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**Autor:** Domin, Karel  
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9. It is sometimes very difficult to distinguish stable and transitional (resp. initial) stages as well as it is difficult to decide which types belong to the same sociation as the result of a chance or antropic change of the habitat. Thus I have described (<sup>4</sup>, p. 23—24) from Subcarpathian Russia beech forest types of an essentially different physiognomy but in reality brought about by the increase in light intensity. In the shade of an old, tall-trunk beech forest on a stony ground, we find the *Mercurialis-Phyllitis* type with very abundant *Urtica dioica*; in the lighter shade of more open forest places, the *Athyrium filix femina* type dominates; and on the still lighter places on coarse talus, a shrubby growth of *Rubus idaeus*, *Ribes grossularia* and *Lonicera nigra*, is to be found.

Besides, the same type (for instance *Carex pilosa*, *C. alba*, *Melica uniflora*) may be, in some instances, only a stage of another stable sociation or else a final stable community.

As a distinct sociation one cannot accept a growth which is characterised only by the fact that a single species of this or that sociation determines locally the aspect by its high dominance. A sociation must have its own sociological structure, a certain stability, and a certain geographical distribution. As I have already mentioned, it is a matter of personal opinion whether the geographical and edaphic variants ought to be evaluated as distinct sociations.

Sociations and variants of beech forests we characterise by the floristic composition and by the physiognomy of their tree, shrub and ground vegetation strata (also of the mossy layer, if present). In a broader sense, these principal sociations are complicated by other accompanying sociations, namely the epiphytic growths of bryophytes, lichens, algae, the mycoflora, and, of course, also the microbe vegetation of the soil.

#### **XI. Sociations, variants and facies of Czechoslovakian beech forests.**

As far as the beech forests of our state are concerned, it seems advisable to distinguish two sociologically and ecologically essentially different groups, namely the true beech forests (*F a g e t u m v e r u m*) and the spurious beech forests (*F. s p u r i u m*) to which latter may also be joined the degraded beech forests. The bare-floor beech

forests (*F. nudum*), entirely or almost without any herbaceous undergrowth, are widely distributed. It is, however, impossible to regard them as distinct sociations, since they are in reality only special stages of other sociations whose undergrowth became latent, but is potentially present.

The spurious beech forests have an undergrowth with dominants and other species foreign to the true beech forests and mostly belonging to the spruce (for instance *Vaccinium myrtillus*, *Calamagrostis villosa*, *Homogyne alpina*, *Lycopodium annotinum*, *Struthiopteris spicant*, *Gentiana asclepiadea*, Hercynians bryophytes, etc.), sometimes to the oak. The true beech forests always exclude, under favourable habitat conditions, all characteristic Hercynian elements such as *Deschampsia flexuosa*, *Vaccinium*, *Calluna*, etc., wherein they differ essentially from the usual spruce forest sociations.

In this chapter I shall try to give a short description of the main types characteristic of our true beech forests. This enumeration, however, is not complete but at least gives a general picture of our beech forests. These types I classify at present as follows:

A. *Fageta herbosa*.

1. *Asperula odorata* sociation.
  - a) *Sudetic-Hercynian* variants;
  - b) *Carpathian* variant;
  - c) *Mercurialis perennis* variant;
  - d) *Asperula odorata-Glechoma hirsuta* variant;
  - e) *Cephalanthera rubra-Epipactis microphylla*.
2. *Fagetum asperulacum mixtum* sociation.
  - a) *Hercynian* facies;
  - b) *Carpathian* facies.
3. *Asperula odorata-Polystichum Braunii* sociation.
  - a) *Tatra calcicole* facies;
  - b) *Eastern Carpathian Flysch* facies.
4. *Geranium Robertianum* sociation.
5. *Dentaria* sociation.
6. *Oxalis* sociation.
7. *Galeobdolon-Oxalis* sociation.
8. *Allium-ursinum* sociation.

B. *Fageta altiherbosa*.

9. *Cortusa sociation*.
10. *Pleurospermum-Cirsium erisithales sociation*.
11. *Lunaria-Urtica sociation*.
  - a) *Phyllitis-Parietaria* variant;
  - b) Carpathian calcicole *Lunaria-Urtica* variant;
  - c) *Sudetic-Hercynian* facies;
  - d) *Urtica dioica* variant.
12. *Senecio Fuchsii sociation*.

C. *Fageta subhygrophila*.

13. *Petasites albus sociation*.
  - a) *Sudetic-Hercynian* facies;
  - b) *Western Carpathian* facies;
  - c) *Eastern Carpathian* facies;  
non-mossy variant;  
mossy variant.
14. *Petasites albus-Mercurialis-Chaerophyllum hirsutum sociation*.
15. *Impatiens noli tangere sociation*.

D. *Fageta filicina*.

16. *Athyrium filix femina sociation*.
  - a) *Sudetic-Hercynian* facies;
  - b) *Eastern Carpathian non-mossy* facies;
  - c) *Eastern Carpathian mossy* facies.
17. *Dryopteris Robertiana sociation*.
18. *Eastern Carpathian Mercurialis-Phyllitis sociation*.

E. *Fageta caricina*.

19. *Carex pilosa sociation*.
  - a) poor variant;
  - b) *Carex pilosa-Dentaria bulbiflora-Staphylea* variant;
  - c) *Carex pilosa-Hacquetia-Cephalanthera rubra* variant;
  - d) *Carex pilosa-Luzula nemorosa* variant.
20. *Carex alba sociation*.

F. *Fageta luzulina*.

21. *Luzula silvatica sociation*.
  - a) *Eastern Carpathian Flysch* facies;
  - b) *Western Carpathian limestone* facies.
22. *Luzula nemorosa sociation*.



G. *Fageta graminosa*.

23. *Melica uniflora* sociation.
  - a) *Western Carpathian* calcicole facies;
  - b) *Western Carpathian* silicicole facies.
24. *Dactylis Aschersoniana* sociation.
25. *Sesleria calcaria* sociation.
26. *Festuca silvatica* sociation.
27. *Milium effusum* sociation.
28. *Brachypodium silvaticum* sociation.
29. *Poa nemoralis* sociation.
30. *Calamagrostis arundinacea* sociation.

Besides these, there are some sociations of degraded and spurious beech forests, as:

31. *Majanthemum bifolium* sociation.
32. *Festuca ovina-Luzula nemorosa* sociation.
33. *Myrtillus-Homogyne* sociation.
  - a) *Struthiopteris spicant* variant;
  - b) *Calamagrostis villosa* variant.
34. *Calamagrostis villosa* sociation.

A. *Fageta herbosa*.

1. *Asperula odorata* sociation. (*Fagetum asperulaceum odoratae*.)

It is questionable whether all the variants of the woodruff beech forests can be included into one sociation. They form, it is true, a certain natural unit but it seems that some of the types which I place provisionally into this sociation show a rather marked sociological character.

First, we may distinguish three geographical variants (facies), namely the Sudetic-Hercynian, the Western Carpathian, and the Eastern Carpathian, each of which can be further subdivided into silicicole and calcicole variants, and these again into submountain, mountain, respectively also supermountain variants. Thus the classification becomes very complicated but agrees with the communities found in nature. There are, of course, various transitions and frequently also transitions to other forest types. In the normal woodruff type, tall herbs and grasses are either missing, or only very scattered, or they may be more frequent but then weak and mostly sterile in-

dividuals and do not belong to the dominant species. If the canopy is artificially more or less opened, these herbs under certain habitat conditions may determine the aspect and thereby the undergrowth takes on the character of the second group (*Fagetum altilherbosum*). To join both groups into one is not advisable, because types of both groups occur side by side under the same light conditions, and therefore cannot be considered as stages of one and the same sociation.

