The Physicogeographycal Landscape Types of the Sand Wood Steppe of Csévharaszt

BY DR. J. JUHÁSZ

The theoretical basis for the physicogeographical district division of the landscape types was determined by Dokuchaev and Berg (1). According to Berg the smallest basic territorial division in physical geography is the landscape. This theory was further developed by their followers. According to Kalesnik (4) the landscape is a relatively homogeneous area which in the course of its evolution was formed in a natural way and differs qualitatively from other landscapes in its structure as well as in the relation and character of its individual geographical factors.

Landscapes are distinguished from one another by two characteristic features: one is the geographical character which is the result of the separation of the lithology, surface, climate, waters, types of soil, vegetation and fauna; the other is the physical geographical unit, the result of the inseparability of the various factors, which is characterized by a specific structure and specific laws of evolution (6).

Landscapes can be determined on the basis of specific local conditions. Ukranian landscape researchers, following the example of Solntsev (5), take into account the values of the individual factors in the process of change. Thus distinguished are strongly resistant factors: [i] geological structure, lithology, surface [as lithogenic factors], [ii] climate, waters [as hydroclimatogenic factors]. The less resistant factors: the kinds of soil, vegetation and fauna, have to be taken into account as biogenic factors.

Isachenko (3) said that owing to the power of resistance of the lithogenic factors the duration of the existence of the region can be measured in geological terms. According to Gerenchuk (2) the lithogeomorphological complexes manifest themselves also in the kinds of soil and the vegetation, and he suggests that the delimitation of the landscapes should be done according to the river valleys and the spread of the top rock formations. If in parts of the landscape the various relief forms change, a new system with a structure of its own evolves in a smaller area within the boundaries of the landscape. Units with new structures. according to the Soviet landscape researchers *landscape mosaics* („urochishches") and *basic landscape units* („facies"), develop within the landscapes.

The facies are characterized by the same lithogenic composition, humidity conditions, microclimate, the same soil varieties and a certain biocenosis. The basis for the distinction of the facies is the vegetation; the variations of the other factors within it confirm the distinction. The biogenic components change under the influence of human activity and so the differences of the soil and the vegetative cover provide a basis for the distinction of the different facies (5) and we can even speak of primary and secondary facies within them. These landscape types are shown on very detailed maps.

A larger morphological unit than the facies is the landscape mosaic or „urochishche" which is nothing else but the ensemble of similar factors. This larger area is characterized by a change of soil as well as by the diversity of the plant community. The landscape mosaic is usually delimited by very good natural boundaries, e. g. forest edges, the edges of different levels, small streams, slope degrees, etc (6).

Soviet landscape researchers have been using the term „geographical small landscape" („mestnost") since 1956. This is a relatively larger, genetically homogeneous area characterized by the same local climate, formation groups, smaller differences in the geological structure, frequent changes in the plant communities which have been modified by the recurrent flooding of the rivers (6).

Determination of the basic units of the landscape was done on the basis of the investigation of all the geographical factors. The landscape division cannot be substituted by the disciplinary (climatic, physicogeographical) zone division. According to Berg „the task of geography is to elucidate the mechanism of the intricate complex called landscape" (1). The following methods have been used in landscape research: the method of principal factors, the comparative, the weighing, the surveying, the selecting, the comprehensive and the geochemical methods (6).

In our investigations we used the method of principal factors. Our aim was to find out how, on what sort of soil, and under what temperature conditions the different plant communities forming independent, dominant, and subdominant facies live. We tried to determine on the basis of our investigations the boundary lines of the facies and „urochishches" on the sandy woody steppe of Csévharaszt.

The measurements in the field lasted from July 11 to July 21, 1960; from April 25 to April 28 and from October 31 to November 4, 1962; and from October 28 to November 2, 1963. The investigations were carried out in the spring before full development of the foliage, in the summer in the vegetative — and usually — generative period when the temperature is highest, and in the autumn in the period of the falling of the leaves On the basis of the available data we think that from the soil and air temperature conditions we have been able to form a picture according to which, together with the evaluation of other characteristics, we can better delimit the investigated area and the physicogeographical types of its surroundings, although the continual seasonal changes of the weather created different temperature conditions, but the main characteristics remained.

Ot the whole of the 30 km^2 of woodland composed of the woods of Pótharaszt, Gombos, Buckás, Puszta Pótharaszt and Kelemen, the wood of Buckás covering an area of 6 km^2 was the subject of concrete investigation, but, from the results we drew conclusions concerning the whole woodland. The whole area is part of the alluvial fan between the Danube and the Tisza. The deposit near the surface derives from the Pleistocene alluvial aggradation of the Danube. The uppermost soil layer, which was important from the point of view of the investigation, consists of alluvial drift-sand, sandy silt and loess. When after drainage the surface was free from water, the alluvial deposit was morphologically transformed. For the quicksand formations developed here the investigations of Pécsi (7) and Molnár (8) give an explanation.

The movement of the sand must have been the most intense in the hazel-nut period of the Holocene. The composition of the uppermost layer of the surface changes even within relatively small distances. On the higher formations, on sand deposits, textureless sandy soil and chernozyom-like soil rich in humus have formed. In the old river beds and deflation valleys also meadow clay and bog soils developed. The elevation of the area above sea level varies between 115 and 145 m. The sand layer covering the soil surface generally contains calcium carbonate. In the environs, where enough humus and colloid has accumulated, continuous agricultural production is going on. The lower-lying areas are by the nature of their composition much more fertile than the more elevated parts of the table-land.

During the periods of investigation we measured the air temperature, the velocity and direction of the wind, air humidity, precipitation, the sunshine hours and radiation intensity. With the instruments of the instrument shelter we measured and recorded the values of the local climatic elements of the different parts of the area.

On the basis of the results of the investigations we ascertained the physical and chemical properties and heat conductivity of the uppermost soil layers as well as the velocity and time of the propagation of heat in them. In each part we examined the temperature conditions under which the plant communities live on the soil and the microclimate areas that form there. The areas of Csévharaszt represent the main characteristics of the land between the Danube and the Tisza. They show distictly the dominant and subdominant landscape mosaics and their groups.

