brno and near the mouth of the river Svitava near Obřany. In the proper Moravian Karst the thermophile elements are forming only islets on exposed limestone rocks. For the sake of its great natural-scientific significance (the karst phenomenon, the flora, the fauna), the territory of the Moravian Karst has been declared in 1930 already a protected landscape area.

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INTENSITY OF KARSTIFICATION OF LIMESTONE IN THE ZONE OF THE VERTICAL CIRCULATION IN THE MILD CLIMATE OF CENTRAL EUROPE

Intenzita krasovění vápenců v zóně vertikální cirkulace ve středoevropském mírném klimatu na příkladu Moravského krasu. — Předložená práce přináší základní údaje o intenzitě rozpouštění vápenců v zóně vertikální cirkulace v současných klimatických podmínkách. Zkoumány byly vody skapávající s krápníků v jeskyních Punkevních a Sloupsko-šošůvských, tj. srážkové vody, které dopadají na krasovou plošinu, prosakují tenkou vrstvou humusu, pokryvných útvarů a vápencovým masívem, a bezprostředně se podílejí na rozšiřování puklin, na vzniku jeskyní, propastí a komínů v zóně vertikální cirkulace (změny v chemickém složení skapávajících vod v průběhu jednotlivých ročních období jsou znázorněny na přilehlých grafech).

Množství odnášeného vápence činí za období od května 1960 do dubna 1961 v jeskyních Punkevních 0,004 08 m^3, v jeskyních Sloupsko-šošůvských 0,000 39 m^3. Získané hodnoty jsou extrémně vysoké uvážíme-li, že prosakující vody mají minimální plochu povodí a mocnost vápencového masívu jímž procházejí měří 150 a 50 m. Získané hodnoty odpovídají nejvyšším hodnotám odnosu v zoně horizontální cirkulace na zemi, uváděným v literatuře. Ukazují na intenzívní rozčleňování vápencového masívu ve svislém směru v současné době.

The karst searchers turn their attention at present time more and more from the study of the individual karst phenomena or of whole areas to the study of the processes passing on limestones. This change in the orientation of the karst research is influenced by the development of the karst geomorphology, which emphasizes more and more the share of the climate in the origin of the karst relief. The change in opinions of the main factor in the karst processes must necessarily carry with it also an other view of the genesis of many karst forms and of whole areas. The geomorphologic classification of the karst areas elaborated by A. Penck (1924), J. Cvijić (1893), A. Grund (1914), Emm. de Martone (1948), W. M. Davis (1930) and others, based on the opinion, that all the karst forms develop successively, in a cycle, the end stage of which are large plains, does not agree with the knowledge acquired recently. The searchers are therefore trying to improve the older classifications, resp. to substitute for them a new one, the base of which would be formed by the groups of the karst forms characteristic for areas with a certain type of climate. For the compilation of such a classification a series of data is missing up to this time, especially the reliable data about the intensity of the dissolution of limestones in different climatic zones. As far as such data are given, they are usually concerning areas, the climate of which is assumed not to have changed substantially during Tertiary and Quaternary. These are the zones, where the karst forms developed by the activity of predominantly one of the factors forming the relief. But a proportionately small attention is paid to the karst areas, where substantial climatic changes took part during the Younger Tertiary and Quaternary and in consequence of it even several kinds of the modelling of the karst forms by different factors forming the relief occurred. First of all the areas with a mild humid climate, which include even the Moravian Karst, belong to these zones.

This study gives the basic data of the intensity of the dissolution of limestones in the zone of the vertical circulation, which enable to establish the velocity of the karst processes on present climatic conditions. The basis for this work was acquired by long range investigations carried out in equal intervals during 14 months (March 1960—April 1961) in the north part of the Moravian Karst. The water dropping down the dripstones, i.e. precipitation water falling on the karst plain, soaking through the thin humus bed and the sheet forms and having an immediate share in the opening of the fissures, in the origin of the caves, of the light holes and chimneys in the zone of the vertical circulation is of decisive importance for the origin of the dripstones too. The research showed the chemical composition of the soaking water and its changes during the individual seasons.

The mode and the conditions of the water sampling

The waters soaking through the limestone massif and dropping down the dripstones into the underground hollows were caught on two places — in the Punkva caves in the part called Zadní dóm and in the Sloup-Šošůvka caves in the Eliška-cave and later (from September 1960), after the interruption of the circulatory ways in the corridor called "U řezaného kamene". In both cases large systems of caves and corridors are concerned here. The caves of Sloup and Šošůvka have developed in the east steep slope of the half-blind valley of Sloup, about 50 m below the surface of the relief. The upperst dry cave level is formed by them today. The entrance into the cave is in the height of about 465 m above sea level. The Eliška-cave is found near the way in the labyrinth of Sloup-Šošůvka and it belongs to the largest caves in the Moravian Karst. Its height reaches 18 m, its length 40 m and its width 30 m. On NE the bottom of the cave is covered by thick debris of the collapsed ceiling. The water samples were caught from the big stalactite in the NE part of the cave. The distance between the stalactite and the collecting vessel was about 5 m. After the interruption of the system of circulation the stand was transported into the corridor "U řezaného kamene", founded on the bedding plane. The corridor is 2—4 m high and 2,5 m wide on average. In the place of the sampling the west wall of the corridor is enlarged in a small niche with little stalactites, from which the dropping down water was caught. The distance between the stalactite and the collecting bottle was 1,3 m.

The entrance in the Punkva caves can be found in the canyon-valley called Pustý Žleb, about 140 m below the surface of the extensive limestone plain, in the height of 355 m above sea level. The caves join the bottom of the canyon-valley with the bottom of the Macocha-chasm. They belong to the central cave level inundated from time to time by the underground karst streams. The Zadní dóm developed in 2/3 of the length of the caves and it occupies the highest positions of the dry caves of Punkva. Its maximum width is 10—15 m, its length is 40 m and its height 8—10 m. The dóm is tilted towards SE, in the direction to the Macocha-chasm. The water was caught in the central upperst part of the dóm, from a big stalactite. The distance between the stalactite and the collecting vessel was about 5 m.

The dropping waters were caught into special stoppered bottles of 1 litre, which were immediately after the filling transported to the laboratory for treating.

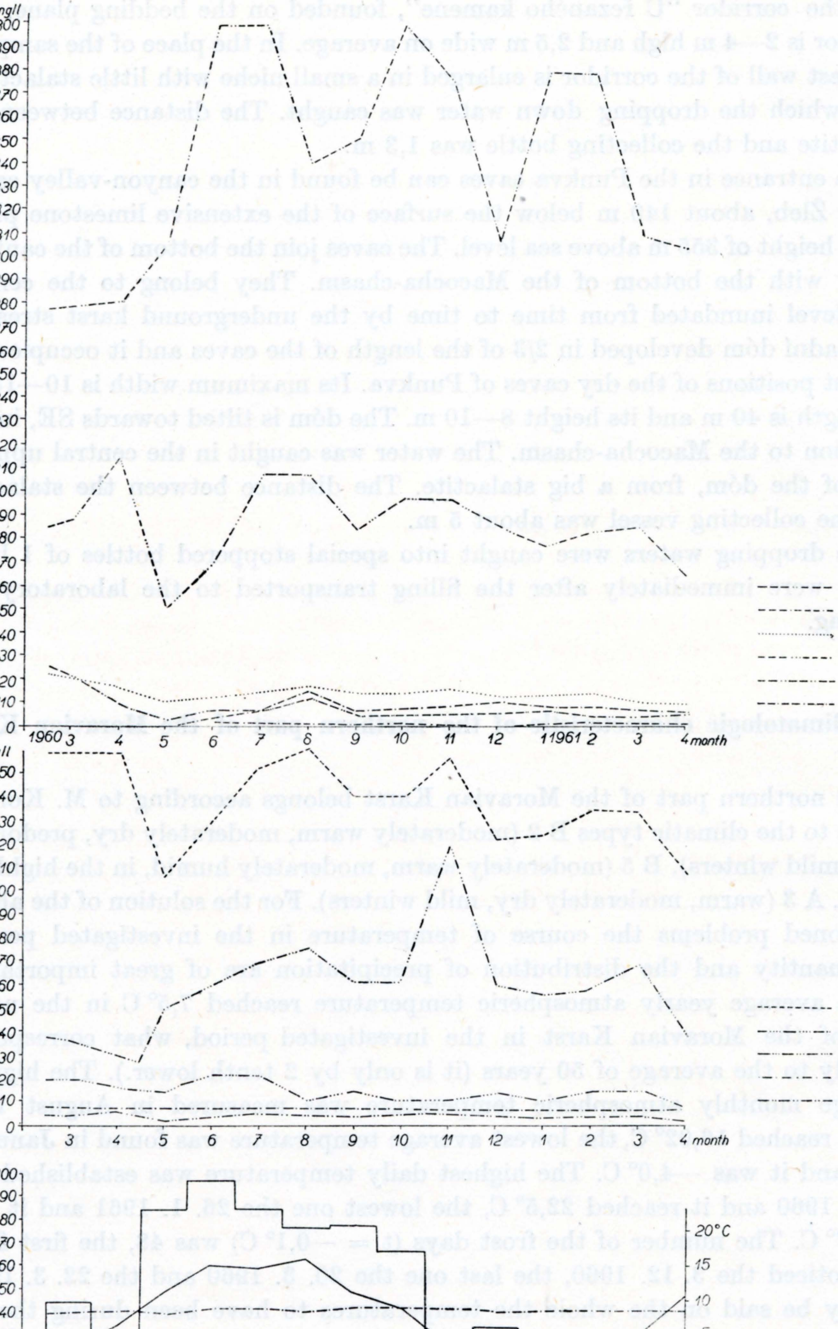
The climatologic characteristic of the northern part of the Moravian Karst

The northern part of the Moravian Karst belongs according to M. Končck (1958) to the climatic types B 2 (moderately warm, moderately dry, predominantly mild winters), B 5 (moderately warm, moderately humid, in the highland areas), A 3 (warm, moderately dry, mild winters). For the solution of the above mentioned problems the course of temperature in the investigated period, the quantity and the distribution of precipitation are of great importance.

The average yearly atmospheric temperature reached 7,5° C in the north part of the Moravian Karst in the investigated period, what corresponds roughly to the average of 50 years (it is only by 2 tenth lower.). The highest average monthly atmospheric temperature was measured in August 1960 and it reached 16,02° C, the lowest average temperature was found in January 1961 and it was —4,0° C. The highest daily temperature was established the 28. 8. 1960 and it reached 22,5° C, the lowest one the 26. 1. 1961 and it was —11,7° C. The number of the frost days (t = —0,1° C) was 48, the first frost was noticed the 3. 12. 1960, the last one the 20. 3. 1960 and the 22. 3. 1961. It may be said on the whole the temperatures to have been during the investigated period slightly below the normal.

The total sum of precipitations was for the investigated period 652,2 mm, the average monthly sum reached 46,5 mm. The highest monthly sum was

Fig. No.1



measured in June 1960 by 96,1 mm, the lowest one in November 1960 by 68,00 mm. The greatest quantity of precipitations during one day occurred the 12. 5. 1960 and it reached 41,8 mm. The snowing lasted 43 days, the snow-cover kept up 59 days. The precipitations were not distributed equally during the investigated period. In the time from May to October 74,2 % of all precipitations have fallen. The temperatures as well as the precipitations were slightly below the normal in the investigated period.

The chemical composition of the water dropping down the dripstones in the caves of Punkva and Sloup-Šošůvka

The waters dropping down the dripstones are pure, colourless, or with a slight light-grey mudding, they are smelless. The extraordinarily high contents of a series of elements shows the soaking of the precipitation water to be slow, what enables all the phases of the chemical solution to pass (Bögli 1960). The chemical composition of water as well as its changes during the individual seasons are drawn for the both investigated localities on the figures 1 and 2. It may be seen from the enclosed figures that the maximum removal of limestones occurs in the zone of the vertical circulation in summer, which lasts 6 months (May—October). This period is characterized by maximum temperatures and great precipitations. The precipitation water soaks through the humus bed, where it is enriched by the biogenic CO_2, so that it is strongly aggressive when reaching the limestone. In contradistinction to it in winter, when the upper humus bed is frozen through and covered by snow, the removal of limestone is substantially smaller. The water circulation passes below the frozen bed, the enrichment of the water with the biogenic CO_2 is substantially

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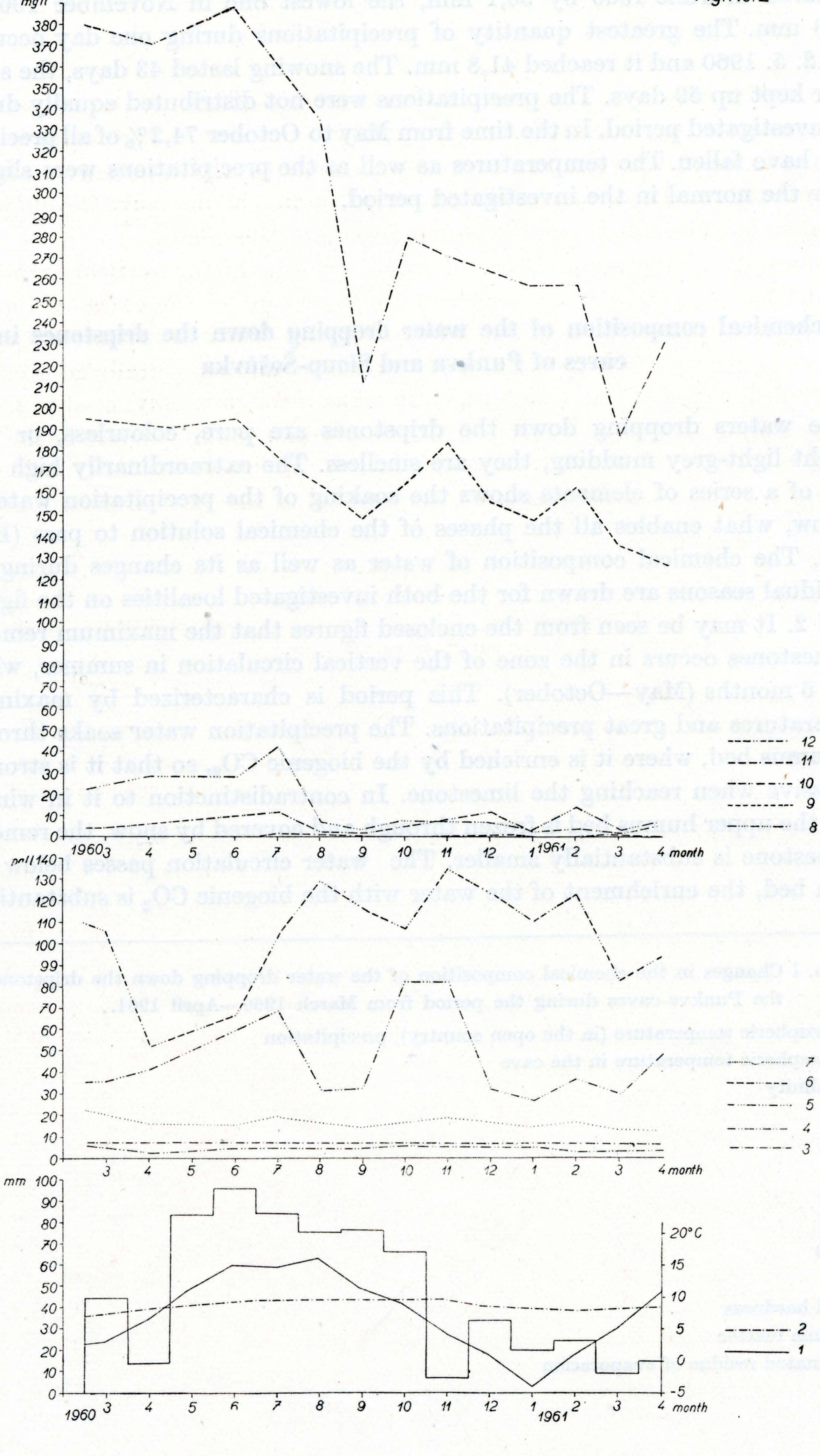
Fig. No. 1 Changes in the chemical composition of the water dropping down the dripstones in the Punkva-caves during the period from March 1960—April 1961.

1 atmospheric temperature (in the open country), precipitation
2 atmospheric temperature in the cave
3 alkalinity
4 pH
5 SO_4''
6 Cl
7 CaO
8 NO_3'
9 MgO
10 CO_2
11 total hardness
12 organic matter
13 calcinated residue of evaporation

Fig. No. 2



smaller than in summer, so that the water comming to the limestone is less aggressive.

The transport of the calcium carbonate passes exclusively in the form of chemical solutions on ways, some of which developed already during previous geological periods. These ways are at present time intensively enlarged resp. restored. Due to this process the lapiés, chimneys and especially sinkholes were formed on the surface of the limestone plain, the intensive development of which changes substantially the microrelief of this plain.

The quantity of the removed limestone in the zone of the vertical circulation reached for the period from May 1960 to April 1961 in the caves of Punkva 0,00408 m^3, in those of Sloup-Šošůvka 0,00039 m^3. These values are extremely high, considering, that the soaking water has a minimum drainage area and that the thickness of the massif which it soaks through is only 50 upto 150 m. The acquired values correspond to the highest values of the removal in the zone of the horizontal circulation on Earth mentioned by J. Corbel (1959). They prove the intensive dissecting of the karst relief in the vertical direction.

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Fig. No. 2 Changes in the chemical composition of the water dropping down the dripstones in the caves of Sloup—Šošůvka during the period from March 1960—April 1961.

1 atmospheric temperature (in the open country), precipitations
2 atmospheric temperature in the cave
3 pH
4 alkalinity
5 SO:
6 CO:
7 total hardness
8 Cl
9 CaO
10 MgO
11 organic matter
12 calcinated residue of evaporation

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ON THE PROBLEM OF SMALL URBAN AGGLOMERATIONS

Malé městské aglomerace. — Vymezování městských aglomerací ve specifických podmínkách Československa (viz zpráva ve Sborníku čes. společnosti zeměpisné, 1962 str. 258 a další) přineslo některé poznatky, které mohou mít širší platnost. Ukázalo se, že geografické spojení měst a dalších sídel na jejich obvodu existuje i u malých měst. Tato schopnost vytvářet aglomerace zřetelně slábne se snižující se velikostí města (dolní hranice kolem 5 000 obyv.). I menší sídla mají ve své blízkosti další seskupení obyvatelstva. Tato se však vyvíjejí v podstatě nezávisle. — Ukazuje se, že hustota obyvatelstva se úměrně zvyšuje s velikostí měst, ale u měst s více než 50 000 obyvateli se zvyšuje již jen pomalu. U malých měst neklesá lidnatost pod 250, výjimečně 220 obyvatel na km². — Města i po rozšíření svého obvodu se nadále výrazně odlišují od venkovských sídel i když aglomerováním podstatně nerošířily svoje zastavěné území. — Ukázalo se dále, že existují i zemědělské aglomerace tam, kde venkovská sídla spolu stavebně souvisí a jejichž zemědělská velkovýroba je jednotně organizována. U těchto „aglomerací" vzniká potenciální možnost jejich vývoje jako měst nového typu.

The delimitation of agglomeration belongs to some of the tasks most frequently dealt with. The author has made extensive use of foreign as well as Czechoslovak literature (Arnold A., Bastié J., Beaujeu-Garnier J., Bobek H., Boustedt O., Davidovič V. G., Dziewonski K., George P., Chabot G., Pokshisevskij V. V., Sirp E., Hůrský J., Korčák J., Verešík J., etc.) and according to the following characteristics: compactness of the built-up area, economic composition, internal relations of transportation and in part also services (the author has not investigated the external character and concentration of the population with regard to changes after 1945) 285 towns and urban agglomerations have been delimitated, e.i. their contemporary administrative boundary enlarged in accordance with the geographical feature (see: Sborník československé společnosti zeměpisné 1962, pp. 258—264).

Czechoslovakia is one of the densely populated countries (13,8 million inhabitants to an area of 128,000 km², density of population 108 inhabitants per one km²) with a great density of settlements (some 20,000 agglomerated settlements without any isolated houses) with an average distance of about 2—3 km between the neighbouring settlements. Especially in Bohemia small villages prevail (62% of all administrative communities have less than 500 inhabitants).

Size of towns	Number of towns	Number of agglo-meration	% of agglo-meration	Number of inhabitants	Average in 1.000 inhab.	Area in 1.000 ha	Average Area	Denisty of population
1,000,000 and more	(1)	1	(1000)	1.068,6	1.068,6	28,0	28,0	4.851
100,000 to 350,000	(4)	3	(75)	951,7	193,4	66,5	13,3	1.431
50,000 to 99,999	(14)	14	(100)	883,7	63,1	84,8	6,1	1.042
20,000 to 49,999	39	34	87	1.093,5	28,0	196,1	5,0	558
10,000 to 19,999	75	53	70	1.012,4	13,5	254,3	3,4	398
5,000 to 9,999	152	54	35	1.066,5	6,9	431,9	2,8	247
5,000 and more	285	159	55	6.077,4	1.120,0	1.061,6	3,7	1.564

The delimitation of agglomerations in such a territory has brought to light certain results which might be of wider validity.

The basic informative data are as follows:

1. The delimitation of agglomerations is often limited only to large towns. Urban agglomeration as a geographical (functional and spacial) union of towns and other settlements on its outskirts exists also in the case of small towns.

2. The capacity of creating urban agglomerations clearly weakens considerably with the reduction in the size of the town which is to be its node. The administrative delimitation of the town more or less confirms this. In Czechoslovakia the lowest limit of the capacity to create agglomeration may be set at about 5000 inhabitants. In the Czechoslovakia there exist a whole number of other settlements partly with the character of a town (according to the central statistical service about 214 administrative units which often have other settlements in their close vicinity). These however basically develop independently as agricultural, transport and sometimes partially industrial settlements.

3. Analysis has shown that there exists not only the well known relation between the size of agglomeration and the density of population on the built-up area, but in connection with this phenomenon also the dependence between the size of the town (urban agglomeration) and its administrative territory. If we ignore local deviations we shall find that the density of population in towns (and agglomerations) usually increases with its size. Density of population in towns with more than 50 thousand inhabitants and an agglome-

ration of a quarter million inhabitants increases only slowly and there are no large differences between their density of population. In the case of small towns (and agglomerations) density of population does not drop below 250, exceptionally 220 inhabitants per km^2. A certain more characteristic group among small towns is formed by the agglomeration (towns) from between 10—25 thousand inhabitants. They have a density of population of about 400 inhabitants per km^2.

Towns after the delimitation of agglomeration according to gross indexes of density of population per total area also distinctly differ from villages. The relationship between the density of population and their groupings is a valuable corrective in the delimitation of agglomerations. These by the linking up of the nodes with the settlements on the outskirts considerably increase their territory without noticeably extending their built-up area.

4. In regions with a high density of population some groups of towns are often formed. In the author's opinion, however, these groupings cannot always be referred to as "conurbation". This term should be used only in reference to such groupings forming a certain system and unity and analogically to agglomeration have their node and to a considerable extent common functions. There are two such conurbations on the territory of the Czechoslovakia in the coal field of Ostrava and in the lignite field in northern Bohemia. The groupings of towns par exemple in north east Bohemia cannot be called conurbations even though we find there towns only 5—10 km distant from each other. They exist however as comparatively isolated settlements with different functions. In future it will be necessary to organise these groups according to a unified plan and with the development of reciprocal division of function between them. Thus the more exact determination of the term "conurbation" and its differentiation for the groups of towns has its practical importance.

5. It has been found that there exist agricultural, non-urban agglomeration where villages are connected structurally (with a maximum distance of 2 km between built up areas) and by the formation of cooperative agricultural large-scale production are organised as one sole production unit. Thus organisationally and functionally linked up settlements possess all preconditions for a speedy development as the node village for the entire surroundings. In the case of large villages there thus arises the potential possibility of their development into small towns. According to the composition of the population and their occupation there already now prevails employment in services over employment in agriculture. Changes in the organisation of production in another form are the basis for the development of new types of settlements, respectively their grouping.

The confrontation of the indicated conclusions with conditions in other countries would permit the formulation of some general rules for future work both in the theory of the geography of towns as well as and in the application to the practical reconstruction of settlements.

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CHANGES IN THE GEOGRAPHICAL DISTRIBUTION OF POPULATION IN CZECHOSLOVAKIA

Změny v geografickém rozložení obyvatelstva v Československu. — Přesná čísla o počtu obyvatel podle jednotlivých obcí poskytují censy konané po 10 letech již celé století. Rok 1921 můžeme považovat za důležité rozmezí. V obdobích největší kapitalistické konjunktury zesiluje se diferenciace v hustotě osídlení jednotlivých částí Československa. Podíl obyvatelstva Slovenska z počtu obyvatelstva Československa klesl z 25 % r. 1869 na 22 % r. 1910.

Největší změny v geografii obyvatelstva nastaly v souvislosti s odsunem Němců po druhé světové válce. Teprve r. 1961 máme o něco více obyvatelstva než r. 1921. Ale jeho geografické rozložení je zcela odlišné.