The Sudetic-Hercynian, woodruff beech forests are characterised chiefly by the absence of Carpathian species of which only a few penetrate into this region, where they are either very scarce or only locally abundant. Many of these beech forests have been described by our authors. These forests, occurring on humous and rather porous soils, show, however, more hygrophytic and xerophytic variants, connected by numerous intermediates. A moss-carpet on the floor is lacking, only the roots, stumps or stones may be mossy. Together with *Asperula odorata*, which is not only a constant species but also a dominant, the following species are usually found in this sociation (an asterisk designates species rare at low altitudes):

<i>Actaea spicata</i>	* <i>Lonicera nigra</i>
<i>Anemone nemorosa</i>	<i>Melica nutans</i>
<i>Asarum europaeum</i>	<i>Mercurialis perennis</i>
* <i>Bromus asper</i>	<i>Oxalis acetosella</i>
<i>Cardamine impatiens</i>	<i>Phyteuma spicatum</i>
<i>Carex digitata</i>	<i>Polygonatum multiflorum</i>
<i>Carex silvatica</i>	<i>Polygonatum verticillatum</i>
<i>Daphne mezereum</i>	* <i>Prenanthes purpurea</i>
<i>Dentaria bulbifera</i>	<i>Pulmonaria obscura</i>
<i>Epilobium montanum</i>	* <i>Rosa pendulina</i>
* <i>Festuca silvatica</i>	<i>Sanicula europaea</i>
<i>Galium silvaticum</i>	<i>Senecio Fuchsii</i>
<i>Hedera helix</i>	<i>Senecio nemorensis</i>
<i>Hepatica triloba</i>	* <i>Veronica montana</i>
<i>Lactuca muralis</i>	<i>Viola mirabilis</i>
<i>Lamium luteum</i>	<i>Viola Riviniana</i>
<i>Lathyrus vernus</i>	<i>Viola silvatica</i>
<i>Lilium martagon</i>	

In the Carpathian facies, all these species are present (only *Hepatica* and *Galium silvaticum* are mostly missing) and are joined by others, as for instance, *Galium Schultesii*, *Glechoma hirsuta*, *Hacquetia epipactis*, *Isopyrum thalictroides*, *Scrophularia Scopolii* etc., in the Eastern Carpathians also *Symphytum cordatum*, *Veronica urticifolia*.

The woodruff sociation under unfavourable conditions may be reduced to almost a *Fagetum nudum*. For instance in Slovakia on Mt. Trstje in the Rimava gneiss Mts., there are, in the lower zone of a rather steep slope on both sides of a creek, such beech forests almost without any herbaceous undergrowth, the floor covered only with a thick leaf-carpet. By analysis of an extensive area here, I was able to ascertain only the following species: *Asperula odorata*, *Mercurialis perennis*, *Carex digitata*, *Oxalis acetosella*, *Cardamine impatiens*, *Galium vernum*, *Dactylis Aschersoniana*, *Luzula nemorosa*, *Rosa pendulina*, all of them only sparsely scattered while *Glechoma hirsuta* grows rarely only in the higher parts.

The woodruff type, in its poorer to very poor variant, is widely distributed especially in the Sudetic-Hercynian region where the beech forests (with interspersed *Acer pseudoplatanus*, *Carpinus betulus* and *Fraxinus excelsior*, in the shrubby undergrowth also *Sambucus racemosa*) which Zlatník describes (<sup>3</sup>, p. 21) on the basaltic Bukový vrch in the České Středohoří Mts. (a somewhat stony slope, NE by E, 650 meters) also belong to this category. The growth is a fine, tall-trunked and almost pure beech forest with the following soil profile: leaf-carpet about 2 cm thick shows a reaction pH 5.94; beneath is a grey humous loam with a pH 6.15 and this stratum gradually merges (at about a depth of 20 cm) into an ochre-grey loam with a 10% fine skeleton and with an acidity pH 6.29 at 50 cm depth. In the undergrowth *Asperula odorata* has the highest dominance, then *Lactuca muralis* and *Senecio Fuchsii*; only scattered are *Carex silvatica*, *Elymus europaeus*, *Coronilla varia*, *Galeopsis grandiflora*, *Geranium Robertianum*, *Impatiens noli tangere*, *Veronica officinalis* and a few other species are solitary. Already this beech forest shows the penetration of some foreign elements. Other analyses which Zlatník gives from this district represent, however, mostly atypical growths, inappropriate as examples of sociologically well-defined types. Also the beech forests, described by Fírbas (<sup>1</sup>, p. 141) on

Mt. Milešovka in the České Středohoří Mts., are mostly remains of this type with abundant *Asperula odorata* and *Mercurialis perennis*.

Of the numerous variants of the woodruff sociation, I give only the following few:

**a) Hercynian-Sudetic variants.**

These variants are widely distributed in this region, and according to local conditions, they may be floristically poor or even rich. Hilitz er (<sup>1</sup>, p. 70), for instance, described this type from the neighbourhood of Kdyně in the Český Les Mts. on amphibolite substratum. Floristically, this type is comparatively rich, the woodruff covers on the average 60 % to 85 % of the surface, but its low and not quite continuous growth does not prevent other accompanying species to come in. Constantly present is *Oxalis acetosella*, but only with small dominance, just as is true of *Lamium luteum*, *Geranium Robertianum* and *Viola silvatica*. Besides *Asperula odorata*, only *Mercurialis perennis* (always present) has a greater dominance. Of the species with only a slight dominance the following were ascertained in 3 analyses (out of 4): *Epilobium montanum*, *Fragaria vesca*, *Impatiens noli tangere*, *Milium effusum*, *Senecio Fuchsii* and *Urtica dioica*, in two analyses (out of 4): *Asarum europaeum*, *Bromus asper*, *Dryopteris filix mas*, *Festuca silvatica*, *Galeopsis grandiflora*, *Hypericum perforatum*, *Lactuca muralis*, *Lathyrus vernus*, *Melica nutans* and *Neottia nidus avis*. Other species were found only in a single analysis, among these were also *Dentaria bulbifera*, *D. enneaphyllos*, *Actaea spicata*, *Pulmonaria obscura*, *Hepatica triloba*, *Paris quadrifolia*, *Brachypodium silvaticum*, etc. In the tree stratum, *Fraxinus excelsior*, *Tilia platyphylla*, *Acer pseudoplatanus*, *A. platanooides*, *Ulmus scabra* and *Picea excelsa* also occur, but not in all instances; of the shrubs *Sambucus racemosa* and *Rubus idaeus* are the most frequent.