The sandy woody steppe area of Csévharaszt is characterized by undulating land lanes between rivers and small landscapes in the flood-basins. The landscape mosaics in the investigated area can be delimited distinctly. In the lower parts soil humidity is greater than in the elevated flat, sloping, and hilly parts. The texture of the soil, the plant community growing upon it, as well as the fauna are different; so the landscape mosaics can be delimited. We are going to describe the character of each landscape mosaic and possible variation.

In the course of our investigations we found that the areas of the sandhill tops, the interspaces between the sandhills, the poplar wood with junipers, the oakwood, the steppe meadow, the poplar grove, the oakwood with lilies of the valley, the reeds with nettles, and the meadow with bulrushes form facies of different characters, Characterizing the facies on the basis of their qualities we established the urochisches and the small landscape comprising the whole area (4):

1. Calciphilous sandy wasteland top type of Festucetum vaginatae danubiale stipetosum penatae, half-closed plant community on the 5—10-degree slopes of the tops, wirth a sward cover of approximately 40 %.

In the upper layer of the soil (to a depth of 200 cm) sand is the predominating rock; its mud and clay content is small, calcium carbonate occurs in it only in traces. The low capillary suction of the soil suggets that it contains much undecomposed organic matter. The subsoil water is low, its values of hygroscopicity are small. The prevailing plant species develop slowly. Brown and yellow colors predominate in the geologic sample columns. The thickness of the humus is 15 cm on the average, the water conductivity of the soil is good, the interstices between the granules are large; from 20 cm downward there is little organic matter (Table 1). The level of subsoil water could not be found between 2—3 m depth. (It must be mentioned that the soil samples were obtained by boring or for control measuring by digging sample columns.)

The heat conductivity of the soil of the sandhill top is 0,18 cal/cm deg min, its specific heat 0,20 cal/deg g,its density 2,05 g/cm^3. The heat diffusion constant is. $7,3 \times 10^{-3}$ cm^2 sec^{-1}, the propagation speed of the temperature wave $1,02 \times 10^{-3}$ cm/sec, and the time of propagation 0,272 hr/cm.

Owing to its greater elevation above sea level, the alluvial talus of the sandhill top was hit by direct solar radiation earlier than the other areas of the facies in all seasons. In the spring the diurnal variations of the soil temperature and the phase delay were greater in the uppermost layer than in the interspace between the sandhills. There were considerable differences in the summer and spring variations of the soil temperature which can be explained by the stronger dawn cooling in spring. In the fall the temperature of the soil was lower than in the spring or the summer. However, important differences of temperature were found only near the surface (generally in 2 cm depth) and this phenomenon was always connected with the heat conductivity, specific heat and the density of the soil. The phase delays of the extreme values downward from the surface were small in the fall; in the spring the situation was inverted; in the summer the differences were leveled.

In the scanty vegetation of the sandhill top the air layer near the soil cooled off strongly at night in each season. Owing to the surface form of the terrain, the accumulated cold air always flowed down into the lower area of the interspace between the sandhills. Comparing the extreme air temperature values of the local climate and those of the sandhill top we found that the air of the facies warmed up more in every case in the daytime. The temperature of the sandhill top rose fast in the daytime. The temperature of the sandhill top rose fast after sunrise and

Table 1

Data of the soil sample from the hilltop

Depth of soil sample	Siltable part	Index of compactness	hy	Capillary water-lifting capacity	in H_2O	Calcium carbonate content	Alkalinity as soda
cm	%	K_A	%	5h		%	%
10	2	30	0.25	160	7.5	traces	0
20	2	30	0.25	160	7.5	traces	slight traces
30	3	30	0.20	345	7.5	traces	slight traces
40	3	19	0,20	345	7.6	traces	slight traces
50	3	25	0.18	345	7.6	traces	slight traces
60	4	20	0.18	345	7.7	traces	slight traces
70	4	26	0.16	345	7.7	traces	slight traces
80	14	21	0.15	320	7.6	traces	0
90—200	14	20	0.15	320	7.5	traces	0

Total salt: 0.02%

Table 2

Data of the soil sample from the hill interspace

10	5	21	0.32	300	6.7	6.4	slight traces
20	5	24		300	7.1	5.6	slight traces
30	5	25	0.35	300	7.7	8.5	slight traces
40	7	21	0.30	300	7.7	8.1	slight traces
50	15	21	0.30	300	7.8	9.4	slight traces
60	15	21	0.31	300	7.7	8.5	slight traces
70	16	20	0.25	300	7.7	11.5	slight traces
80	15	23	0.19	300	7.6	7.7	slight traces
90	15	22	0.18	300	7.6	7.7	slight traces
100	15	21	0.20	300	7.6	9.0	slight traces
130	15	25	0.31	350	7.7	10.4	slight traces
150	14	26	0.28	350	7.7	8.5	slight traces
160	16	31	0.17	350	7.6	8.1	slight traces
170	15	30	0.19	350	7.7	9.0	slight traces
200	15	28	0.22	350	7.7	9.2	slight traces

Total salt: 0.02%

Table 3

Data of the soil samples from the Quercus robur stand and the juniper wood with poplars

10	8	33	0.4	380	6.9	traces	0
20	9	27	0.4	380	7.3	traces	0
30	9	29	0.4	360	7.3	traces	0
40	10	25	0.5	364	7.4	traces	0
50	12		0.6	325	7.5	traces	0
60	12	26	0.6	334	7.5	traces	0
70	12	24	0.7	340	7.5	traces	0
80	14	30	0.6	350	7.5	traces	0
90	14	25	0.6	346	7.5	traces	0
100	14	25	0.6	328	7.4	traces	0
120—200	13		0.6	326	7.5	traces	0

Total salt: 0.02%

sank slowly and gradually after sunset. The role of advection as well as that of dynamic convection manifested themselves alternately in the development of the extreme values of the period of warming and the period of cooling. The air near the ground was nearly constantly being exchanged owing to advection. The above mentioned conditions in the sector of the investigated plant communities were the basis of their difference from the local climate.