Tomuto tématu je věnována autorova mapa v měřítku 1 : 200 000, vystavená na XX. Mezinárodním geografickém kongresu v Londýně.

Rozdíly v geografickém rozložení obyvatelstva v Československu sledujeme dále různými statisticko-geografickými metodami. Použili jsme směrodatné odchylky, Lorenzovy křivky a metody centrografické. Ukázalo se, že rozdíly jsou menší, než se předpokládalo.

Czechoslovak geography pays much attention to population, the main reason being the fact that the changes in the distribution of population have been extraordinary in this country. The ČSSR has also a low natural increase of population (in the last decade the average annual increase on 1000 ~~middleclass~~ inhabitans is 8,3), so that the problem of labour is the more pressing. Censuses made every ten years during the last century give us exact figures as far as the population numbers in individual localities are concerned. The changes in the geographical distribution of population can be traced only after a difficult reconstruction of territorial units (parishes) to the present state has been carried out. This has been done with districts (and regions) since 1869, and localities since 1921. The year 1921 is considered an important turning point. The previous period is characterized by a high natural increase of population diminished by an extensive emigration, and by the capitalist boom and appurtenance of this country to the large economic complex of the Austro-Hungarian Empire as well. The year 1921 brings a change in all of these factors.

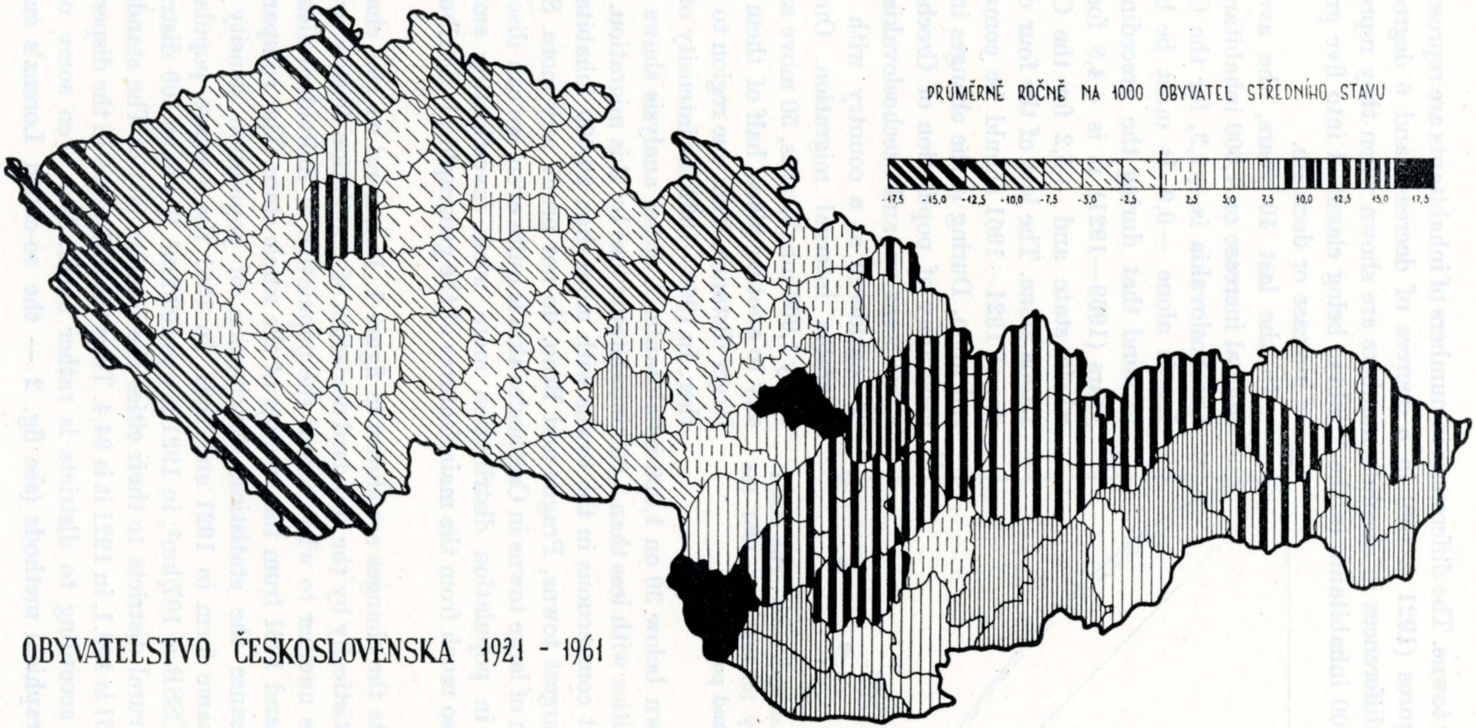
The development of population in the Czechoslovak regions (1921 = 100)

Region	1869	1890	1910	1930	1950	1961	1961 number of inhabitants in thousands
Central-Bohemian + Prague	66	81	98	114	113	120	2,273
South-Bohemian	94	98	102	97	74	77	650
West-Bohemian	76	86	101	105	66	70	829
North-Bohemian	68	83	104	108	70	74	1,085
East-Bohemian	94	99	105	102	84	87	1,199
South-Moravian	75	85	98	106	101	110	1,900
North-Moravian	70	81	99	108	92	106	1,163
West-Slovakian	73	82	95	113	120	143	1,761
Central-Slovakian	83	86	98	109	111	139	1,301
East-Slovakian	96	92	100	112	113	139	1,113
Czechoslovakia	78	87	100	108	95	106	13,742

Before the first World War there was a considerable development of industries in the Czech Lands, and in a number of districts, to which the immigration from both neighbouring and more remote districts was directed, the annual natural increase of population amounts to 20, or even more, on every 1,000 inhabitants. Two decades were enough for the number of inhabitants of such districts to be doubled. Slovakia takes no part in the economic development and the consequences of this fact are to be seen in the share of this eastern part in the total number of inhabitants of Czechoslovakia. Amounting to 25 per cent in 1869 (more than 30 per cent in the 18th century), this share was lowered to 23 per cent in 1890 and 22 per cent in 1910. (Today it is again over 30 per cent.)

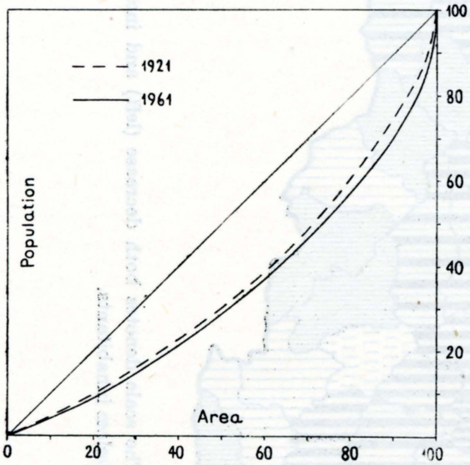
The changes in the geography of population, unique in their extent, are connected with one of the consequences of the 2nd World War — the transfer of the Sudete Germans. According to the census of 1950, the number of inhabitants was by 1,660 thousands lower than that of 1930 (in 1940 there was no census owing to the German occupation). The natural increase could not compensate for the decrease caused by the transfer and war loss. As late as in 1961 the number of inhabitants reaches, roughly, that of 1930, and is a little higher than in 1921. However, its composition is rather different, not only as to nationalities and economic and age structures, etc., but as to the geographical distribution as well. It is in these changes, which have been in progress these years as concomitant phenomena of the socialist industrialization, that the geographer is interested most.

For the exhibition of maps at the 20th International Geographical Congress in London, we have prepared a map in the scale of 1 to 200,000, depicting in detail the period of 1921—1961. Only the smallest localities (of less than 100 hectars or with less than 100 inhabitants) have been joined to some of the neighbouring ones, and agglomerated settlements have been



1. The changes in the number of inhabitants of Czechoslovakia in 1921—1961. The scale denotes both decrease (left) and increase (right) — the annual increase on 1,000 ~~middle-class~~ inhabitants.

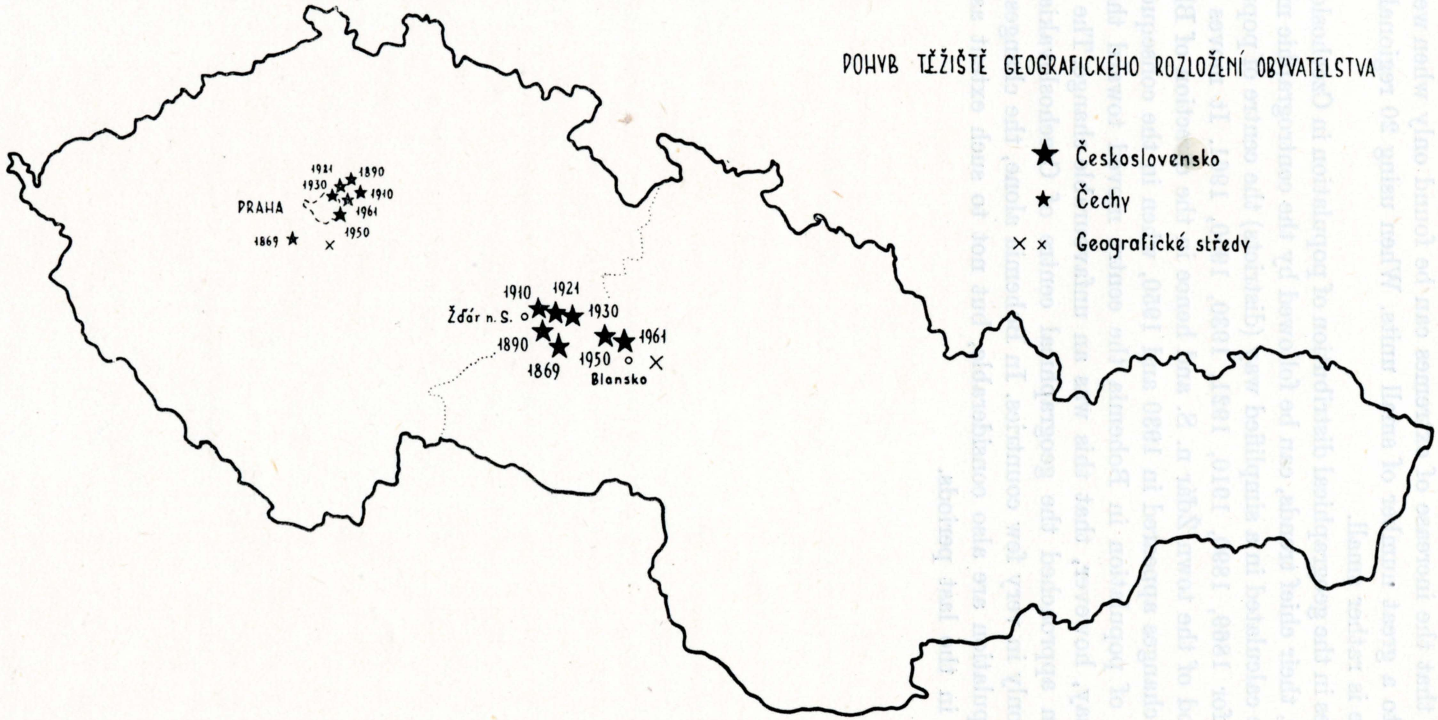
annexed to big towns. The differences in numbers of inhabitants are represented by relative figures (1921 = 100) in 5 degrees of decrease and 6 degrees of increase. The differences in absolute numbers are shown when they represent more than 1,000 inhabitants in the locality, being classified into five groups of increase or decrease.



2. The so-called Lorenz's curve. The distribution of territory (in 1921 and 1961 the same) and population.

In the last 40 years, the average annual increase on 1,000 inhabitants in Czechoslovakia is +1,3, for the Czech Lands alone —0,9. It must be borne in mind that during the preceding 40 years (1969—1921) it is +4,8 for the whole state and +5,2 for the Czech Lands alone. The last of the four decades of 1921—1961 should be commented upon. During it the changes in the geography of population of Czechoslovakia went on, and Czechoslovakia can be considered as a country with considerable internal migration. Out of every 1,000 inhabitants, 50 move annually to another place, half of them to a larger distance, from one region to another. In 1960—1962 the intensity of migration fell down below 30 on 1,000 inhabitants. A closer analysis shows that almost all localities with less than 5,000 inhabitants lose by this migration. The increase is most conspicuous in the towns with more than 20,000 inhabitants; however, the largest towns, Prague and Brno, do not profit any more. Since the distribution of large towns in Czechoslovakia is quite even, we can discover large changes in population distribution more when investigating smaller areas, and not so much from the main features of the geographical distribution of population.

As to districts the changes are shown in figure 1. In general we can characterize them statistically by the standard deviation of population density, which shows us in one number to what extent the population of individual districts differs in 1921 and 1961 from the average of the whole state. The comparison is possible because the statistical distribution of population density has, basically, the same form in 1921 and 1961. In 1961 the average population density in the ČSSR is 107/km²; in 1921 it was 102/km². We have 109 districts; if we join the rural districts to their cities the number is 103. The standards deviation in 1961 is 108.1, in 1921 it is 94,4. Thus the difference in the dispersion of settlements according to districts is rather small. But even some other statistical-geographical methods (see fig. 2 — the so-called Lorenz's curve)



3. The centre of population in Czechoslovakia (and in Bohemia alone) and its movement in 1869—1961. The asterisks denote the position of the centre for the year in question, the cross represents the geographical centre of the area.

show as well that the increase of extremes can be found only when we divide the CSSR into a great number of small units. When using 20 regional units, the difference is rather small.

The changes in the geographical distribution of population in Czechoslovakia, better to say, their chief trends, can be followed by the centrographic method, too. We have calculated in a simplified way (districts) the centre of population distribution for 1869, 1890, 1910, 1921, 1930, 1950, 1961. It moves in the neighbourhood of the town Žďár n. S. and hence in the direction of Blansko. The deepest changes appeared in 1930 and 1950, when in the consequence of the decrease of population in Bohemia the centre moved toward the east. We cannot say, however, that this was an unfavourable change. The centre of population approached the geographical centre of Czechoslovakia. This has occured only in very few countries. In Bohemia alone, the changes of the centre of population are also considerable, but not to such extent as could be expected in the last periods.

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THE COMMUTING INTENSITY OF CZECHOSLOVAK TOWNS

Dojížďka do práce v československých městech. — Zjištění, že téměř polovina mužů a téměř třetina žen má pracoviště mimo obec stálého bydliště, svědčí o velkém společenském i ekonomickém významu dojížďky do zaměstnání v Československu. Autor usiloval o maximální využití údajů z celostátních výsledků sčítání lidu z r. 1961, neboť je to u nás poprvé, kdy census skýtá i údaje tohoto druhu. Mají mimořádný význam hlavně proto, že jsou jednotné a srovnatelné pro celé státní území. Na rozdíl od běžných způsobů kartografického znázornění vyjadřuje přiložená mapa hodnoty nejen v rozlišení pro muže a pro ženy, ale navíc kromě dojížďky znázorňuje i vyjížďku. Při daném měřítku mapky nebylo již možno uplatnit na ni i ukazatel daleké dojížďky, jehož hodnotu (0—9) však uvádí tabelární seznam měst. (První dvě čísla tam značí celkovou hodnotu dojížďky a vyjížďky.) Tabulka v textu dokládá korelaci mezi hlavními ukazateli a velikostí centra jako cíle dojížďky.

In Czechoslovakia, similarly as in other highly industrialised countries, the commuting of workers is of great importance. In 1961, for example, nearly half of the men (49,7 %) and a third of the women workers (31,5 %) were employed outside the community of their permanent residence, which represents 42,8 % of all the working population.

Our paper is based on the results of *the last census* of March, 1961 which were for the first time compiled regarding the relation between the place of residence and work. The data on commuting based only on districts would not have been sufficient for geographical investigation and therefore we had to take the data of the towns as our basis. In accordance with these data the commuting is understood in the general sense of the word i.e. weekly and monthly journey inclusively. The daily commuting represents in Czechoslovakia almost 70 %. Our special interest lay in the study of *the women commuting* since the planned increase of labour force in Czechoslovakia will greatly depend on the number of women.

We have chosen towns as the geographic unit not according to the limits fixed by the number of inhabitants but according to *a complex classification of communities* which was carried out two years ago by a staff of geographers, urbanists, sociologists and particularly of demographers. This classification is based on a special investigation carried out in all communities having more than 1000 inhabitants, and concerning many attributes which are specific for the urban character of the community. According to this classification there are in Czechoslovakia 221 towns in the true sense of the word and 335 of transitory type even though still having a predominant urban character. The census elaboration took into consideration only selected communities, which represents 94 % of the proper towns and 34 % of other communities of urban type. This fact as well as the limited space were the reasons why we have concentrated our attention on the towns only. Thus our paper concerns 207 towns, which provide roughly 61 % of active population.

The census compilation gives the following data (both sexes separately): the total number of working inhabitans, number of commuters into the towns and the number of working inhabitants living permanently or temporarily in the locality of their work. We have combined these data from the viewpoint of geography and compiled some indices; the results are summarized in the table and in the map. There are difficulties in determining the proportion of *the long-range commuting*. In view of the fact that the data on the permanent residence of the commuters are classified only according to the districts it was possible to determine this rate only on the basis of general maps; this is why it was not worth while constructing a two-hourly isochron of the individual towns for this purpose. We only determined the percentage of workers commuting outside a radius of 50 km by aerial distance with corrections for districts and regions through which the imaginable circle pass on one hand and on the other for those territories where the rail and road arteries make great detours. Moreover in the case of employed women in consequence of their small number, in the middle-sized and particularly in small towns, we had to limit ourselves to the larger production centres. We could not make use of the long-range commuting index in the cartographic representation because of the scale of the map. It is therefore given — as one degree of a ten-degree classification (0—9) — at least in the list appended to the map besides the indices of "commuting-mobility" — i.e. commuting both to and from the town — separately for men and women.

A brief characteristics to explain the connections shown in the table I.

The commuting-mobility, i.e. the number of commuters per 100 active population, is combined with 5 groups of the size of the town measured by the number of active population.

The percentage of commuters represents a basic general information. There are 9 towns in which not even one third of the local inhabitants can find a job there, out of which 6 are situated in West Slovakia. There are 75 towns (36 %) of the 207 studied in which only less than 50 % of the local inhabitants can find employment in their home town. The nearer the state frontiers the smaller is the sphere of influence of the towns and the commuting is smaller unless it is a case of an important economic centre, particularly mining. Therefore the two towns where the commuting is the lowest (less than 25 %) are situated

Table I

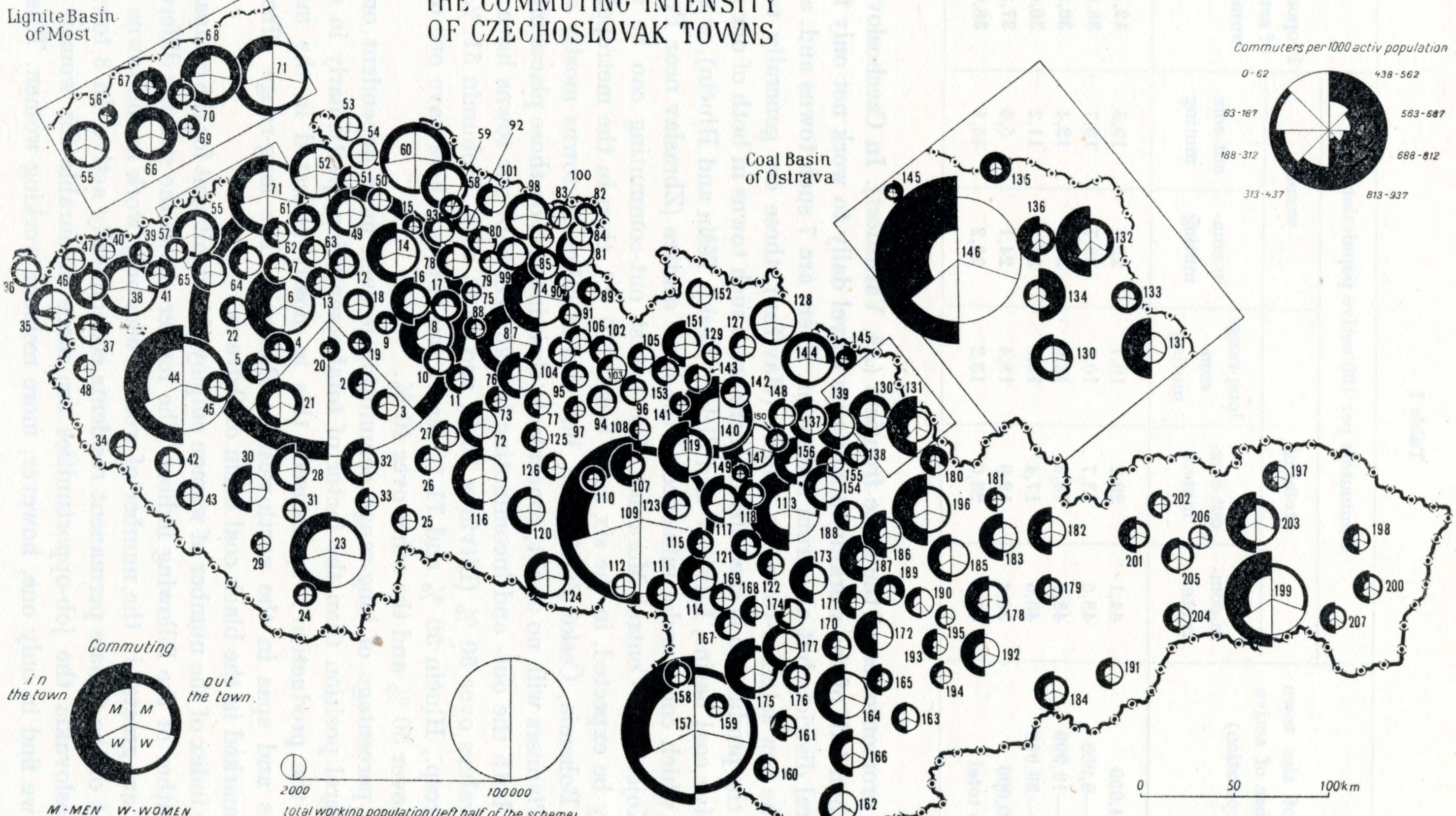
Size of the town (number of active population)	Commuters per 100 active population					Proportion of active women
	total of			women		
	in-commuters	out-commuters	long-range commuting	in-commuting	out-commuting	
up to 4,999	44,1	29,7	10,7	22,1	19,5	42,1
5,000—9,999	48,5	23,7	10,4	38,7	15,7	38,6
10,000—19,999	48,7	18,3	12,0	37,7	12,4	36,8
20,000—39,999	45,6	17,4	13,1	34,1	11,2	36,6
over 40,000	38,4	12,9	18,4	24,1	5,6	37,3
Towns total	46,5	23,0	13,2	33,2	15,1	38,9

in the promontories of the state frontiers (Aš, Varnsdorf). In Czechoslovakia more than half of the working inhabitants travel daily to work not only from the rural districts but also from the towns. There are 7 such towns and, apart from the new satellite-town for miners (Havířov), these are generally towns where the production is specialised (there are 2 such towns in both of our most extensive coal basins, Litvínov and Jirkov, Český Těšín and Hlučín), or small towns which come under influence of the large centres (Zbraslav near Prague and Kojetín in Central Moravia). The lowest out-commuting can be seen, as may be expected, in the six large towns (10 %), then in the metropolis of South Bohemia, České Budějovice, but also in other 10 towns mostly small ones. Planners will, no doubt, concentrate their interest on those places mainly where both the out- and incommuting is high. Three of our towns have both these values over 50 % (Litvínov 56 % and 66 % resp., Bohumín 51 % and 53 % resp., Hlučín 50 % and 71 % resp.) and twelve others have one of the values over 50 % and the other over 40 %.

The percentage of long-range commuting is even more dependent on the peripheral position than the factor of total commuting, particularly in areas where the production is specialised; this is mostly reflected in the mining centres and spas in the north-western Bohemia. The long-range effect ist most marked in the black coal basin of Ostrava.

The index of the number of women employed is significant for the comparison with either of the following indices. The former shows the striking differences which are greater in the number of women who only work in the towns than in that of the female permanent residents economically active. In 8 towns in Czechoslovakia the job-opportunities are more favourable for women than men, we find in only one, however, more resident working women. This fact

THE COMMUTING INTENSITY OF CZECHOSLOVAK TOWNS



(Illustration to the paper of J. Hůrský) can be explained by the character of industry which, in this case, is light industry mainly. The other extreme is represented in towns where only 25 % of job-opportunities are suitable for women — most of the seven towns of such type are the mining and metalurgical centres (three are situated in the Ostrava coal basin, others are Jáchymov, Žiar n. Hr. as well as Dobruška and Poprad). If we study the percentage of employed women out of the resident inhabitants we find only one town having this index under 25 % (Handlová in Slovakia, the centre of brown-coal mining).