**b) Carpathian variant.**

R. Mikyška (<sup>1</sup>) describes from Štiavnické Středohoří Mts. (Slovakia) on tertiary eruptive rocks (mostly andesites) a type of pure or mixed beech forests which he considers to be a distinct association. He designates it as the *Asperula odorata* type and distinguishes the following 4 subtypes: 1. *Asperula odorata* subtype, 2. *Asperula odorata* — *Mercurialis perennis* subtype, 3. *Asperula odorata* — *Se-*

*Senecio Fuchsii* subtype, 4. *Asperula odorata* — *Impatiens noli tangere* subtype. Mikyška's first subtype belongs here, the second to the following variant, whereas the last is given in our classification as a distinct sociation. For this woodruff type, *Asperula odorata* as a dominant is most important and decreases in dominance only in those individuals where other species with a high sociability are present (*Glechoma hirsuta*, *Lamium luteum*, *Mercurialis perennis*, *Impatiens noli tangere*) and take up its layer, and thereby give rise finally to new types. The author designates as important the presence of the following constant species: *Dryopteris filix mas*, *Lamium luteum* and *Senecio Fuchsii* (not constant in other forest types of the same district), further *Pulmonaria officinalis*, *Viola Riviniana* and *silvatica* (only accessory in the bare-floor beech forest as well as in the *Poa nemoralis* type), then *Epilobium montanum* and *Geranium Robertianum* (inconstant in the bare-floor beech forest and in the *Carex pilosa* type); finally *Lactuca muralis* is a constant species, approaching in its occurrence and constancy the woodruff and *Dentaria bulbifera*.

Carpathian variants of the woodruff sociations are, of course, rather numerous. As an example, I give the following Western Carpathian mountain calcicole variant of the *Hacquetia* type. It is an old beech forest near the summit of Rokoš, on dolomite, at 1000 meters, NE by N slope. In the undergrowth shrubs are only scattered (*Rosa pendulina*, *Corylus avellana*, *Lonicera xylosteum*, *Sorbus aucuparia*, young *Fraxinus excelsior*, *Acer platanoides* and *pseudoplatanus*, the last species also solitarily as old trees). According to the dominants, we could designate this growth as a mixed *Asperula odorata* + *Mercurialis perennis* type; the woodruff is more conspicuous, though the dominance of both species is nearly equal. It is rather surprising that two species of such a high sociability as the two mentioned dominants maintain an approximately even balance. It can be explained by the peculiar habitat conditions of this dolomite district where there is no apparent surface water, and even at high altitudes the soil is hardly fresh and is covered by a dry leaf-carpet which prevents *Mercurialis* from taking possession of the ground. Floristically this growth is comparatively poor:

*Aconitum vulparia* only scat.

*Astrantia major* scat.

*Asarum europaeum* scat.

(*Campanula trachelium*)

(*Cirsium erisithales*)

(*Convallaria majalis*)

*Dentaria bulbifera* scat.

*Hacquetia epipactis* scat.

(*Lactuca muralis*)

(*Lathyrus vernus*)

(*Melittis melisophyllum*)

*Prenanthes purpurea* scat.

(*Primula elatior*)

*Senecio Fuchsii* scat.

*Symphytum tuberosum* scat.

c) *Mercurialis perennis* variant.

The dominant of this type with its great capacity of vegetative propagation takes possession of the ground and forms dense growths, seemingly entirely pure but always having some species though frequently only very weak, of the woodruff sociation. This type is very abundant in many variations throughout the Czechoslovak region. Hilitzer, for instance, describes (<sup>1</sup>, p. 12—13) this variant from the neighbourhood of Kdyně in the Český Les Mts. and states that from the accompanying beech forest species only some very ombrophilous (for instance *Asperula odorata*, *Lamium luteum*) can maintain themselves, further some herbs of taller growth, while others are restricted to occasional gaps. It is therefore a very excluding type and thus acquires a characteristic physiognomy. It is up to the present disputable whether this beech forest type represents a distinct sociation or only a variant of the woodruff sociation with which this type agrees in its floristic composition and with which it is connected by various transitions. Especially there where the *Mercurialis* type is developed on old talus covered by humus, it is often very characteristic and has also the tree stratum more mixed than usual. It occurs, however, also on humous soils, loamy beneath. I have described (<sup>4</sup>, p. 8, 9) two typical growths from Subcarpathian Russia differing, as a geographical facies of the Eastern Carpathians, only by the presence of *Symphytum cordatum*. The first growth occurs on non-mossy humous soil on Mt. Kečírka in the Velký Trostinec valley (700 meters) in an old shaded virgin beech forest, interspersed with old firs and spruces, less frequently also *Acer pseudoplatanus*, *A. platanoides*, *Fraxinus excelsior*, *Ulmus scabra*, and is exceedingly dense and therefore to such a degree excluding that only *Circaea lutetiana*, *C. alpina* and *Geranium Robertianum* (ster.), are scattered, whereas other species are only solitary and also *Asperula odorata* forms only small colonies here and there.



The second growth in the same neighbourhood (730 meters) is characterised by extensive *Mercurialis* growths which are continuous, dense to very dense. On the rather humous, non-mossy ground covered by a decayed-leaf carpet, the shrubs *Lonicera nigra* and *Daphne mezereum* are scattered as well as a few young maples (*Acer pseudoplatanus*) and solitary *Sambucus racemosa*. The composition of the *Mercurialis* undergrowth is floristically richer, *Salvia glutinosa* is abundantly scattered, *Asperula odorata* is also fairly abundant and almost equally distributed, *Athyrium filix femina* (in a small form) and *Oxalis acetosella* are abundantly enough scattered, further *Sanicle europaea*, *Circaea lutetiana*, *Symphytum cordatum*, *Ranunculus lanuginosus*, *Chrysosplenium alternifolium*, *Carex silvatica* are scattered, *Lactuca muralis*, *Pulmonaria obscura* only scattered, less frequent are *Circaea alpina*, *Stachys silvatica*, *Geranium Robertianum*, *Impatiens noli tangere*, *Aegopodium podagraria* (ster.) and quite solitary is *Galeopsis grandiflora*. We see thus, that it is quite a typically developed growth of this type.

**d) *Asperula odorata* — *Glechoma hirsuta* variant.**

Into this category belong the characteristic Carpathian types which most likely represent a distinct sociation. As an example I cite, from my numerous analyses in various parts of the Carpathians, only the three following, rather essentially different, types:

a) The Eastern Carpathian facies without *Lamium luteum*. I described this type from Subcarpathian Russia (<sup>4</sup>, p. 7) in an old untouched, almost pure beech forest in the upper part of the Bilina creek valley on a rather steep SW slope, at an altitude of about 820 meters, on a Flysch substratum. The floor here is non-mossy, the soil covered by a thick layer of decaying leaves and beneath is a deep layer of slope loam with a fine gravel. Sparcely scattered are *Acer pseudoplatanus*, *Ulmus scabra* and *Fraxinus excelsior*; the undergrowth is fairly rich, herbaceous, but not continuous. *Asperula odorata* and *Glechoma hirsuta* are dominants in the undergrowth, accompanied by the abundantly scattered *Mercurialis perennis* and *Circaea lutetiana*; abundantly enough are scattered *Symphytum cordatum* and *Stellaria nemorum*, scattered *Salvia glutinosa*, *Epilobium montanum*, *Athyrium filix femina*, *Dryopteris filix mas*, *Asarum europaeum*, only scattered *Pulmonaria obscura*, *Actaea spicata*,

*Rubus* sp. and *Petasites albus* (small groups), and solitarily appear *Prenanthes purpurea*, *Doronicum austriacum*, *Dentaria bulbifera*, *Veronica urticifolia*, *Lactuca muralis*, *Stachys silvatica* (lighter places), *Senecio nemorensis*, *Solidago virga aurea* (ster.).

