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# INTERMOUNTAIN BASINS — A CHARACTERISTIC ELEMENT IN THE RELIEF OF SLOVAKIA

The West Carpathians and the genetically connected Sub-Carpathian lowlands cover nearly the whole territory of Slovakia.

The West Carpathians are an extended but relatively broad upwarp. Only its maximum reaches essentially more than 2000 m a. s. l. and its highest point is the peak Gerlachovský štít (2655 m). The summit region of the West Carpathian's upwarp with the high-mountain relief features is not large and it is practically limited to one mountain — group to the Tatra. Some orographic systems in the centre of Carpathian's upwarp reaching above the tree-line, form a group of so-called alm mountains. There it is possible to see signs of the periglacial modellation and sporadicaly also glacial signs (Low Tatra — 2043 m a. s., Malá Fatra — 1709 m a. s., Chočské pohorie — 1611 m a. s., Veľká Fatra — 1592 m a. s., Babia hora — 1725 m a. s., Pilsko — 1557 m a. s.). Otherwhere, the highland and upland relief dominates on a great part of the area of the Slovak West Carpathians. The chains of mountains, respectively groups of them, slope from the top of upward to the edges, sometimes gradually, sometimes by means of morphologically distinct spur ridges in the adjacent lowlands.

The Sub-Carpathians lowlands represent on our territory an other category of forms. Owing to the mountain relief — their area is much smaller (the ratio is about 1 : 5) In the southwest, it is the lowland Záhorská nížina as a part of the Vienna basin, in the south the lowland of Danube, as the northern part of the Little Hungarian lowland and in the east it is the East Slovakian lowland as the northern tip of the Great Hungarian lowland. Its mountainous edge in the north covers the north-east tip of Slovakia and belongs to the East Carpathians.

The upward of the West Carpathian is no continual, undistrubed uparching area and no massiv system formed by mountain ridges laying side by side as e. g. the Alps. It represents more an irregular mosaic of individual mountain chains, resp. mountain groups divided each from the other by distinct depressions — by intermoutains basins. These very contrast from the surrounding mountains by means of the hight a. s. l., by means of the structure and the surface forms as well and represent a third category of relief forms on the territory of Slovakia, a certain degree between the lowlands and the proper mountain systems of the Carpathians (see l. c. 17). It is necessary to emphasize that, owing to their area, basins represent an important component of the surface. Several basins have nearly the some area as the surrounding mountains.

Although the inter-mountainous basins as a contrast of the mountainous forms are a characteristic sign of the whole upwarp of the West Carpathians, the inner part of the West Carpathian upwarp — owing to the forms, area and frequency of occurence — is the classic territory of basins; it is identical with the so-called Slovak block (l. c. 7).

On the other side, the outer part of the West Carpathians which surrounds the Slovak block on its whole northern part in form of flysh mountains arc does not reach so distinct signs of both contrary forms. The heights mostly represent long mountain ridges and zones; vith a few exceptions, the linear component reaches great validity. The basins and concave forms on the whole, mostly are long depressions and furrows. Also the differences of hight between the basins and the mountains and also the expressivness of the morphological limit are in the outer arc of the West Carpathians much less distinct than in the inner Carpathians. Whereas we may speak in the inner Carpathians about a mosaical ground-plan of the principal macroforms, the auter arc of the Carpathians has more signs of a zonal chain of mountains.

The difference between the relief of the outer flysch zone and the inner Carpathians has been referred by D. Štúr (1860), F. Hauer (1869), A. Supan (1887), A. Rehmann (1895), V. Uhlig (1903), L. Sawicki (1909), J. Hromádka (1931, 1943, 1956) and others. These differences of the relief, of course, under the influence of geological knowledges, got another comprehension that to-day. They were thought to be differences between individual tectonical zones, i. e. between the flysch and the central zone and the area of volcanoes mountains as an other equivalent zone. According to our conception, we want to show the morphostructural dualism of the West Carpathians from the point of macroforms, as we will see later.

Owing to the fact, that the inner Carpathians with intermountain basins cover the greater part of Slovakia (outer flysch zone forms only a narrow edging in the west and north), the landscape may be suitably expressed by the definition a basin area. The Sub-Carpathians lowlands, penetrating by a few bays deeply into the inner Carpathians, do not disturb this property, but on the contrary emphasize it.

The distribution of the basins, i. e. principially tectonical forms, may be divided into three systems owing to the structure and morphology (modified classification of J. Hromádka — 1956):

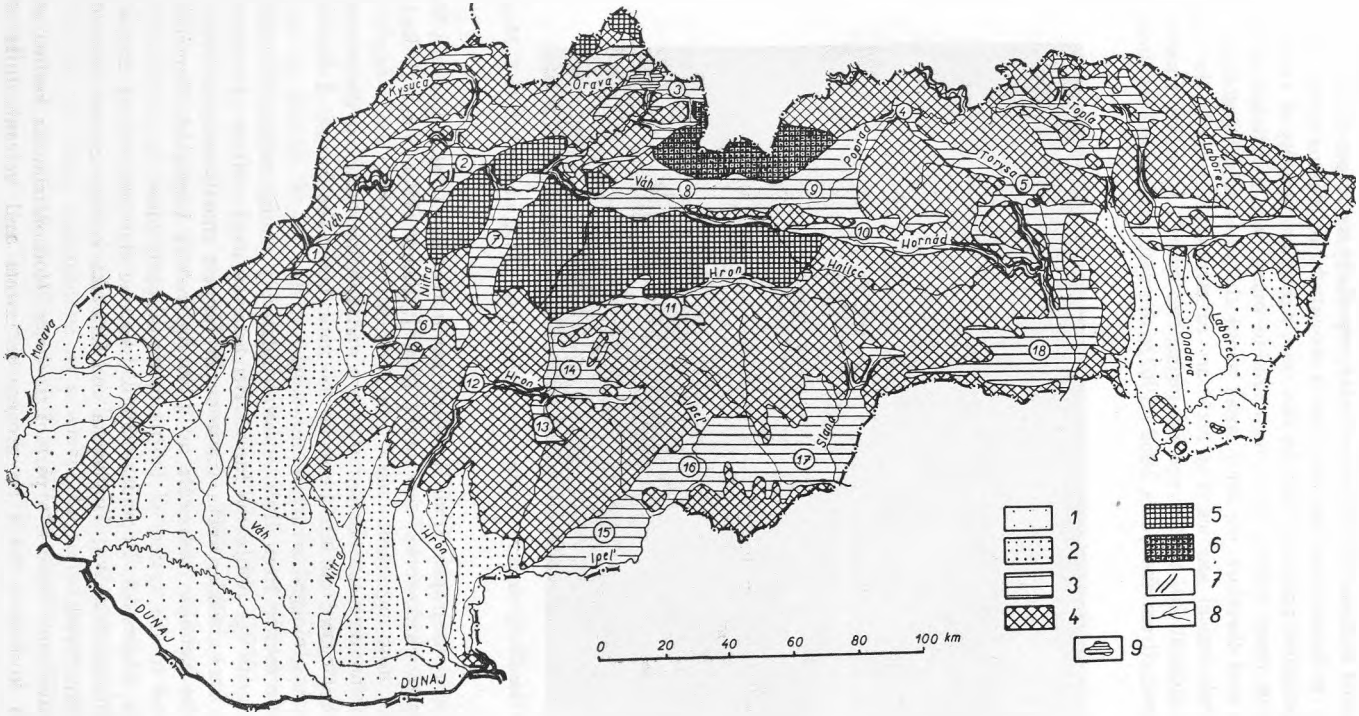
1. *System of the peri-pieninian lineament basins* (northern one); it is connected, on the whole, with the form of the klippen zone, with the contact of the Slovak block and the flysch arc. The furrow Stredopovažský úval, the basin of Žilina, Orava and Ľubovňa and the dale Šarišský úval belong to it.

2. *System of Central Carpathian basins (middle one);* it is in the inner part of the Central West Carpathians. The Basins Hornonitrianska, Turčianska, Liptovská, Popradská and Hornádska kotlina and the furrow Horehronský úval belong to it.

3. *System of intravolcanic basins (southern one);* this lays between the Central Carpathians and the volcanic region and in the inner part of the latter one. The basins Žiarska, Pliešovská, Zvolenská, Ipeľská, Lučenecká, Rimavská and Košická kotlina belong to it.