The percentage of in-coming women in relation to all the working women is greater than 50 % in 26 towns. This is certainly a fact to be kept in mind in planning since in the majority of these towns the out-commuting of women is higher than 10 % and in six of them it amounts to more than 20 %.

The percentage of out-commuting women in the town is the highest in the small centres situated in the proximity of large cities (Zbraslav and Říčany near Prague with 60 % and 46 % resp., Bohumín and Hlučín near Ostrava with 48 % and 49 % resp., etc.). Apart these, only in Litvínov and naturally in the new residential satellite Havířov their respective ration exceeds 50 %, and in Kojetín 40 %.

Table II

Greatest Czechoslovak cities	Number of in- commuters (in thousands)	Number of out- commuters (in thousands)	In- commuters per 100 working population*)	out- commuters per 100 working population*)
Praha	77	40	13,9	7,7
Brno	50	12	26,4	19,8
Bratislava	47	5	30,8	4,9
Ostrava	94	5	48,1	4,3
Plzeň	32	5	34,8	7,8

*) Total working population (for in-commuting) or resident working population (for out-commuting)

The long-range commuting of women has been dealt with only for the 29 largest centres on account of the reasons already mentioned. Among our four largest cities — and in the category of towns with a population of over 40 000 inhabitants in general — Bratislava holds the first place with a rather large difference (21 %), followed by Ostrava (16 %) and Olomouc (15 %). A lower percentage than Prague (10 %) can also be seen in Brno (10 %), České Budějovice (7 %) and Kladno (5 %). The foremost place in the above mentioned 29 towns is held by Karlovy Vary (29 %) and Liberec (22 %), the last of them being Třinec (2 %) and Trnava (2 %).

From the table follows the positive correlation with *the economic weight of the town*, i.e. the total number of workers, is striking only as to long-range commuting. In the other indices the dependence is indirect or the dependence changes direction. Thus the total commuting increases at first parallelly with the growing size of the town, but the percentage is decreasing in the middle-sized towns till it rapidly falls in large towns, so that in Brno it represents only 26,4 % and in Prague only 13,9 %. Such a change takes place much sooner in the case of women commuting. We may pressume that in the long-range commuting of women the relation of indirect dependence is reflected.

In the *appended map*, too, the distribution of towns showing an intensive commuting (more than 60 % of activ population) can be easily followed. They are either the individual centres, these are smaller in Central Bohemia (Hořovice, Mnichovo Hradiště, Přelouč) and larger in Moravia — particularly so in the southern part (Uherské Hradiště, Uherský Brod, Břeclav, Rožnov p. R.) — or towns, which are clearly of the "production satellite" type (Lovosice near the historical North Bohemian metropolis of Litoměřice, Blansko lying in the sphere of influence of Brno, Kopřivnice on the boundary line of Ostrava) and finally the old mining base Jáchymov, which has again been revived. True grouping of such centres forming areas of long-range commuting can be found, however, in the western part of Slovakia, mainly to the west, and south-west of Banská Bystrica, the administrative centre of Central Slovakia. These groupings are the results of the recent industrialization of Slovakia, which is going on a such a rapid space, that the building of settlements in the proximity of the plants cannot keep abreast.

Similarly, the map also gives a survey of the towns according to the *maximal values* of the other three indices as, for instance, the concentration of towns with a high percentage of out-commuting women (over 33 % - in three cases even over 50 %), and that mainly in North Moravia, the main factor here being the lack of job-opportunities for women in the centres of mining, steel production and heavy engeneering as well as in North Bohemia, which is dominated by the traditional bases of textile-industry. In some of the areas we can see a typical combination of the individual indices. Here again the two most extensive mining areas, the black-coal Ostrava basin (having the highest share in the long-range commuting but a low percentage of job-opportunities for women and therefore the relative number of out-and in-commuting women-workers is below the average) and the lignite basin of Most (with a markedly lower total commuting and the number of out- and in-commuting women is slightly above the average). Using the cartographic representation of the individual indices we can further delimit other characteristic commuting areas.

Numbers and names of the towns and their indices of commuting mobility (1 : men, 2 : women) and of the long-range commuting (3 : total). *)

1.	Praha	005	45.	Rokycany	632	89.	Rychnov n. Kn.	632
2.	Benešov	623	46.	Sokolov	538	90.	Dobruška	421
3.	Vlašim	311	47.	Kraslice	219	91.	Kostelec n. O.	522
4.	Beroun	733	48.	Tachov	307	92.	Semily	324
5.	Hořovice	532	49.	Česká Lípa	312	93.	Turnov	424
6.	Kladno	421	50.	Mimoň	415	94.	Svitavy	312
7.	Slaný	422	51.	Nový Bor	422	95.	Litomyšl	533
8.	Kolín	432	52.	Děčín	205	96.	Moravská Třebová	412
9.	Český Brod	832	53.	Rumburk	314	97.	Polička	520
10.	Kutná Hora	312	54.	Varnsdorf	109	98.	Trutnov	314
11.	Čáslav	533	55.	Chomutov	318	99.	Dvůr Králové n. L.	312
12.	Mělník	524	56.	Jirkov	949	100.	Úpice	326
13.	Kralupy n. Vlt.	635	57.	Kadaň	529	101.	Vrchlabí	313
14.	Mladá Boleslav	321	58.	Jablonec n. N.	313	102.	Ústí n. O.	423
15.	Mnichovo Hradiště	640	59.	Železný Brod	533	103.	Česká Třebová	315
16.	Nymburk	531	60.	Liberec	206	104.	Choceň	524
17.	Poděbrady	623	61.	Litoměřice	623	105.	Lanškroun	421
18.	Brandýs–St. Boleslav	422	62.	Lovosice	732	106.	Vysoké Mýto	413
19.	Říčany	950	63.	Roudnice n. L.	520	107.	Blansko	741
20.	Zbraslav	962	64.	Louny	522	108.	Boskovice	530
21.	Příbram	529	65.	Žatec	315	109.	Brno	204
22.	Rakovník	422	66.	Most	637	110.	Tišnov	731
23.	České Budějovice	202	67.	Litvínov	967	111.	Břeclav	535
24.	Český Krumlov	525	68.	Teplice	533	112.	Mikulov	314
25.	Jindřich. Hradec	412	69.	Bílina	637	113.	Gottwaldov	323
26.	Pelhřimov	412	70.	Duchcov	742	114.	Hodonín	522
27.	Humpolec	422	71.	Ústí n. L.	219	115.	Kyjov	742
28.	Písek	313	72.	Havlíčkův Brod	423	116.	Jihlava	203
29.	Prachatice	324	73.	Chotěboř	521	117.	Kroměříž	411
30.	Strakonice	410	74.	Hradec Králové	424	118.	Holešov	520
31.	Vodňany	411	75.	Nový Bydžov	524	119.	Prostějov	431
32.	Tábor	422	76.	Chrudim	522	120.	Třebíč	211
33.	Soběslav	521	77.	Hlinsko	320	121.	Uherské Hradiště	742
34.	Domažlice	422	78.	Jičín	422	122.	Uherský Brod	630
35.	Cheb	209	79.	Hořice	511	123.	Vyškov	521
36.	Aš	219	80.	Nová Paka	423	124.	Znojmo	412
37.	Mariánské Lázně	419	81.	Náchod	225	125.	Žďár n. S.	422
38.	Karlovy Vary	419	82.	Broumov	414	126.	Velké Meziříčí	421
39.	Jáchymov	746	83.	Červený Kostelec	312	127.	Bruntál	315
40.	Nejdek	209	84.	Hronov	316	128.	Krnov	115
41.	Ostrov	729	85.	Jaroměř	323	129.	Rýmařov	425
42.	Klatovy	422	86.	Nové Město n. Met.	322	130.	Frýdek-Místek	524
43.	Sušice	422	87.	Pardubice	525	131.	Třinec	535
44.	Plzeň	206	88.	Přelouč	633	132.	Karviná	529

*) Scale of the index of long-range commuting: (0) 0—2,9 (1) 3,0—5,9 (2) 6,0—8,9 (3) 9,0—11,9 (4) 12,0—14.9 (5) 15,0—17,9 (6) 18,0—20,9 (7) 21,0—23,9 (8) 24,0—26,9 (9) 27,0 . . .

133.	Český Těšín	743
134.	Havířov	739
135.	Bohumín	869
136.	Orlová	649
137.	Nový Jičín	423
138.	Frenštát p. R.	543
139.	Kopřivnice	533
140.	Olomouc	413
141.	Litovel	631
142.	Šternberk	412
143.	Uničov	515
144.	Opava	412
145.	Hlučín	952
146.	Ostrava	309
147.	Přerov	423
148.	Hranice	422
149.	Kojetín	732
150.	Lipník n. B.	522
151.	Šumperk	422
152.	Jeseník	315
153.	Zábřeh	524
154.	Vsetín	322
155.	Rožnov p. R.	541
156.	Valašské Meziříčí	532
157.	Bratislava	209
158.	Malacky	623
159.	Pezinok	622
160.	Dunajská Streda	531
161.	Galanta	631
162.	Komárno	214
163.	Levice	421
164.	Nitra	312
165.	Zlaté Moravce	760
166.	Nové Zámky	321
167.	Senica	421
168.	Myjava	541
169.	Skalica	423
170.	Topolčany	631
171.	Bánovce n. B.	641
172.	Partizánske	542
173.	Trenčín	532
174.	Nové Mesto n. V.	521
175.	Trnava	521
176.	Hlohovec	521
177.	Piešťany	422
178.	Banská Bystrica	537
179.	Brezno n. Hr.	524
180.	Čadca	831
181.	Dolný Kubín	532
182.	Liptovský Mikuláš	432
183.	Ružomberok	432
184.	Lučenec	431
185.	Martin	327
186.	Považská Bystrica	540
187.	Dubnica n. V.	544
188.	Púchov	542
189.	Prievidza	822
190.	Handlová	314
191.	Rimavská Sobota	322
192.	Zvolen	423
193.	Žiar n. Hr.	537
194.	Banská Štiavnica	422
195.	Kremnica	324
196.	Žilina	433
197.	Bardejov	441
198.	Humenné	531
199.	Košice	305
200.	Michalovce	521
201.	Poprad	534
202.	Kežmarok	531
203.	Prešov	522
204.	Rožnava	323
205.	Spišská Nová Ves	412
206.	Levoča	312
207.	Trebišov	531

ZDENĚK LÁZNIČKA

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RESIDENTIAL AND INDUSTRIAL AREAS OF THE CZECHOSLOVAK TOWNS

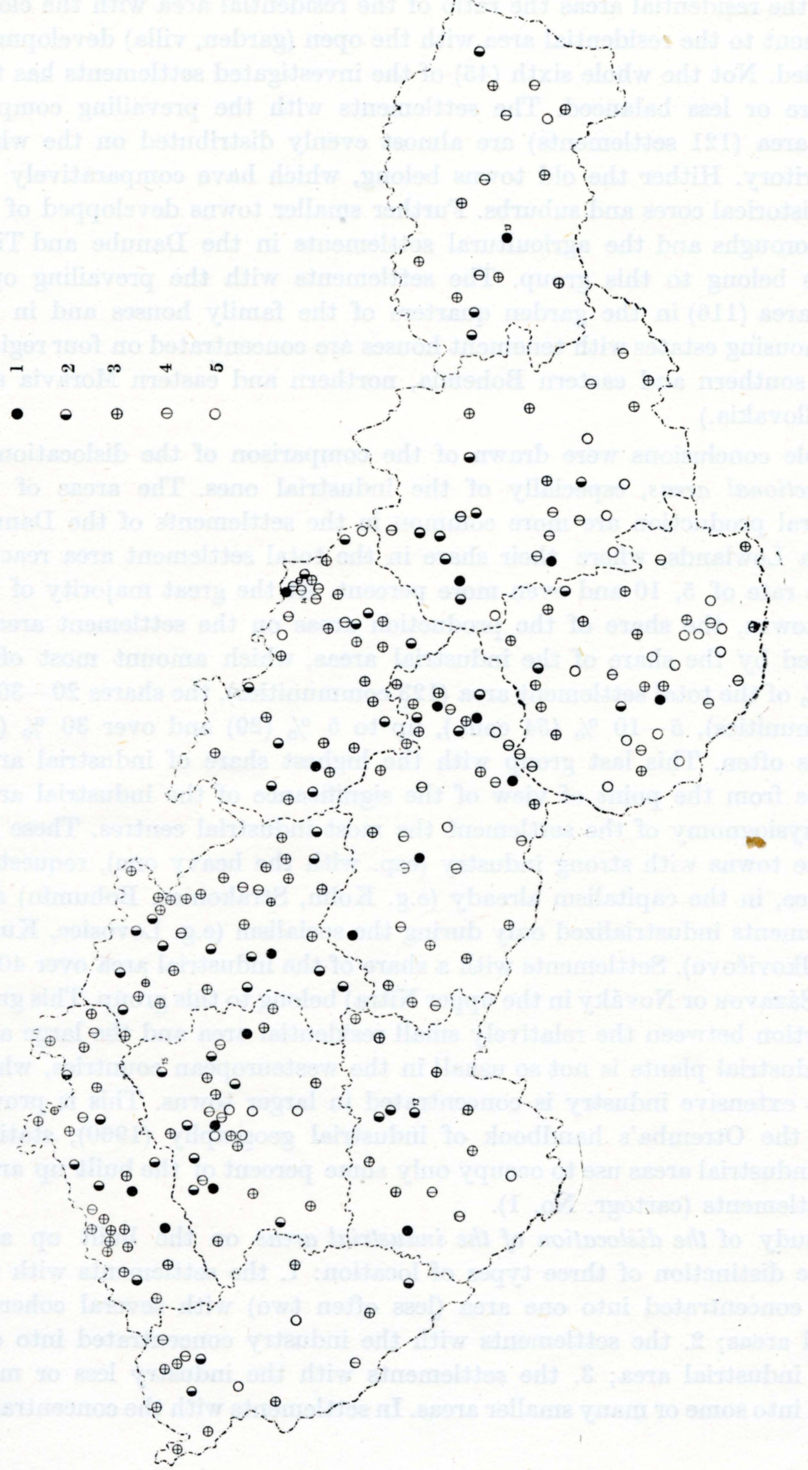
Obytné a průmyslové plochy československých sídel s více než 5000 obyvateli (kromě velkoměst). — Ve spolupráci s Výzkumným ústavem výstavby a architektury byly ve 282 československých obcích zjišťovány obytné, výrobní, dopravní plochy a plochy veřejné zeleně. Zdaleka největší plochy zaujímají plochy obytné a průmyslové. Obytné plochy zaujímají nejčastěji 70—80 nebo 80—90 %, průmyslové 10—20, 20—30 a 5—10 % celkové sídelní plochy. Nejvyšší podíl průmyslových ploch vykazují střediska silného průmyslu již v kapitalismu a sídla industrialisovaná v socialismu. Většina studovaných sídel (zvl. na Slovensku) se vyznačuje větším či menším soustředěním průmyslu do určité části sídelní plochy. Menšina sídel (zvl. v českých zemích) má průmysl rozptýlený po celé sídelní ploše dík menším závodům zvl. lehkého průmyslu. Větší prostorová koncentrace slovenského průmyslu lépe vyhovuje moderním požadavkům na rozmístění průmyslových ploch. Topografická poloha průmyslových ploch zvl. těžkého průmyslu se vyznačuje vázaností na železnici, rovinatý terén a okraj obytných ploch. Je patrný i vliv struktury průmyslu na jeho rozmístění.

The Czechoslovak geographical literature did not deal hitherto in a special study with the location of the functional areas in the towns. In the foreign literature such studies are also rarely met with and they refer to the study of the location of the industry in the cities most often (e.g. Robertson's study about Edinbourgh, Zimm's about Berlin, Bencze's about Budapest). The comparing studies, occupying on this theme by more settlements for the certain region are exceptional (e.g. Jonas' study about the towns of Low Saxo.),.

In cooperation with the Research Institute for Construction and Architecture in Brno, the settlement areas in the Czechoslovak settlements with more than 5000 inhabitants with the exception of 5 greatest cities were investigated in the Geographical Institute of the Czechoslovak Academy of Sciences in Brno. The military maps with the scale 1 : 25.000, giving the state of the years 1950—57 approximately, served as a basis for these investigations. The settlement areas have been planimetrically established in 282 towns altogether. In these towns only the parts of the administrative communities near of their core or united with it were included. The farther and separated parts of the communities and the parts of scattered plan were dropped from the investigations. The built-up areas (i.e. the areas of the buildings and courtyards), the areas of streets, squares and gardens in the residential areas are included. The productional areas are divided into industrial and agricultural areas. To the industrial areas the areas of the industrial plants (i.e. of the factories with courtyards) including the tractordepots and storehouses are added. To the agricultural areas belong the areas occupied by the state farms, by the farm buildings and by the equipment of the collective farms. To the transportational areas the larger railway-stations (i.e. buildings, ramps, rails) and the broader railway tracks limited by the excavations and embankments belong. The spaces of public green relate on the parks and forested areas with the distinguished paths. The investigations showed, that the largest areas are occupied by the residential and productional, especially industrial areas, which assert consequently most strongly in the physiognomy of the studied settlements. The following table shows the differentiation of the settlement area in ha:

Size of the town:	Settlement area	Residential	Production	Transport	Public green
		area in ha			
50-100 000 inhabitants therein:	8798	6 438	1 677	452	231
Košice	847	686	120	28	13
Olomouc	1 059	765	192	49	53
Liberec	996	818	109	42	27
Č. Budějovice	988	710	173	83	22
Ústí n. L.	899	572	198	106	23
Hradec Králové	672	457	179	17	19
Gottwaldov	606	509	83	2	12
Pardubice	736	530	149	31	26
Havířov	231	201	24	6	—
Kladno	681	432	211	32	6
Karviná	668	454	170	16	28
Most	415	304	69	40	2
10—50 000 inhabit.	31 347	22 647	6 118	1 324	1 257
Settlem. w. 5—10 000 inhabit.	26 584	20.774	4 504	458	848
Total	66 729	49 859	12 299	2 234	2 336

The residential areas occupy most often 70—80% (at 96 communes) and 80—90% (at 80 communes) of the whole settlement area of the community. Among the towns with a high percentage of the residential area (over 90%) there are settlements with a less developed industry, some towns and communities of the Ostrava-Karviná Basin with the large workers' colonies, the communities in surroundings of Prague and the agricultural communities of the Danube Lowland. The lowest percentage of the residential area (below 60%) occur mostly at towns with a well developed industry, eventually with a railway crossing.

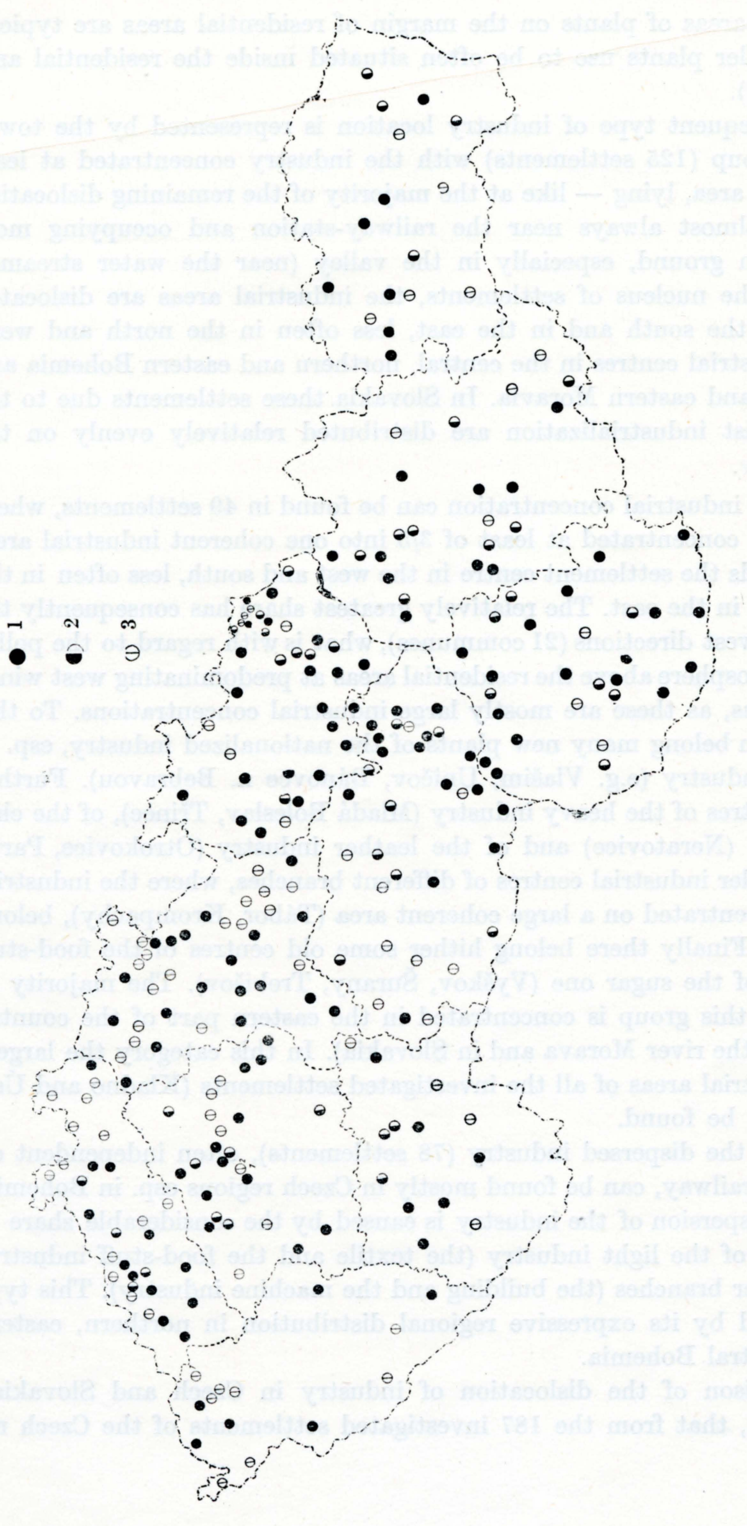


1. The industrial areas in the Czechoslovak settlements with more than 5000 inhabitants (with the exception of 5 greatest cities). The share of the industrial areas on the total settlement area amounts: 1. more than 30%, 2. 20—30%, 3. 10—20%, 4. 5—10%, 5. less than 5%.

Inside the residential areas the ratio of the residential area with the closed development to the residential area with the open (garden, villa) development was studied. Not the whole sixth (45) of the investigated settlements has this ratio more or less balanced. The settlements with the prevailing compact built-up area (121 settlements) are almost evenly distributed on the whole state territory. Hither the old towns belong, which have comparatively extensive historical cores and suburbs. Further smaller towns developped of the former boroughs and the agricultural settlements in the Danube and Tisza Lowlands belong to this group. The settlements with the prevailing open built-up-area (116) in the garden quarters of the family houses and in the modern housing estates with tenement houses are concentrated on four regions (central, southern and eastern Bohemia, northern and eastern Moravia and central Slovakia.)

Valuable conclusions were drawn of the comparison of the dislocation of *the productional areas,* especially of the industrial ones. The areas of the agricultural production are more common in the settlements of the Danube and Tisza Lowlands, where their share in the total settlement area reaches often the rate of 5, 10 and even more percent. At the great majority of the studied towns, the share of the production areas on the settlement area is determined by the share of the industrial areas, which amount most often 10—20 % of the total settlement area (123 communities), the shares 20—30 % (59 communities), 5—10 % (54 com.), up to 5 % (29) and over 30 % (17) occur less often. This last group with the highest share of industrial areas represents from the point of view of the significance of the industrial areas in the physiognomy of the settlement the most industrial centres. These are partly the towns with strong industry (esp. with the heavy one), requesting large space, in the capitalism already (e.g. Kolín, Strakonice, Bohumín) and the settlements industrialized only during the socialism (e.g. Lovosice, Kunovice, Sládkovičovo). Settlements with a share of the industrial area over 40 % (Žďár n. Sázavou or Nováky in the upper Nitra) belong to this group. This great disproportion between the relatively small residential area and the large area of the industrial plants is not so usuall in the westeuropean countries, where the more extensive industry is concentrated in larger towns. This is proved even by the Otremba's handbook of industrial geography (1960), stating, that the industrial areas use to occupy only some percent of the built up areas of the settlements (cartogr. No. 1).

The study of *the dislocation of the industrial areas* on the built up area led to the distinction of three types of location: 1. the settlements with the industry concentrated into one area (less often two) with several coherent industrial areas; 2. the settlements with the industry concentrated into one coherent industrial area; 3. the settlements with the industry less or more dispersed into some or many smaller areas. In settlements with the concentrated



2. The dislocation of the industrial areas in the Czechoslovak settlements with more than 5000 inhabitants (with the exception of 5 greatest cities and towns where the share of the industrial areas amounts up to 5% of the settlement area) Settlements: 1. with the industry concentrated in one area (less often two). 2. with the industry concentrated in one coherent industrial area, 3. with the dispersed industry.

industry large areas of plants on the margin of residential areas are typical, while the smaller plants use to be often situated inside the residential area (cartogr. No. 2).