β) Western Carpathian mountain calcicole *Glechoma hirsuta* + *Galeobdolon* with *Hesperis nivea* facies.

This type is developed, for instance on Mt. Vysoká in the Little Carpathians, in a tall-trunk beech forest, located on a southern limestone slope at about 600 meters altitude; abundantly interspersed is *Acer campestre*, also *Ulmus scabra*, *Acer pseudoplatanus*, solitarily old and tall trees of *Carpinus betulus*. The undergrowth on its humous soil is luxuriant, entirely closed, *Glechoma hirsuta* and *Lamium luteum* are present as the two dominant elements; with them grow *Hesperis nivea* abundant even in whole growths as a higher layer, *Asperula odorata* (v. ab.), *Triticum caninum* and *Heracleum sphondylium* (v. scat.), *Salvia glutinosa*, *Impatiens noli tangere*, *Senecio Fuchsii*, *Pulmonaria officinalis* and *Chaerophyllum temulum* scat. *Lamium maculatum* and *Sisymbrium strictissimum* only scat., *Arabis turrita*, *Allium ursinum* and *Geranium phaeum* only rarely.

γ) In the limestone mountains in the territory of the western Váh river, a somewhat different type is to be found which is in a certain sense an approach to the mixed beech forest types. For instance in the gorge-like valley near Mojtn, in the beech forests on the slopes, *Asperula odorata* is quite common, often forming large growths, and in its company we find *Glechoma hirsuta* (abundantly), *Lamium luteum* (scattered), further, *Aconitum vulparia* (abundantly enough), *Actaea spicata* (locally), *Arabis hirsuta* (v. scat.), *Asarum europaeum* (ab.), *Cardamine impatiens* (scat.), *Circaea lutetiana* (more humid places), *Cephalanthera rubra* (v. ab. scat.), *Dentaria bulbifera* (scat.), *Epipactis latifolia* (sol.), *Galium Schultesii* (ab.), *Hedera helix* (rather ab.), *Lactuca muralis* (ab. scat.), *Lathyrus vernus* (ab. scat.), *Lilium martagon* (only scat.), *Melica nutans* (scat.), *Mercurialis perennis* (scat.), *Myosotis silvatica* (scat.), *Polygonatum multiflorum* (only scat.), *Pulmonaria obscura* (scat.), *Salvia glutinosa* (scat.), *Senecio Fuchsii* (only scat.), *Viola silvatica* (scat.), *Atropa belladonna* grows only solitarily in the shade of the forest, in one place, among mossy stones, grows gregariously enough *Phyllitis sco-*



*lopendrium*, and on a mossy beech root only rarely *Asplenium viride*.

e) ***Cephalanthera rubra* — *Epipactis microphylla*. variant.**

A mountain calcicole type frequent in the southwestern Carpathians, particularly on the slopes below the ridges. For instance on the ridge Kamenná Vrata near Trenčianské Teplice (Slovakia) we find, on the southern slope, wild and dense beech forests in which *Asperula odorata* is constantly present, very often *Melica uniflora*, *Melittis melisophyllum*, *Brachypodium silvaticum*, *Inula conyza*, and scattered *Epipactis microphylla*, *E. rubiginosa*, *E. latifolia*, *Cephalanthera rubra*, *C. alba*, *C. ensifolia* (the last species rarely), also *Arabis hirsuta*.

On Mt. Strážov (on the slope above 800 meters alt.), we find in a humous shady beech forest, with very abundant *Asperula odorata* and with numerous other ombrophilous species (also *Hacquetia epipactis*), *Epipactis microphylla* abundantly scattered besides *E. rubiginosa* as well as *E. latifolia*, only scattered *Cephalanthera alba* (the two other species of this genus are missing here), further *Lamium luteum* (ab.), *Dentaria bulbifera*, *Hedera helix*, *Galium Schultesii*, *Lathyrus vernus*, *Oxalis acetosella*, *Senecio Fuchsii*, etc., etc. In reality, it is a mixed woodruff type but with the above mentioned orchids.

Analogous types may arise also in the Western Carpathian beech forests in a loosened *Caricetum pilosae* or *Caricetum albae*.

In southern Bohemia there occurs, on limestone in the Strakonice-Sušice district in the region of the Hercynian vegetation (for instance on Mt. Čepičná) a parallel facies *Asperula odorata*—*Cephalanthera rubra* in which, in the company of the usual Hercynian beech forest elements, *Prenanthes purpurea* and *Vicia silvatica* are also to be found; *Epipactis rubiginosa* and *Cephalanthera alba* are here rather abundant but, of course, all Carpathian species, are lacking.

## 2. Sociation *Fagetum asperulaceum mixtum*.

Where the beech forests have very favourable habitat conditions for the full development of the tree stratum as well as of the

ground vegetation, the herbaceous undergrowth usually is copious and vigorous, and represents a mixture of various types, namely the herbaceous, tall herb, fern, grass, and hygrophilous types. The elements of these types, however, are intermingled in such a manner that it is hardly possible to keep the individual types apart. In places, it is true, the predominance of this or that species causes that the growth approaches some of the above named types, but in general, the growth is a mosaic which cannot be sociologically split into individual sociations and their variants. It is more likely that out of this mosaic, which unites elements of numerous types under special, in general, less favourable habitat conditions, single specialised types have been differentiated.

**a) Hercynian facies.**

As an example, I may give the beech forests of the basaltic Dou-pov Mts., which formally were the absolutely predominating forest communities in this district and even to-day have a rather wide distribution. For instance, I analysed, in the year 1914, on the slope of the Oedschloss-Berg (about 600 meters alt.) these splendid high-trunk beech forests with more or less interspersed spruces and with single maples *Acer pseudoplatanus*). Everywhere on the humous soil on the slope (without flowing water), there is a continuous herbaceous undergrowth; the leading species either form extensive areas or pure or nearly pure growths or they are more or less intermingled. Nowhere is *Asperula odorata* absent, often grouped in large and nearly pure, very dense growths, elsewhere again overgrown by other, higher vegetation. *Senecio Fuchsii* is exceedingly abundant and often forms dense «woodlets» extending over an area of more than 100 m in length. *Impatiens noli tangere* is another leading plant, the enormous growths of which with their softness and glaucous green colour, form an agreeable contrast to the light green of *Asperula odorata* and the dark green of *Mercurialis perennis*, which grow always in more or less small groups. *Prenanthes purpurea* is abundant and in places rather high, *Ranunculus lanuginosus* is abundantly scattered, *Stellaria nemorum* very gregarious, *Oxalis acetosella* abundant, *Pulmonaria obscura* rather abundant, *Lamium luteum* scattered, *Actaea spicata* rather abundantly scattered, *Urtica dioica* abundant and in places forming quite extensive growths, *Pe-*

*tasites albus* often appears in groups, *Sanicula europaea* is rather abundantly scattered, *Geranium Robertianum* abundant and only locally missing, *Lactuca muralis* and *Viola silvatica* are scattered, *Neottia nidus avis* solitary, *Vicia silvatica* rather abundant, *Myosotis silvatica* only scattered, *Chrysosplenium alternifolium* scattered, *Astrantia major* along forest margin and *Chaerophyllum hirsutum* only in places. Of the grasses, *Bromus asper* is the most abundant, more or less abundant is *Poa nemoralis*, scattered *Melica nutans*, abundantly scattered *Milium effusum*, and only scattered *Festuca silvatica*. Ferns are also characteristic components, of which *Dryopteris filix mas* and *Athyrium filix femina* are very abundant and in places seem to dominate the whole aspect, especially the latter species; *D. pulchella* is scattered, appears, however, in places even in rather large groups.