## SURVEY OF THE GEOMORPHOLOGICAL AND STRUCTURAL-LITHOLOGICAL CONDITIONS OF THE BASINS

There was paid no corresponding attention to the basins of Slovakia in spite of their extraordinary significance for the konwledges about the evolution of the West Carpathian relief and especially about their significance in the economy of our mountain territory. Although there exists in the geological and geomorphological literature a lot of material about the basins, e. g. D. Štúr (1860), A. Supan (1887), A. Rehmann (1895), V. Uhlig (1903), L. Sawicki (1909), F. Machatschek (1924, 1927). J. Hromádka 1931, 1943, 1956), D. Andrusov (1938), and L. Dinev (1942) there exists no sufficiently exhaustive




Map. 1. 1 — lowlands, 2 — hilly lowlands, 3 — intermontane basins and furrows (1 — Basins of stredné Považie, 2 — Žilina b., 3 — Orava b., 4 — Ľubovňa b., 5 — Šariš furrow, 6 — horná Nitra b., 7 — Turiec b., 8 — 9 — Liptov and Poprad b., 10 — Hornád b., 11 — Furrow of Horehronie, 12 — Žiar b., 13 — Pliešovce b., 14 — Zvolen b., 15 — Ipeľ b., 16 — 17 — Lučenec and Rimava b., 18 — Košice basin), 4 — uplands and highlands, 5 — alm mountains (above treeline), 6 — high mountains (Tatra), 7 — Superimposed walleys, 8 — Rivers, 9 — Water basins.

study. The problem of basins has been studied most exhaustive by J. Hromádka (1931) Many of his conclusions demand modifications today, especially as to genesis. In the last years, we can see a principal turning-point as to the study of basins from the geomorphological and geological point of view. In this time, a greater quantity of knowledges has been gathered than never before. It is impossible to bring here a detailed survey of the newest literature and therefore we shall speak about the most important ones only.

Among the geomorphological studies it is necessary to mention especially the studies publisehd in the „Explanations to the general geological maps" from M. Lukniš, E. Mazúr and J. Kvitkovič (from the years 1962—1963), the synthetising survey from M.

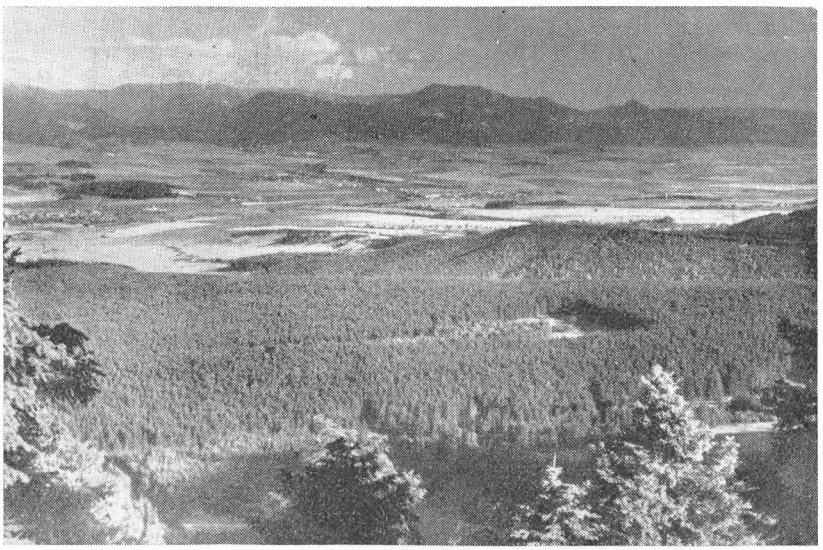


Fig. 1. Turiec basin. In the background mountain range Veľká Fatra (1592 m a. s.). Foto E. Mazúr.

Lukniš (1962) and the monography from E. Mazúr about the middle stretch of the Váh (1963). Among the geological works, the survey from J. Seneš (1960) and T. Buday (1959, 1960) are the most important ones.

On the contrary to the very complicated structure and lithology and on the contrary to the extraordinary variegated surface forms of the mountains, the basins of Slovakia have a relatively simple geological structure and relief.

The basins are built mostly from little resistent, relatively young sediments, mainly of Paleogene and Neogene age. Only the furrow Horehronský úval consists of a greater part of pre-paleogene rocks. Older rocks (mezozoicum) appear mostly only in form of small islands from the younger sediments, e. g. in the basins Liptovská, Popradská, Turčianska kotlina and in the system of basins in the klippen zone.

The basins Žilinská, Liptovská, Popradská, Hornádska and Šarišská kotlina and also parts of the basins Hornonitrianska, Turčianska and Oravská kotlina consist of paleogene central Carpathian flysch.

The system of intravolcanic basins, a part of the basin Hornonitrianska kotlina and the basin Turčianska kotlina is built by neogene sediments and volcanic tuffs and tuffitoes. The neogene sediments build the basins Turčianska and Ilavská kotlina. The

structure of basins consits in a great measure also of quaternary-period sediments, mostly of river gravel sediments, delluviums and sometimes loess.

Owing to the relatively low resistance of the rocks and to depression position, the surface form of the basins is not variegated, sometimes monotonous. Together with J. Hromádka (1931) we may establish that the stereotype picture returns nearly in all basins. This is the existence of two tearine steps. The lower one of them consists of narrow strips of a river plains — flood plains. The higher one usually represents a moderately waved, mostly smoothly modelled hilly relief. Therein change usually low broad ridges (interfluves), relatively shallow open beds of currents flowing from the

Fig. 2. Žilina basin — south part. Foto P. Plesník.

surrounding mountains to the main river. The relative height in the basins reach 60—70 till 150—180 m, only rarely more. For first step we use the expression basin hillyland (1963). Between the river plains and hillyland step, in the relief of basins there exists a certain conjunction, quaternary terraces, or terracing alluvial cones.

The hill ridges in the basins on the whole, have a constant height and moderate slope from the foot of the mountain edging to the hydrographical axis of the basins. The ridges often have a more or less disturbed cover of river gravel or hillside-waste. As we have shown on the example of the basin Žilinská kotlina (1963), such sloped basin hills represent pediments or glacis (H. Mensching — 1958), mostly articulated pediments.

This survey is very generalized and there exist many differences, depending from local circumstances of evolution in basins.

In the conclusion, it is necessary for the general characteristic of basins to emphasize one important fact of great value for the knowledge of genesis of the basins and of the relief of the West Carpathians as a whole. As stated above, the height forms show expressively enough the broad upwarp of the West Carpathians. This is similarly reflected in the increase of the hight above sea level of the basins to the inner part of the Carpathians. The height above sea level increases from the edge basins gradually

from values about 150—200 m till 700—800 m a. s. in the inner part of the upwarp and reaches in the maximum of this over 900 m. The increase of the hight above sea level of the basins in relation to the mountains towards the inner part of the West Carpathians is discordant and therefore, the West Carpathian's upwarp is mostly articulated on its top. The fact, that the basins ars built mainly by young paleogene, neogene till quarternary-period sediments shows — in comparision with their surroundig mountain ranges — negative tectonic movements of their bottoms. Specialists for problems of the West Carpathians advocated this opinion. On the other hand, there was no such corresponding agreement concerning the character of these movements and their age.

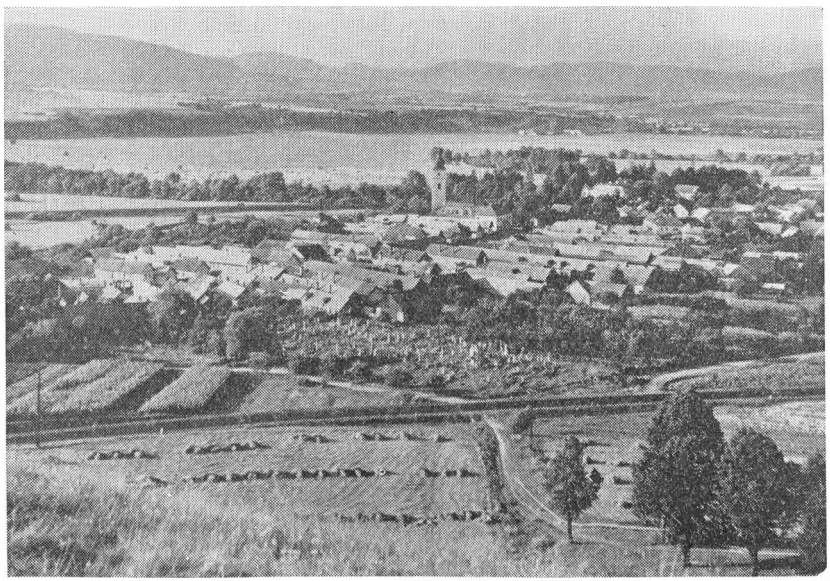


Fig. 3. Žiar basin. View from the south. Foto P. Plesník.