The most frequent type of industry location is represented by the towns of the first group (125 settlements) with the industry concentrated at least of 2/3 into one area, lying — like at the majority of the remaining dislocation categories — almost always near the railway-station and occupying most often the plain ground, especially in the valley (near the water streams). In regard to the nucleus of settlements, the industrial areas are dislocated most often in the south and in the east, less often in the north and west. These are industrial centres in the central, northern and eastern Bohemia and in the central and eastern Moravia. In Slovakia these settlements due to the uniform socialist industrialization are distributed relatively evenly on the whole territory.

The extreme industrial concentration can be found in 49 settlements, where the industry is concentrated at least of 3/5 into one coherent industrial area, situated towards the settlement centre in the west and south, less often in the South-west or in the east. The relatively greatest share has consequently the orientation to west directions (21 communes), what is with regard to the pollution of the atmosphere above the residential areas at predominating west winds disadvantageous, as these are mostly large industrial concentrations. To this type of location belong many new plants of the nationalized industry, esp. of the machine industry (e.g. Vlašim, Uničov, Bánovce n. Bebravou). Further some older centres of the heavy industry (Mladá Boleslav, Třinec), of the chemical industry (Neratovice) and of the leather industry (Otrokovice, Partizánské) and older industrial centres of different branches, where the industrial plants are concentrated on a large coherent area (Tábor, Krompachy), belong to this group. Finally there belong hither some old centres of the food-stuff industry esp. of the sugar one (Vyškov, Šurany, Trebišov). The majority of settlements of this group is concentrated in the eastern part of the country (in the east of the river Morava and in Slovakia). In this category the largest coherent industrial areas of all the investigated settlements (Kladno and Ústí n. Labem) can be found.

The type of the dispersed industry (78 settlements), often independent on the site of the railway, can be found mostly in Czech regions esp. in Bohemia. The relative dispersion of the industry is caused by the considerable share of smaller plants of the light industry (the textile and the food-stuff industry) and of the other branches (the building and the machine industry). This type is characterized by its expressive regional distribution in northern, eastern and partly central Bohemia.

The comparison of the dislocation of industry in Czech and Slovakian regions showed, that from the 187 investigated settlements of the Czech regions 121 (64.7%) communities belong to the first two categories with a concentrated industry and only 66 (33.3%) communities to the group with a dispersed industry. In Slovakian regions this relation is 53 communes (81.4%) with a concentrated industry to 12 (18.6%) with a dispersed one. The space concentration of the Slovakian industry is due to the actual socialist industrialization consequently greater than in Czech regions.

The rough establishment of the main features of the dislocation and of the topographic situation of industrial areas in the studied Czechoslovak settlements showed the basal dependence of these areas on railways and on plain terrain and the influence of the structure of the industry on its dislocation. The more detailed explanation of the causes of the industry dislocation would require at least at older industrial centres the study of the historical development.

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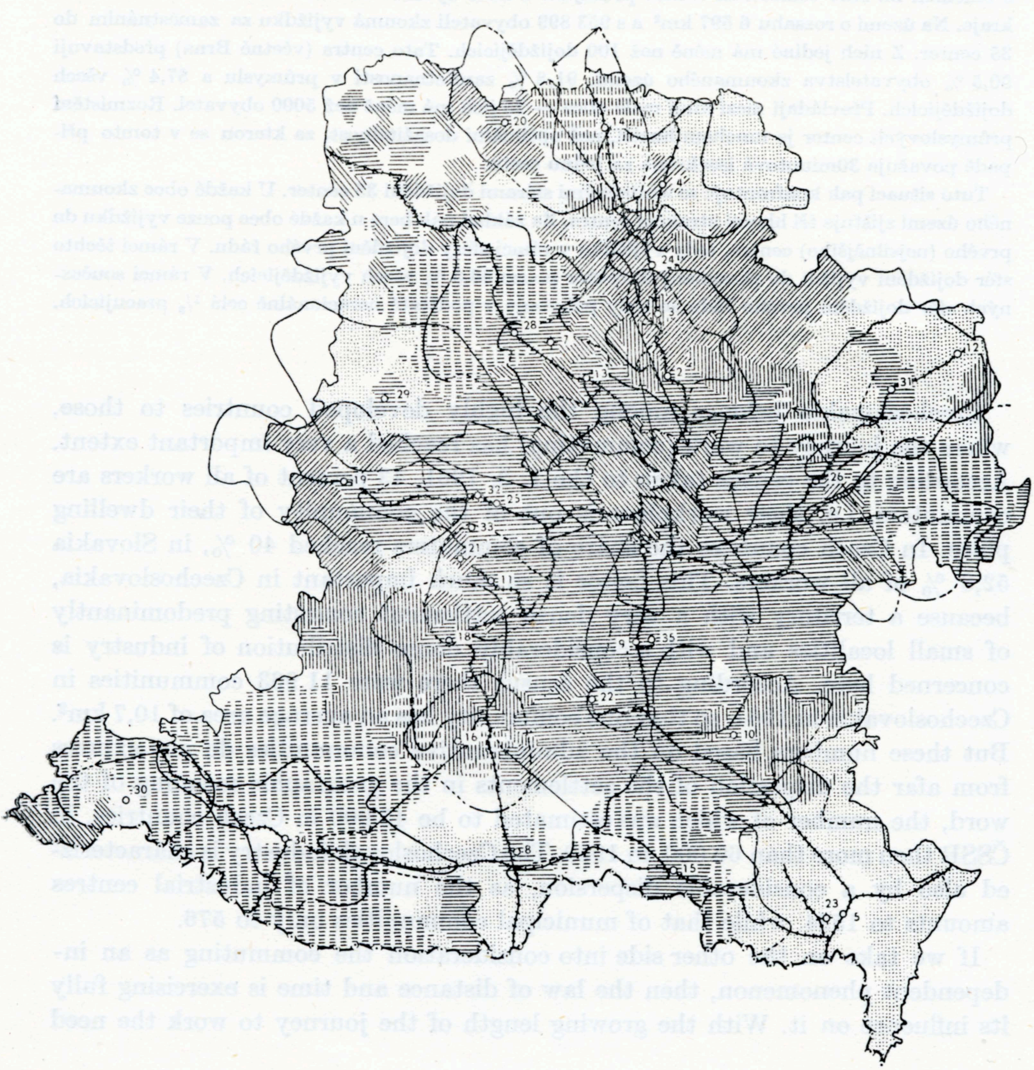
OVERLAPPING COMMUTING IN THE REGION OF SOUTH MORAVIA

Překrývající se dojížďka v Jihomoravském kraji. — Autor se zabývá problematikou dojíždění s ohledem na stav rozmístění center průmyslu a míst bydliště na části území Jihomoravského kraje. Na území o rozsahu 6 597 km² a s 953 899 obyvateli zkoumá vyjížďku za zaměstnáním do 35 center. Z nich jediné má méně než 100 dojíždějících. Tato centra (včetně Brna) představují 50,5 % obyvatelstva zkoumaného území, 91,8 % zaměstnanosti v průmyslu a 87,4 % všech dojíždějících. Převládají mezi nimi malé obce — 25 jich má méně než 5000 obyvatel. Rozmístění průmyslových center je mnohem hustší, než optimální dosažitelnost, za kterou se v tomto případě považuje 30minutová isochrona za jednu cestu.

Tuto situaci pak konfrontuje se skutečnými sférami dojíždění 35 center. U každé obce zkoumaného území zjišťuje tři hlavní atrakční centra. Za základ pak bere u každé obce pouze vyjížďku do prvého (nejsilnějšího) centra, tedy vyjížďku v rámci sféry dojíždění prvého řádu. V rámci těchto sfér dojíždění vyjíždí do zkoumaných center pouze 66,5 % všech vyjíždějících. V rámci současných sfér dojíždění prvého řádu se tedy pohybuje v podstatě neracionálně celá $^1/_3$ pracujících.

Czechoslovakia belongs among the highly developed countries to those, where the journey to work (commuting) has reached a very important extent. According to the census taken to the 1. 3. 1961, 43 percent of all workers are commuters, i.e. their workplace is out of the community of their dwelling place. In Czech countries the share of commuters reached 40 %, in Slovakia 52,8 % of all workers. This factor is so much important in Czechoslovakia, because a territory with a very dense settlement consisting predominantly of small localities and with a considerably dense distribution of industry is concerned here. According to the census there were 11 963 communities in Czechoslovakia in 1961, so that one community has an average area of 10,7 km². But these numbers based on the administrative communities do not express from afar the dispersion of the settlements in the geographic meaning of the word, the number of which was estimated to be 45 000 in Czech countries, in ČSSR then more than 60 000, in 1950. The Czechoslovak industry is characterized also by a considerable dispersion, as the number of industrial centres amounts to 1524, while that of municipal communities only to 576.

If we take on the other side into consideration the commuting as an independent phenomenon, then the law of distance and time is exercising fully its influence on it. With the growing length of the journey to work the need of time is increasing obviously to a certain limit, behind which the commuting becomes unremunerative. The problematics is more complicated, as the present stage of the dislocation of industry shows often the results of the preceeding development, which is much denser than the certain tolerable attainability. The most favourable conditions are created by this for many industrial centres to be able to recruit the labor forces mutually of their backlands. The too dense distribution of industry is just an important geographically conditioned reason for the origin and development of the disadvantageous crossing commuting, which does then cause the strong endosmosis and the overlapping of the spheres of commuting, the competition of many industrial centres and the weakening of the effective utilization of their backlands.



The situation sketched generally in the specific conditions of Czechoslovakia, is shown concretely on the example of the commuting on the territory of the former administrative region of Brno (Moravia), with the exception of the two most northern districts. Our analysis concernes the area of 6597,8 km², on which 953 899 inhabitants were living to the 1. 3. 1961. Brno, which is the centre of this territory, is the third largest industrial centre and the second largest centre of the machine industry in Czechoslovakia. Besides Brno 34 further industrial centres of this region having (with the one exception of Vranov

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Explanations to the cartogram:

1. List of the centres: 1. Brno, 2. Adamov, 3. Blansko, 4. Boskovice, 5. Břeclav, 6. Bučovice, 7. Drásov, 8. Hrušovany n. J., 9. Hrušovany u B., 10. Hustopeče, 11. Ivančice, 12. Ivanovice n. H., 13. Kuřim, 14. Letovice, 15. Mikulov, 16. Miroslav, 17. Modřice, 18. Moravský Krumlov, 19 Náměšť n. O., 20. Olešnice, 21. Oslavany, 22. Pohořelice, 23. Poštorná., 24. Rájec n. Sv., 25. Rosice, 26. Rousínov, 27. Slavkov, 28. Tišnov, 29. Velká Bíteš, 30. Vranov n. Dyjí, 31. Vyškov, 32. Zastávka, 33. Zbýšov, 34. Znojmo, 35. Židlochovice.

2. State frontier.

3. Boundaries of the former region of Brno and of the investigated area.

4. Boundaries of the territory of the town Brno.

5. Railway.

6. 30 min. isochrone (at Brno the 60 min. one).

7. 15 min. isochrone.

8. The isochrone for the respective centre left out.

9. Spheres of commuting of the first order:

a) Brno.

b) Adamov, Ivanovice n. H., Hustopeče, Mor. Krumlov.

c) Kuřim, Pohořelice, Slavkov (Austerlitz), Vranov n. Dyjí, Zbýšov.

d) Blansko, Ivančice, Náměšť n. O., Olešnice, Židlochovice.

e) Boskovice, Břeclav, Hrušovany n. J., Oslavany, Velká Bíteš, Vyškov.

f) Bučovice, Mikulov, Znojmo, Tišnov.

g) Letovice, Miroslav, Rájec n. S., Rousínov.

10. 0 9 km.

n. Dyjí) more than 100 in-commuters, were taken into consideration. As for the number of inhabitants, three of them have less than 2000 inhabitants, 22 belong to the group 2000—5000 inhabitants, 6 to the group 5000—10 000 inhabitants, 3 to the group 10 000—25 000 inhabitants, and the last one, Brno, has 320 000 inhabitants. It is evident, that the prevailing part of the workplaces and of the in-commuting centres are small communities. The investigated 35 centres represent 50,5 % of the population of the studied territory, 91,8 % of the employment in industry and the proportion of all in-commuters reaches in them 87,4 %. The investigation of the commuting was carried out by the planning commission for the region of Brno in 1957. There were established on the whole 71 595 out-commuters on the investigated territory.

The development of the dislocation of industry reached such an extent on the investigated territory, that it is predominantly much denser, than the certain optimum attainability, which has been choosen and not derived. The suppositions for this fact are shown graphically on the enclosed cartogram. They are plotted here for the investigated centre the isochrones of 30 minutes for one way. The centre of these isochrones is always the railway-station and the bus-station. Only for the town Brno the 60-min. isochrone is drawn, constructed in a different way. Here even the average attainability of the railway- and bus-station from the individual localities of industry and from other ones is taken into account, computed of the complex of more than 26 000 in-commuters. We did not plotted the 30 minutes' isochrone for the sake of simplification of the figure for the 6 centres (specified in the cartogram) neighbouring with the further investigated centre. We plotted only the 15 minutes' isochrone for the further three centres. The isochrones are constructed on the basis off all existing transport opportunities. We leave out the question of the so called optimum attainability and we use the 30 minutes' isochrone as the working one. It follows from the cartogram that especially on the territory northwards, westwards and eastwards of Brno, the territories attainable easily from the individual centres are overlapping several times; a better situation can be found only in the stripe along the southern boundaries of the region and of the border of the region NW and NE of Brno.

To be able to establish the influence of this situation on the simultaneous overlapping of the spheres of commuting and the rationality of the movements, we computed for all communities of the investigated area the out-commuting into the first three most preferred workplaces. Of every emigration community working people are out-commuting to some different centres. The fact, that of one community all workers would commute out only to one centre, does not occur. On the contrary, at the prevailing part of communities the out-commuting to a larger number of centres is characteristic. Having taken into consideration at every community only the out-commuting to the first three centres, every of the emigration communities is arranged into the sphere of commuting of three of the investigated 35 centres. 62 607 workers were out-commuting on the whole to the investigated centres and we seized 89 % of them by this method. But it was possible to draw in our cartogram only those communities for every centre, from which one is out-commuting on the first place. But these spheres of commuting (we shall call them the spheres of commuting of first order) show graphically that there is a great difference among the present spheres of commuting and the limit of the optimum attainability of the individual centres. For the sake of conciseness only the main features of this figure can be emphasized. The very strong centre — such as Brno indisputably — overlaps the part of the centres in its surroundings, especially in south, which is, as for the industry, weaker. Due to the economic pressure of Brno, the spheres of commuting of the first order of all surrounding centres (with the exception of the stripe along the southern border) are developed excentrically and this pressure is transfered gradually on further remote centres. The spheres of commuting of the first order of our centres cover in substance the whole investigated territory.

Theoretically, if all the out-commuters of the respective sphere of commuting were out-commuting to the respective centre, the 100 % of out-commuters should be identical with the extent of the investigated area. But we notice here, just due to the decisive influence of the above mentioned fact, that to these centres only 74,7 percent are commuting of the number of out-commuters we established. The rest, i.e. 25,3 % belongs consequently to the category of the crossing commuting. If the whole out-commuting and not only the out-commuting to the first three most preferred centres is taken into account at every emigration community, we can see, that 66,5 % only of all workers commuting out on the territory of the spheres "of the first order" are in-commuting in these centers. Consequently the commuting of the whole one third of workers is not rational. Their considerable part (especially with the exception of Brno, where the extent of the in-commuting is exceeding), belongs nevertheless to the category of the optimum commuting from the view of the attainability of the centres.

Owing to the crossing we get this resulting picture of the investigated territory. The territory of the three spheres of commuting of all centres occupied 15 342,7 km^2 on the whole and 1 697 622 inhabitants were living in the communities lying on this territory. It appears, that the mentioned centres recruit the labor forces due to the crossing of the in-commuting of the territory the area of which is in fact 2,3 times larger than that of the investigated territory and the number of inhabitants of which is 1,8 times greater than the number of inhabitants of the same territory. Brno was not included into this balance with respect to the misstaking due to the influence of the metropolis. The respective multiples would be including this town 2,5 resp. 2,7. These high coefficients are the index of the considerable crossing of the in-commuting and out-commuting and they prove the movement between the workplace and the dwelling place not to be quite rational. This question becomes to be of growing actuality, because of the important further increase in the commuting (and so even in its negative aspect) since 1957.

It follows consequently that in such complicated territories as were shown here, the regionalization of the in-commuting is desirable, which is assumed perspectively here. The regionalization of the commuting means not only savings on the dispersed and uselessly crossing traffic and on the possibility to concentrate it to advantage, but it has for aim to improve substantially the situation of the commuters.

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OVERPOPULATION IN AGRICULTURAL AREAS OF JAWA

Zemědělské přelidnění Jávy. — Typickou formou relativního přelidnění Indonésie a především Jávy, kde žije na 65 % obyvatelstva státu, je agrární přelidnění. Jeho základní příčinou je pokles variabilní složky kapitálu, a dále je také způsobuje rychlý růst obyvatelstva, takže podíl obdělávané půdy na jednoho obyvatele se stále zmenšuje. Na tomto ostrově, kde 68 % činných je zaměstnáno v zemědělství, prakticky již neexistují půdní reservy a další odlesňování se jeví jako nežádoucí. V současné době je na Jávě na 8 mil. lidí, pro než není v zemědělské výrobě celoroční zaměstnání; odcházejí buď natrvalo, nebo na část roku do měst, kde stejně už existuje zjevné přelidnění. Určitým řešením je přesun „nadbytečných" lidí na reservní plochy Sumatry, Kalimantanu, Sulawesi po případě dalších ostrovů. Pokud se však současně s tím nezmění způsob obdělávání půdy, pak tyto přesuny mají cenu omezenou.

The provision of means of existence in sufficient quantity is not merely a technical question, not exclusively a question of developing the forces of production, but likewise the social relations of production. There exist technically very advanced countries that have found the answer — to the better or worse — to the problem of production of sufficient quantities of essential requirements for existence, but even there numerous people have not found a useful place in society. If the question of the distribution of products and means of production has not been treated as a vital moment in social relations, even highly developed capitalist societies encounter the problem of excessive populations, surplus manpower.

This problem is much more acute in the newly developing countries, where for decades and even centuries the economies were biased in favour of the needs of the metropolitan countries.

A basic cause giving rise to the relative overpopulation is the growth of the organic composition of capital with the resulting drop in the demand for manpower, on the one hand, and, on the other, the increase in the total labour force, respectively the proletariat. The striving for maximum profits leads the enterpreneur to make fullest use of labour power in a variety of ways. As a result unemployment increases. In the case at hand the most frequent is the so-called hidden or agrarian over population, since we are dealing with an agrarian country (industry has a 17% share in the creation of the social product).

According to the 1961 census Indonesia has a population of 97 085 00, 64,8% of which refer to Jawa with Madura that form an administrative unit. Of the total number of inhabitants in Jawa 62% are of working age, of which 68% are active in agriculture, not quite 10% in industry and crafts, including mining and building industries. For Indonesia as an economically underdeveloped country this economic structure is typical. The population problem of Jawa represents one of the key social and economic problems of the whole of Indonesia.

Many factors can together be held responsible for the agrarian overpopulation of the island. One of them is the rapid growth of the population, the considerable natural increase. For example in 1815 Jawa had 4.4 million inhabitants, in 1845 9,3 million, in 1930 41,7 and by 1961 63,05 million persons. The natural increase ranged from 1.5 to 1.7%.

There is an enormous density of population in Jawa. On the average this density amounts to 400—700 persons per 1 km² of total land. The very fertile soil in the proximity of Malang holds more as 2300 persons per 1 km² of irrigation ricefields, in Madura 1800 to 4000 persons of total inhabitants of Malanga (excepting plantation areas).

With the constantly increasing population the per capita area of cultivated soil on Jawa and Madura is decreasing. E.g. in 1939 there was 0,17 hectare per capita, in 1957, 0,15 and in 1959, 0,14 hectare of all kinds of fields; the corresponding figures for land under irrigation (sawah) are: 0,07, 0,06, 0,05 hectares.

By December 31, 1959 Jawa had a total of 8,429.000 hectares of cultivated agricultural land, and 16.378.440 working peasants (excluding plantations and plantation labourers).

According to these figures one peasant has roughly 0,51 hectare of soil to cultivate. Long experience with migrants to Sumatra and with the traditional peasant way of work on Jawa has shown that one labourer can cultivate roughly one hectare of land per year, using today's techniques. This simplified calculation shows that the reserve army of peasants on Jawa amounts to about 8 million people, who are useless to agriculture today, and might be useful elsewhere, if no basic change in agricultural production were to take place. This reserve army works on the fields only part of the year, in the off season periods they find occasional work in sugar-mills, hotels, transport (betja) etc. This fluctuation of unusually vast dimensions shows the same rhythm as the cultivation of the main plant, rice, which makes large demands on manpower. This fluctuation takes place four times a year. Part of the country population of Jawa goes into the towns or industrial centres either permanently or seasonally. The consequence is pressure on the employment market which, in any case, is saturated with a more than sufficient number of town workers.

One of the ways of solving the production of food and also the relative overcrowding would be to make use of land not under cultivation, which exists in large quantities in Indonesia as in a number of countries of south-east Asia. It would be a question of determining which regions provide most suitable conditions for agricultural production as well as the manner of putting these areas in use. There are vast expanses of potentially productive areas on Kalimantan, Sumatra, Sulawesi, and to a more limited extent on the Islands of Maluku. A total of 45 million hectares of "reserve" land has been estimated so far in Indonesia; all these could be used for agriculture. (Production Yearbook FAO, 1958.)

By the outbreak of the second world war a total of 127.391 families had been moved, i.e. 509.564 persons, if we count an everage of 4 persons per family. Between 1950 and 1959 roughly 33—46 thousand persons migrated annually. The migration of populations is hampered by obstacles that slow down such campaigns or make them quit impossible. There are, for instance, considerable problems connected with clearing of forests in the rainy period or in difficult terrain, with the construction of irrigation systems, the construction of villages, etc.

In the new areas the family is allotted 2.5 hectares of land, of which 1 ha is intended for the cultivation of basic products, 0,75 ha for export produce, and another 0,25 ha for the erection of a house, farm buildings and a garden. 1/2 hectare per family is set aside for the construction of communication lines, administrative buildings, temples, etc. Another problem to be solved in those newly settled areas is that of the local population who fees itself treatened by the new settlers.

The growth of the local population in the newly settled areas is another factor in favour of considered planning of migrations of the inhabitants of Jawa, or possible other islands to those potentially productive lands. Although a reserve of 45 million ha seems considerable at first, it is in reality limited by the growth of the native population. In the firt place it is a question of some 5 million ha which can be irrigated after certain, comparatively inexpensive adaptations. It is, in other words, a question of finding the right proportions between the number of new settlers respectively labour power, and the extent of land allocated with regard to the growth of the native population. With a 2% increase the population on Sumatra, Kalimantan and Sulawesi increases annually by about 500.000 persons, so that resettlement of Jawanese to sawah land is not a feasible proposition.

The resettlement of the population to those reserve areas is undoubtedly one of the ways of solving some of the burning social and economic problems of Indonesia. The most densely crowded parts lie in central Jawa and particularly on the territory of Jjogjakarta. Second place is held by eastern Jawa. The differences in the mobility of Jawanese population in 1956—60 were as follows:

	West Jawa	Central Jawa	Territory of Jogjakarta	East Jawa
Number of Migrants	200 000	500 000	934 000	366 000
Per 1000 Inhabitants	11,6	30,1	455,8	18,9

On the other hand, Sumatra is one of the main immigration region of Indonesia, which receives almost three quarters of Jawanese emigration. Mainly the southern part of the island (Lampung), where there is excellent soil of volcanic origin. It is volcanic ash after the eruption of Krakatau.

So far the controlled migration had the task of removing the "surplus" population of Jawa and some other islands and to settle new areas for agricultural production, in the existing primitive manner. Experiences and the tempo of controlled migration have shown that this is not a manner to solve the problem of relative overpopulation. At best this manner solves only the narrow problem of nutrition for the newly settled families. Controlled migration is only one, and certainly an important way of solving the population problems of Indonesia. But the situation would show only small changes as the result of this resettlement policy if none of the other conditions in the overcrowded areas change. In the first case it demands changes in the methods of production in agriculture itself. The existing system of palawidja, by which tobacco, soja or groundnuts are sown after the rice crop in one and the same year admittedly increases the area under crops by 15% annually (referring to 1959), but the production of basic foodstuff remains practically unchanged. A solution of a kind could be achieved by the introduction of two crops of rice on one paddyfield in one year. This would involve irrigation and the use of fertilizers of all kinds. Which, to a large degree depends on the growth of industry.

Jawa has a problem with yields, which, before the war, were slightly larger than they are at present. At the present time it amounts to 21,3 q for rice, in India about 14 q, in Burma 17 q, in Malaya 18 q, in Japan 47 q, South Vietnam 21 q.