This is the analysis of a single extensive individual; in another place, in a similarly mixed type, we also find *Elymus europaeus* (abundant in groups), scattered *Luzula pilosa*, *Carex silvatica*, *Polygonatum verticillatum* and *Rosa pendulina*.

This is a typical example of beech forests under very favourable conditions (basaltic substratum and sufficient humidity), which even in a light shade cause the formation of these luxuriant closed growths that one might consider as a mosaic of sociations, difficult to distinguish in the field.

It is interesting that even the very small but sturdy beech forest that still remains between Olešnice and Dreihäuseln has a typical, rather mixed undergrowth; *Asperula odorata* grows there gregariously in places, *Prenanthes purpurea* is the most abundant of all and usually dominates the undergrowth, then we find *Viola silvatica*, *Lamium luteum*, *Pulmonaria obscura*, *Actaea spicata* (ab.), *Impatiens noli tangere* (only locally gregarious), *Mercurialis perennis*, *Vicia silvatica*, *Sanicula europaea*, *Neottia nidus avis*, *Ranunculus auricomus*, *Majanthemum bifolium*, *Melica nutans*, *Poa nemoralis*, *Bromus asper* and *Equisetum silvaticum*. Considering the small area the mixed type here is not so richly developed but is, notwithstanding, rather characteristic. As another example, I have selected from the large number, I have at hand, the beech forests on Železné Hory Mts. in the Zlatý potok valley where it narrows down to a

picturesque gorge called «Peklo» (Hell) and in its continuation, the Hedvičino údolí. Here, mostly on the more humid northern slope, there are mixed to nearly pure beech forests (with interspersed *Acer pseudoplatanus*), partly spoiled by spruce culture. Also both *Tilias* (*Tilia platyphylla* and *T. ulmifolia*) are scattered and in the shrubby undergrowth we find *Rosa pendulina* (only locally), *Daphne mezereum* (rather seldom), *Lonicera xylosteum*, *Sambucus racemosa* and *S. nigra* only very scattered, *Rubus idaeus* not frequent. The herbaceous ground vegetation is not uniform, its differentiation is caused by local variations of humus and humidity as well as by the expansiveness and sociability of the respective species. Because of the numerous transitions it is, however, impossible to distinguish individual types. Along the forest creek, hygrophilous plants as *Crepis paludosa*, *Chaerophyllum hirsutum*, *Lychnis flos cuculi*, *Angelica silvestris*, *Myosotis palustris*, *Festuca gigantea* with *Alnus glutinosa* are grouped into a distinct sociation. The beech forest's herbaceous undergrowth starts on the slope above the creek and gradually becomes less luxuriant. Its composition is as follows:

<i>Actaea spicata</i> (rather ab. scat.)	<i>Lamium luteum</i> (very common!)
<i>Anemone nemorosa</i> (scat.)	<i>Mercurialis perennis</i> (locally)
<i>Anthriscus nitida</i> (inabundantly)	greg.)
<i>Asarum europaeum</i> (rather ab.)	<i>Oxalis acetosella</i> (in humous loc-
<i>Asperula odorata</i> (only loc. greg.)	alities very greg.)
<i>Epilobium montanum</i> (ab. scat.)	<i>Paris quadrifolia</i> (rather sc.)
<i>Euphorbia dulcis</i> (scat.)	<i>Polygonatum verticillatum</i> (only)
<i>Fragaria vesca</i> (scat.)	very locally)
<i>Galium silvaticum</i> (scat.)	<i>Sanicula europaea</i> (locally)
<i>Geranium Robertianum</i> (very	<i>Senecio nemoralis</i> (rather ab.
common and often greg.)	scat.)
<i>Impatiens noli tangere</i> (v. com-	<i>Stellaria nemorum</i> (scat.)
mon, greg. and even on slopes	<i>Urtica dioica</i> (ab. scat.)
locally predominant)	<i>Viola Riviniana</i> (v. ab. scat.)
<i>Lactuca muralis</i> (common)	<i>Viola silvatica</i> (ab. scat.)

Of the grasses, *Festuca silvatica* (scarce), *Melica nutans* (scat.), *Poa nemoralis* (on the whole abundant), grow here, of the ferns are present *Athyrium filix femina* (abundantly scattered, locally even

very gregarious), *Dryopteris spinulosa* (rather abundant), *D. phegopteris* (scattered) and *D. pulchella* (in places rather gregarious).

Another type I have already described (<sup>6</sup>, p. 35) from the side valley near Jinčov in Central Bohemia. The beautiful high-trunk beech forest here has a very abundant and luxuriant undergrowth, consisting of herbs and grasses, attaining its highest development on light places but also, very rich, in the forest shade. *Luzula nemorosa* is only scattered, *L. pilosa* appears only locally, *Carex silvatica* is abundant especially near the creek. Of the ferns *Dryopteris pulchella* grows here locally. Besides, we find in the undergrowth:

<i>Aquilegia vulgaris</i> (ab.)	<i>Neottia nidus avis</i> (scat.)
<i>Asarum europaeum</i> (ab.)	<i>Oxalis acetosella</i> (scat.)
<i>Asperula odorata</i> (greg.)	<i>Paris quadrifolia</i> (rather ab. scat.)
<i>Astrantia major</i> (especially in the lower, more humid zone)	<i>Phyteuma spicatum</i> (ab.)
* <i>Chrysanthemum corymbosum</i> (only loc.)	<i>Polygonatum multiflorum</i> (loc. in the lower zone)
<i>Euphorbia dulcis</i> (ab. scat. especially in the more humid lower zone)	<i>Polygonatum verticillatum</i> (only scat.)
* <i>Galium rotundifolium</i> (loc.)	<i>Prenanthes purpurea</i> (only v. loc.)
<i>Galium silvaticum</i> (ab. scat.)	<i>Pulmonaria obscura</i> (ab.)
<i>Impatiens noli tangere</i> (loc. ab.)	<i>Ranunculus lanuginosus</i> (v. common in the lower, more humid zone)
<i>Lathyrus niger</i> (ab.)	<i>Senecio Fuchsii</i> (ab.)
* <i>Lathyrus silvestris</i> (v. loc.)	<i>Senecio nemorensis</i> (ab.)
<i>Lathyrus vernus</i> (rather ab.)	<i>Stellaria holostea</i> (loc.)
<i>Lilium martagon</i> (ab.)	<i>Veronica chamaedrys</i> (ab. scat.)
<i>Majanthemum bifolium</i> (only in colonies)	<i>Vicia silvatica</i> (loc.)
<i>Mercurialis perennis</i> (ab.)	<i>Viola mirabilis</i> (rather ab. scat.)
	<i>Viola Riviniana</i> (ab. scat.)

This growth shows a certain differentiation in the more humid lower zone along the creek and higher up on the slope. Besides, there penetrate some species which have their principal distribution in the hornbeam-oak woods of the same region; they give to this community the aspect of a somewhat different type.