The former opinion about the basin structure in the West Carpathians emphasized the significance of folds with a great radius of curvature owing to the fault structure. The basins very often were considered as synclinals sometimes accompanied by flexures, or one-sided faults. It is possible to say that there existed a certain aversion against the fault structure of the West Carpathians and that the significance of fold structures or errosion processes at the rise of basins was overstimated. Such an opinion was represent mostly by D. Andrusov and his school. It is also expressed in his works from 1938 till 1943.

The newer research, on the contrary, emphasizes the significance of the fault structure and vertical movements at the origin of the basins and mountain chains of the West Carpathians, mainly in the inner Carpathians (Tectonic development of Czechoslovakia — 1960, Report from the 5 th KBA Congress — 1961, Explanations to the general geologic maps — 1962, 1963.)

As mentioned above, owing to their depressive position against the surrounding mountains and the lithological character of the bottom (low resistance of rocks), the basins of Slovakia generally have specific relief features common to all basins on the whole —

*the basin relief*. Nevertheless it is possible to see a few differences between the landforms of basins and the above-mentioned characteristic. Some of these basins have neither terrace nor cones; in others, there is no basin hillyland as a pediment; besides this, it is possible to see a very different relief forms of certain parts in one and the same basin, and so on.

We get an analogical picture at the study of the structure of the basins. Some of this, have a homogenous, others a very complicated structure and lithology. A part of the basins is built by paleogene sediments, eventually with isles of older formations; an other consists of neogene sediments which may belong to the burdigal till the pliocene, from maritime, lake and river sediments to volcanogenious rocks; certain basins have great quaternary covering.

As to the structural character of the basins, we obtain a similarly variegated picture. Here we may see synclinal to brachy-synclinal structures, a combined structural style and a fault one.

From hence it follows that also the genesis of basins is very complicated and changes from case to case. We may follow up the genesis of some basins from the paleogene at least as a structural formation, others in various neogene periods till the quaternary period. Comprehensively, in our survey it is impossible to reach an interpretation of the genesis of individual basins and their particularities. Our aim is to give a picture about the evolution of basins in Slovakia as a whole and to try to answer mainly questions about the chronology of the evolution of basins as one of the fundamental elements in the West Carpathian relief and to explain processes, which have involved them.

For our interpretation we may base on the analyse of the basin-relief, on geological knowledges about their structure and lithology; nevertheless we must also examine the character of the relief and structure of surrounding mountain ranges and mainly the correlation of old erosion surfaces to the sediments of basins.

## OLD EROSION SURFACES OF THE WEST CARPATHIANS AND THEIR CORRELATION TO NEOGENE SEDIMENTS OF BASINS AND LOWLANDS

The study of West Carpathians erosion surfaces has a tradition of over fifty years One of the first experts, who systematically examined those problems, is L. Sawicki (1909).

Sawicki presumes in the West Carpathians the existence of two denudation levels: the higher intra-Beskyd and the lower submountainous level, which cut the paleogene elements and structures of the so-called post-paleogene folding and, therefore he thought them be younger. As to the occurrence of torton in the valley incisions of these levels he dated them as mediterranean. L. Sawicki speaks about the basin evolution of the inner Carpathians in the Miocene and supposed their subsidence also in the pliocene. He thought the quaternary period movements — at least for the West Carpathians — of smal significance.

In the next period, in our country the geomorphological research has been under great influence of the works from H. Hassinger (1914, 1918); this author empasized the significance of abrasion for the relief. Abrasion terraces were searched and found not only on the edges but also in the inner part of the West Carpathians and basin erosion surfaces have been thought nearly generally to be an form of abrasion. The same opinion we can state in the works of J. Daneš (1920), V. Dědina (1922), F. Vitásek (1932) and J. Hromádka (1931—1943) especially. V. Dědina showed the existence of old miocene peneplains in the mountain range Slovenské rudohorie and in old volcanic

mountains of middle Slovakia and he emphasizes the sarmat and pont abrasion terraces from the edges of the Danube lowland. J. Hromádka classifies in the West Carpathians a few neogene levels above the co-called critical step (limit against the quaternary period), beginning with basin hilyland across high levels with plain character in the upland up to the summit level in the Tatra. The last one was studied also by J. Kunský and D. Andrusov (1933). J. Hromádka thought the most part of erosion surfaces to be formed by abrasion and searched its traces not only in basins but also on high plains (1931). Remarkably, of course, is his remark about the existence of an exhumated surface in the mountain range Slovenské rudohorie (1943).

With the territory of Slovakia deal also a few works of F. Machatschek (1924, 1927, 1955). He advocates Sawicki's opinion and modifies the dates according the newer research results. Young movements in the West Carpathians, in connection with the subsidence of basins, he classifies as the upper Miocene or between this and Pont and he connects with them also the course of the main phase of volcanism. On the other hand, he supposes a continuation of movements also into the Pliocene. Such evolution on stages he supposes according tho the existence of a few erosion surfaces.

Among the Polish authors, the following ones deal with our territory, resp. with the surrounding regions: M. Gotkiewicz (1931, 1934), J. Szaflarski (1934, 1937), B. Swiderski (1932) and especially M. Klimaszewski (1934, 1952, 1958).

M. Klimaszevszki advocates the levels of L. Sawicki. He calls the lower one submontane, the higher one intramountane level. He speaks about a relatively hight of the first one 120—150 m rel., the hight of the second one 250 m rel. He classifies the higher level as a Sarmat, the lower one as a Pont formation.

Newly (1952) M. Klimaszewski desists from the original hight dates and classifies to the submontane level also sloping broad ridges of Gubalówka. He does not speak about a higher level more detailed.

The work of L. Dinev (1942) is a significant progress in the study of old erosion surfaces. He classifies in the central West Carpathians following denudation surfaces: level $N_I$ (top level of the High and Low Tatra) — remnants of the pre-tortone surface, the level $N_{II}$ (level 1450 $\pm$ 50 m in the Low Tatra, top parts of the Malá and Veľká Fatra and of the mountain chain Slovenské rudohorie) — Tortone till lower Sarmate, the level $N_{III}$ (level 1000—1200 m in the mountain chain Slovenské rudohorie, in the Veľká and Malá Fatra and in the mountain Kremnické pohorie) old Pliocene, the level $N_{IV}$ (750—850 m. a. s.) — young Pliocene, the level $T_{nk}$ and Pfl — prequaternary terraces. Dinev supposes the basin relief of the West Carpathians to be a result of folding than fault tectonics.

Among the newer ones, it is necessary to mention the work of J. Krejčí (1944), who according to the morphological analysis supposes the peneplain Zlínska parovina a to be Posttortone age and suppose its Pliocene faulting. M. Lukniš (1946) speaks in the area of the Beckovská brána about a Pliocene level 120—150 m rel. and about an older Miocene level, where he under the influence of J. Hromádka — admits the effect of abrasion.

In the Moravsko-slezské Beskydy, are described parallels of the Klimaszewszki' „pogorski" and „środgorski" levels of low-pliocene, resp. Sarmat age (l. c. 40).

M. Lukniš speaks in his newest works (1962, 1963) even about four erosion surfaces in the West Carpathoans, i. e.: two exumated ones: the Pre-eocene and the Helvetic erosion surface and two younger ones: the so-called sarmato-pannonian or the initial and Upper-pliocene surface. He parallises the last two levels with Sawicki's high and submountaineous level. The submountaneous level he comparises as a parallel with the river level of E. Mazúr (1958).

E. Mazur (1958, 1962, 1963) supposes the existence of 3 levels: the so-called summit (high), upland (middle) and river (low) level. The oldest one he classifice as lower Tortone — upper Sarmat, the higland (middle) level as Pannonian and the river level as upper Pliocene.

As showed by our short survey, there exist very much studies about the denudation surfaces of the West Carpathians. On the other hand there are, great differences as to the number of levels,, not speak about their age classification. In the greater part of works, the levels are localized and defined very generally only. If we emphasize the fact that these are studies in limited areas our deducation may be comprehensice, i. e that we have no detailed work with a survey location, resp. paralelization of the levels of the West Carpathians as a whole. This shortage is certainly in connection also with the fact, that the Western Carpathian relief, especially of the inner Carpathians, is very articulated (basin landscape) and that the erosion surfaces are very deformed (often in short distances); therefore, the genetically the same levels are in various hights.

We are fully aware of the troubles and of the possibility to come to incorrect conclusions; nevertheless we shall try to give a short survey about the erosion surfaces in the area of the Slovak Carpathians and to compare them with the vicinal territories.