In my opinion the problem of relative overpopulation of Jawa and the other islands has to be solved in situ. It involves a consistent agrarian reform, the extension of irrigation to larger areas, the introduction of two annual rice crops from a maximum area under cultivation, larger yields per hectare and in this connection an increase in the production of fertilizers of every kind. In this manner could be avoided the costly and often ineffective resettlements of the population on the scale planned at present.

In other words, agricultural production — with which country is concerned in the initial period of the construction of its economy — must be organized in such a manner as to afford effective division of labour between the individual islands according to the most suitable conditions for production. This will determine their economic relations, the problem of specialisation of production according to the conditions and requirements of the national economy. The surpuls population of Jawa, where it still to exist even after the introduction of two crops of basic foodstuffs, could be absorbed into the construction of industry, which is decisive for the solution of surplus populations.

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THE MEASUREMENTS OF CONCENTRATION OF INDUSTRY AND POPULATION IN CZECHOSLOVAKIA

K oblastní koncentraci průmyslu a osídlení v Československu. — Poměry rozmístění československého průmyslu lépe charakterizuje „celkový stupeň industrializace oblastí", který je stanoven na základě specifické plochy, z níž byla vypočtena specifická hustota obyvatelstva, velikosti, hrubé intenzity, hustoty a specifické hustoty průmyslu. Specifickou plochu tvoří zemědělsky a stavebně využitelné plochy. Průměrně se tím zmenšuje území okresů o 36,7 %. Specifická hustota obyvatelstva odstraňuje nežádoucí rozdíly pokud jsou způsobeny rozdílnou strukturou ploch. Celostátnímu průměru 107 obyv./km² odpovídá 170 obyv./km²sp. Regionální vztah rozmístění průmyslů a obyvatelstva je v ČSSR těsný. Sledujeme-li velikost průmyslu všech odvětví celkem $Vp = \Sigma_{pp1-15}$, lze říci, že rozmístění je již značně rovnoměrné ve srovnání s podmínkami geografickými i s poměry v zahraničí. Hrubá intezita průmyslu $Ip = \frac{pp}{1000 \text{ obyv.}}$ činí v průměru republiky 161. Průměrné hustotě průmyslu $Hp = \frac{pp}{10 \text{ km}^2} = 173$ odpovídá specifická hustota průmyslu $Hp/sp = \frac{pp}{10 \text{ km}^2/sp} = 236$.

Ve srovnání se sousedními zeměmi je u nás stupeň regionální industrializace značný. Nejnižší stupeň vykazují okresy Tachov, Prachatice, Znojmo, 6 okresů na západním a 6 na východním Slovensku. K nim se druží Dol. Kubín a Rim. Sobota a do jisté míry Lounsko, Domažlicko, Nitransko a Břeclavsko. Industrializaci je třeba zaměřit zvláště tam, kde tyto okresy mají dobré polohové, přírodní, dopravní a další podmínky a tvoří souvislejší oblast. Maximální stupeň industrializace je již překročen na Jablonecku, Mostecku a Ostravsku, dosažen na Teplicku a Brněnsku a blíží se mu ještě 14 okresů v Čechách na Moravě i na Slovensku.

Demands for application of the geographical, especially of economic geographical research appear in the planed economy very often. These tendencies are generally marked by trying to find a more exact typological and quantitative expression in geographic works and in their cartographical supplements.

In 1960 the districts of Czechoslovakia have been enlarged in order to correspond better to conception of representation the economic units of an industrial country. The average area of these districts is about 1 300 sq. kms (if the biggest towns are included in the surrounding districts), beeing so similar to that of the „powiats" in Poland (average area — 1 053 sq.kms.) or „arondissements" in France (average area — 1450 sq.kms.).

In a country with such a variable surfice and a dispersed industry and population as Czechoslovakia, these large districts are of course very different from the geographical point of view. The scientific value of simple statistical data as e.g. the density of population, the density of industry etc. is limited, because as the result appear average numbers of large and asymetric variations. However, it is often necessary to characterize the district as a whole with one or several convenient quantitative indexes.

For this reason we have tried to derive a complex index for the measurement of the total *degree of regional industrialisation* in the relation to the area and settlement. The degree of regional industrialisation is based on the specific area which was used for the calculation of specific density of population, on the magnitude of industry, rough intensity, density and specific density of industry.

Specific area (sq.km. sp.) is determined for Czechoslovakia as a total area useful for agriculture or building i.e. even for industry and settlements. Thus the woods, mountains and some other terrains are excluded, being not of interest for a more intensive economic use for settling of population. The specific area is the starting relation for stating the regional differences in the density of settlement and industry. By the use of this index the territory of an average district is reduced by 36,7% but in many districts the reduction is much greater: e.g. Prachatice by 51,6%, Jablonec n. N. by 56,3%, Vsetín by 57,5%, Banská Bystrica by 61,1%, Rožňava by 61,7%.

The density of population for sq.km has been based on the specific area. This *specific density of population* removes the undesirable sharp differences in the density of population, as long as they are caused by a different structure of the district areas. A more perfect expression of the territorial composition of the population, which was used even before by some authors, can be especially useful for considerations about the distribution of production, industrialisation and working-power reserves in various regions of the country. For the whole national territory the density of 107 inhabitants/sq.kms. corresponds to the specific density of some 107 inhabitants/sq.kms.

The regional relation between the distribution of industry and population is very narrow in Czechoslovakia. If we measure the magnitude of industry by summing up numbers of workers (Vp = pp) of all the represented branches according to the different localities, we are able to watch the degree of industrialization not only by the density of industry, or by the specific density of industry, but even by the intensity of industry.

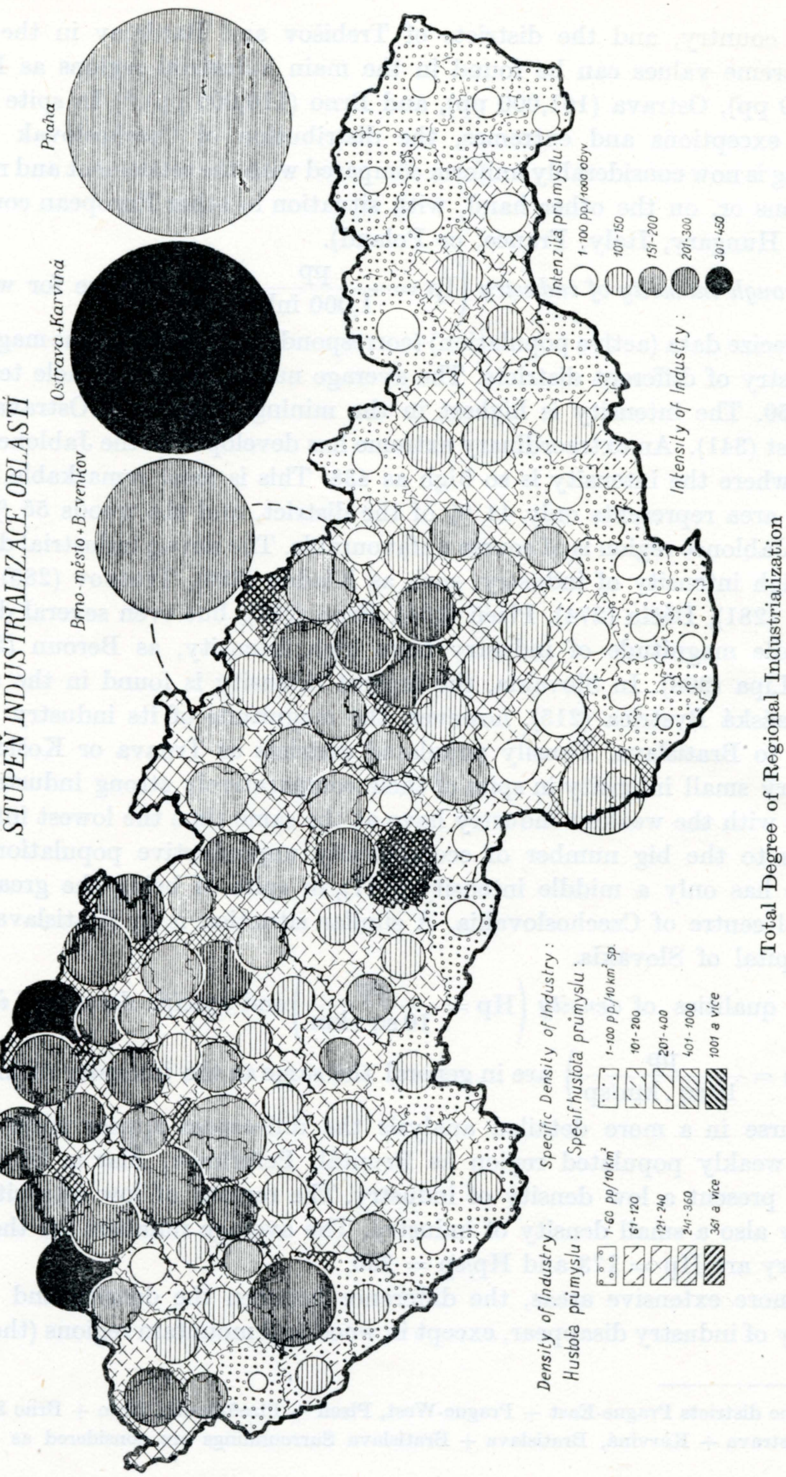
Examining the *magnitude of industry* we observe, that, with exception of 6 districts, in the whole territory of Czechoslovakia the industry is today clearly represented. This representation is most weak in Velký Žitný ostrov (The Danube Island), but this region lies in the tight neighbourhood of the first Slovak industrial centre Bratislava. Other regions relatively less industrialized are the frontier territories of Tachov and Prachatice in the western part of country, and the districts of Trebišov and Bardejov in the East. The extreme values can be found in the main industrial regions as Prague (178,000 pp), Ostrava (161,000 pp), and Brno (110,000 pp).*) In spite of the quoted exceptions and extremes, the distribution of Czechoslovak manufacturing is now considerably uniform compared with the settlement and natural conditions or, on the other hand, with situation in other European countries (e.g. in Hungary, Italy, France, or Poland).

The *rough intensity of industry* $\left(\mathrm{Ip} = \frac{\mathrm{pp}}{1{,}000\ \mathrm{inh.}}\right)$ that we use for want of more precize data (active population) (corresponds only partly to the magnitude of industry of different districts. The average number for the whole territory Ip = 160. The intensity is highest in the mining districts of Ostrava (360) and Most (341). An extraordinary extreme has developed in the Jablonec n. N. region where the intensity is so high as 438. This is most remarkable, as the specific area represents only 44 % of the district, and the woods 55 %. The case of Jablonec region is of course unfavourable. The strong industrial districts have high intensity of industry, such as Kladno (286), Trutnov (285), Gottwaldov (281), Děčín (274), Plzeň (254), Brno (232), but even several districts of middle magnitude of industry have high intensity, as Beroun (223) or Česká Lípa (208). In Slovakia, the highest intensity is found in the district of Považská Bystrica (215), however, the magnitude of its industry is only second to Bratislava. Densily populated districts as Trnava or Košice have still very small intensity in spite of their comparatively strong industry. The regions with the weakest industry have at the same time the lowest intensity. Thanks to the big number of economically unproductive population, even Prague has only a middle intensity (177), in spite of being the greatest industrial centre of Czechoslovakia. A similar situation is in Bratislava (124), the capital of Slovakia.

The qualities of *density* $\left(\mathrm{Hp} = \frac{\mathrm{pp}}{10\ \mathrm{sq\,.\,km}}\right)$ and *specific density of industry* $\left(\mathrm{Hp/sp} = \frac{\mathrm{pp}}{10\ \mathrm{sq\,.\,km/sp}}\right)$ are in general the same as the intensity of industry. Of course in a more detailed analysis the differences appear more clearly. Some weakly populated region as Bruntál, Pelhřimov, Žiar n. H. or Strakonice present a low density of industry. The regions of low intensity have usually also a small density of industry. The average numbers for the whole territory are Hp = 173 and Hp/sp = 236.

In more extensive areas, the difference between the density and specific density of industry disappear, except in wood and mountain regions (the Upper

*) The districts Prague-East + Prague-West, Plzeň + Plzeň-South, Brno + Brno Surroundings, Ostrava + Karviná, Bratislava + Bratislava Surroundings are considered as one unit.



Total Degree of Regional Industrialization

Hron Valley, Moravian-Silesian Beskydy, Javorníky Mountains, etc.). The lowest specific density of industry can be found in the East and South of Slovakia even in the districts with greater towns and more dense population as Prešov (70), Komárno (60), and Nové Zámky (50). In the western half of the country the same condition appears in the frontier districts of western and southern Bohemia and southern Moravia, and what is surprising, even in the district of Louny (90). The maximum specific density has been found out, apart from Prague, in those industrial districts which have a strong nodal centre, as the district of Brno (1,300), Ostrava (4,030), Most (1,250), Teplice (1,120), and Jablonec n. N. (2,080).

The *total degree of industrialisation* is a cartographical construction depending on combination of this various mentioned indexes. We have tried to present a map based on the reveals, the difference of both magnitude and character of industrialization in different parts of the national territory. Compared with the neighbouring countries, the degree of regional industrialization is considerable. In 1960 the districts with the lowest degree of industrialization were those of Tachov, Prachatice, Znojmo, and 6 districts in western and 6 districts in eastern Slovakia (including Dolný Kubín and Rimavská Sobota). To these 17 districts stay near also the districts of Louny, Domažlice, Nitra and Břeclav. It is necessary to direct further industrialization into the regions where they form compact groups of districts with a lack of job opportunities in manufacturing. Many of them have favourable position, natural and transport conditions (e.g. Poprad, Komárno, Nitra, Trebišov, Znojmo and others).

From our point of view, the maximum degree of industrialization has been surpassed and further absolute industrialization is undesirable in the districts of Jablonec n. N., Most, and of course Ostrava. The mentioned degree has been nearly achieved even in Brno and Teplice. The 14 other districts in Bohemia, Moravia and Slovakia are close to the state of complete industrialization too.*) As it has been mentioned above, the situation of Prague and Bratislava is specific from this point of view.

These and many other conclusions are results of fulfilling the task dealing with the regional structure of Czechoslovakia a part of the Government Plan of Research, which has been confined to and has been worked up by the Geographical Institute of the Czechoslovak Academy of Sciences. The conclusion report has been passed to the competent authorities.

*) Sokolov, Ústí n. L., Děčín, Plzeň, Kladno, Pardubice, Liberec, Semily, Trutnov, Náchod, Blansko, Gottwaldov, Vsetín, Pov. Bystrica.

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POLISH SEAPORTS AND CZECHOSLOVAK FOREIGN TRADE

Polské námořní přístavy a československý zahraniční obchod. — Československo je jako vnitrozemský stát nuceno používat v nákladním přepravním styku se zámořím cizích evropských námořních přístavů. Předností geografické polohy Československa však je, že může používat k překladu svého tranzitního zboží většího počtu evropských přístavů, ležících na pobřeží více moří. Po druhé světové válce staly se pro čs. zahraniční obchod nejvýznamnějšími přístavy polské, zvláště Štětín. V příspěvku je stručně rozebrána struktura čs. tranzitu polskými přístavy v posledních letech a význam těchto přístavů pro čs. námořní plavbu. Zvláštní pozornost je věnována otázkám přepravy zboží mezi Československem a polskými přístavy. V závěru vyslovuje autor názor, že polské přístavy, zejména pak Štětín, zůstanou i v budoucnu pro čs. zahraniční obchod nejvýznamnějšími evropskými námořními přístavy.

Czechoslovakia as an inland state is obliged to make use of foreign seaports for carrying trade with overseas countries. The total volume of the Czechoslovak seaborne trade is considerable: in 1961 it amounted to 6,229,000 metric tons.

The advantage of Czechoslovak geographical position in the heart of Europe is, however, that she is able to use for the shipping of goods in transit a larger number of European ports, lying in various countries on the shores of different seas, while at the same time the distance of none of these ports from Czechoslovakia differs much from that of any other.

Among such ports there are also the Polish ports. All three main seaports of present-day Poland: Gdańsk, Gdynia and Szczecin, were already used to a considerable extent for the shipping of Czechoslovak goods in transit before the World War II. Thus in 1937 the tonnage of Czechoslovak transit goods amounted in Gdańsk to 1,036,000 metric tons, in Gdynia to 223,000 metric tons. The leading position in the shipping of Czechoslovak transit goods in the pre-war period was of course taken by Hamburg, with which, along with the above-mentioned three ports, the Adriatic seaports, especially Trieste, competed for Czechoslovak transit goods.

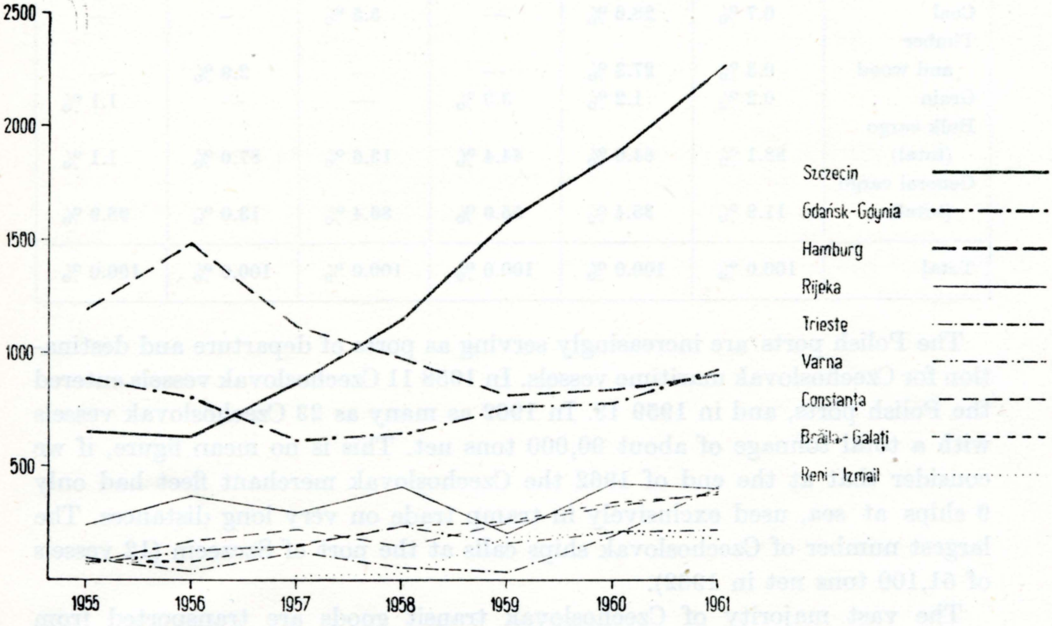
After the second world war, the setting up of a People's Democratic regime both in Czechoslovakia and in Poland created favourable conditions for the close cooperation of both countries. Czechoslovakia had now the possibility of using the Polish seaports for the shipping of its goods to a much greater extent than ever before. Czechoslovakia began to make intensive use of this possibility as early as 1947 and 1948. In 1950 the amount of Czechoslovak goods in transit handled in Polish seaports reached 1,440,000 metric tons. In the period 1951—1953 the amount of Czechoslovak goods passing through Polish ports decreased, this being caused among other factors by the decrease of Czechoslovak trade with capitalist countries. Since 1954 the extent of Czechoslovak transit goods passing through Polish ports again rapidly increased. At the same time, however, Czechoslovak transit goods passing through Hamburg also increased, the amount in 1954 attaining a figure higher than that of 1938. The peak figure was reached in 1956, when the port of Hamburg dealt with over 1,448,000 tons of Czechoslovak transit goods. A cause of this development was, among others, the existence of the Elbe water route, which enabled Czechoslovakia to transport goods to and from Hamburg in her own vessels, and further, the sufficiency of suitable liner connections from Hamburg to those countries and ports with which the Polish seaports at that time had not yet direct or not sufficiently ample shipping connections. The improved equipment of the Polish ports and the extension of liner services on the overseas routes enabled Czechoslovakia to transfer gradually, after 1957, part of her trade from Hamburg to the Polish seaports.

The extension and modernisation of the seaports of socialist countries on the Black Sea and the lower Danube, along with the improvement in the number of overseas routes covered, brought about, in the second half of the fifties, favourable conditions for the considerable growth of Czechoslovak transit via these ports, i.e. Constanta, Braila and Galati, Varna, Reni and Izmail. For transport of goods between these ports and Czechoslovakia the Danube route may be used. Further, the use of these ports instead of the Polish ports for transport of goods between Czechoslovakia and the countries of the Near East, Southern Asia and the Far East means the shortening of the sea-journey by as much as 2000 nautical miles.

During the same period the amount of Czechoslovak goods shipped via Rijeka also increased considerably. The extent of Czechoslovak transit via Trieste varied very much during the whole post-war period.

In spite of these facts the shipping of Czechoslovak transit goods via the Polish ports constantly increased from 1957 onwards and in 1961 amounted to 3,303,000 metric tons. In other words, in 1961 about 52 % of the entire Czechoslovak seaborne trade went through the Polish ports, while about 37 % of this entire seaborne trade passed through Szczecin.

Czechoslovak imports in general and especially seaborne imports consist for the most part of heavy bulk cargoes such as ores and other raw materials, while Czecholovak exports are mostly made up of general cargo. For this reason the tonnage of Czechoslovak transit goods imported via the Polish ports greatly surpasses the export tonnage. This can be seen strikingly in the case of Szczecin and Gdańsk, to a lesser degree in Gdynia, which plays a larger part than the other Polish seaports in handling general cargoes. This is illustrated by the following figures of Czechoslovak transit goods handled by the Polish seaports in the years 1959—1961:*)



1. Czechoslovak transit goods traffic through various European ports and port groups in 1955 to 1961 (according to) J. Beránek 1962 and O. Šlampa 1962
Československý tranzit různými evropskými námořními přístavy a jejich skupinami v letech 1955—1961 (podle) J. Beránka 1962 a O.Šlampy 1962

	1959		1960		1961	
	Imports	Exports	Imports	Exports	Imports	Exports
	(thousand metric tons)					
Szczecin	1,350.3	251.5	1,510.4	403.1	1,895.1	463.4
Gdynia	239.6	163.1	326.6	180.2	288.6	148.4
Gdańsk	287.2	60.7	257.7	56.6	458.6	48.6

A more detailed picture of the structure of Czechoslovak transit via the Polish seaports in 1960 is given by the following table (compiled from Morski rocznik statystyczny 1961/I, table 30):

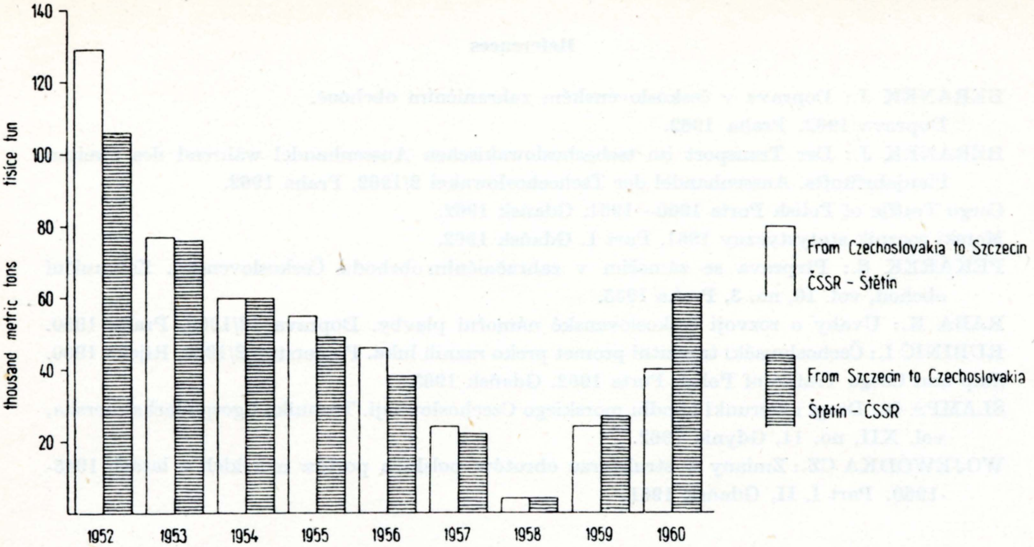
*) Official figures of Czechoslovak transit published by the Administration of Polish and the most other European ports slightly differ from the figures given by J. Beránek (1962).

	Szczecin		Gdynia		Gdańsk	
	Imports	Exports	Imports	Exports	Imports	Exports
Ores	70.0 %	0.2 %	40.4 %	—	79.4 %	—
Coal	0.7 %	28.6 %	—	5.5 %	—	—
Timber and wood	0.3 %	27.3 %	—	—	2.9 %	—
Grain	0.2 %	1.2 %	3.9 %	—	—	1.1 %
Bulk cargo (total)	88.1 %	64.6 %	44.4 %	13.6 %	87.0 %	1.1 %
General cargo (total)	11.9 %	35.4 %	55.6 %	86.4 %	13.0 %	98.9 %
Total	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %

The Polish ports are increasingly serving as ports of departure and destination for Czechoslovak maritime vessels. In 1958 11 Czechoslovak vessels entered the Polish ports, and in 1959 13. In 1962 as many as 23 Czechoslovak vessels with a total tonnage of about 90,000 tons net. This is no mean figure, if we consider that at the end of 1962 the Czechoslovak merchant fleet had only 9 ships at sea, used exclusively in tramp trade on very long distances. The largest number of Czechoslovak ships calls at the port of Szczecin (12 vessels of 51,100 tons net in 1962).