Another interesting type of beech forest of the same category,



I found on the Českomoravská Vysočina Mts. on the granite ridge north of the small ponds of Ransko. It is an old beech forest, with mossy boulders strewn here and there and with little or no undergrowth in its rather deep shade; only locally the herbaceous vegetation is somewhat richer. Ferns are almost completely missing, of shrubs are inabundant *Daphne mezereum* and *Rubus idaeus*. The composition of the undergrowth is as follows:

<i>Actaea spicata</i> (ab. scat.)	<i>Galium rotundifolium</i> (in ab. col.)
<i>Asperula odorata</i> (rather scat.)	<i>Impatiens noli tangere</i> (loc.)
( <i>Atropa belladonna</i> )	<i>Lactuca muralis</i> (scat.)
<i>Brachypodium silvaticum</i> (loc.)	<i>Lamium luteum</i> (scat.)
<i>Bromus asper</i> (loc.)	<i>Lathyrus vernus</i> (scat.)
<i>Cardamine trifolia</i> (v. ab.!)	<i>Moehringia trinervia</i> (ab. scat.)
<i>Carex silvatica</i> (v. common! in robust indiv.)	<i>Oxalis acetosella</i> (rather ab.)
	<i>Polygonatum verticillatum</i> (scat.)
<i>Circaea alpina</i> (col.)	<i>Sanicula europaea</i> (v. ab.)
<i>Dentaria bulbifera</i> (rather ab.)	<i>Senecio Fuchsii</i> (loc. ab.)
<i>Dentaria enneaphyllos</i> (scat.)	<i>Valeriana sambucifolia</i> (scat. in shade only ster.)
<i>Epipogon aphyllus</i> (sol.)	
<i>Festuca silvatica</i> (ab.)	<i>Veronica montana</i> (only scat.)

This type I have designated as the *Sanicula-Cardamine trifolia-Carex silvatica* type of the *Asperula* sociation. It will be necessary, however, to ascertain whether this type has a wider distribution.

#### b) Carpathian facies.

In the Carpathians some of the mixed herbaceous types are very interesting, especially those on limestone. As example I give the south western slope of Rokoš, dolomite, at 800 meters and more altitude. The ground is covered with half-decayed leaves, the layer of humus is only thin. Of woody plants, ash and maples (*Acer platanoides* and *A. pseudoplatanus*) are interspersed but they appear almost exclusively only as young individuals very scattered; in addition there are only scattered *Daphne mezereum* and *Lonicera xylosteum*, solitary *Sorbus aria*, *S. aucuparia* (only as shrub), *Corylus avellana*, *Populus tremula*, *Rhamnus cathartica*. The herbaceous undergrowth is rather rich; of grasses, *Brachypodium silvaticum* is scattered, *Bromus asper* and *Melica nutans* only scattered; *Carex di-*

*gitata* is only rare here. Of the ferns, we find only quite locally in-abundant *Pteridium aquilinum*. Besides:

<i>Aconitum vulparia</i> (ab. scat.)	<i>Galium Schulthesii</i> (scat.)
( <i>Ajuga reptans</i> )	<i>Hacquetia epipactis</i> (rather ab. scat.)
<i>Aquilegia longisepala</i> (scat.)	
( <i>Arabis arenosa</i> )	<i>Heracleum sphondylium</i> (scat.)
<i>Asarum europaeum</i> (scat.)	<i>Hieracium murorum</i> (only scat.)
( <i>Astrantia major</i> )	( <i>Laserpitium latifolium</i> )
( <i>Calamintha clinopodium</i> )	<i>Lathyrus vernus</i> (only scat.)
<i>Campanula rapunculoides</i> (scat.)	<i>Lilium martagon</i> (only scat.)
( <i>Centaurea mollis</i> )	<i>Melittis melisophyllum</i> (scat.)
<i>Cephalanthera alba</i> (only scat.)	<i>Mercurialis perennis</i> (only loc.)
( <i>Chrysanthemum corymbosum</i> )	( <i>Neottia nidus avis</i> )
<i>Cirsium erisithales</i> (scat.)	<i>Prenanthes purpurea</i> (only scat.)
( <i>Clematis recta</i> )	<i>Primula elatior</i> (ab.!)
<i>Convallaria majalis</i> (scat.)	<i>Pulmonaria obscura</i> (only scat.)
<i>Dentaria bulbifera</i> (only scat.)	<i>Pulmonaria mollissima</i> (only scat.)
( <i>Epipactis latifolia</i> )	<i>Ranunculus nemorosus</i> (only scat.)
<i>Euphorbia amygdaloides</i> (only scat.)	<i>Rubus saxatilis</i> (only scat.)
	<i>Sanicula europaea</i> (only scat.)
<i>Euphorbia polychroma</i> (only scat.)	<i>Viola mirabilis</i> (scat.)

This type, which can be designated as the *Hacquetia-Aconitum vulparia* type of the mixed *Asperula* beech forests, is only an example of the Carpathian calcicole beech forests which also appears elsewhere in different variations.

### 3. The *Asperula odorata* — *Polystichium Braunii* sociation.

This sociation belongs to the mixed herbaceous types of mountain beech forests. As an example, I give the following two variants:

#### a) The calcicole Tatra facies.

An old beech forest, in parts with a more or less open canopy, on the slope of Mount Šotla in the Tatras of Biela. Of shrubs, the following are scattered in the undergrowth:

*Daphne mezereum*, *Lonicera nigra* and *Sambucus racemosa*. Of ferns *Polystichum Braunii* is very abundant, *P. lobatum* scattered, *Dryopteris filix mas* abundant, *D. austriaca* scattered, *D. spinulosa*

only scattered, *D. pulchella* loc. greg., *Athyrium filix femina* abundant scattered. Of grasses, we notice *Melica nutans* abundantly scattered, *Bromus asper* scattered (on clearings abundant), *Festuca gigantea* (only loc.), *Elymus europaeus* (locally), *Calamagrostis arundinacea* (very scattered), *Milium effusum* (scarce). Besides there grow *Luzula nemorosa* scattered and *Carex silvatica* scattered, mostly on light places. Otherwise the composition of the undergrowth is as follows:

<i>Actaea spicata</i> (ab. scat.)	<i>Moehringia trinervia</i> (ab. scat.)
<i>Ajuga reptans</i> (ab. scat.)	<i>Monesis grandiflora</i> (scat.)
<i>Anemone nemorosa</i> (ab.)	<i>Monotropa hypopitys</i> var. <i>hypophega</i> (only v. scat.)
<i>Asarum europaeum</i> (ab.)	
<i>Asperula odorata</i> (on more places very greg.)	<i>Myosotis silvatica</i> (scat.)
<i>Cardamine impatiens</i> (ab.)	<i>Oxalis acetosella</i> (v. ab. to greg.!)
<i>Circaea alpina</i> (often and greg.)	<i>Paris quadrifolia</i> (scat.)
<i>Dentaria bulbifera</i> (ab. scat.)	<i>Petasites albus</i> (only in scat col.)
<i>Epilobium montanum</i> (ab. scat.)	<i>Polygonatum verticillatum</i> (only scat.)
<i>Euphorbia amygdaloides</i> (ab. scat.)	<i>Prenanthes purpurea</i> (ab. scat.)
	<i>Primula carpatica</i> (loc.)
<i>Galium Schulthesii</i> (v. scat.)	<i>Pulmonaria obscura</i> (loc.)
<i>Impatiens noli tangere</i> (loc.)	<i>Salvia glutinosa</i> (only v. scat.)
<i>Isopyrum thalictroides</i> (scat.)	<i>Sanicula europaea</i> (v. com.!)
<i>Lactuca muralis</i> (ab. scat.)	<i>Senecio Fuchsii</i> (ab. scat.)
<i>Lamium luteum</i> (v. ab!)	<i>Stellaria nemorum</i> (loc. greg.)
<i>Lilium martagon</i> (only scat.)	<i>Veronica montana</i> (loc.)
( <i>Majanthemum bifolium</i> )	<i>Veronica officinalis</i> (ab. scat.)
<i>Mercurialis perennis</i> ( $\pm$ , loc. greg.)	<i>Vicia silvatica</i> (inab.)
	<i>Viola silvatica</i> (scat.)