2. The flora of the space between the sandhills is characterized by the calciphilous sandy wasteland sandhill interspace type of Festucetum vaginatae danubiale salicetosum rosmarini foliae. It is a community developed on a once wetter, even now meadowlike gleyey, sandy soil. Its sward cover is 70 %, the hight of its bush level 1—1,5 m.

The upper layer of the facies is composed of coarse, fine, and gleyey sand layers. Its clay and silt content is somewhat higher than that of the hilltop. Its capillary conductivity increases in the lower layers. Large part of the organic matter in the soil is already decomposing. On the basis of its calcium carbonate content the soil may be called calcarious, slightly alkaline. The soil conducts water well; in the lower layers of the sample column the effect of subsoil water was already noticeable (Table 2).

The soil differed in its density from the soil of the hilltop in consequence of which its heat diffusion constant was modified; the velocity of the propagation of heat in it was slowed down. Near the ground surface, between 2 and 5 cm, the variation of the soil temperature in the spring, summer, and fall was greater on the hilltop than in the space between the hills (e. g. the difference between the variations in the spring was 10°C on the hilltop and 4°C in the space between the hills, while in the fall it decreased already to 4°C and 2°C respectively). In spite of better heat conductivity and a denser vegetation the soil of the space between the hills cooled down more intensely than that of the hilltop. The cold air that seeped down intensified in every case the cooling of the soil in the space between the hills at night. Owing to the differences of elevation, warming of the soil in the space between the hills in the morning was slower in all three seasons because the exposition of the hill was unfavorable to the incoming of direct radiation. The vegetative cover of the soil and the lower speed of the propagation of the temperature waves reduced the vertical differences of soil temperature between the layers both during cooling and during warming. In the course of the fall observations the warming of the soil layers fell considerably behind that in the spring and in the summer; e. g. the spring soil temperature minima in 2 cm depth varied around 12°C; in the fall only the maxima showed similar temperature values (10).

Owing to the difference of elevation between the two facies the shade effect in the space between the sandhills early in the morning and late in the afternoon moderated in all three seasons the warming of the air layers near the ground but on the other hand it accelerated their cooling. The combined effect of the radiation conditions, the constant changing of the shade effect, the properties of the soil, the plant communities, the air flow and the surrounding vegetation determined the temperature of the air layers near the ground to such an extent that qualitative differences between the temperatures of the two facies and of the local climate could be demonstrated (10). In the case of northerly and north-easterly or easterly air currents the wind speed was moderated in each case on account of the trend of the hill range. When the direction of the wind was favorable, dynamic advection disturbed the air temperature stratification which had developed by thermal convection. This stratification was occasionally influenced also by the warmer or colder air of the surrounding vegetation. We could ascertain that owing to the thinning of the foliage the effect of the surrounding areas was stronger in the fall period of observation than in the spring or summer period. As a consequence of the interaction of the microclimate areas, besides radiation, differences of 1,5—2 C were found in most cases at 10 cm between the air temperature variation of the hilltop and that of the space between the hills in the fall. There were cases when the diurnal variations were nearly leveled [10]. The fauna of the space between the hills consists only of rabbits. The area of the hilltop and the space between the hills as basic landscape units form a landscape mosaic. On account of the differences of elevation (11 m) the whole terrain may be called „undulating urochishche" (Fig. 3). The vegetation of the hilltop in the area of the „urochishche" is characterized by the calciphilous sandy wasteland hilltop type of Festuca vaginatae danubiale stipetosum pennatae. On the gentle slopes of 5—10 deg of the hilltop there is a half-closed plant community with a sward cover of circa 40 %. The vegetation of the space between the hills is characterized by the calciphilous sandy wasteland sandhill interspace type of Festucetum vaginatae danubiale salicetosum rosmarini foliae. In the upper layer of the soil of the hilltop (to a depth of 200 cm) sand with little clay and silt content is the dominant rock. The low capillary water-lifting capacity indicates that the soil contains an abundance of undecomposed organic matter. The subsoil water is low, the hygroscopy values are small. The dominant vegetation develops slowly. The propagation speed of the temperature wave is 1,02x10 cm/sec. The clay and silt content is somewhat higher in the soil of the sandhill interspace. Its capillary water-lifting capacity increases in the lower layers. Large part of the organic matter in the soil is already decomposing; on the basis of its calcium content it can be considered calcipherous, slightly alkaline. This soil differed from the soil of the sandhill also in density [2,05 and 2,24 g/cm^3 respectively]. In consequence of this its heat diffusion constant was modified and the speed of heat propagation in it was reduced. The diversified plant community and the difference between the physical and chemical properties of the soils, the identical lithogenic composition, the differences between the humidity conditions, the soil temperatures and air temperatures and the microclimates and occasional agreement ensured the formation of a landscape mosaic within the flood-basin small landscape.

3—4. The vegetation of the juniper wood mixed with poplars and of the Quercus robur wood are characterized by Festuca-Quercetum roboris danubiale juniperetosum. The Quercus robur woody steppe community is a subassociation in varied situation formed during the process of degradation. The hight of its crown level is 5—8 m, the hight of its bush 3—4 m. The Qeurcus robur wood is a remainder of the thermophilic brushwood of the original woody steppe vegetation. The hight of the crown foliage of Quercus pubescens and of Quercus robur is 10—12 m. In the brushwood level Lingustrum is predominant. The sward is characterized by Poa angustfolia. The remainders of the two plant communities are to be found near to each other on equally high, slightly prominent ranges. In the uppermost layer of the soil coarse sand, from 50 cm to 200 cm already fine and gleyey forms, are found. The compactness values (Table 3) support our findings. The capillary water-lifting capacity of this soil is great, large part of the organic matter in it is decomposing. The surface of the area is gently undulating, the thickness of its humus layer is about 60 cm, the plant communities growing on it are vigorous. The lower part of the soil sample column is wet, airless, with calcium carbonate only in traces.