The vast majority of Czechoslovak transit goods are transported from Czechoslovakia to the Polish seaports and vice versa by rail. Transport of goods between Czechoslovakia and Szczecin and vice versa, is also carried on along inland waterways, on the one hand down the Elbe from the Czechoslovak Elbe—Vltava ports, along the German canals and lower Oder, and on the other hand from the Polish port of Koźle to Szczecin. The latter passage from Koźle to Szczecin, which up to 1958 was also taken part in by Czechoslovak barges, is now entirely carried out by the Polish Oder fleet. The extent of goods transported from Czechoslovakia to Szczecin and vice versa in Czechoslovak barges in the period 1952—1960 is shown in diagram 2. The diagram clearly shows the continual decline in the extent of this transport up to 1958 and its rise from 1959 in connection with the extension of the Elbe — Szczecin route, on which Czechoslovak water transport has of recent years been concentrated. By this route mostly timber and sugar are carried from Czechoslovakia to Szczecin, while mainly ores, apatites and recently also phosphates for the fertilizers factory at Lovosice are transported from Szczecin to Czechoslovakia.

The Polish transport of Czechoslovak transit goods via the Oder shows also a marked tendency to rise. While Polish barges in 1956 carried only 16,600 metric tons of Czechoslovak transit goods, in 1960 they transported 111,900 and in 1961 as much as 147,600 metric tons.



2. Transport of goods between Czechoslovakia and Szczecin along inland waterways by Czechoslovak barges). Morski rocznik statystyczny 1961.
Přeprava zboží mezi Československem a Štětínem po vnitrozemských vodních cestách československými plavidly). Morski rocznik statystyczny 1961

The total tonnage of goods shipped by water between Czechoslovakia and Szczecin while it is greater than pre-war and has strikingly increased during recent years, is not yet sufficiently high. In 1960 only 11.2 % of the total tonnage of Czechoslovak goods shipped via Szczecin was carried to or from Szczecin via the Oder. Favourable conditions for increasing this proportion undoubtedly exist. Any considerable change can, however, in the author's opinion, be brought about only by means of improved shipping conditions on the Oder, especially on its middle course, by an increase in the available barges on the Oder, and further, by a lengthening of the navigable reaches of the Oder at least, for the present, as far as the Ostrava region, as well as by some other improvements.

In conclusion, we may say that in spite of the considerable increase in shipping of Czechoslovak transit goods via the Black Sea and Adriatic ports during the last few years, we may expect that the Polish seaports and, among them, above all Szczecin, will retain in the future the position of being the most important seaports for the Czechoslovak foreign trade, especially in connection with the further extension of trade relations between Czechoslovakia and the countries of Latin America and West Africa.

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GEOGRAPHICAL STUDIES AND ANALYSIS OF NEW TOWNS AND NEW SETTLEMENTS

Geografický výzkum a analýza nových měst a nových sídlišť. — Nová města a nová sídliště (NMS) doplnila dosavadní sídelní strukturu a stala se novou složkou sídelní sítě. NM jsou města založená po 2. světové válce a dále ta, jejichž počet obyvatel vzrostl za posledních 20 let na několikanásobek. NS mají nejméně 10 nových bloků nebo 30 velkých domů tvořících sídelní celek (ve velkoměstech 3krát více), což odpovídá 1000 (ve velkoměstech 3000) obyvatelům. Uvádíme společné a potom specifické znaky NMS. Ekonomickým stimulem pro výstavbu NMS bylo: osídlení panenských půd, rudná nebo uhelná těžba, přeložení sídel při stavbě vodních děl nebo těžbě, velké nové hutě, nové velké závody strojírenské nebo chemické, potřeba nových center v zemědělských oblastech, nová hlavní nebo provinční střediska, nové přístavy, vojenská NMS, odlehčení přelidněným městským centrům, rychlý růst obyvatelstva nebo velká imigrace.

V ČSSR je nejčastějším stimulem pro založení NMS rudná nebo uhelná těžba. Při řešení ekonomických problémů NMS mohou pomoci geografové. Proti technickému schematismu inženýrů je třeba rozvíjet geografickou interpretaci celých NMS i jejich vnitřního funkčního členění.

Kartografické služby si dosud obstarávají informace o NMS individuálně, proto některá důležitá NMS na mapách chybí nebo jsou zakreslena špatně. Při IGU by pracovní skupina mohla vypracovat celosvětový seznam NMS a stimulů, jež vedly k jejich založení, nepřetržitě sledovat všechny změny a poskytovat kartografickým službám přesné informace o NMS.

After the World War II every year dozens of New Towns and New Settlements (NTS) have been built as Harlow, Corby, Vällingby, Nowa Huta, Havířov, Dimitrovgrad, Volžskij in Europe, Angarsk, Bratsk, Chandighar in Asia, Tema in Africa, Brasilia in America. NTS completed the recent settlement structure of the concerned countries, become a new element of the settlement net and a subject of study of urbanists and also geographers as can be seen in UNESCO list of works on NTS (J. Viet: Les villes nouvelles — New Towns, UNESCO, Paris 1960). However this list is incomplete what the socialist countries are concerned (with the exception of the USSR), although the problems of NTS are been studied here in a great measure (in Czechoslovakia two conferences on this theme were organised in 1959, 1962 and a third one is in preparation). We propose this geographical definition of a NTS: NT are the towns founded after the World War II and further those whose population rose several times during the last 20 years. NS are the settlements with at least 10 new blocks of houses or 30 new detached big houses grouped together, in the case of the settlements in the great towns regions at least 30 new blocks of houses or 90 big houses. These parametres correspond to 1000, in the region of great towns 3000 inhabitants. — As a special group we can distinguish small settlements with less than 4000 inhabitants (in the region of great towns less than 12 000 inhabitants) and about 15—25 new blocks of houses, the majority of them being miners-settlements built for the reason of a rapid development of ore or coal-mining, some of them (esp. in underdeveloped areas) were built in order to make possible the founding of a machinery plant.

The common features of NTS: new, young and heterogenous population which came (except point *d*) from different parts of the country; assimilation and acculturation of the NTS' population; the specific scholar and education problems rising of the unusual age-structure; the high degree of technical equipement; the problem of water-supply, of green belts and (in the temperate and cold climatic zone) the heating.

The specific features of NTS are based in the economic aim and function of the NTS, in their situation and position in the settlement and economic structure of the region. Thus it is not possible to transfer them from one new town to another. Some of these features are e.g. the space-relation between the old and the new town, the process of the incorporation of the new towns into the settlement structure and economic life of the surrounding region.

The economic stimuli for the construction of the NTS are: *a*) colonization of new lands (in the USSR, Canada, Izrael etc.); *b*) ore mining; *c*) coal-mining or oil exploitation; *d*) necessity of transfering the settlements caused by building of dams or by mining (Kariba in Africa, Ervěnice in Czechoslovakia); *e*) new big iron-foundries or steel-works; *f*) new big machinery or chemical plants (but very scarcely other branches of industry), *g*) the necessity of new centers of agricultural regions caused by the raising mechanisation for agricultural production (often in Bulgaria); *h*) important administrative function i.e. new capitals (Brasilia, and in perspective) or new provincial centres (Chandighar), *i*) new ports (Tema in Ghana), *j*) military reasons (Islamabad), *k*) building-up of satellite-towns aimed to lower the density of population of the overpopulated towns and city centres (NTS in the region of London, NS of Prague), *l*) rapid growth of population of some regions e.g. in India, or immigration of refugees (India, Pakistan, Germany).

In Czechoslovakia, the stimulus of the ore or coal mining is the most frequent. The economic demand of rapid developing of the mining in a deposit (basin) leeds to a concentration of working-power and so to the need of building NTS. In the regions of surface-mining, the devastation of the country is so great that it is necessary to leave the old towns and villages and to settle the population in NTS built on a place where mining is not planned (region of Ostrava, the North-Bohemian Brown-coal Basin). — The cases mentioned in point *k* differ deaply one from another. Detailed analyses are necessary to prove if the aim to help the overpopulated centre has been fulfilled. — The convenience of various branches of engineering for the NTS is different (examples from Czechoslovakia).

In many countries the first NTS were built according to foreign examples (in the socialist countries according to the USSR) but gradually specific forms in every country are developed. The preparation of building-up NTS should be based on à geographical analysis of the whole region and in seeking best location, the best form, magnitude and function of the NTS in the region. Contrary to the technical schematism of the engineers, it is necessary to develop the geographical interpretation of the NTS not only in the whole but also in the internal division of the NTS.

The NTS have a great economic significance, and the geographers can help in resolving these problems. The studies and evidence should be organized by IGU; this organisation would be the best institution able to do the classification of the NTS according to the economic stimulus. The cartographic services are seeking informations about the NTS individually and thus the location of these NTS on some maps is sometimes not strict (including the number of inhabitants of the NTS) or some important NTS are even missing. For this reason it would be a great advantage if a special group formed by IGU worked-up and maintained a World list of NTS for the use of cartographic services of various countries.

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RETROAZIMUTHALS ON A GLOBE AND THEIR IMAGES IN A MAP

Retroazimutály na glóbu a jejich obrazy v mapě. — V příspěvku se sleduje otázka, jak jsou po kulovém globu rozloženy hodnoty retroazimutu β (tj. azimutů ortodrom spojujících místa z kulového globu s cílem ležícím v zeměpisné šířce $\varphi = 50°$) a jak je můžeme vyhledat z tzv. retroazimutální mapy k tomu účelu sestrojené. Jsou připojeny pravoúhlé souřadnice x a y pro obrazy průsečíků geografické sítě této retroazimutální mapy v hustotě $\Delta\varphi = \Delta\lambda = 10°$. Této tabulky dá se užít ke konstrukci retroazimutálních map pro kterýkoli cíl podél 50°-rovnoběžky, tedy právě tak pro Prahu jako pro Krakov nebo Mohuč, Charkov nebo Lands End, Karagandu nebo Winnipeg atd. Hodí se také pro výpočet retroazimutů ve všech vrcholech 10° - sítě vůči cíli ležícímu na 50° - rovnoběžce. Poněvadž cotg β = x : y, dostáváme je jednodušeji nežli řešením sférického trojúhelníka OPM.

Points on a spherical globe, in a given direction (or azimuth) α from a given point $O(\varphi_0, \lambda_0)$ constitute an orthodrome. The arc of an orthodrome with end points O and a given $M(\varphi, \lambda)$, intersect the meridians λ_0 to λ under different angles. Thus the azimuth varies from point to point on the orthodrome; the corresponding convex angle, measured from north on the incident meridian, is then $180° - \beta$, where β is the so-called retrograde azimuth, or *retroazimuth,* of the arc MO of an orthodrome.

We shall be interested in the question as to the distribution of retroazimuth values β on a spherical globe, and their determination from a conveniently constructed *retroazimuthal map*.

Curves of constant retroazimuth β on a spherical globe will be called **retro-** *azimuthals;* from each point $M(\varphi, \lambda)$ on a retroazimuthal, orthodromic arcs in the direction β are directed towards the given point $O(\varphi_0, \lambda_0)$. The angles β are measured from the north direction of the meridian at M to the orthodromic arcs leading from M to O in such sense that β is not greater than 180°. Thus all retroazimuth values are in the interval $<0°, 180°>$. With the given point O there is associated the point $O'(-\varphi_0, -\lambda_0)$ opposite to O on the globe. Let the orthodromic arcs from M have azimuths β' with respect to O'; if these are measured from meridional south so as not to exceed 180°, then $\beta = \beta'$ for every point M of the globe. The meridional circle passing through both O, O' divides the globe into two hemispheres, an eastern and a western. Points on the globe, symmetric about the plane of this meridional circle, have complementary azimuths. Thus it suffices to consider the distribution of retroazimuths only on one hemisphere, i.e. to restrict the values of the coordinate λ to the interval $<0°, 180°>$. Furthermore, the distribution of retroazimuths on the globe is also centrally symmetric; and thus, on each hemisphere, this distribution is spherically centrally symmetric with respect to the spherical center R(0°, 90°) of the hemisphere. Therefore it is sufficient to consider only a certain half part of the hemisphere (cf. fig. 1).

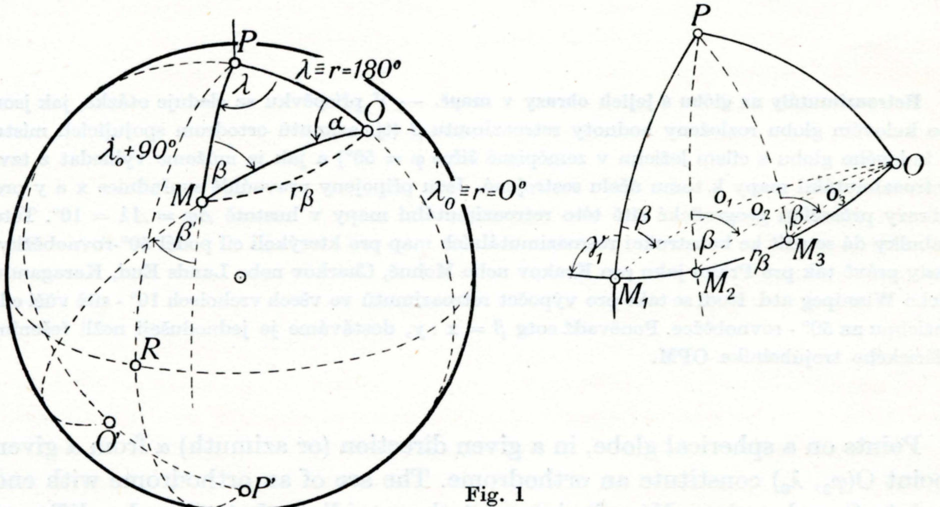

Fig. 1

If P and P′ are poles on the globe, then from the spherical triangle MOP (or MOP′) there follows

$$\cot \beta = \frac{1}{\sin \lambda} (\tan \varphi_0 \cos \varphi - \sin \varphi \cos \lambda) . \tag{1}$$

This is the defining equation of retroazimuthals; φ, λ are independent variables, the coordinates of points on the curve, and β is a parameter whose values, in $<0°, 180°>$, distinguish between distinct retroazimuthals. A meridian λ intersects a retroazimuthal under an azimuth γ; it is measured from the same direction on the meridian as β or β', but in the opposite sense. Also

$$\tan \gamma = \frac{\tan \varphi_0 \sin \varphi \cos \varphi - \cos^2 \varphi \cos \lambda}{\cot \lambda (\sin \varphi \cos \lambda - \tan \varphi_0 \cos \varphi) - \sin \varphi} ; \tag{2}$$

here γ also determines the tangents to the retroazimuthal. Equations (1) and (2) determine retroazimuthals analytically.

The meridional arcs OP and O′P′ correspond to the retroazimuthal $\beta = 180°$, the arcs OP′ and O′P to the retroazimuthal $\beta = 0°$. At the pole P we have $\beta = 180° - \lambda$, at P′ $\beta = \lambda$, so that at either pole, β takes on all values from 0° to 180°; thus both poles belong to all retroazimuthals. At the points O and O′, $\cot \beta = 0/0$ is indeterminate, and these two points also belong to all retroazimuthals. From the values tan γ assumes at these points it follows that the retroazimuthals approach these points under different azimuths β; thus the points P, P′, O, O′ are all nodal points of the system of retroazimuthals.

Each retroazimuthal decomposes into two components. For the retroazimuthal $\beta = 90°$ (considered on the whole globe), one component contains the points P and O, and at these points it is orthogonal to the meridian $\lambda = 0°$; the second component contains P′ and O′ and is orthogonal to the meridian $\lambda = 180°$. All other retroazimuthals have angular points at the poles and at O and O′. The retroazimuthal $\beta = 90° - \varphi_0$ is specific in that one component passes through P, P′, the second through O, O′; they intersect at the spherical centers R of both hemispheres, which are thus double points of the complete retroazimuthal. The first component is tangent, at P, to the meridian $\lambda = 90° + \varphi_0$, and at P′ to the meridian $\lambda = 90° - \varphi_0$. Thus, on either hemisphere, this component lies within the spherical bi-angle bounded by the mentioned meridians. At the points R this component has azimuth $\gamma = \frac{1}{2}\varphi_0$.

This component (i.e. the component of the retroazimuthal $\beta = 90° - \varphi_0$ passing through the poles), divides the globe into two parts; in one, retroazimuthals are taken with respect to O, in the other, with respect to O′. The second component (passing through O, O′) has, on both hemispheres, the azimuth $\gamma = 90° - \frac{1}{2}\varphi_0$ at the points R, and azimuth $\gamma = 90° + \frac{1}{2}\varphi_0$ at the points O, O′. This component lies within the strip bounded by the parallels φ_0 and $-\varphi_0$. The two components divide the globe into four bi-angular sectors. An opposite pair of these contains arcs of the retroazimuthal $\beta = 90°$, and consists of all points M with β within $<90° - \varphi_0, 180°>$. The second pair of opposite sectors consists of all points M with β within $<90° - \varphi_0, 0°>$.

Now project the points of each retroazimuthal (on the eastern or western hemisphere) along normals to the globe, to a height proportional to the corresponding values of β. There results the surface of interpolation of the field of retroazimuthals; it is essentially of hyperbolic type, since above the spherical center R there appears a simple saddle point, with relative maxima over the arcs OP and OP′, and relative minima over O′P and OP′. The asymptotic curves are perpendicular at the saddle point. These phenomena are preserved by a stereographic — and hence conformal — mapping of the retroazimuthal field into the plane tangent to the globe at R.

The spherical globe with retroazimuthal field may of course be mapped onto any kind of map; however, only for the so-called retroazimuthal maps it is possible to determine easily the retroazimuths β from a point $M(\varphi, \lambda)$ towards a point $O(\varphi_0, \lambda_0)$ given in advance. In current cartographic literature, the description of retroazimuthal maps is rather summary. The purpose of the present paper is their detailed study, including mention of methods and instruments for finding retroazimuth values of any point on the globe using retroazimuthal maps.

In practice, retroazimuthal maps are used not for the complete globe, but only for the bi-angular sector bounded by the meridians $\lambda_0 - 90°$, $\lambda_0 + 90°$, and with central meridian λ_0.

Retroazimuths β, both positive and negative, may be determined from (1), as angles between 0° and 180°, measured north of meridians through M towards O.

The image of the geographical network in a retroazimuthal map is unexpectedly complex. This is caused by the fact that the directions of retroazimuthals at O and the directions of their images in the map are different. The images of meridians are parallel straight lines, their distances from the central meridian $\lambda_0 = 0°$ are on the Y axis; the X and Y axes intersect at the image of the point O. In this coordinate system, the map of the spherical bi-angular sector had determining equations

$$x = r \cos \varphi_0 \operatorname{arc} \lambda \ ,$$

$$y = x \operatorname{cotan} \beta \ , \tag{3}$$

where the independent variables φ, λ are coordinates of any point M of the spherical sector on the globe.

From the second of these equations it follows that points M with fixed β (i.e. on a given retroazimuthal on the globe) and with λ of fixed sign, have map images on a ray with vertex in the origin. Such rays are then images of retroazimuthals; and thus we may assign to each of them the corresponding value of β, and conversely, use them to determine retroazimuths of points on the globe.

Thus, in the map constructed for $\varphi_0 = 50°$, images of retroazimuthals are rays incident with the given point O. With the assumption $\lambda_0 = 15°$ E. Gr. (i.e. the given point has approximately the location of Prague), contours of continents and islands were drawn in the network corresponding to (3). If, in this map, a straight line segment is drawn from the image of any point to the image of Prague, then the reading on an angular scale of this segment is the retroazimuth of Prague at the given point on the globe. The map images of retroazimuthals have inclinations to the image of the central meridian in agreement with the characteristics of the retroazimuthal, measured clockwise from meridional south on an angular scale.

The images of geographical parallels φ may again be determined from (3) with φ kept constant. For $|\varphi_0| \neq 0$ they are all curvilinear and symmetric with respect to the Y axis. This also holds for the parallel φ_0; the images of poles are similar singular curves. The images of parallels φ and $-\varphi$ intersect on the images of meridians 90° and $-90°$. In considering their curvature, let $\bar{\varphi}$ be the parallel with $\tan \bar{\varphi} = (1 - \frac{\pi}{2}) \operatorname{cotan} \varphi_0$. Then for $\varphi_0 > 0°$ all parallels $\varphi > \bar{\varphi}$ are convex in the south direction, all parallels $\varphi < \bar{\varphi}$ are convex in the north direction; for $\varphi_0 < 0°$ the seare interchanged. The parallel $\bar{\varphi}$ thus divides the biangular sector into two parts whose images are not disjoint.

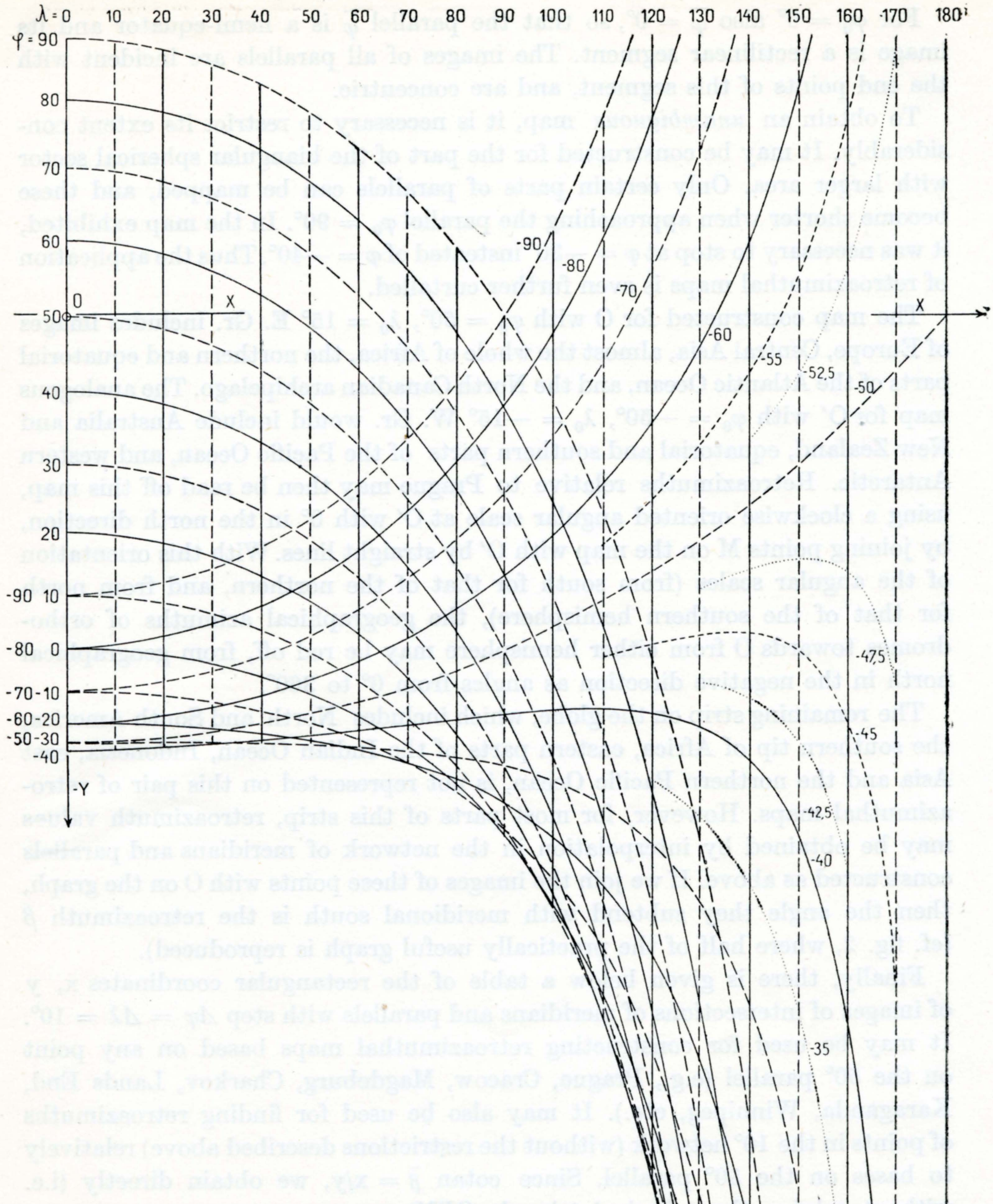
λ = 0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
φ = 90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-90
-80
-70
-60
-50
O
X
X
Y
-90
-80
-70
-60
-55
-52,5
-50
-47,5
-45
-42,5
-40
-35
-30

Fig. 2

For $\varphi_0 = 0°$ also $\bar{\varphi} = 0°$, so that the parallel $\bar{\varphi}$ is a hemi-equator and its image is a rectilinear segment. The images of all parallels are incident with the end points of this segment, and are concentric.