To the dominants, besides the ferns, belong in the first place *Oxalis*, *Sanicula*, *Lamium luteum* and *Asperula odorata*.

#### b) Eastern Carpathian Flysch facies.

This variant I have described from Subcarpathian Russia (<sup>4</sup>, p. 9) as the *Glechoma hirsuta*-*Polystichum* type from about 1120 meters altitude on the southeast slope in the valley of the Gropjenec creek below the shepherd settlement Gropa. It is an old, not very



shady beech forest, of a virgin forest character, where the surface is strewn with stones and has a relatively deep layer of loam and rather thick humus. There are no mosses on the forest floor, no continuous leaf-carpet, and in places the ground is nearly bare. The beech forest is only slightly mixed, interspersed are *Acer pseudo-platanus* and *Abies*. In the shrubby stratum infrequently appear *Daphne mezereum* and *Sambucus racemosa*, scattered *Rubus* sp. The herbaceous undergrowth is abundant and we find also plenty of young beeches. Of ferns, *Polystichum Braunii* is abundantly scattered, *P. lobatum* and *P. Luerksenii* scattered, *Athyrium filix femina* only scattered, *Dryopteris pulchella* seldom. Of grasses, there are none. *Luzula nemorosa* is only scattered. Besides these we find the following species:

<i>Anthriscus nitida</i> (only scat.)	( <i>Lamium luteum</i> v. scat., mostly
<i>Asperula odorata</i> (ab. scat.)	totally lacking)
<i>Chrysosplenium alternifolium</i>	<i>Oxalis acetosella</i> (rather ab.)
(loc. in col.)	<i>Ranunculus lanuginosus</i> (scat.)
<i>Circaea alpina</i> (loc. in col.)	<i>Ranunculus repens</i> (loc. ab.)
<i>Doronicum austriacum</i> (scat.)	<i>Salvia glutinosa</i> (in rather ab.
<i>Euphorbia amygdaloides</i> (scat.)	scat. col.)
<i>Galeopsis grandiflora</i> (scat.)	<i>Scrophularia Scopolii</i> (only scat.)
<i>Geranium Robertianum</i> (scat.)	<i>Stachys alpina</i> (scat.)
<i>Glechoma hirsuta</i> (v. ab., often	<i>Stachys silvatica</i> (only scat.)
greg.)	( <i>Stellaria nemorum</i> only v. loc.)
<i>Impatiens noli tangere</i> (rather	<i>Symphytum cordatum</i> (scat.)
ab. scat.)	<i>Urtica dioica</i> (rather ab.)
<i>Lactuca muralis</i> (scat.)	<i>Verbascum lanatum</i> (only scat.)
	<i>Veronica montana</i> (only v. scat.)

#### 4. *Geranium Robertianum* sociation.

This plant community is characteristic for a stony ground and talus and appears here and there in our beech forests. It is sometimes only an evolutionary stage of the fern or the *Asperula* type; sometimes, however, it appears as a stable community. Its fern variant I have described (<sup>4</sup>, p. 24—25) from Subcarpathian Russia from Svidovec (above Sterešora, at 1240 meters alt.). It is an old beech forest, interspersed with *Acer pseudoplatanus*, on a rough stony

ground where *Geranium Robertianum* is found growing abundantly, even gregariously so that it dominates the aspect. Of the ferns, there grow here *Polystichum lobatum* (abundantly scattered!), *P. Braunii* (scattered), *Dryopteris pulchella* (loc. scat.), *D. filix mas* (only scat.), *D. phegopteris* (scat.), *D. spinulosa* (scat.), *Athyrium filix femina* (scat.), besides there is *Lamium luteum* abundantly scattered!, *Oxalis acetosella* only scattered, to scattered, *Stellaria nemorum* and *Epilobium montanum* (scat.), *Rubus* sp. infrequent.

In the Hercynian region, *Geranium Robertianum* is sometimes associated with abundant *Urtica dioica*, which can, in places, even predominate.

### 5. *Dentaria* sociation.

In shady humous beech forests, there appears, sometimes on larger areas, a type in which *Dentarias* are almost the only herbs in the undergrowth. So, for instance, in the Little Carpathians on the slope of Mt. Vysoká at an altitude of about 550 meters; above the zone of the bare-floor beech forest, but on limestone, we find in a beech forest with maple (*Acer pseudoplatanus*), *Dentaria enneaphyllos* growing very abundantly and *D. bulbifera* very abundantly scattered. Otherwise, however, nothing or next to nothing grows there, on the ground; I could only ascertain *Allium ursinum* infrequent and *Arum maculatum* scattered.

Whether this type belongs to some other sociation is for the present difficult to decide.

### 6. *Oxalis* sociation.

The distribution of wood-sorrel in our beech forests is almost general, but there are beech forest districts where *Oxalis* does not grow at all because of the too-pronounced dryness, as for instance, in the Southwestern Carpathians on the dolomitic Tematin hills and also in the dolomitic Rokoš group (more than 1000 meters high), where *Oxalis* grows only very scarcely and quite locally. As the *Oxalis* type, in the true sense of the word, I designate such growths where *Oxalis* governs the whole aspect as the leading dominant and forms often more or less continuous carpets. Such types, however, are characteristic for spruce forests or mixed spruce forests, whereas in normal beech forests they hardly ever appear.

The next sociation, when poorly developed, may have spots where *Oxalis* is dominant, but here we can only speak of them as fragments of the sociation which I am next describing separately. J a r. Klika (<sup>1</sup>) writes that the greatest part of the beech forests in the region of the Velká Fatra Mts., which he has examined, belongs to the *Oxalis* type and that this type is characterised by deep soil, numerous herbs in the undergrowth, and abundant shrubs. But apparently Klika comprehends this type quite differently. His analysis from Koňská dolina (southeastern slope, 600 meters alt.) is meant apparently to be an example of this type. The plant community here, however, is quite atypical for beech forests. *Asperula odorata* is missing and among the species enumerated by Klika are *Galium silvaticum* (certainly *G. Schultesii*, since *G. silvaticum* does not grow in the Central Carpathians), also *Lactuca quercina*, *Lithospermum purpureocoeruleum*, *Carex alba*, *Cephalanthera rubra* and *Gentiana cruciata*, fairly abundant mosses and also rather numerous mountain beech forest species.

#### 7. Galeobdolon-Oxalis sociation.

My conception of this sociation is to be seen from my published analyses from Subcarpathian Russia (<sup>2</sup>, p. 16—17). I quote here the two following typical growths.