The heat conductivity of the soil is 0,17 cal/min deg, its specific heat 0,21 cal deg g,its density 2,14—2,12 g/cm^3. The heat diffusion constant is 6,2x10^{-3} and 6,3x10^{-3} cm^2 sec^{-1}, at the same time when the velocity of the propagation of the heat wave is 9,5x10^{-4} cm/sec and the time of propagation is 0,292 hr/cm. That is to say the modification of the values of the heat diffusion constant changed the speed of the propagation of temperature. The above-mentioned properties and the plant communities growing on the soil determine the temperature of both the soil and the air. In their area they create vertically and horizontally an independent microclimate.

In the summer the soil of the stand of junipers mixed with poplars cooled intensely. This phenomenon was connected with the thickness of the humus layer and the increase of porosity. At the same time the more moderate warming and cooling of the stand of Quercus robur was due to the fact that the high crown foliage hindered radiation. Direct radiation reached the soil usually between 13 and 14 hours. On the other hand, direct radiation reached the soil of the nearby stand of junipers and poplars already from 10 hours orward. The legth of the above-mentioned radiation periods became doubled during the summer observations, and the nautral consequence of this was more intense warming.

Although there is a considerable difference in the composition of the soils, the effect of the vegetation on the soil temperature must be taken into account first of all. The microclimate-forming role of the vegetation is well proved by the daily amplitudes of the soil temperatures (e. g. on the steppe-meadow 21,3°C in the juniper stand with poplars 10,7°, and in the stand of Quercus robur 7,1°).

In the spring the amount of heat stored in he lower layers was smaller than in the summer and it decreased considerably in the fall [e. g.]

the soil temperature on the steppe-meadow at 20 cm depth on April 26th was 20,9°C, on June 15th 28,2°C, and on Nov. 3rd 11°C]. The warming and cooling of the soil was considerably influenced, besides radiation and the vegetative cover, by the density of the foliage and the insulating effect of the fallen leaves (10). In the half-closed area of the juniper stand with poplars and the stand of Quercus robur the temperature in the crown level, in the foliage, in the zone of the trunks, and near the ground was determined by radiation, air flow, vegetation, and environmental effects. In the area of the facies the double active surface could be observed already in the spring. But in the area of the juniper stand mixed with poplars it must be taken into account that the vegetation does not hinder radiation toward the zenith, so the cooling is more intense here than in the stand of Quercus robur and exceeds even the values measured on the sandhill top. Owing to the characteristic arrangement of the vegetation, 50—70 cm wide open corridors developed within which the air cooled down and the cool air even accumulated and this is just the characteristic feature of this area. In the juniper stand with poplars the smallest temperature difference between the 10 and the 150 cm levels was 2,4°C on April 27th and 1°C on April 28th. From this it follows that the temperature conditions of the vegetation itself are heterogeneous.

Comparing these findings with the summer values we could ascertain that as a result of the thinning of the foliage the active surfaces developed in a different way in the Quercus robur wood in the fall. The brushwood zone which had had a leading role in the summer had become a secondary factor. Only a smaller amount of direct radiation reached the soil which was covered by an insulating layer of fallen leaves and so vertical microclimatic spaces could not develop in the air.

It could be ascertained that the air layer of the Quercus robur stand became the characteristic eradiation type at night. In the levels examined the temperature rose upward from below. In the daytime, however, the situation is not so clear; the 10 cm level is generally the warmest, but the next temperature value belongs not to the 50 cm level but to the 500 cm and then the 300 cm level, that is the air layer of the 50 cm level is the coolest. From this we can conclude that in the Quercus robur stand the two warmest zones in fall are found at 10 cm and in the crown zone [e. g. 12,2°C at 10 cm, 11,1°C at 50 cm, 11,9°C at 150 cm, 12°C at 300 cm and 12,1°C at 500 cm on Nov. 2nd].

According to our observations direct radiation could penetrate into the dense foliage to a height of 150 cm in the juniper stand with poplars only occasionally; from this it follows that the rise and fall of the temperature is in the first place a function of the temperature conditions outside the stand (i. e. of the temperature of the neighboring areas), in the second place it is a function of the foliage as an active surface. The primary and the secondary roles were often interchanged, especially in the cases when under the influence of direct radiation, in the midday hours, the active surface was transferred to the ground (10).

5. The steppe-meadow [sandy wasteland meadow] is an original steppe-meadow remainder, the dominant species on it is the meadow fescue [Festuca pratensis], its concomitant is the feather-grass [Stipa satulora] and Festuca vaginatae. In the uppermost layer of its soil coarse sand, deeper than 50 cm fine and gleyey sand kinds are to be found. The capillary water-lifting capacity of the easily closing soil is great, the organic matter that has got into the soil is decomposing. According to its chemical effect it is a neutral soil with calcium carbonate only in traces. In other respectes [color, granule size, basic substance, humus content etc]. it agrees with the soil of the juniper wood with poplars and that of the Quercus robur wood.

In the summer the uppermost layer of the soil warmed up considerably but cooled more moderately. This is evident when we compare the extreme data for the 2 cm and the 5 cm levels (e. g. the maximum was 40,5°C and 33°C respectively and the minimum was 18,2°C and 20,5°C respectively on July 15th). From this it follows that the heat conductivity of the soil changed with the seasons.