In the whole territory of the West Carpathians, the relatively easiest erosion level surface to study is the level, which we caled *river* or *submountaine* level (E. Mazúr — 1958, 1962, 1963). It has the form of narrow stripes along all greater rivers of the West Carpathians. It reaches its classical evolution especially in the basins. There is river level also on foothills around the West Carpathians. The river level represents no denudation surface of a large area, but rather an epicyclic formation. A moderate slope to the valley axis, on foothills aroung the Carpathians to the vicinal lowlands, is characteristic for its surface. The slopes mostly reach 5—8°; they are greater only in the upper parts (above 10°). At the great river wo may see sametimes on it so-called poor gravels (mostly quarze and quartzite), e. g. in the Váh-, Hron-, Hornád volley and so on. In basins the river level is almost covered by gravels from alluvial fans of the quaternary age. The connection of the river level with the main valleys, basins and with the foot of mountains and also the relief of river level and other signs shows it is a creation partly of lateral errosion (especially its lower parts along great rivers) and mainly at the foot ot mountains it is a pediment (E. Mazúr — 1963). Owing to its incision by quaternary valleys, it represents an articulated pediment — glacis according to H. Mensching (1958).

The relative and absolute hights of the river level are very considerably. The relative heigths along the main rivers reach from 70—80 to 120—150 m; but there also often deviations below and above this limit, evolved by young tectonical deformations. As shown on the example of the central Váh valley in tectonical emphasized parts of the Váh valley, the river level reaches a rel. height of 350—400 m (Strečno-, Kraľovany-breach — E. Mazúr, 1963). On the other hand, in the lowered territories, the river level sametimes very declines below quaternary alluvions (e. g. in the basins Turčianska, Oravská, Popradská and Košická kotlina). A similar situation exists at the pediments on the edges of West Carpathians.

In spite of the here shortly emphasized deviations of relative height in the river level, it is characterized in the relation to the West Carpathians as a whole by means of the increasing of the hight above sea level. In comparision with values of about 150—200 m on the edges of the Carpathians, the river level reaches in the inner part of the mountains 800—900 m a. s. and more (Liptovská kotlina, Horehronský úval, Podtatranská brázda). So it shows distinctly the broad upwarp of the West Carpathians.

In contrast to the valley position and the linearly very regulated river level, a higher level, increasing on the ridges of the West Carpathian mountains, is distinctly distingui-

shed by the regional extension. The original too broad expression mountain level (1958, 1962) was substitued by the expression *intramountaine (middle)* leve (l. c. 35 — 1963). It better characterizes its position in the frame of the West Carpathian upwarp. If we have seen significant tectonical deformations in the river level, at the middle level they are much more distinct. On one side, these are local deformations (hight or angle) and general deformation — involved by the West Carpathians upwarp — on the other side. By the reconstruction of the middle level, we based mainly on its relation to the river lever or to the highest level and to the neogene sediments, respectively. The dates about hight (relative or absolute) give only very few starting-points.

Fig. 4. Dissected pediment (river level) on the west slope of mountain range Považský Inovec. Foto E. Mazúr.

The middle level maintained in some mountain chains in form of greater or smaller moderately waved plateaus and sometimes it is shown by broad ridges and sometimes only by the level of interfluves.

We can study the middle level very well in the Malé Karpaty. In the southern part of this mountain range it is in the height of about 350—400 m a. s.; in the centre, it gradually rises up to a hight about 600 m a. s. and in the northern part it reaches about only 400 m a. s. again. In the Považský Inovec, the middle level is most beautifully maintained in the surroundings of Stará and Nová Lehota in the hight of about 550 m a. s. To the south, the level gradually declines under 400 m a. s. and gradually connects with the river level and than is continued by the Danubian lowland. In the mountain chain Strážovská hornatina, we can relativly well study rests of the middle surface in the group of Zliechovská hornatina in a height about 700—800 m a. s. and also in the broad ridge of the Rovne (about 800 m). In the Malá Fatra, the level of interfluve ridges indicates the middle level in a hight of about 1000 m a. s. A similar circumstance is in the mountain range Veľká Fatra. In the mountain range Tribeč we

consider forms of the system I of M. Lukniš (1948) as a parallel of the middle level. These forms we find again in various hights above sea level in the individual parts of this mountain range (about 400—650 m). Very well preservated rests of the middle level are in the mountain group Žiar in hights about 800 m a. s.

A classical territory with broad areas of erosion surfaces is themountain range Slovenské rudohorie; it also represents the most complicated problem as to the number, genesis and age of the levels. The broad erosion surface is in the territory to the east from Poľana (1458 m) in the height of about 1000 m a. s. To the south, it declines to a hight of about 500 m. Another rest of the surface also about 1000 m a. s., we may study in the Stratenská hornatina and in the Muránska planina. With these surfaces there are genetically jointed high plains of the Slovenský kras. They slope from north to south, from values of about 800 m a. s. to 400—450 m a. s. In the central and east part of the Slovenské rudohorie the broad ridges in heights about 1000 m s. s. with slopes to the mountain edges indicate also the former erosion surface.

Some authors consider the niveau of the Slovenské rudohorie as composed of a few temporally different surfaces. J. Hromádka (1943) suposes here residues of an exhumated surface and M. Lukniš bases on these opinios and supposes that the niveau of the Slovenské rudohorie of Sarmato-pannon age includes a Helvetian exhumated surface. The niveau of the Slovenské rudohorie we consider as a parallel of the middle level, which, at least could originate in the overmodellation of the older exhumated surface.

In the Low Tatra, the level of inturfluve ridges in the height of about 1200—1400 m a. s. corresponds to the middle erosion surface. In the north-east and south-west, this niveau falls down to values of about 900—1000 m a. s. In the Tatra, the level in a height of about 1600—1700 m in the Group Osobitá and Roháče, probably corresponds to the middle level.

In the mountain ranges of the central Carpathian paleogene there are also the rests of the middle level. We can study it very well in the mountain range Levočské pohorie in a hight of about 800 m a. s. on the edges, in the centre up to 1000—1100 m a. s. In the mountain range Spišská Magura it is in a height of about 1100—1200 m a. s. and slopes to north down to 700 m a. s. We see an analogical picture in the Skorušinské pohorie, sloped to the north-west.

Remains of the middle level we may find in volcanic mountain ranges also. They lay, e. g. in Kremnické mountain group (in the envorions of Kunešov) in the height of about 800—900 m. a. s., in the Pohronský Inovec mountain in the height of about 700—800 m a. s., in the mountain group Štiavnické pohorie in about 500—600 m a. s.; in the upland Krupinská vrchovina we may see it from the height of about 650 m in the north and northwest with a little slope to the south and southwest up to values of about 300 m a. s.

In the outre flysch arc there are residues of the middle level similarly like in the inner Carpathoans allmost in all mountain chains. In the White Carpathians, the middle level reaches values of about 400—500 m in the southwest, gradually it rises up to 600—700 m a. s. in the middle and NW part. It is necessary to emphasize that in the direction to the pre-Carpathian depression this niveau slopes and reaches values below the abovementioned ones. Quite the same situation is in the upland Myjavská pahorkatina. In the mountains Javorníky, the middle niveau reaches a hight above sea level of about 800—900 m. In the Podjavornícka vrchovina, it value decreases to about 500—550 m a. s. In the Turzovská vrchovina below the mountain chain Moravskosliezske Beskydy, it reaches in the west part about 800 m a. s., to the east, it decreases to 600—650 m a. s. In the mountain chain Slovenské Beskydy it raises again up to 800—900 m a. s., similarly as in the northern part of the Kysucká hornatina. Towards the south it decreases

to 600—650 m a. s. In the Podbeskydská vrchovina in the western part, the middle niveau is preserved near Oravská Lesná in an height about 850—950 m a. s. Towards northeast in direction to the basin Oravská kotlina it decreases to 750—800 m and less. In the moutain chain Čerchovské pohorie, it reaches in the southern part about 900—1000 m a. s., towards the north, it slopes to 700 m a. s. In the upland Ondavská vrchovina, the middle niveau very decreases and mostly reaches 400—500 m a. s. It the south, it decreases also below these values (to about 300—350 m a. s.), in the notrh it reaches mostly more than 500 m and it hight similarly increases towards the east (up to more than 600 m a. s.). In the mountains range Užská hornatina, it reaches

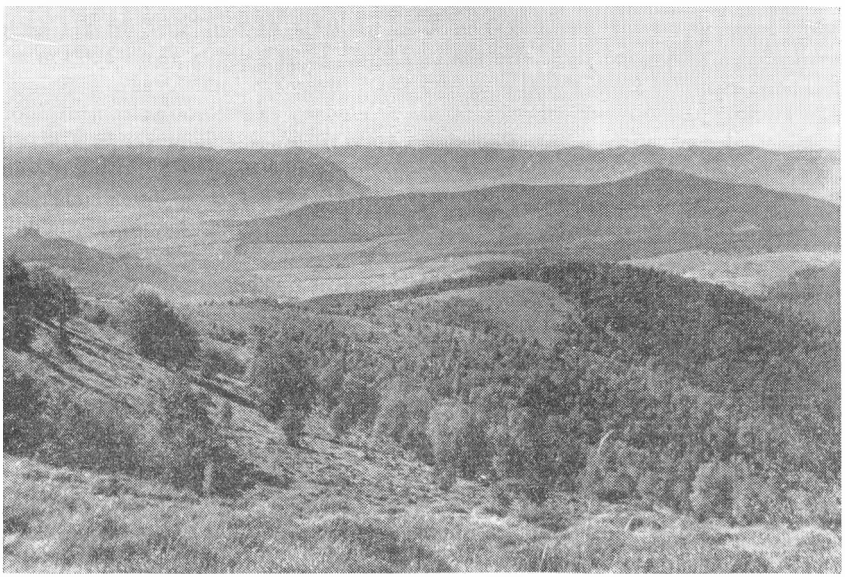


Fig. 5. Rožňava basin and in the background high karst plains of Slovenský kras (middle level). Foto E. Mazúr.

again 800—900 m a. s. Less preserved remains we can find practically in all mountains of our Carpathians.