To obtain an *unambiguous* map, it is necessary to restrict its extent considerably. It may be constructed for the part of the biangular spherical sector with larger area. Only certain parts of parallels can be mapped, and these become shorter when approaching the parallel $\varphi_0 = 90°$. In the map exhibited, it was necessary to stop at $\varphi = -30°$ insteated of $\varphi = -40°$. Thus the application of retroazimuthal maps is even further curtailed.

The map constructed for O with $\varphi_0 = 50°$, $\lambda_0 = 15°$ E. Gr. includes images of Europe, Central Asia, almost the whole of Africa, the northern and equatorial parts of the Atlantic Ocean, and the North Canadian archipelago. The analogous map for O′ with $\varphi_0 = -50°$, $\lambda_0 = -15°$ W. Gr. would include Australia and New Zealand, equatorial and southern parts of the Pacific Ocean, and western Antarctic. Retroazimuths relative to Prague may then be read off this map, using a clockwise oriented angular scale at O′ with 0° in the north direction, by joining points M on the map with O′ by straight lines. With this orientation of the angular scales (from south for that of the northern, and from north for that of the southern hemisphere), the geographical azimuths of orthodromes towards O from either hemisphere may be red off, from geographical north in the negative direction as angles from 0° to 360°.

The remaining strip on the globe, which includes North and South America, the southern tip of Africa, eastern parts of the Indian Ocean, Indonesia, east Asia and the northern Pacific Ocean, is not represented on this pair of retroazimuthal maps. However, for most parts of this strip, retroazimuth values may be obtained by interpolation in the network of meridians and parallels constructed as above. If we join the images of these points with O on the graph, then the angle they subtend with meridional south is the retroazimuth β (cf. fig. 2, where half of the practically useful graph is reproduced).

Finally, there is given below a table of the rectangular coordinates x, y of images of intersections of meridians and parallels with step $\Delta\varphi = \Delta\lambda = 10°$. It may be used for constructing retroazimuthal maps based on any point on the 50° parallel (e.g., Prague, Cracow, Magdeburg, Charkov, Lands End, Karaganda, Winnipeg, etc.). It may also be used for finding retroazimuths of points in the 10° network (without the restrictions described above) relatively to bases on the 50° parallel. Since cotan $\bar{\beta} = x/y$, we obtain directly (i.e. without solving the spherical triangle OPM) e. g.,

	φ	λ	x	y	retroazimuth.
M_1	70°	60°	428,86	30,82	265°53′20″
M_2	—60°	160°	1143,65	726,87	237°34′0″
M_3	—30°	—90°	—643,30	—663,94	44°5′40″
M_4	80°	—170°	—1215,17	—8234,62	8°23′40″

	λ = 0°	10°	20°	30°	40°	50°
φ	x = 0,00	71,48	142,95	214,43	285,91	357,39
90°	y = 409,53	405,36	392,76	371,41	340,73	299,89
80°	318,56	314,02	300,30	277,01	243,51	198,78
70°	217,91	213,14	198,71	174,23	138,88	91,64
60°	110,64	105,82	91,09	66,10	30,04	— 18,29
50°	0,00	— 4,79	— 19,31	— 44,02	— 79,72	—127,66
40°	—110,63	—115,21	—129,11	—152,78	—187,05	—233,15
30°	—217,91	—222,14	—234,00	—256,92	—288,70	—331,56
20°	—318,56	—322,32	—333,75	—353,25	—381,58	—419,90
10°	—409,53	—412,70	—422,35	—438,84	—462,87	—495,48
0°	—488,06	—490,54	—498,12	—511,10	—530,08	—555,99
—10°	—551,77	—553,48	—558,76	—567,83	—581,20	—599,67
—20°	—598,70	—599,60	—602,41	—607,31	—614,65	—625,00
—30°	—627,44	—627,51	—627,77	—628,33	—629,43	—631,50
—40°	—637,12	—636,34	—634,04	—630.26	—625,08	—618,68
—50°	—627,44	—625,84	—621,06	—613,04	—601,74	—587,11
—60°	—598,70	—596,33	—589,21	—577,20	—560,12	—537,71
—70°	—551,76	—548,69	—539,44	—523,81	—501,48	—471,96
—80°	—488,07	—484,39	—473,30	—454,52	—427,60	—391,88
—90°	—409,53	—405,36	—392,76	—371,41	—340,73	—299,89

	λ = 60°	70°	80°	90°	100°	110°
φ	x = 428,86	500,34	571,82	643,30	714,77	786,25
90°	y = 247,60	182,11	100,83	0,00	—125,04	— 286,17
80°	141,36	69,15	— 20,87	—133,13	—274,32	— 454,98
70°	30,82	— 45,80	—141,92	—262,21	—414,27	— 609,96
60°	— 80,65	—159,56	—258,67	—383,32	—541,64	— 746,41
50°	—189,68	—268,38	—367,56	—492,79	—652,54	— 860,18
40°	—292,93	—368,03	—465,27	—587,28	—743,61	— 947,81
30°	—387,30	—458,48	—548,85	—663,94	—812,11	—1006,65
20°	—469,89	—533,99	—615,76	—710,39	—855,91	—1034,90
10°	—538,20	—593,29	—663,96	—754,00	—873,71	—1031,70
0°	—590,16	—634,55	—691,97	—766,65	—864,97	— 997,15
—10°	—624,19	—656,54	—698,97	—755,00	—829,95	— 932.31
—20°	—639,26	—658,57	—684,73	—720,41	—769,70	— 839,14
—30°	—634,90	—640,56	—649,65	—663,94	—686,07	— 720,48
—40°	—611,25	—603,15	—522,03	—492,79	—459,44	— 421,74
—50°	—569,02	—547,38	—594,89	—587,28	—581,59	— 579,91
—60°	—509,52	—474,99	—433,31	—383,33	—323,34	— 250,75
—70°	—434,52	—388,15	—331,42	—262,21	—177,40	— 72,13
—80°	—346,33	—289,53	—219,46	—133,13	— 26,09	— 108,66
—90°	—247,60	—182,11	—100,83	0,00	126,04	286,17

	λ = 120°	130°	140°	150°	160°	170
φ	x = 857,73	929,21	1000,68	1072,16	1143,64	1215,12
90°	y = — 495,21	— 779,70	—1192,54	—1857,05	—3142,10	— 6891,18
80°	— 692,65	—1018,90	—1496,59	—2272,62	—3786,38	— 8234,62
70°	— 868,03	—1227,10	—1755,16	—2619,07	—4315,53	— 9327,76
60°	—1019,03	—1398,06	—1960,42	—2886,02	—4713,64	—10137,65
50°	—1138,05	—1526,49	—2106,07	—3065,20	—4968,44	—10639,23
40°	—1222,49	—1608,56	—2187,75	—3151,30	—5072,29	—10817,67
30°	—1269,80	—1641,77	—2202,99	—3141,67	—5022,14	—10667,64
20°	—1278,51	—1625,09	—2151,26	—3036,53	—4819,27	—10193,21
10°	—1248,40	—1559,03	—2034,18	—2839,17	—4470,05	— 9409,22
0°	—1180,32	—1445,59	—1855,27	—2555,50	—3984,93	— 8339,23
—10°	—1078,41	—1288,24	—1620,01	—2194,20	—3378,78	— 7015,94
—20°	— 939,77	—1091,74	—1335,52	—1766,24	—2669,96	— 5479,44
—30°	— 774,59	— 862,08	—1010,45	—1284,60	—1880,00	— 3776,39
—40°	— 585,86	— 606,19	— 654,65	— 763,89	—1032,89	— 1958,59
—50°	— 379,35	— 331,93	— 279,02	— 220,07	— 154,48	— 81,45
—60°	— 161,30	— 47,55	105,13	330,50	726,87	1798,35
—70°	— 61,65	238,26	486,08	871,02	1589,69	3623,43
—80°	282,72	516,84	852,25	1385,08	2402,40	5338,37
—90°	495,21	779,70	1192,54	1857,05	3142,10	6891,18

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EQUIDISTANCE LINES AND THEIR USE IN STRUCTURAL CARTOGRAMS

Ekvidistanty a jejich použití ve strukturálních kartogramech. — Jako prostředek k znázornění, jak jsou v ohraničených areálech zastoupena statisticky zjištěná množství různých geografických hodnot nebo jejich jednotlivých druhově odlišných složek, lze užít i rozdělení areálu vnitřními ekvidistantami jeho hranic. Areál A lze rozdělit v různém poměru na vnitřní část C a vnější pás B (nebo na několik takových pásů) a na plochách B a C lze různými rozlišovacími prostředky vyjádřit další znaky. Pro československé okresy byla vyšetřena závislost ploch uzavřených vnitřními ekvidistantami okresních hranic na vzdálenosti ekvidistanty od hranice (isografické křivky) a vzdálenosti ekvidistant rozdělujících areál v poměru B : C byly tabulkovány (v km). Interpolací v tabulkách nebo na isografických křivkách můžeme určit kilometrovou hodnotu hledané ekvidistanty a zakreslit ji do kartogramu kteréhokoli měřítka. V připojeném kartogramu jsou uvnitř našich krajů zakresleny ekvidistanty, které vymezují tak velká území, aby obyvatelstvo kraje mělo v nich stejnou hustotu jako v kraji středočeském, kde je hustota zalidnění největší.

The term equidistance line is used to denote, in geography, lines of equal distances from the lines of a horizontal projection of the earth's surface.*) To be more precise, any geographically considered equidistance line is a curve any point of which has the property that its connecting lines with any point of the initial curve are equal to or longer than a given distance, with equality occurring in at least one case. This definition coincides, for smooth parts of the curve, with the definition of construction by means of normals and in edges it is by this definition that undesirable complications are eliminated. Equidistance lines are a special case of isarithms of geometrical continua.

The term *continuum* is used to denote phenomena which fill a surface or or a space in such a way that their state, value or intensity change continuously from point to point. Most of the continua are continua of spacial extent but cartographically primarily their characteristics on the earth's surface are represented. This is done by secants of surfaces of equal values of the continuum with a topographic surface. This is also the most common kind of isarithms in the field of physical-geographic sciences. However, even in these

*) In conformity with the mathematical terminology the term "equidistance" is used instead of "isodistance" as used in cartographic literature (see E. Imhof: Isolinienkarten; Intern. Jahrb. f. Kartogr., 1961).

sciences isarithms are dealt with which express the distribution in space of the continuum by contour lines of surfaces of equal values of it (e.g. by contour lines of isothermic surfaces in the atmosphere) and, of course, also isarithms of continua which are plainly continua of superficial extent.

Apart from concrete continua also *conventional* continua of both spacial and superficial extent exist which can also be represented by systems of isarithms. Such continua are produced, for instance, by any coordinate system chosen in a space or on a surface. Then definite coordinates belong to any point and for every coordinate there are surfaces or lines of equal values. Meridians and parallels are isarithms of geographical longitudes and latitudes, concentric circles in a plane isarithms of distance from a point in the plane, radii originating from that point isarithms of direction, etc. Also a distance from other lines of a projection of the earth's surface — fictitious as well as actual, natural as well as man-made — are a *geometrical* continuum and its isarithms, known as equidistance lines, have long been known and used in political, legal, economic and transportation contexts. Also belonging here are equidistance lines of coast lines, equidistance lines of towns (mileage right), equidistance lines of thoroughfares (isochoric curves) and many others.

Inside and outside of any closed curve a system of equidistance lines can be constructed. For the subject dealt with in this article we shall limit ourselves to *internal* equidistance lines. These can be looked upon as a system of isarithms from which a statistical surface can be formed and for the latter further statistical characteristics of the area enclosed by some curve can be derived, i. e. characteristics referred to that boundary.

A system of internal equidistance lines constructed at an arbitraly chosen but fixed mutual distance $\varrho = \Delta d$ reminds one of a system of isarithms of height in the neighbourhood of a negative peak of a topographic surface, i.e. a system of isobathes of an enclosed basi nwhich would have everywhere a uniform slope. This comparison is satisfied also by the fact that a statistical surface formed by equidistance lines of some enclosed curve splits up into parts intersecting along the edges produced by the shape of the zero equidistance line, i.e. of the boundary line itself. The majority of these edges (analogous to the valley lines of a negative shape of a topographic surface) terminates before reaching the negative peak of the surface given by the equidistance lines and only some of them actually meet in it.

Equidistance lines of any given line are constructed as *envelope lines* of circles of a radius $\varrho = n \,.\, \Delta d$, the centres of which are located on the initial line, or any subsequent internal equidistance line can be constructed from the preceding one by using $\varrho = \Delta d$, the latter being considered as a new initial line (an analogy of Huygens's explanation of wave-propagation in a homogeneous medium). The surfaces enclosed by internal equidistance lines constructed to the boundaries of administrative units (e.g. districts, regions, etc.) can be measured. It is further possible to construct graphs similar to hypsographic curves used for a representation of the dependence of the area of elevated positions of a topographic surface on the altitude above sea level. These so-called *isographic curves* representing the dependence of surfaces enclosed by equidistance lines on the magnitude of d of the equidistance lines permit the determination, for any area under examination, of the **mean distance** of its points from the boundary. For that purpose the same procedure is followed as for the determination of the mean altitude of a topographic surface from a hypsographic (or bathygraphic) curve.

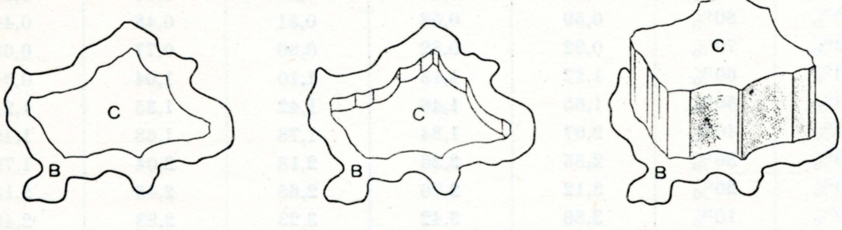

Fig. 1a,b,c.

Isographic curves have been constructed for all districts and regions in Czechoslovakia and this was done from the planimetric results on the maps of internal equidistance lines of districts with Δd = 2 km at a scale of 1 : 200 000 and on the maps of equidistance lines of regions with Δd = 5 km at a scale of 1 : 500 000. Neither the numerical values used for the construction of these graphs nor the graphs themselves are published but they have been used for the interpolation of the values listed in the tables which follow, for isographic curves can be used for the finding of equidistance lines which limit a definite part of the area A of the territory under examination.

Every internal equidistance line of the boundary line divides the figure into a boundary belt B and an inside part C. Therefore A = B + C. The ratio B : A will be designated by 1 : n. The distance d of the internal equidistnace line of a given figure separating the boundary belt $B = \frac{1}{n} A$ and enclosing the inside part $C = \frac{1}{n} A (n - 1)$ depends on the shape and size of the figure. In figures of an equal area every equidistance line separates a belt which is the larger, the more elongated and articulated the figure is. Thus, for instance, in a circle of an area of 100 cm^2 (r = 5.64 cm) a belt of an area B = C is separated by an equidistance line d = 1,65 cm^2, while a square of the same area is halved by an equidistance line d = 1,46 cm^2, a rectangle a = 2b by an equidistance line d = 1,35 cm, etc. For a square and a rectangle of an area A and a circumference p the distance d of an internal equidistance line limiting an inner part $C = \frac{1}{n} A (n - 1)$ can be calculated from the formula

$$d = \frac{1}{8}\left[p - \sqrt{p^2 - 16\,A\left(\frac{n-1}{n}\right)}\right];$$

demanding that K = x% A, we obtain

$$d = \frac{1}{8}\left(p - \sqrt{p^2 - 0.16 \times A}\right).$$

For A = 100 cm^2, d (in cm) is given in the table below.

B	C	Circle	Square	Rectangle		
				2a = 3b	a = 2b	a = 3b
10%	90%	0,29	0,26	0,25	0,23	0,22
20%	80%	0,59	0,53	0,51	0,48	0,46
30%	70%	0,92	0,82	0,80	0,77	0,69
40%	60%	1,27	1,13	1,10	1,04	0,94
50%	50%	1,65	1,46	1,42	1,35	1,21
60%	40%	2,07	1,84	1,78	1,68	1,49
70%	30%	2,55	2,26	2,18	2,04	1,79
80%	20%	3,12	2,76	2,65	2,45	2,15
90%	10%	3,86	3,42	3,23	2,93	2,46

For any area A′ = m . A the corresponding d′′s are equal to $d\sqrt{m}$, e.g. for a rectangle, with a ratio of sides of 1 : 2 and A′ = 1600 cm^2 d′ of an equidistance line separating a 20% boundary belt is

$$d' = 0{,}48 \text{ cm} \times 4 = 1{,}92 \text{ cm} .$$

Territories which are required to be divided by equidistance lines into two or more parts at a definite proportion have, however, only exceptionally simple geometrical shapes such as were dealt with in the above formulas and table. At most it is sometimes possible to ascribe to them, to a rough approximation, one of these shapes and then to determine, also only to a rough approximation, the distance of the equidistance line sought. In most cases, however, it is necessary to proceed by the *method of isographic curves* which, for Czechoslovakia, yielded the following results.

Distance d (in km) for Czechoslovak Regions:

	B = 10% C = 90%	B = 20% C = 80%	B = 30% C = 70%	B = 40% C = 60%	B = 50% C = 50%	B = 60% C = 40%	B = 70% C = 30%	B = 80% C = 20%	B = 90% C = 10%
Central Bohemian Region	2,05	4,40	6,88	9,70	12,70	16,25	20,50	25,58	31,95
Southern Bohemian Region	1,68	3,80	6,30	9,03	12,05	15,90	19,75	24,55	30,50
Western Bohemian Region	1,75	3,85	6,25	8,98	11,83	15,15	18,73	22,75	27,48
Northern Bohemian Region	1,08	1,45	4,13	5,73	7,50	9,53	12,03	14,70	17,98
Eastern Bohemian Region	1,58	3,38	5,33	7,53	10,05	12,93	16,25	20,58	25,90
Southern Moravian Region	2,03	4,55	7,45	10,50	13,70	17,20	21,25	25,80	31,75
Northern Moravian Region	1,50	3,48	5,78	8,50	11,38	14,55	18,20	22,05	26,00
Western Slovak Region	2,50	2,83	8,50	12,00	15,80	20,50	24,90	30,47	37,03
Central Slovak Region	2,38	4,88	7,80	11,25	15,05	19,15	23,93	29,53	37,70
Eastern Slovak Region	2,15	4,75	7,80	11,10	14,63	18,63	22,95	27,87	34,00

There are many graphical means to represent how statistically determined absolute quantities of various geographic values are distributed over the earth's surface — at definite points or in limited areas — and the relative representation of their individual distinctive kinds. As far as discontinuously distributed values are concerned (geographic discreta) structural *cartograms* and cartodiagrams are used in which the absolute quantities are represented by circles of radii proportional to the square roots of the quantities represented. By a division of the circles into sectors, the centre angle of which is proportional to the percentage of the qualitative components, several absolute data can be combined in one figure and their mutual proportion expressed. With choropleth cartograms we are limiting ourselves either to a single quantitative feature and graduate the same quantitatively (e.g. the percentage of agricultural land by a pattern or by a shade of colour) or we represent the proportions of several quantitative features of the phenomenon under consideration in the given area by division of this area into parallel stripes the width of which is proportional to the individual proportions (e.g. to the percentages of arable, forest and other land). Striped cartograms have the advantage that they facilitate the simultaneous perception of several features and that they replace several monothematic cartograms in which the concentrated colour of the individual stripes would be thinned by the pattern of the entire corresponding area of a choropleth cartogram.

The question arises whether, instead of a striped cartogram, which shows the proportional representation of the individual components accurately only by the width of the stripes (but not by their surface), it is not possible to use a *division of the area by internal equidistance lines of its boundaries.* In certain cases this is very easily possible and it presents, in fact, a very clear picture when a discontinuous phenomenon of surface is thus represented which is compared to the total surface of some territory (e.g. the above mentioned proportion of various kinds of utilization of the land). In such a case several equidistance lines will be used to separate several belts B and the remaining portion C. It depends on the nature of the situation to be represented and on the effect to be achieved by the cartogram to which component the outer belt will be allocated and to which one the inner part. Thus, for instance, when only forest land and its proportion to all land is being represented, it is of advantage to centralize the forest land in a compact area C while, when areas to be emphasized are areas bare of forests or deforested, waste lands etc., it is, on the other hand, more effective to allocate particularly to these negative, shortage components of the areas C empty, uncoloured windows of the cartogram; cf. fig. 16.*)

*) See Helburn-Edie Lightfoot: Montana in Maps, where this principle was applied for the differentiation between federal and country land.

Equidistance cartograms afford a possibility of marking, on surfaces B or C, the individual components in accordance with their proportional occurrence (e.g. the composition of forests by the stripe method).

Choropleth cartograms are used to represent, as already mentioned, mostly relative indicators (such as the percentage of the population belonging to industry). If two areas (districts) of such a cartogram receive the same shade of colour or the same pattern, it creates an erroneous impression of a quantity proportional to the area. Large areas of thinly populated mountain towns may receive high and even the highest shades of the scale expressing the proportion of the populations belonging to industry while small areas in densely populated territories receive the same or a lower value although high multiples of the industrial mountain population are concealed behind this value of the scale. Cartograms of occupations cannot be correctly interpreted without a simultaneous perception of a choropleth cartogram of the density of population.

Choropleth cartograms may mislead the reader in the same way as a beginner who lacks geographic experience is misled when he allows himself to be influenced only by the size of states and territories and attributes to them, in all respects, an importance in proportion to their size. This has long been realized by cartographers when they excluded, from certain special maps, uninhabited territories or attempted to produce *so-called anamorphated cartograms* in which each area was distorted and reduced in accordance with its importance. Thus, for instance, the sizes of territories were reduced in accordance with the population. The materialization of this highly logical concept is, of course, graphically difficult because the construction of the cartogram lacks geometric regularity.

The method of equidistance lines permits us to *replace an amorphated cartogram* without any disturbance of the concept of mutual position and shape of a territory. Every territorial unit of the cartogram can be reduced in surface by an equdistance line of the border. Even though the equidistance lines do not outline similar figures, the affinity of the original and of the derived figure is obvious. When a certain phenomenon is observed in a system of territorial units, the surfaces of the units can be reduced in accordance with the ratio of the value of each unit to the unit which is the maximum one of the whole system or to some other chosen comparative value. Thus we have reduced the regions of Czechoslovakia, each of which has a different density of population, by a comparison with the Central Bohemian Region which has the highest density, i.e. each region A was reduced by an equidistance line to $C = A \frac{h}{h_{max}}$

The population of each region was crowded together into an area enclosed by an equidistance line in such a way that the population then had, on this area, the density of the population of the Central Bohemian Region.

Only these surfaces can be filled with shades of colours or a pattern expressing some demographic or economic criteria linked with the population (e.g. the natural growth, the proportion of the population occupied in different fields of activities, etc.). In these areas the method of stripes can be applied, too.

However, even equidistance lines can be used to classify, in these artificially created areas with a uniformly concentrated population, the population by further criteria.

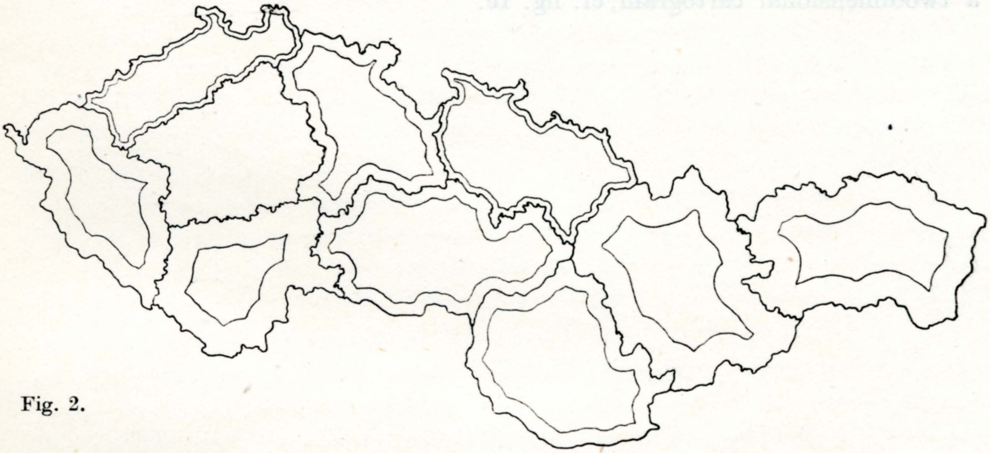

Fig. 2.

Very easily the question will arise, whether it is not possible to replace the division of surfaces by equidistance lines by division by geometric similarity, which is theoretically simple. However, arbitrariness occurs already in the choise of the centre of gravity, which does not affect the correctness of the reduction of the surface, but precludes uniqueness in the carrying out of the graphical work. In any case, however, a picture of unsatisfactory appearance is obtained in cases of intricate shapes of territories and the outlines of individual surfaces often touch or even overlap. Tests performed proved the unsuitableness of this method.