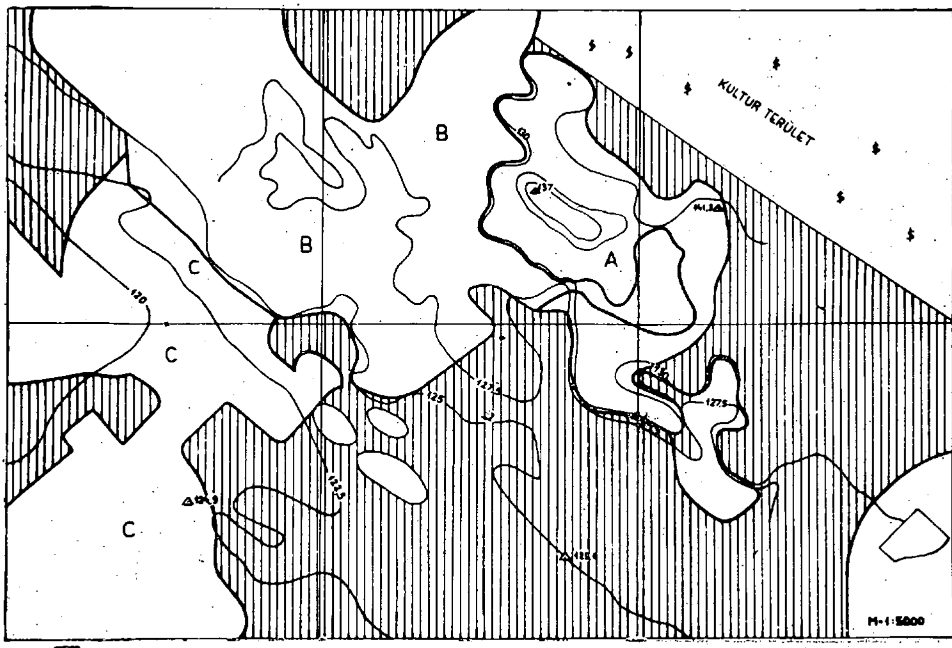
The soil of the steppe-meadow was the warmest in the area of the small landscape. Similar warmth was observed only on the sedge meadow (e. g. the temperature was 40,5°C at 2 cm depth on the steppe-meadow, 38,2°C on the sedge meadow on July 15th).

In the course of the examination of the soil temperature values measured on the steppe-meadow, in the Quercus robur wood and in the juniper wood with poplars it was proved that besides the radiation conditions the plant communities, the vegetative cover, the soil conditions and the precipitation have a very important role in the formation of the soil temperature and thereby in the development of the microclimate areas.

In the course of warming it was found out to what extent the above-mentioned qualities, together with the changing air currents influenced the temperature of the air near the ground in the various layers. The diurnal variation of the temperature on the steppe-meadow was great on clear days, for it was here that the air warmed up most intensely in the daytime. In the half-closed areas as for instance in the juniper stand mixed with poplars and in the Quercus robur wood the air was not so warm (34°C at 10 cm on the steppe-meadow, 27,2°C in the Quercus robur wood on July 15th). The difference in the degree of warming was connected with the density and habit of the vegetation.

The areas of the steppe-meadow, the juniper stand mixed with poplars and the Quercus robur wood as basic landscape units form together a landscape mosaic which extends over much of the woodland examined. This landscape mosaic may be said to be of the meadow type [Fig. 3 B] which is characterized by various kinds of plant communities, substantial agreement of the geological and physical properties, its differences in soil temperature, heat conductivity, specific heat, density, and heat diffusion constant as well as the microclimatic differences of the half-closed areas, the „facies".

6—7. West of the landscape mosaic of the meadow type lie the lowest areas of the former flood-basin: the subdominant and the dominant facies which have developed from the poplar grove and the oakwood with lilies of the valley. The reedbed with nettles and the sedge meadow form a separate facies; together they form a boggy landscape mosaic [Fig. 3 C].



akác = acacia grove, kultúrterület = culture area

Fig. 3. Landscape mosaic

Subdominant facies is the poplar grove which grows on the edge of the lowest-lying and wettest soil of the aggraded channels and which gives much wood material. The height of its crown zone is 14—16 m; the gray poplar, the black popler, and Quercus robur are prevalent in the area. Its brushwood is rich in species [privet, hazelnut] and in the grass level there are many hygrophilous species.

We treat the area of the oakwood with lilies of the valley as a dominant facies. On the once high banks of former aggraded riverbeds there is a closer, shadier timberwood in which the xerothermic elements can still be found. Dominant and characteristic among its plant species is Populus nigra with 20 % closeness and with the upper crown level at 22—24 m. The degree of closeness of Quercus robur and Pyrus piraster is 70 %, with a crown height of 15—16 m. Down to a depth of -200 cm in the soil of the poplar grove and of the oakwood with lilies of the valley sandy loam, clay loam and clay are to be found. The hygroscpy also indicates the above-mentioned soil kinds. The water conductivity decreases with the depth but the water-storing capacity is good. The swelling and shrinking capacity is great, the uppermost layer chaps in summer when there is too little rain. This soil belongs to the slightly alkaline, slightly calcareous kinds (Table 6). Among the facies of the investigated old flood-basin small landscape it is here that the humus layer is the thickest. The roots are therefore very well developed. Owing to the high-lying clay layer the soil stores much water; the water can be found already at 1,5 m depth.

Table 4

Data of the soil sample from the sedge meadon

Depth of soil sample	Siltable part %	Index of compactness	hy	Capillary water-lifting capacity	PH in H_2O	Calcium carbonate content	Alkalinity as soda	Salt
cm		IC	%	5h		%	%	%
10—30	28	36	2.6	85	7.5	39.3	traces	0.02
30—90	35—39	40—42	3.4—3.8	72—42	7.5—7.8	50.8—68.4	traces	0.02
90—100	39—32	42—49	3.8—3.4	42—35	7.8	68.4—62	traces	0.02
100—200	31	40	3.9	25	7.9	68.5	traces	0.02

Table 5

Data of the soil sample from the reed-bed with nettles

10—20	24	37	1.7	80	7.3	35.9—39.9	traces	0.02
20—70	24—68	37—43	1.7—5.2	80—145	7.3—7.8	39.9—64.5	traces	0.04
70—100	68	43—32	5.2—1.0	145—240	7.8	64.5—trac.	traces	0.02
100—200	30—28	32	1.0—0.8	240—390	7.8—7.7	traces	traces	0.06

Table 6

Data of the soil samples from the oakwood with lilies of the valley and from the grove

10—50	26	27—39	1.65—2.72	40	7.1—7.4	—	—	0.02
50—100	26—54	39—37	2.7—3.4	45—35	7.4—7.8	—	—	0.02
100—140	54—74	37—54	3.4—5.4	35—20	7.8—7.8	—	—	0.02
140—200	74	54—56	5.4—5.3	20	7.8	—	—	0.02

The poplar grove and the oakwood with lilies of the valley differed essentially in geological respect from the soil conditions in the surroundings of the steppe-meadow and the sandhill interspace.