In much smaller areas dividen one from the other, one could say in form of greater or smaller enclaves, from the middle level there rise, remains of an other old surface of the West Carpathians, i. e. the so-called *top (high) niveau* (E. Mazúr — 1958, 1962, 1963). We have chosen this expression therefore, because the residues ot this erosion surface are mostly connected to the highest top parts of individual mountains. The high niveau represents the oldest erosion surface of the West Carpathian's upwarp. From the relative small area and the morphologically strongly exposed position of the remains of the high niveau it comprehensibly results, that these are mostly very deformed. They often occur only in from of monadnocks, disparsed over the middle surface. Neveretheless, in some mountain ranges, we can find today (owing to the favourable conservation conditions) also larger enclaves of the high niveau with distinct signs of the old erosion surface.

In the mountain range Malé Karpaty, we consider as remains of the high niveau a plain

relief in the territory of Klenová (585 m) and the plain ridge of Nedze, both in the hight of about 500—550 m a. s. that is 150—200 m rel. above the middle niveau. Besides the above-mentoined two enclaves there exist also remmants of a pre-middle surface in form of strong residuals in the central part of the mountains, e. g. Záruby, Veterník, Raštúň a. o. In the mountain range Považský Inovec, the very deformed remains of the high niveau represents a high main ridge (about 900—1000 m a. s.) and perhaps also the top parts of the Marhát group (about 700 m a. s.). In the higland Strážovská hornatina, which is especially differenciated structure-lithologically, we may see residues of the oldest relief, mostly in form of isolated strong residuals and long ridges. Greater

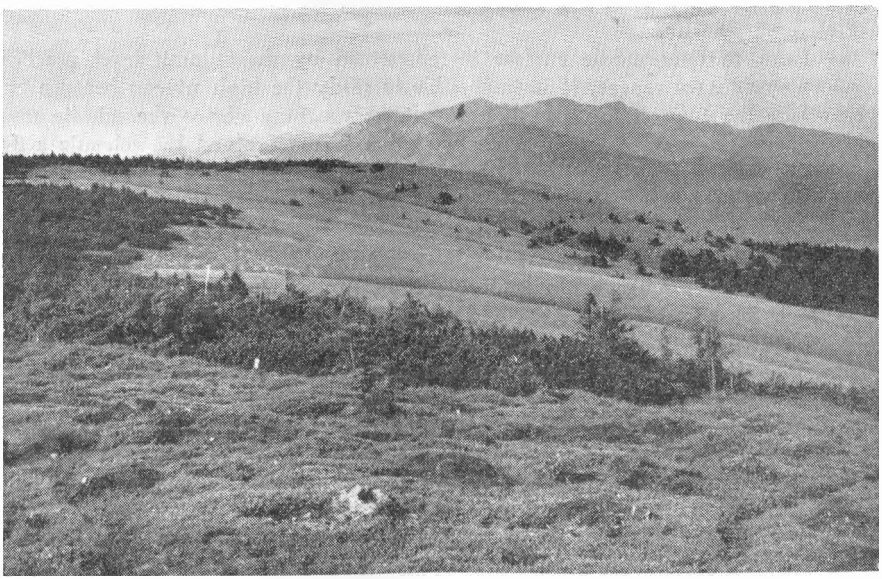


Fig. 6. High level on the top of mountain range Lúčanská Malá Fatra (about 1400 m a. s.). In the background Krivánska Malá Fatra (1708 m a. s.). Foto E. Mazúr.

areas belonging to the high system, we may find in the central parts of the Malá Magura (about 1000 m a. s.) and, perhaps of the Rokoš (900—100 m a. s.). To the high system belong also the central parts of the Tribeč.

The high niveau in the mountain range Lúčanská Malá Fatra in the height of about 1400 m a. s., i. e. about 350—400 m above the middle surface, is preserved in the classic form. Remains of this old surface in the Krivánska Malá Fatra represent on a great area central parts with a very articulated relief, reaching more than 1600 m a. s. In the Great Fatra, a broad central ridge in the southern part of the mountain range in a height of about 1400—1500 m a. s. represents a relatively large area of the high niveau.

Perhaps the largest area of the high system in the West Carpatians we may find in the central parts of the Low Tatra. From a height above sea level of about 1400 m in the western part of the highland, it increases in the group of the Ďumbier up to 2000 m and decreases again to a height of about 1600—1700 m above the saddle of Čertovica. It has a character of a moderately large dome. In the eastern part of the mountain chain there plain ridges of the Veľký Bok (1728 m), Homolka (1661 m), Veľká Váp-

nica (1692 m) and the ridge Kráľovohoľský chrbát (1943 m) belong to the high niveau. We may find remains of the high niveau also in the mountain chain Slovenské rudohorie. Besides many strong residuals, protruding isolated from the middle niveau, we consider the plain ridges of the group of the Fabova hoľa (1439 m), the western part of the karst plateau Muránska planina and the central ridge of the mountain Voniaca (1227 m) to be remains of the high niveau; besides this, we have the same meaning about the central plain ridges of the massive Stolica (1477 m) and others. In the group Spišské rudohorie, the central ridge of the mountains with Volovec (1286 m) and Kojšovská hoľa (1248 m) represent the remains of the high niveau mostly about 200—300 m above the middle niveau. In the Karst plateau Slovenský kras, we find forms older than the middle surface only as strong residuals, especially in the northern part on the high plain Plešivecká planina.

In the Tatra, the pre-middle surface is represented by the summit level practically.

In volcanic mountain ranges, it is impossible to study the high niveau because of the fact, that here the highest top parts of mountains reaching above the middle niveau, probably represent remains of younger construction forms evolved by volcanic activity, may be in the time of the evolution of the middle surface, resp. after its evolution.

In the outer flysch arc, it is necessary to consider as remains of the high niveau central massiv ridges, e. g. Veľká Javorina (970 m), Veľký Lopeník (912 m), Kobylináč (908 m), Zubák (817 m) in the White Carpathians, in the mountain chain Javorníky the main ridge and strong residuals of high interfluves, in the mountains Slovenské Beskydy high massives Veľká Rača (1236 m), Ošust (1156 m), Pilsko (1557 m), Babia hora (1725 m), the central ridge of the Oravská Magura, many strong residuals (Inselbergs) of the Ondavská vrchovina and high ridges of the highland Užská hornatina.

The comparison of the relations between the mentioned-above three surfaces from the areal and vertical point of view gives us some significant conclusions for our knowledges about the relief evolution in the West Carpathians and about the evolution of the intermontane basins.

The river level, as mentioned above, shows strong linear components and — on the whole — a depressive position in the scope of the West Carpathians. The hight difference from the edges to the inner part of the Carpathians reaches about 150—200 m a. s. up to more 900 m a. s. Partial denivelations in the river niveau are mostly not large and only sometimes reach 300—400 m rel. The river level has distincts signs of foot plains-pediments.

Compared with the river level, the middle niveau is a large planated surface, connected to height forms and ascends onto the moutain ridges. From its large remains in nearly all West Carpathian mountains, we may deduce, that the relief of the West Carpathians reached in the time of its existence a considerable progressive state of evolution. The middle surface, on the other side, had no peneplain character, but had very much, although not too large — enclaves of the high niveau. The correlation of both these niveaus, especially the bay-like curved limits between them, the often occurence of Zeugenbergs on the edge of greater enclaves of the high level and sometimes the existence of Inselbergs among a middle surface demonstrate the character of the last one to be pediplain. The state of planation of the middle surface, on the other hand, excludes the existence of inter-mountainous basins in the sense of today. The basin relief, evidently, is a result of deformations in the middle niveau. The deformations took place in form of diverse vertical movements, inclinations and, may be, also partial doming upheavel or subsidence of the crust, as we may see it from the correlation between the remains of the middle niveau and the nowadays basins, especially the young-neogene sedimental filling

of the last ones. These differenciated movements took place as relative ones in the scope of the whole upwarp of the West Carpathians; we may see it on the increasing of the altitude of the middle surface from the edges to the inner parts of the Carpathians (from values of about 150—200 m from subsidence edges into the Sub-Carpathian lowlands up to 1600—1700 m in the Tatra).