In certain applications the method of equidistance lines is limited by the belts B being too narrow when the central surface C is fairly large in comparison with the whole area. This happens when $B<30\%$ or $C>70\%$. This is also one of the factors which decide the sequence in which the parallel belts between equidistance lines should be used for the individual structural components when there are more of them. The outer belt has to be allocated to the component most strongly represented, the inner one to components of a lower relative representation. Equidistance structural cartograms are therefore not suitable for the representation of too small proportions, for they cannot be allocated, for the above reason, the belts B, but also not the central portion C, the boundary of which deviates, in this case, too much from the boundary of the area A.

The internal equidistance line (with a large d, i.e. for small proportions of C) sometimes split up into two parts and enclose two surfaces C_1 and C_2. In such a case the smaller one must be added to the larger one, i.e. d of the equidistance line of the surface C_1 must be increased and the area C_2 cancelled.

The surfaces C may become the bases for a three-dimensional cartogram (or built-up choropleth cartogram). This creates the possibility of using the height of columns for the expression of a further quantitative feature while there is a space, on their upper bases, for data which would be included in a twodimensional cartogram; cf. fig. 1c.

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THE INTERNATIONAL COOPERATION IN THE FIELD OF HISTORIC GEOGRAFICAL RESEARCH

K otázkám mezinárodní spolupráce na poli historicko-geografického výzkumu. — V národních atlasech se postupně realizuje myšlenka edice jednotného a srovnatelného geografického obrazu současného světa. Takový obraz historicko-geografického vývoje zemského povrchu ovšem také nemáme. Nepodávají jej ani historické atlasy,pokud jsou zaměřeny všeobecně na vývoj lidské společnosti, na rozdíl od geografického pojetí, kde předmětem historické geografie je utváření zemského povrchu v jeho minulých formacích a vývoji.

Písemná historická líčení dějin států a oblastí zvládají látku jejím utříděním do epoch a používají k tomu periodizačních mezníků. V důsledku nerovnoměrného hospodářsko-společenského vývoje v jednotlivých částech světa není snadné stanovit takové mezníky v světovém měřítku. Jen formování světového trhu a vznik světové imperialistické soustavy na rozhraní 19. a 20. století dosáhl obecného přijetí. Jinak se počítá s přechodnými obdobími v trvání i několika set let.

Pro další rozvoj výzkumu v oboru historické geografie by bylo účelné získat především kartografický obraz nejdůležitějších geograficky relevantních elementů vývoje zemského povrchu ve vztahu k činnosti člověka, jako jsou říční síť, lesy a využití půdy, rozložení obyvatelstva, jeho sídla a národnost, průmysl, komunikace, hranice států a jejich správní členění. Mezinárodní spolupráce by se měla zaměřit k výzkumu a zakreslení takových jevů do moderních podkladových map. Pro srovnatelnost, tak důležitou v geografii, mělo by význam především synchronní vyjádření. Za účelem srovnatelnosti pokládal bych proto za účelné obrátit pozornost k roku 1900 a dále uvažovat o letech 1850 a 1800 jako o datech, k nimž by měla být zaměřena mezinárodní spolupráce. Pro země s nevelkou vědeckou tradicí bylo by ziskem soustředit se na datum zcela nedávné, např. 1950. Dohodnuté časové termíny pokládal bych pro začátek práce spíše za směrnici, jejíž plnění a zpřesňování by bylo odvislé od podkladového materiálu a vůbec stavu a stupně výzkumných prací v jednotlivých zemích.

Atlases having a historical aspect represent an outstandingly valuable aid for historical geography as they show the progress made in the research and the scientific methods.

As far as atlases, of historical conception, are published by historical institutes, naturally the attention is focused on the solution of problems historically most outstanding. In these the function of the historical maps is mainly to illustrate cartographically the historical events, to give a picture of their situation or evolution in the past of the world. Many of these maps are of great importance to historical geography whereas others are of no significance geographically. It is worth mentioning that in Czechoslovakia it was V. K. Yatsunski (10, 11) who, after the Second World War, contributed greatly to the determination of the concept of historical geography, later the Polish discussion on this subject (4, 6) and the work of A. H. Clark (2). Recently Anuchin's work (1) awoke much interest. Yatsunski stressed the great importance and the possibility of future application of geographical findings in history. He, as a historian, assigns to historical geography the place of historical science in which the work of geographers may also be necessary. He seems to base his opinion on the fact that in historical geography written material is mainly processed and that it is being done by a historical method. It should be mentioned that the point of view of the Czechoslovak geographers was expressed by J. Martinka (8) at the Conference on theoretical problems of geography, held in Bratislava in 1962. He stressed particularly the point that historical geography on account of the subject of its research differs in no way from geography of course but it studies the surface of the earth and the relation of man to it in its historical past forms. Martinka advocates the term geographical history for historical science with a geographical aspect and he points out the incorrect tendencies in the past when the history of geography was included under this heading as well as the history of discovery and navigation, sometimes even the history of cartography and of other branches. In historical geography the written material does not constitute the main source of information but the field research and new methods based on natural science are becoming more and more important (cf. 9 : 9). One may say that historical geography is in reality an outstanding component of geography and that it is the evolutional historical principle in geography that makes geography a branch of science. I feel that the basic difference between history and geography must be emphatically stressed: history is a science dealing with the evolution of society whereas the subject of geography is the formation of the earth's surface.

The publication of national atlases is the realization of the aim of gradually achieving a uniform and comparable geographical picture of the whole world. Contrary to the cartographical representation, the written record of the history of the world cannot be elaborated in a synchronical form. Attempts to achieve this, presented mostly in the form of tables, were always rather a type of surveys in their character. Apart from the geographical point of view, in historical account of the events it is necessary to take into consideration chronology as another factor. While it is possible to interprete the geographical element by placing the countries into certain areas, the chronological factor necessarily requires history to be divided into time periods. Such a division of the history of the world has always been the cause of serious difficulties, the roots of which lie in the difference of viewpoints. The unbalanced historical social development in the different parts of the world presents the greatest obstacle (5). A general opinion may be said to be that the dates cannot be used to mark the milestones in the evolution of the world but rather it should be the transitional periods, sometimes lasting even several centuries, which naturally become shorter towards the present time in keeping with the more rapid course of historical process. Only those dates marking development of world markets and the origin of imperialist system at the end of the ninteenth and the beginning of the twentieth century are generally accepted as the turning-point in the evolution of the world.

It may be rightly said that the determination of a uniform time delimitation of the periods is the key-problem in making uniform and comparable historical geographical maps. That does not mean, however, that cartographical representation based on the historically given periods is incorrect. It is indeed only a means of overcoming the difficult obstacle in the uniform cartographical representation on the bases of international cooperation.

What are the reasons leading to such contempletions and what are the issues? Above all, the need of using in practice the results of historical geographical research will become more and more urgent. The scope of research and the developing of scientific methods exceeds far beyond the state boundaries of any one country. The study of evolution of the earth surface, particularly in the recent period, in relation to the changes created by man, will become a necessity for all the cultural countries. This will prove to be an absolute requirement in order to improve the scheme of formation of the landscape. The fact that in many countries, especially in those highly industrialised, the present state in this respect is not an ideal one must be taken into consideration. All transformations affecting the natural development must be made in the future on the bases of studies of the existing laws. This point of view was the reason which led, for instance, to the foundation of a separate Institute for Shaping and Protection of Landscape at the Czechoslovak Academy of Science in 1962. In the regions, for example, where coal is being mined such changes in the surface of the earth have taken place that the landscape there has taken on a completely different shape. Another evidence of the significance and the urgency of historical geographical research is the development of agriculture in our country in connection with the transformations in the structure of rural settlements.

I believe that keeping in mind the social needs and the tasks of historical geography it is impossible to wait any longer for further changes without taking any suitable steps as they are bound to occur in the nearest future due to, for example, making use of nuclear energy. Not only in our country but all over the world the whole structure of the basic productive power will be shifted. And even up till today there has been no reliable and over-all picture presented of the historical geographical changes that took place in the transformation of our country in the period of the first industrial revolution. Scientific evaluation of this phenomenon from the geographical aspect ought to be the foremost task of historical geography in all the branches. The changes in the course of the rivers and water management in general, fytogeographical changes, building new transport networks, etc, are only a few to illustrate the point.

We are aware of the fact that the aim of geographers usually is to elaborate synthetical maps. Such a map would not be of great importance in the first stages for international cooperation in the field of historical geographical research, its purpose would be much simpler — only to a cartographical picture of the most outstanding elements necessary for the compilation of synthetic maps that means, therefore, a picture of the geographical distribution of the geographically significant phenomena. I have in mind mainly the network of rivers, woodlands and the use of land, distribution of the inhabitants, their settlements and nationality, industry, transport routes, the state frontiers and administrative division, etc. These would represent more or less a preliminary elaboration but which is extremely important for all geographical work. It would however be necessary to come to an agreement as to the content, as well as the cartographic symbols. In this respect a great step forward has already been taken in the conception of international cartographic works which are in hand. Nearly a hundred years ago E. Desjardins (3) used such methods in order to represent historical geographical situations. Here different scales of the maps serving as bases might be mentioned, their maintainance, completion and additional up-to date changes in accordance with the progress in research, establishing respective documentation and finally the publication of historical geographical maps.

In the past K. Malík (7 : 6), in our country, pointed out that the comparison of economic maps covering the different time periods might be a very important source of information in order to establish the character and consequences of the far-reaching changes in economy, their regional reflection and their geographical correlation.

The conception of comparable historical geographical maps, uniformly elaborating the same given time period of the past, may also be defined thus: the influence of man on nature and their interrelations are the causes which bring about a constant change of the landscape at any given moment which greatly differs from the picture of the same landscape at another period. It is beyond the human power to depict the evolution all over the world in its unceasing changes but it is possible to concentrate it on limited time periods. In order to determine the time limitation of historical periods it is necessary to keep in mind the fact that the evolution of the human society is progressing at a quicker and quicker rate in the more recent periods. In studying the past it is necessary to draw conclusions from our knowledge of the contemporary time. For the purpose of historical geography it would be worth while, in my opinion, focusing attention on the year 1900 and later to the years 1850 and 1800. I am fully aware of the objection that these dates would introduce a principle of equidistance into the time aspect and also that they are without a historical significance. According to the experience in practise as well as in the compilation of atlases I consider them to be reasonable for geographical research if keeping in view the international needs. A synchronical determination of period-marking limits, others than proposed above is unattainable (5 : 112) due to the lack of uniformity in the economical and social development in the different parts of the world. If periods covering 50 years were accepted as satisfactory for the epoch most closely preceeding the present one then hundred-year periods might be considered for the study of the more distant past or any other number of years according to the experience gained. Countries without a long-standing scientific tradition might benefit if they concentrated on dates quite recent such as, for instance, the year 1950. No doubt it might be advantageous if the attention were focused in the initial stages on any one of the three- four periods for which the conditions would be the most favourable in the country in question. The chosen time periods, in my opinion, would offer the general line which should be followed in the initial stages of the work and the realization and completion would depend on the source of materials, the extent of its study and the existing conditions of research in general. Experience has shown that in order to determine the existence and quality of many geographically important phenomena for certain periods there is no urgent need of actual written evidence.

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HISTORICAL ATLAS OF CZECHOSLOVAKIA

Historický atlas ČSSR. — Historický atlas ČSSR, jehož vědecké koncepty byly dokončeny počátkem roku 1963, má 46 listů formátu 85 × 50 cm a na vědecké úrovni zachycuje hlavní rysy dějinného vývoje na nynějším území ČSSR od nejstarších dob do r. 1960. Je rozdělen na 11 periodizačních období podle hlavních stránek dějinného procesu. Počíná se většinou znázorněním ekonomické struktury společnosti a pokračuje jevy politickými, administrativními a vojenskými, sociálním vývojem a konečně kulturními jevy. Kromě legendy jsou jednotlivé listy opatřeny metodickými poznámkami, zachycujícími nejdůležitější prameny a literaturu a vysvětlivky o způsobu zpracování a významu tématiky listu. Při stanovení značkového klíče a způsobu kartografického a polygrafického zpracování byly vykonány speciální výzkumy. Zásadně se používá současného názvosloví s případnými dubletami vžitých historických názvů, které jsou v úplnosti obsaženy v rejstříku.

Nahromaděné zkušenosti v oblasti vědecké, organizační a výrobně technické by bylo třeba udržet v aktivním stavu a přikročit k postupnému vydávání jednotlivých specializovaných sešitů Analytického akademického atlasu dějin ČSSR, k němuž je připravena značná část podkladů a konceptů. Při realizaci tohoto vědecky významného projektu bude třeba prohloubit mezinárodní spolupráci a koordinovat metodu zpracování pramenného materiálu, stanovení periodizačních mezníků, časových průřezů a dynamických řad stejně jako způsobu kartografického zobrazení. Tím se dosáhne co největší srovnatelnosti kartografického zpracování různých stránek dějinného procesu v rozsáhlejších historických oblastech než na nynějším území jednotlivých států.

The first project for compiling a comprehensive atlas of Bohemian history in the 10th to 15th century, which was published in 1897 by Hermenegild Jireček is closely connected with the endeavours — mainly at the end of the 19th century — of a cartographic illustration of the most important historical developments taking place in the foremost European countries. This plan was not realized.

In 1945 the endeavours to prepare a scientific historical atlas, which was to be a profound analysis of the historical data available[1]) were repeated.

But it was only at the beginning of 1960 that decisive steps were taken which raised the preparatory work on the Historical Atlas of the ČSSR to a new level

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[1]) See ROUBÍK F.: K historickému atlasu republiky Československé, Časopis Společnosti přátel starožitností (To the Historical Atlas of the Czechoslovak Republic, Joural of the Society of the Friends of Antiquities), Prague, vol. LX (1952), pp. 57—64.

of a really creative work. The Historical Institute of the Czechoslovak Academy of Sciences signed an agreement with the Central Office of Geodesy and Cartography for the atlas to be published by 1965, an editorial board of the atlas was established,[2]) a new plan of the theme, the project and later the first and second model of the atlas were made. On the basis of the new, more precise model the workers of the Department of Historical Geography of the Historical Institute of the Czechoslovak Academy of Sciences and other non-staff workers began to prepare the material and drafts of the maps, cartograms, diagrams and graphs. By 1963 the drafts were finished and during the year 1963 the originals of the individual pages were drawn and discussed by the editorial board and finally the originals were prepared for publication. The atlas is being cartographically and polygraphically compiled by the Central Office of Geodesy and Cartography[3]).

The scientific contents of the atlas reflects in general outline the stage of historical research in Czechoslovakia by the end of 1962; new sources and literature data were, however, used in the preparation of maps, cartograms and diagrams.

The Atlas which has 46 pages of 85 × 50 cm, is divided into 11 periods, in which the subject matter is divided chronologically according to the main trends of historical progress. Every period starts with the description of the economic structure of the society and continues with political, administrative and military phenomena, social development and finally cultural phenomena. Only the arrangement of the first three pages, which have been mainly compiled on the basis of archeological material, is somewhat different. On these pages the paleolithic, mesolithic, neolithic and eneolithic cultures and the settlements in the bronze period are cartographically illustrated. Then follow illustrations of the Celt and German population and of the situation in the Roman period and finally detailed account of the Slav settlements from the oldest times up to the beginning of the 10th century are given. Special attention is paid to the Empire of Samo and the Great Moravian Empire, where, on a number of maps and detailed plans the result of the latest archeological research work, mainly in the South Moravia and West Slovakia, are described.

The next part deals with the period of feudalism (up to 1848), and is divided into a number of sections. Two pages show the economic, political and cultural development in the period of early and supreme feudalism, at the time of the

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[2]) Dr. J. PURŠ, head of the Department of Historical Geography of the Historical Institute of the Czechoslovak Academy of Sciences, was nominated chairman of the editorial board. Dr. O. ROUBÍK, head of the department of the Central Office of Geodesy and Cartography in Prague, was nominated secretary of the editorial board; further members were workers of the foremost historical and geographical institutes.

[3]) The Atlas can be ordered from the Central Office of Geodesy and Cartography, Prague 1, Hybernská 2.

expansion of the feudal domination during the reign of the House of Přemysl and Luxemburg, the invasion of the Tartars and the strengthening of the domination of the Hungarian feudal lords in Slovakia. The next two pages deal with the Hussite revolution, which not only shook the foundations of the feudal domination in Bohemia and Moravia, but also was of great international significance. The topography of Bohemia and Moravia at the time of the Hussite revolution, illustrations of military campaigns, plans of significant battle-fields, maps of foreign expeditions, the Hussite movement in Slovakia and the international response of the Hussite movement, afford a thorough explanation of this significant period.

The following pages of the atlas pay great attention to economic factors: the land ownership in Slovakia at the end of the 16th century, illustrations of selected feudal dominions in Bohemia and Moravia, the confiscations in Bohemia in 1547, the political development during the reign of Georg of Poděbrad and the Jagellons', the origin of the Austro-Hungarian monarchy, the anti-feudal struggles in Bohemia and Moravia and in Slovakia and finally the cultural conditions in the period prior to the battle of the White Mountain (maps of schools, print-shops, architecture, cultural relations of the Czechs and Slovaks, etc.).

Special attention is paid to the anti-Habsburg risings and the Thirty Years War. The maps of the phases of the Bohemian War are followed by cartographic illustrations of the coalitions and the military campaigns during the various stages of the Thirty Years War and by more detailed plans of the individual battle-fields and the map of the confiscations in Bohemia and Moravia in the years 1620 to 1648, elaborated on a larger scale (1 : 1 mil.), on the basis of new research work. The next pages illustrate economic conditions in the period before the battle of the White Mountain (feudal ownership and economic conditions in the second half of the 17th century in Bohemia and Moravia and in Slovakia and maps of selected feudal estates in these countries), the class struggles in the second half of the 17th century (the main stress here lies on topographic illustrations of the great serf uprising in 1680) and monuments of baroque art.

The following pages deal with the period of the breakdown of feudalism and the development of new productive forces and capitalist relations up to the year 1848. The maps of feudal ownership at the end of the 18th century and the map of manufactural and industrial production, followed by demographic maps, the maps of serf uprisings (especially the year 1775), political- military maps and maps of the cultural development, are elaborated on a larger scale. These maps contribute to the clarification of the economic, social and cultural presuppositions for the first stage of the Bohemian and Slovak national revival. The following series of maps illustrates the feudal estates and economic conditions prior to 1848, development of transport, class struggles in the period between 1781—1848, demographic development from the end of the 18th century up to 1848 and cultural conditions, illustrating the situation before March. These maps help to clarify the next page dealing with the bourgeois revolution in Europe, in Bohemia and Moravia and in Slovakia in the years 1848—1849 and the petering out of the revolutionary wave in the Habsburg monarchy in the sixtieth. The last efforts of this wave were the immense open-air meetings ("tábory") in Bohemia and Moravia in the period of 1868 to 1871. These are illustrated on a special map. This section also includes maps of military campaigns during the 1848—49 revolution and the Prusso-Austrian War in 1866 and the development of the administrative divisions up to the end of the sixtieth.

The next couple of pages deal with the growth of the various industrial branches and the development of agriculture in the second half of the 19th century. The description of the development of the steam engine in industry in the period of the expansion and completion of the industrial revolution is most instructive (the dynamic sequences of the years 1834, 1841, 1852, 1863 and 1876 according to the branches and districts). A detailed map (1 : 1 mil.) illustrates the state of industry in Bohemia and Moravia and in Slovakia in the period of the rise of imperialism. From the individual branches of industry the maps of the textile, sugarrefinery, glassmaking, iron and steel and engineering industries and the exploitation of coal are of the greatest significance. These maps are followed by illustrations of the concentration and monopolization of industry, the growth of finance capital, the development of road and rail transport and by isochronous maps. The origin and growth of the workers' movement is described in a number of maps dealing with workers' federations and the strike movement in the various periods. In this section special attention is paid to the relation between Czechs and Slovaks in the years 1848—1918 and mainly to the response evoked by the Russian revolution of 1905—1907, which is described both on a map of the whole territory of the contemporary republic and on a special little map showing the response it evoked in Prague. The demographic development, the changes of social structure of the population, the depopulation of the country-side, the growth of large towns, the development of education, cultural institutions and art up to the First World War are illustrated by a number of maps.

A special page illustrates the events of World War I. and the Great October Socialist Revolution, demonstrations of the people against war, the origin of the Czechoslovak Republic, the Slovak Republic of Soviets of 1919 and the administrative division of the country. A number of pages illustrates the general situation in industry and the location of its individual branches, conditions in agriculture, development of the class and social structure of the population and the growth of industrial centres, health service, national and cultural conditions in the period 1918—1938. Special attention is paid to the class struggles in this period. The struggle of the people for socialization in the ČSR and the December General Strike in 1920, manifestations in defence of Soviet Russia up to 1922, strikes and the revolutionary movement in the twentieth and thirtieth, the struggle against unemployment during the economic crisis in the thirtieth, the peasants' movement and manifestations in defence of the republic in 1938 are dealt with in a series of maps. And now we come to the next section of the atlas, dealing with Munich and the occupation of Czechoslovakia by nazi Germany. In connection with the aggressions of nazi Germany and fascist Italy and with the illustration of their defeat, the development of the resistance movement, gaining its peak in the Slovak National Rising in the summer of 1944, is also dealt with. A number of the following maps illustrates the coming of the Soviet Army and the other Allied Armies in spring 1945, the rising of the people in May 1945 and the liberation of Czecholovakia by the Soviet Army.

The last period deals with the construction of socialism up to 1960. It illustrates the nationalization of industry and its development in the period of the Two-Year Plan and the first two Five-Year Plans, it brings special maps of the most important branches of industry, the development of all kinds of transport, the course of the collectivization of agriculture and the development of agricultural production and the changes in the class and social structure of the population of Czechoslovakia in the period from 1945—1960. The economic development of Slovakia in the period of the construction of socialism, mainly characterized by the rapid progress of industrialization, are made very clear. The following maps illustrate the development of the workers' social insurance, the building of new health facilities and the development of large industrial centres in the period of the construction of socialism. The next series of maps deals with the cultural revolution in the Peoples' Democratic Czechoslovakia — it shows the educational system, libraries and archives, the most important monuments, museums and galeries, theatres and cinemas. At the end of the Atlas is a large map of the Czechoslovak Socialist Republic and political map of Europe in the year 1960.

Each page has, besides the key, also methodical footnotes, giving the most important references as to the source of data and literature and explanations on the subject of that page. A detailed index has been worked out for the whole atlas.

The scientific contents of the atlas is the work of the department of Historical Atlas (former department of Historical Geography) of the Historical Institute of the Czechoslovak Academy of Sciences, the head of this department is the chairman of the editorial board and the scientific workers of the department are editors of the individual sections of the atlas. A number of specialists of the Historical Institute and other scientific institutions cooperated in compiling the atlas.

The Cartographic and Reproduction Institute in Prague compiled the atlas from the publishing point of view and also prepared the two models. The main subjects are illustrated on the largest scale, the other maps are on various smaller scales according to the significance of the subject. To make it possible to compare the illustrated phenomena in the different sections of the historical development, the principle of using the same scale has been adhered to. The historical phenomena are recorded on the territory of the present-day ČSSR.

A number of problems arose when chosing the most suitable expressions to describe the very diverse and changeable historical subject matter illustrated in the atlas. The Geodetic, Topographic and Cartographic Research Institute[4]), therefore, cooperated in determining the symbol key for the cartographic and polygrahic execution of the atlas. Terminology was also discussed at a number of meetings.

The authors, reviewers, members of the editorial board, workers of the Historical Institute and a number of cooperating institutions gained — in preparing and compiling the atlas of the History of the Czechoslovak Socialist Republic — invaluable experience and brought together a great number of specialists of different branches. These accumulated experiences in the field of scientific research and scientific- organizational and productional-technical work should be kept in an active state and — in connection with the work on the comprehensive Czechoslovak History — individual specialized booklets of the Analytical Academic Atlas of the History of the ČSSR should be published. For a number of subjects the draft material has already been prepared, as, in the course of the preparations for this atlas profound historical research has been carried out and all the collected data could not be made full use of in the cartographic illustrations. For the realization of this scientifically significant project it will, however, be necessary to extend international cooperation and to coordinate the method of compiling the original documents and the preparation of the draft maps. Cartographic drawings and the determination of the period divisions of the individual sections and the dynamic sequences of the individual series of the depicted phenomena will also have to be coordinated. In this way the greatest possible comparability of the cartographic executinos of the different sides of the historical process in wider historical territories than only within the boundaries of the individual states, can be reached.

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[4]) MEDKOVÁ M.: Příprava tvorby a vydání Atlasu dějin ČSSR, Sborník Československé společnosti zeměpisné (The Preparations of the Compiling and Publishing of the Atlas of the History of the ČSSR, Journal of the Czechoslovak Geographical Society), vol. 68 (1963), no. 1, p. 101.

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