Under airless conditions the organic matter in the lower layers, already at 1 m depth, becomes transformed with difficulty. Because of the lush vegetation, radiation could reach the ground only rarely and even then for a short time. The effect of this manifested itself both in the soil and the air temperatures.

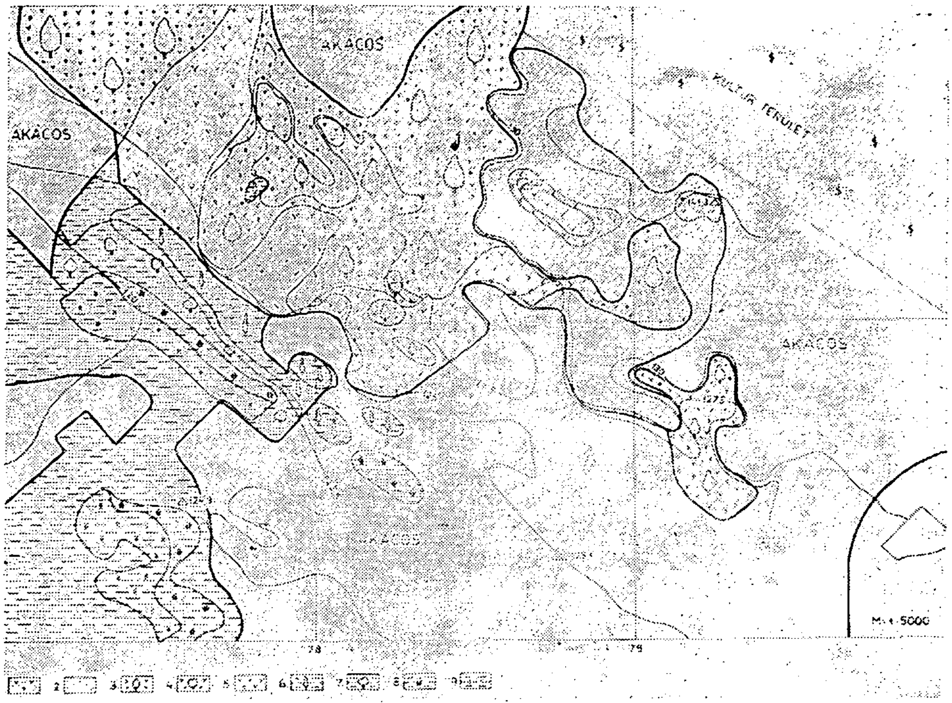
The warming and the cooling of the soil of the oakwood with lilies of the valley was moderate, that of the poplar grove was even weaker (e. g. the maximum of the oakwood with lilies of the valley in 2 cm depth was 20,9°C, its minimum 13,4°C; the maximum of the poplar wood was 17,7°C and its minimum 12,2°C on April 26th). In both areas the luxuriant crown of the woods, the brushes and the undergrowth reflected or absorbed most of the radiation. The natural result of this was that they fell behind the open areas in respect of warming and cooling. In connection with this it may be mentioned that the oakwood with lilies of the valley approximates to one half, the poplar grove to a third, of the daily variation of the sedge meadow (10). In the autumn the thick cover of fallen leaves further moderated the stronger cooling and warming of the soils (e. g. the magnitude of the variation in 2 cm depth on the sedge meadow was 5,4°C, in the oakwood with lilies of the valley only 3°C, and in the poplar grove 1,4°C on Nov. 2nd).

The heat conductivity of the soils of the poplar grove and of the oakwood with lilies of the valley is 0,15 cal/cm deg; the specific heat in the soil of the first was 0,34, in the soil of the second 0,3 cal/deg g; the density of the soil in the first is 2,2 and in the second 2,25 g/cm. The heat diffusion constant is $3{,}3 \times 10^{-3}$ and $4{,}0 \times 10^{-3}$ cm^2 sec^{-1} respectively. The propagation speed of the soil temperature wave is $6{,}92 \times 10^{4}$ and $7{,}62 \times 10^{-4}$ cm/sec respectively, the time of propagation 0,401 hr/cm and 0,365 hr/cm respectively (11).

Owing to the shade effect and the closeness of both areas the warming of the air was slow as compared to the open areas. The changes in the sunshine hours and the air flow had a decisive role in the development of the different microclimatic areas. As a result of the frequency of the western air current and the lower elevation of the area, the warming and cooling of the air near the ground in the poplar grove and the oakwood with lilies of the valley was connected with the temperature of the sedge meadow outside the stands and the agricultural area beside them (11)

The vegetation of the poplar grove is dense; on the other hand, the crown level is not so closed as in the oakwood with lilies of the valley. Thus under the influence of the sunrays an active surface sometimes develops not only in the crown zone but also at the brushwood level in the midday hours. We think that the temperature conditions of the crown zone influenced the warming and cooling of the air near the ground only partially. On the other hand, the brushwood level as an active surface exerted, even though temporarily, an effect on the air layers both under and over it. Generally, however, slow, moderate warming and cooling was characteristic of the temperatures of both facies.