Although the remains of the high niveau are relative limited and strongly deformed tectonically and errosively, they have certain signs; according to them we may consider about the principal features of this oldest relief of the West Carpathians, which we can study morphologically. This initial surface, probably, was planated surface in the progressive state of evolution. The hight differenciation of its individual parts in comparison with the middle surface and their discordance from the edges to the inner of West Carpathians parts show, that the high surface was also under the influence of differenciated movements in the scope of the whole upwarp of the West Carpathians and that it has been destroyed by exogene processes only during the evolution of the middle surface. The uplifted parts of the high surface became the basis of the individual mountain ranges of today in the central Carpathian zone and the flysch zone of the Carpathians.

For a chronology of the above-mentioned old surfaces and for the reconstruction of the evolution of the basin relief of the West Carpathians as a whole, it is necessary, to study these surface according to their correlation sediments, according to the sedimental filling of basins and Sub-Carpathian lowlands and according to the volcanic forms.

According to the contemporaneous state of knowledge about the Neogene filling of the basins and Sub-Carpathian lowlands (l. c. 5, 7, 8, 50—60), we can distinguish two essential development periods showing by an different facial and spatial distribution of the sedimentation regions during the Neogene. It is the period of the Old Miocene and Young Miocene-Pliocene. The boundary between them goes back to the young Styrian folding phase in the Lower Tortonian (l. c. 7, 8).

According to the distribution of sediments of the Old Miocene period, a spatial limitation of the sedimentation depression was essentially different from the depressions of the Pliocene and the present time. At places, we can observe an uplift of some parts of this old depressions, even the erosion surfaces have been developed on them (for instance in the Little Carpathians). That is why we cannot the sediments of this phase consider for a correlate ones to our erosion surface. This conclusion is also supported by the fact that during the young Styrian folding phase occured a mighty orogenic movement, which led to an owerthrust of the Flysh on the Lower Tortonian in the Carpathian foreland (l. c. 7, 8). In the inner Western Carpathians this movement led also to a mighty denivelations and to a birth of new sedimentation areas both ar the border parts and in the inner of the mountains (l. c. 4, 7, 8). The calibre of material also conspicuously refers to an intensity of the tectonic movement and a heavy erosion made by them. With regard to the above facts and spatial relation of the above-mantioned levelled surfaces with a newborn sedimentation areas, we consider the sediments of this Young Neogene phase, i. e. post-Lower Tortonian, for a correlative ones with the erosion surfaces.

As to a specific dating of the erosions surfaces in the framework of this post-Lower Tortonian period, we have most proofs for the river level. Its upper age limit is determined by the system of the Quaternary forms imbedded into it. Its lower limit is determined by the reality that it cuts the post-Panonian sediments, especially so called „gravel formations" itself. It is consequently the post-Panonian one (l. c. 34, 35). The middle level belongs to the Panonian probably (l. c. 34, 35). We judge so, since it has been developed on the Sarmation volcanites (l. c. 33—35). Mighty series of the Panonian in the low-

lands and basins correspond to him. The origin of its development must be given into connection with the movement in the Attic phase of the Upper Sarmatian (l. c. 7, 8). The high level developed after the Styrian phase of the movement, partly probably in the Tortonian, but chiefly in the course of the Lower Sarmatian. It is sure it to be a pre-Pliocene one.

If we compare our conclusion with the older results of the Czechoslovakian Carpathians or with the knowledge of the Polish and Soviet Carpathians, in spite of some points of contact, it may be seen a considerable difference. Above all, it must be mentioned that the erosion surfaces, besides omitable exceptions, are a work of the subaeric destruction, but no abrasion (comp. with cit. 10, 11, 14, 15, 17, 18, 19). As to the parallelization of the levels by individual authors, it appears, as follows: The river level is comparable spatially with the J. Hromádka's niveau over so called „critical edge" (but not as a creation of the Miocene abrasion). The L. Dinev's (1942) and M. Lukniš' Upper Pliocene niveau (1946, 1962) corresponds to him. But it is no paralell with the pogórska level of the Polish authors L. Sawicki and M. Klimaszewski as concludes M Lukniš. (1962). It is well comparable with the P. N. Cys 150—200 m niveau (1957) Considering that the authors of the Moravian Carpathians (1961) compare the lowest niveau of them with the pogórske niveau, it is impossible to parallel it with the river level of us. The M. Klimaszewski's pogórske niveau (1952, 1958) is considered by us for a parallel of our middle level, but also his „środgórske niveau" we bind spatially with the middle niveau. In an equal degree it holds good also for the authors of the Moravian Carpathians (1961) following the M. Klimaszewski's conception. On the other hand, the middle niveau is well comparable with the $N_{III}$ niveau of L. Dinev (1942) and with the 500—650 m niveau of P. N. Cys (1957). The M. Lukniš' Sarmatian Panonian niveau (1962) corresponds partly to the middle one, partly to the high one.

## THE OUTLINE OF DEVELOPMENT OF THE BASIN RELIEF IN SLOVAKIA

From the structural point of view, the Western Carpathians are an old mountains the origin of which is bound with the old Caledonian, respectively the Variscian base. In the course of the Mesozoic and Paleogene, it had passed a most complicated development, the result of which is a polygenetical fault-fold structure. But the relief of the Western Carpathians is in the main a work of the Neogene development. We consider the high niveau for the oldes morphologically observable relief rests. The outset of development of the recent relief is bound with the young Styrian folding phase, which caused probably a relative articulated relief, as we judge from the rough sediments of the Tortonian. After the intensive Tortonian destruction often interrupted probably by the repeated Upper Tortonian movement, the relief of the Western Carpathians had reached in Sarmatian an advanced stage of levelling with a relative flat relief as it indicates the high niveau. On the basis of a gross distribution of the rests of this surface, the ending of the Tortonian-Sarmatian development period may be pressumed by an uparching of the Western Carpathians en block during the Attic phase. At this uparching the high system was deformed by a differnetiate movement. Some parts of him was uplifted more intensively, respectively uparched or inclined, other ones had subsided relatively so that they became the sedimentation areas. The spatial distribution of the high niveau rests indicates that this movement was putting at least generally the foundations close to the present two groups of antagonistic macroforms. In the course of the Panonian, just the depression parts of the uparching had been transformed first into the middle surface (at the same time we keep in view that in the subsiding Sub-Car-

pathian depressions and some intermontaine basins a sedimentation passed). Stage by stage, the erosion surface had spread also digitally on the uplifted parts of the high niveau, and determined in into present enlclaves, Zeugenbergs and Inselbergs. It occured by a pediplanation process under the conditions of the alternating subtropical dry and more humid climate (l. c. 6, 8, 22, 29). In the central Slovakian volcanic region, the Tortonian-Sarmatian volcanites also had been destroyd ond levelled partly. The volcanic activity continued also in the Panonian at places (the summit parts of mountain ranges). In eastern Slovakia in the Panonian the main mass of the Vihorlat range had been heaped. In the period of the development of the middle surface, the foundations of main streams already had been given.

The following development of the middle surface was interrupted by a new broad upwarp of the Western Carpathians in the Rhodanian phase. This movement was innerly differentiated again, even much more expressively than during the preceding Attic movement. The relative height differentiation often exceedes the values of 500—600 m, and in the inner part of the upwarp it reaches even about 1000 m. This movement gave the present rough outline of the mountain ranges and basins. Dissection of in this way deformed middle surface was passing very unevenly, and it had also being influenced strongly by the lithological properties of the underlying rock. Especially, the uplifted blocks had being destroyed, of them, the currents were carrying away a rough material, and lying it in the adjacent subsided basins and Sub-Carpathian lowlands (so called „gravel formations" — l. c. 5, 7, 8). On the other hand, the less uplifted territories had being formed with ease by the subaeric modelling into so called river level, which had being supported by a soft Neogene and Flysch underlying rock, especially in the basins. The bordering parts of the broad upwarp were strongly inclined at places, and onto their low parts, the Upper Pliocene sediments had being laid (for example the Slovakian Karst). It was formed up the drainage pattern, especially by the birth of the slope streams on the uplifted and inclined blocks. Towards the close of the Upper Pliocene, further developoment of the river level was interrupted by the movement of the Walachian phase, which meaned a moderate upwarp and an easier inner modelling only. In the Quaternary, the river level was dissected. The Quaternary development strongly influenced by the climatical oscillations caused only a detailed forming of the forms inherited from the Pliocene.

## CONCLUSION

The basin landscape of the Slovakian Western Carpathians is a result of the Neogene, but chiefly of the Pliocene development. This development passed stage by stage at a close cooperation of the tectonic movement and subaeric factors.

The tectonic movements were shown in the form of a total upwarp of the Western Carpathians and within by the differentiated movement of individual block. This movements show up against the general inner articulation of the Western Carpathian uparching into two antagonistic groups of macroforms, namely of the mountain ranges and basins. This macrostructural differentiation culminated in the Pliocene during the Rhodanian movement. The main macroforms correspond in substance to the so called „neotectonical forms".

The subaerical processes passed epicyclically, and under a strong influence of the tectonic movements, structural — lithological properties of the underlying rock and the climate, differentiately also. This processes led to an emphasizing of the macroforms on the one hand, and on the other one, especially in the areas of a heterogeneous structure,

they led to birth of the structural forms. Generally, they meaned a completely forming of a detailed shape. The basin relief of Slovakia is a polygenetic tectonic-structural relief.

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## KOTLINY AKO VÝZNAČNÝ PRVOK RELIÉFU SLOVENSKA

Základným reliéfotvorným prvkom na území Slovenska sú Karpaty, a to na veľkej väčšine plochy Západné Karpaty, len na severovýchode na neveľkom území Východné Karpaty.

Západné Karpaty predstavujú pomerne široké, ploché vyklenutie, ktoré len vo svojom maxime, aj to na neveľkej ploche, vystupuje podstatnejšie nad 2000 m a má tu vysokohorský reliéf (Tatry) Inak majú Západné Karpaty väčšinou len stredohorský ráz a na juhozápade, juhu a juhovýchode klesajú do nížin (Záhorská, Podunajská a Východoslovenská nížina).

Západokarpatské vyklenutie ako megaforma netvorí súvislú, neporušenú vypuklú plochu, ale skôr nepravidelnú mozaiku dvoch skupín protikladných foriem, t. j. jednotlivých pohorí a kotlín. Vnútrokarpatské kotliny svojím odlišným stvárnením i zložením oproti okolitým pohoriam tu vystupujú ako osobitná kategória foriem, ktorá predstavuje i plošne významnú zložku povrchu Slovenska a má preto veľký dosah i z hľadiska ekonomického. Územie Slovenska preto priliehavo nazýva už L. Sawicki kotlinovým krajom.

Oproti veľmi zložitej stavbe a zloženiu a z toho vyplývajúcej mimoriadne pestrej povrchovej tvárnosti pohorí sa vyznačujú kotliny relatívne jednoduchým zložením i reliéfom. Na stavbe kotlín sa zúčastňujú prevažne málo odolné paleogénne a neogénne sedimenty s viac alebo menej významným krytom kvartérnych útvarov.

Povrchová tvárnosť kotlín, ako vyplýva už z ich depresnej polohy a malej odolnosti podkladu, je neveľmi pestrá až monotónna. Spolu s J. Hromádkom (1931) tu môžeme konštatovať opakovanie sa stereotypného obrazu takmer vo všetkých kotlinách, a to je existencia dvoch terénnych stupňov. Nižší z nich tvoria neširoké pásy rovinného územia pozdĺž väčších tokov — poriečne nivy. Vyšší stupeň reprezentuje spravidla mierne zvlnený, hladko modelovaný pahorkatinný reliéf — kotlinová pahorkatina. Medzi týmito dvoma stupňami sa uplatňuje v reliéfe kotlín ako akýsi spojovací článok stupeň terás a terasovaných kuželov.

Obraz, ktorý sme tu načrtli, je hodne zovšeobecnený a jestvujú od neho početné odchýlky v závislosti od lokálnych pomerov jednotlivých kotlín.

Zo štruktúrneho hľadiska sa javia kotliny oproti tomu neobyčajne mnohotvárne. Môžeme tu sledovať synklinálne prehnutia až brachysynklinálne štruktúry, kombinovaný i zlomový stavebný štýl. Ak môžeme hovoriť o názorovej zhode v takomto širokom poňatí štruktúry, menej jasná je otázka kotlín pri posudzovaní charakteru negatívnych pohybov, najmä z hľadiska ich časového zaradenia, ďalej úlohy subaerickej deštrukcie, či konštrukcie pri vzniku kotlín. O genéze kotlín z morfologického hľadiska postrádame ešte stále čo i len prehľadnú štúdiu, ktorá by osvetľovala túto problematiku vo svetle novších poznatkov. Naším cieľom je pomôcť vytvoriť, avšak nie nahradiť takúto štúdiu. Pokúsime sa zodpovedať aspoň veľmi prehľadne otázku genézy a časového zatriedenia vývoja kotlín. Za jeden z kľúčových oporných bodov, ktorý nám môže pomôcť pri riešení genézy kotlín v široko regionálnom celoslovenskom meradle, považujeme porovnanie vzťahu kotlín voči vypuklým tvarom Západných Karpát, predovšetkým k starým eróznym povrchom.

Štúdium denudačných povrchov v Západných Karpatoch má už vyše polstoročnú tradíciu — od L. Sawického (1909) cez J. V. Daneša (1920), V. Dědinu (1922) a F. Machatscheka (1924, 1927), M. Gotkiewicza (1931, 1934), J. Szaflarského (1937) a najmä J. Hromádku (1931—1943) a L. Dineva (1942) až po M. Lukniša (1946, 1962, 1963), J. Kvitkoviča (1960, 1962), E. Mazúra (1955, 1956, 1962, 1963) a i. Napriek pomerne značnému počtu prác chýba nám rovnako ako o kotlinách súbornejšia štúdia, ktorá by aspoň prehľadne lokalizovala, resp. paralelizovala úrovne našich Karpát ako celku. Plne si uvedomujeme ťažkosti plynúce z takejto úlohy i možnosť dospieť k chybným záverom, jednako sa pokúsime urobiť prehľad.

Pomerne najľahšie sledovateľným eróznym povrchom v celej oblasti Západných Karpát, pravda, nie plošne najväčším, je niveau, ktoré sme nazvali *poriečna* alebo podhorská roveň (E. Mazúr — 1958, 1962, 1963). Je vyvinutá vo forme neširokých pruhov plochého územia pozdĺž všetkých väčších tokov Západných Karpát, v kotlinách a na podhoriach. Považujeme ju za úpätnú plochu — glacis čiže pediment (E. Mazúr — 1963). Jej relatívne výšky sa pohybujú najčastejšie medzi 70—80 až 120—150 m. Len lokálne sú väčšie odchýlky od týchto hodnôt. V relácii k Západným Karpatom ako celku ju vyznačuje stúpanie nadmorskej výšky od okrajov do vnútra pohoria (z hodnôt okolo 150—200 m n. m. až nad 800—900 m n. m.).

Oproti depresnej pozícii a malej šírke poriečnej rovne sa vyznačuje vyššie niveau plošným regionálnym rozšírením a nadväznosťou na vypuklé tvary Slovenska. Pôvodný, príliš široký názov horská roveň (E. Mazúr — 1958, 1962) sme nahradili priliehavejším termínom *stredohorská roveň* (1963). Oproti poriečnej rovni vyznačujú toto niveau oveľa väčšie tektonické deformácie i subaerická deštrukcia. Deformácie sú jednak lokálne, či už výškové alebo uhlové, jednak regionálne, podmienené západokarpatským vyklenutím.

Stredohorská roveň sa zachovala na viacerých pohoriach v podobe väčších-menších mierne zvlnených plošín, inokedy na ňu poukazujú široké ploché chrbty a miestami už len hladina zúžených chrbtov a rázsoch (bližšia lokalizácia je uvedená v angl. texte).

Na oveľa menších plochách, možno povedať vo forme enkláv, vystupujú zo stredohorskej rovne zvyšky ďalšieho erózneho povrchu, ktorý nazývame *vrcholová roveň* (E. Mazúr — 1958, 1962, 1963). Tento názov sme zvolili preto, lebo zvyšky rovne sa viažu spravidla k vrcholovým častiam jednotlivých pohorí. Zvyšky vrcholovej rovne sú väčšinou silne deformované tektonicky i erózne a prejavujú sa najčastejšie v podobe rozčlenených chrbtov, či hrebeňov, miestami izolovaných tvrdošov. Jednako vo viacerých pohoriach sa zachovali, vďaka priaznivým konzervačným podmienkam, i rozsiahlejšie enklávy s pomerne výraznými znakmi starého zarovnania (napr. v Malých Karpatoch, Lúčanskej Malej Fatre, vo Veľkej Fatre, Nízkych Tatrách, Slovenskom rudohorí ap. — prehľad v anglickom texte). Nemožno tu opomenúť poznámku, že vrcholové partie vulkanických pohorí nepatria k vrcholovej rovni, ale sú výsledkom mladého vulkanizmu.