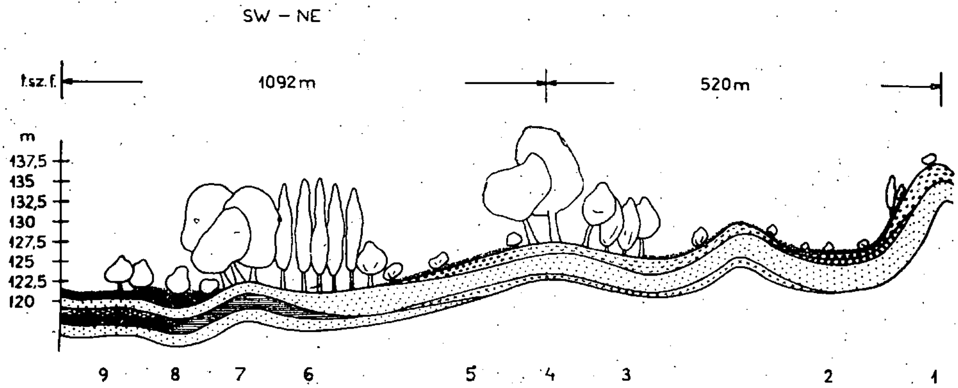
The consideration of the areas as dominant and subdominant facies was justified by the identity of the physical and chemical properties of the soil in both areas, the evenness of the air temperature, the manifestation of the environmental effects, and the difference between the vegetations (Fig. 2).



Akácos = acacia grove, kultúrterület = culture area
Fig. 2. Landscape units

8. To the bog landscape mosaic belongs the reed-bed with an abundance of weeds (nettles). It has lost the water in the former bed which is in an advanced state of aggradation. There is agreement between the compactness and the siltability of the soil. In respect of chemical effect the uppermost layer is neutral and them slightly alkaline. It has a high calcium carbonate content, but it is less after one meter so that it can be found only in traces (Table 5.) Decomposition of the organic matter in this soil is ensured. Much organic matter has accumulated in the formerly submerged area. Humus formation could therefore start after draining. The lower clayey layer (Fig. 1) prevents the roots from penetrating deep. The „Kotu"*-and peat-containing layer over the clay mixes with the fen bottom. Owing to the high water-level its soil is wet, its capillary water-lifting capactiy is weak at the surface but gradually increases downward to the impermeable layer.

* Kotu = solid parts of dead plant that here got mixed with the soil and have not yet carbonized.



durva homok = coarse grained sand, kotu = kotu
finom homok = fine sand, tőzeg = turf
glejes homok = gley sand, agyag = clay

durva homok, finom homok, glejes homok, kotu, tőzeg, agyag

Fig. 1. Upper striation of the soil

The thermal conductivity of this soil is 0,21 cal/cm deg min, its specific heat is 0,28 cal/deg g, and its density is 2,48 g/cm^3. The heat diffusion constant is 5,0x10^{-3} cm^2 sec^{-3} the propagation speed of the soil temperature wave is 8,53x10^{-4} cm/sec and the time of propagation 0,325 hr/cm. Owing to the closeness and the dense vegetation of the area the temperature of the soil layers of the reer-bed with nettles falls so much behind that of the open area of the sedge meadow in respect of cooling and warming that their maxima were often lower than the minima of the sedge meadow. For instance the following readings were recorded on July 21:

	maximum		minimum		amplitude	
	s. m. °C	r. n. °C	s. m. °C	r. n. °C	s. m. °C	r. n. °C
2 cm	38,2	23,2	25,0	16,7	13,2	6,5
5 cm	32,5	22,2	26,1	17,4	6,4	4,8
10 cm	30,6	20,6	26,2	17,6	3,6	3,0
20 cm	28,7	18,2	26,4	16,3	2,3	1,9

The soil temperature readings show that the reed-bed with nettles creates a different microclimate in its own area than in the adjacent areas. The surface of the soil was in all seasons covered by a 5—8 cm thick layer of dead plants which had a considerable influence on the intense heat exchange. On the other hand, the heat exchange of the soil was insignificant already at 20 cm depth with hardly any variation of temperature (11).

It is characteristic of the air temperature of the reed-bed with nettles that its daily veriations were more even than in the open areas (e. g. on the hilltop, in the interspace between the hills, on the sedge meadow and on the steppe-meadow). The daily temperature is generally characterized by small variation and evenness. Warming and cooling are occasionally modified by advection. Under the influence of direct radiation the active surface developed in the midday hours in the lower layers, in other parts of the day it developed in the middle or upper part of the stand. It is this shift of the active surface that makes the microclimate of this area peculiar.

Owing to the characteristic vegetation of the area of the reed-bed with nettles as well as the physical and chemical properties of its soil, the soil and air temperatures of the area differ considerably from the conditions of the oakwood with lilies of the valley and those of the sedge meadow, thus forming an independent facies.

9. An integral part of the landscape mosaic is the meadow as a facies: it is a stand vegetating poorly on peaty, but relatively dry meadow soil developed in an aggraded channel. Its dominant and most characteristic species are: Carex acutiformis, Agrostis alba, Cirsium canum, etc. The basic rock of the flat channel bottom with high subsoil water is fine sand and silt (Fig. 1). The layers are compact, their calcium carbonate content is very high. The soil is slightly alkaline, its water supply is good, calcium deposits in it are frequent, the subsoil water in relatively high, in places it can be found already at 1,5 m depth, while not even conclusions could be drawn regarding the subsoil water level on the steppe-meadow and its surroundings when soil samples were taken.

The meadow area formed in the aggraded channel is drying out gradually. The old, rich vegetation has, in the course of time, become stunted. The soil surface has changed layer after layer. Under the upper kotu-containing layer there are peaty, and then silty layers. There is little peat; in the humus layer there is much organic matter.

The heat conductivity of this soil is 0,2 cal/deg min, its specific heat is 0,28 deg g, its density is 2,38 g/cm^3. The heat diffusion constant is 5,10 cm^2 sec , the propagation speed of the soil temperature waye is 8.53.10 cm/sec and the time of propagation is 0.325 hr/cm.