Zo vzájomného pomeru stredohorskej a vrcholovej rovne môžeme usudzovať, že prvá z nich je pravdepodobne pediplanačným povrchom. Napriek jej regionálnemu rozšíreniu a značnému plošnému rozsahu nemôžeme považovať reliéf Západných Karpát ani v čase jej maximálneho rozvoja za zarovnaný. Hojné tvrdoše a enklávy vrcholového systému vystupovali zo stredohorskej rovne ako základnej plochy často o 300—400 m a miestami i viac (v Malej Fatre, Nízkych Tatrách prinajmenšom o 600—700 m). Ak sme pozorovali u poriečnej rovne mierne stúpanie nadmorskej výšky od okrajov do vnútra Karpát, ešte výraznejšie sa prejavuje vyklenutie stredohorskej rovne (z hodnôt okolo 300 m n. m. do 1600—1700 m n. m., pričom neberieme do úvahy ponáranie stredohorského povrchu pod neogén na obvode Karpát). Vyklenutie je pozorovateľné i u vrcholovej rovne. Ak porovnáme priebeh vyklenutia u všetkých troch povrchov, prejavuje sa u nich od okrajov do vnútra Karpát zrejmá divergencia. V dôsledku vnútornej diferenciácie týchto povrchov prejavuje sa divergencia najintenzívnejšie rozčlenením vrcholu západokarpatského vyklenutia.

Na základe vzťahu ku korelačným neogénnym sedimentom kotlín a prikarpatských nížin, pomeru k vulkanitom a vzájomnej priestorovej i výškovej relácie považujeme pre jednotlivé rovne nasledujúci časový sled: vrcholová roveň — vrchný tortón — sarmat (po attickú fázu pohybov), stredohorská roveň — panón (po rhodanskú fázu pohybov), poriečna roveň — vrchný pliocén (E. Mazúr, 34, 35).

Reliéf Západných Karpát je dielom v podstate neogénneho vývoja. Za najstaršie morfologicky sledovateľné zvyšky reliéfu považujeme vrcholové niveau. Začiatok vývoja dnešného reliéfu sa viaže k štýrskej fáze vrásnenia, ktorá podmienila pravdepodobne dosť členitý reliéf, ako súdime z hrubých sedimentov tortónu. Po intenzívnej tortónskej deštrukcii dospel reliéf Západných Karpát v sarmate do pokročilého štádia zarovnania s relatívne plochým reliéfom, ako tomu nasvedčuje vrcholové niveau.

Z celkového rozloženia zvyškov tohto povrchu možno prepokladať ukončenie vývojovej etapy tortónsko-sarmatskej vyklenutím Západných Karpát en bloc za attickej fázy. Pri tomto vyklenutí bol vrcholový systém deformovaný diferenciačnými pohybmi. Niektoré jeho časti boli intenzívnejšie vyzdvihnuté, prípadne vyklenuté alebo uklonené, iné relatívne poklesli, takže sa stali sedimentačnými oblasťami. Priestorové rozloženie zvyškov vrcholového niveau ukazuje, že tieto pohyby kládli aspoň v hrubých črtách základy blízke dnešným dvom skupinám protichodných makrotvarov. V priebehu panónu boli práve depresné časti vyklenutia najskôr pretvorené v stredohorský povrch (pritom máme na zreteli, že v poklesávajúcich prikarpatských depresiách a niektorých vnútrohorských kotlinách prebiehala sedimentácia). Postupne sa zarovnaný povrch rozšíril zálivovite i do vyzdvihnutých častí vrcholového niveau a obmedzil ho do dnešných enkláv, svedeckých a ostrovných vrchov. Dialo sa tak cestou pediplanácie pravdepodobne za podmienok subtropickej striedavo suchej a vlhšej klímy (cit. l. 6, 8, 22, 29). V stredoslovenskej vulkanickej oblasti boli zarovnané sčasti i vulkanity tortónsko-sarmatského obdobia. Miestami pokračovala vulkanická činnosť i v panóne (vrcholové časti niektorých pohorí). Na východnom Slovensku v panóne bola nakopená hlavná masa Vihorlatu (cit. l. 7, 8, 24). V dobe vývoja stredohorského povrchu boli položené už základy hlavných tokov.

Ďalší vývoj stredohorského povrchu bol prerušený novým celkovým vyklenutím Západných Karpát v rhodanskej fáze. Tento pohyb bol opäť vnútorne diferencovaný, a to oveľa výraznejšie než za predchádzajúcich attických pohybov. Relatívna výšková diferenciácia často prevyšuje hodnoty 500 — 600 m a vo vnútri vyklenutia dosahuje až okolo 1000 m. Týmito pohybmi boli dané už dnešné hrubé obrysy pohorí a kotlín. Rozčleňovanie takto deformovaného stredohorského povrchu prebiehalo veľmi nerovnomerne a ovplyvňovali ho silne aj litologické vlastnosti podložia. Veľmi intenzívnou hĺbkovou eróziou boli rozrušované najmä vyzdvihnuté kryhy, z ktorých toky vynášali hrubý materiál a ukladali v priľahlých poklesnutých kotlinách a prikarpatských nížinách (tzv. štrkové formácie). Oproti tomu miernejšie vyzdvihnuté územia boli pomerne snadno upravované subaerickou modeláciou v tzv. poriečnu roveň, čo ešte podporovalo mäkké podložie neogénne a flyšové najmä v kotlinách. Okrajové časti vyklenutia boli miestami silne uklonené a na ich dolné časti sa ukladali vrchnopliocénne sedimenty (napr. Slovenský kras). Bola dotvorená riečna sieť, najmä vznikom svahových tokov na vyzdvihnutých a naklonených kryhách.

Koncom vrchného pliocénu bol však ďalší vývoj poriečnej rovne prerušený novými pohybmi valašskej fázy, ktorá znamenala už len mierne vyklenutie a slabšiu vnútornú diferenciáciu.

V kvartére bola poriečna roveň rozčlenená. Kvartérny vývoj silne ovplyvnený klimatickými osciláciami už len dotvoril v detailoch tvary zdedené z pliocénu.

Kotlinový reliéf slovenských Západných Karpát je výsledkom neogénneho, a to hlavne pliocénneho vývoja. Tento vývoj prebiehal etapovite v úzkom spolupôsobení tektonických pohybov a subaerických činiteľov.

Tektonické pohyby sa prejavovali vo forme celkového vykleňovania Západných Karpát a v jeho rámci diferencovanými pohybmi jednotlivých krýh. Tieto pohyby sa odrážajú v základnom vnútornom členení západokarpatského vyklenutia do dvoch protikladných skupín makroforiem, a to pohorí a kotlín. Táto morfoštruktúra diferenciácie vyvrcholila v pliocéne za rhodanských pohybov. Základné makrotvary odpovedajú v zásade tzv. neotektonickým tvarom.

Mapa 1. Prehľad kotlinového reliéfu Slovenska. 1 — roviny, 2 — nížinné pahorkatiny, 3 — vnútrohorské kotliny a brázdy (1 — Stredovážsky úval, 2 — Žilinská k., 3 — Oravská k., 4 — Ľubovnianska k., 5 — Šarišský úval, 6 — Hornonitrianska k., 7 — Turčianska k., 8 — 9 — Liptovská a Popradská k., 10 — Hornádska k., 11 — Horehronský úval, 12 — Žiarska k., 13 — Pliešovská k., 14 — Zvolenská k., 15 — Ipeľská k., 16 — 17 — Lučenská a Rimavská k., 18 — Košická k.), 4 — stredohoria, 5 — hôlne pohoria, 6 — veľhory, 7 — prelomy, 8 — toky, 9 — vodné nádrže.

Obr. 1. Turčianska kotlina. V pozadí Veľká Fatra. Foto E. Mazúr.

Obr. 2. Žilinská kotlina — južná rajecká časť. Foto P. Plesník.

Obr. 3. Žiarska kotlina. Pohľad z juhu. Foto P. Plesník.

Obr. 4. Poriečna roveň (pediment) na Z svahu Pov. Inovca. Foto E. Mazúr.

Obr. 5. Rožňavská kotlina a planiny Slovenského krasu (stredohorská roveň). Foto E. Mazúr.

Obr. 6. Vrcholová roveň v Lúčanskej Malej Fatre. V pozadí Krivánska Malá Fatra. Foto E. Mazúr.