Our attention was caught by the strong cooling of the upper soil layers of the sedge meadow at dawn and their intense warming in the daytime. On the basis of our findings we can ascertain that the soil of the sedge meadow and of its surroundings is a relatively bad heat conductor. It is understandable therefore that the absorbed heat flowed slowy toward the deeper layers in the daytime. So it accumulated in the surface layers in — 2, 5, 10 cm depth, the consequence of which was that the soil warmed up considerably. At the same time, replacement of the heat eradiated at dawn and at night became slower. The angle of incidence of the direct rays changed with the seasons. The shade effect of the wood was modified accordingly and this strongly influenced the warming of the soil and of the air. On the sedge meadow the air temperature sank rapidly after sunset, while in the adjacent areas it decreased slowly and gradually. Owing to unhindered eradiation, the temperature in the area of the sedge meadow was higher in all seasons, even at 300 cm height, than for instance at 10 cm height in the air layer of the oakwood with lilies of the valley and of the poplar grove.

The most intense warming and cooling was measured in the open areas among others on the sedge meadow; the temperature of the half-closed and closed areas as the reed-bed, the oakwood, etc. was lower.

The poplar grove, the oakwood with lilies of the valley as dominant and subdominant facies form, together with the independent facies of the reed-bed with nettles and the sedge meadow, the *fen landscape mosaic* (Fig. 3 C). The fen „urochishche" is characterized by an independent plant community, an identical petrological composition and by the fact that within these fine sand, „kotu", peat, silt, and mud alternate as soils int the fifferent areas. There is a certain agreement between the physical and chemical properties of the soils (Tables 4, 5, and 6), but there are differences in their heat conducticity, specific heat, and densiy). Identical humidity conditions, different plant communities and radiation conditions, together with other characteristics, have created different microclimates in the fifferent areas.

There is a certain agreement between the physical and chemical properties of the soils (Tables 4,5, and 6), but there are differences in their heat conductivity, specific heat, and density. Identical humidity conditions, different plant communities and radiation conditions, together with other characteristics, have created different microclimates in the different areas.

The woodland of Csévharaszt with its undulating meadow and fen landscape mosaic (Fig. 3) forms a flood-basin small landscape (Fig. 4).

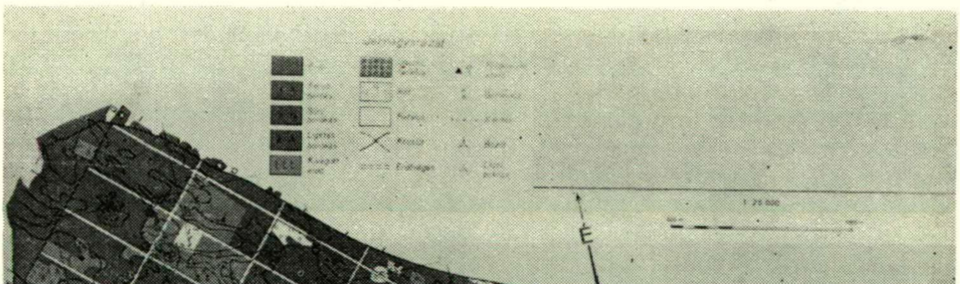


Fig. 4. Flood—basin small landscape

We have called the Csévharaszt district of the sandy woody steppe a flood-basin small landscape, i. e. „mestnost" taking into consideration the categories established by Mikhailov (6) and others (1—5). There are areas endowed with the same properties also in the territory of the woodland, farther away from the sites of observation. These areas constitute basic landscape units and landscape mosaics and are at the same time integral parts of the flood-basin small landscape.

The unbroken woodland of the flood-basin small landscape (Fig. 4) covers nearly 30 km^2. The Pleistocene bed and branches of the Danube are to be found in the area. Alluvium and loess have deposited here. The upper stratification of the soil is very varied both horizontally and vertically (Fig.). The movement of the sand ceased in the recent past; in spite of this fact there is a considerable expanse where humification is only in its initial stage. The characteristics aspects af the landscape, in which the vegetation forms smaller or larger groves, has remained. Owing to their higher humus content, the fen and meadow „Urochishches" are much more fertile than the more elevated parts of the undulating areas.

The hilly wood and hater wooded parts have preserved the old natural aspect of the sandy landscape between the Danube and the Tisza very well. In the area declared a national monument there is a vegetation of the lowland woody steppe zone and this vegetation resembles the old in many respects. In the lower places, so also in the hill interspace in the zone of the former aggraded beds there are also plant communities — Salix rosmarinifolia and Carex acutiformis, Agrostis alba — which are indicative of a fresher soil. The latter, however, are only languishing because the sinking of the subsoil water-level due to canalization in the last century has made their growth areas more unfavorable. Good examples for this are the area of the facies between the sedge meadow and the oakwood with lilies of the valley and the reeds growing on the thick peat layer of the aggraded bed which is now never covered by water. Such are the picturesque marshy bogs and the Calamagrostis canescens willow fens.

The surroundings of the flood-basin small landscape is a culture landscape; its sandhills still preserve the old vegetation. The rest of its vegetation is the same as the vegetation of the sandy areas between the Danube and the Tisza. The continental pontus and pontus mediterranean elements give an eastern and southeastern coloring to the wood and the wasteland grass (9). The southern elements are also represented by Diantus diutinus. The development of its flora generally agrees with the development of the rest of the flora of the Great Hungarian Plain.

The changes of the soil temperature and of the air temperature are in accordance with the properties of the soil, the development of the plant communities and the radiation conditions. In various areas the physical and chemical properties of the soil, the differences of elevation and climatic conditions have made the establishment of different plant communities possible. Thus the plant communities have created dominant and subdominant or independent facies by their characteristic microclimates.

Besides the quantitative variations concerning the soil and air temperatures we have also demonstrated qualitative variations (11). These facts only supported the possibility of delimiting the areas of the individual facies.

In the course of our investigations we ascertained that the flood-basin small landscape is a genetically homogeneous area characterized by a uniform geological base, different plant communities, and local climate within which the different microclimate areas are constantly changing.

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* Kotu = solid parts of dead plant here got mixed with the soil and have not yet carbonized.