The Svidovec group, Mt. Kečírka in the Velký Trostinec valley about 730 meters alt.: an old mixed virgin beech forest with spruces abundantly interspersed and locally even predominant; maple (*Acer pseudoplatanus*) and fir are also scattered, solitarily elm and ash. The growth is developed in a flat saddle on a deeper loamy soil with little humus. The floor, with the exception of stumps, resp. rotten trunks, is only slightly mossy; on it grow only *Mnium rostratum* (of the mosses the most abundant), *Thuidium tamariscinum* and *Eurhynchium striatum*, on decomposed logs also *Sphagnum acufolium* and in it a little of *Vaccinium myrtillus*. Characteristic is the low herbaceous undergrowth which has *Oxalis acetosella* dominant and forming in places rather dense growths; also *Lamium luteum* is very abundant, *Lonicera nigra* is scattered and *Daphne mezereum* only scarce. In addition there appear:

*Anemone nemorosa* (only scat.) *Dryopteris spinulosa* (scat. to  
*Asperula odorata* (scat., loc. rather ab. scat.)  
rather ab.) *Lactuca muralis* (scat.)  
*Circaea alpina* (scat.)

Besides this the following species are scarce to solitary: *Athyrium filix femina* (small), *Carex silvatica*, *Dryopteris filix mas* (small), *Dentaria glandulosa*, *Epilobium montanum*, *Galeopsis grandiflora*, *Geranium Robertianum*, *Mercurialis perennis*, *Paris quadrifolia*, *Polygonatum verticillatum*, *Salvia glutinosa* (ster.), *Senecio nemorensis*, *Urtica dioica*.

The other example of this type comes from an old, high beech forest, located above the shepherd settlement, Sterešora (Svidovec), at an altitude of about 1240 meters. The forest is shady, with abundantly scattered maples (*Acer pseudoplatanus*); in the undergrowth we find a number of young beeches, less of maples, solitarily scattered is *Daphne mezereum*, more abundantly scattered *Lonicera nigra* and rather scarce *Rubus idaeus*. The loamy, somewhat humous, non-mossy ground is covered with a rather thick carpet of decaying leaves and the vegetation covers only about one half of the surface. The composition of the undergrowth:

*Anemone nemorosa* (scat.) *Polypodium verticillatum* (ster.  
*Dryopteris pulchella* (rather ab. ab.)  
scat.) *Rubus* sp. (scat.)  
*Epilobium montanum* (only scat.) *Stellaria nemorum* (rather ab.  
*Lamium luteum* (ab.!) scat.)  
*Luzula silvatica* (scat.) *Vaccinium myrtillus* (scat.)  
*Oxalis acetosella* (v. ab.!) )

In addition, the following species are very scattered to solitary: *Asperula odorata*, *Athyrium filix femina* (small), *Campanula abietina*, *Circaea alpina*, *Dentaria bulbifera*, *D. glandulosa*, *Polystichum lobatum*, *Veronica montana*.

Here we can notice, to a certain degree, the influence of the neighbouring spruce forest but already a few meters down the slope we find *Luzula silvatica* and *Vaccinium myrtillus* very scarce or missing, *Oxalis* and *Lamium luteum* gain in dominance, also there is a little more of woodruff, scattered are *Geranium Robertianum* and *Dryopteris phegopteris*, in scattered colonies grows *Lysimachia*

*nemorum*, only very scattered are *Scrophularia Scopolii*, *Galeopsis grandiflora*, *Lactuca muralis*, *Veronica officinalis* is scarce and *Ranunculus dentatus*, *Poa Chaixii*, *Soldanella hungarica* are locally scattered.

As a Hercynian-Sudetic facies we can add here also Zlatník's <sup>(1)</sup> *Lamium luteum* and *Asperula odorata* type from the Krkonoše Mts. in which with a constancy 5 are present *Lamium luteum*, *Oxalis acetosella*, *Athyrium filix femina* and *Picea excelsa*, with a constancy 4 *Asperula odorata*, *Circaea alpina*, *Impatiens noli tangere*, *Lysimachia nemorum*, *Dryopteris pulchella*, *Prenanthes purpurea*, *Senecio nemorensis* + *Fuchsii*.

These types are evidently already impoverished beech forest types.

#### 8. *Allium ursinum* sociation.

This *Allium* type is especially characteristic for mixed forests on mountain ridges. As an example, I give the mixed deciduous forest on the summit of Havrany (460 meters) near Piešťany with an undergrowth of dominant, and sometimes quite exclusive, *Allium ursinum*. In the tree stratum *Fagus silvatica* is scattered (locally even missing), *Ulmus scabra* and also *Fraxinus excelsior* are there abundant, *Acer pseudoplatanus* abundantly scattered, *A. campestre* only very scattered, then *Quercus sessilis* is interspersed, and in places *Carpinus betulus* and *Tilia platyphylla*. Of shrubs *Staphylea pinnata* is especially frequent and characteristic, scattered are *Corylus avellana*, *Evonymus verrucosa*, *Cornus sanguinea*. Of lianas, *Clematis vitalba* is abundant and along the ground *Hedera helix* is very scattered. In the undergrowth with the dominating *Allium*, of the grasses, there are *Bromus asper*, *Melica uniflora*, *Elymus europaeus* and *Dactylis Aschersoniana* more or less scattered, besides of sedges *Carex muricata*. In addition, the composition of the undergrowth is as follows:

<i>Asarum europaeum</i> (rather ab. scat.)	<i>Dentaria bulbiflora</i> (rather ab. scat.)
<i>Campanula rapunculoides</i> (scat.)	<i>Dentaria enneaphyllos</i> (loc. rather greg.)
( <i>Chrysanthemum corymbosum</i> )	
<i>Convallaria majalis</i> (loc.)	( <i>Galium aparine</i> )

( <i>Geranium Robertianum</i> )	<i>Mercurialis perennis</i> (here and there loose col.)
<i>Glechoma hirsuta</i> (loc. rather scat.)	<i>Polygonatum multiflorum</i> (scat.)
<i>Lathyrus vernus</i> (scat.)	<i>Pulmonaria officinalis</i> (scat.)
<i>Lilium martagon</i> (only scat.)	<i>Vicia dumetorum</i> (loc.)
<i>Lithospermum purpureocoeruleum</i> (only col.)	<i>Vicia pisiformis</i> (loc.)
	( <i>Viola mirabilis</i> )

This is a general picture of this community which in its whole extent undergoes changes in two directions, either into dense and very excluding *Allium ursinum* growths in which only some of the above named species are present with but a small frequency, or into herbaceous or herb-grass types in which *Melica uniflora* is especially abundant. *Carex pilosa*, however, is always missing.

Also on the ridge of Mt. Vysoká in the Little Carpathians, we observe this type, for example in part of the high-trunk forest almost entirely of *Fraxinus* (only locally with interspersed beeches). *Allium ursinum* forms here an extensive continuous growth, very excluding and therefore poor floristically. *Parietaria officinalis* is very abundantly scattered, scattered are *Senecio Fuchsii*, *Impatiens noli tangere*, *Polygonatum multiflorum*, *Hesperis nivea*, *Symphytum tuberosum*, only scattered are *Lilium martagon* and *Geranium Robertianum*, whereas scarce are *Stachys silvatica*, *Poa nemoralis*, *Campanula latifolia*; in the *Allium* growth are also colonies of *Mercurialis perennis* and *Melica uniflora*.

J. K l i k a (2) describes this sociation from the Velká Fatra Mts. as characteristic for very moist beech forests, especially there where the underground water-level is near the surface. As an example, he gives a growth below the Mt. Lubochňa Klak (1220 meters, northern exposure), with *Oxalis acetosella*, *Crepis paludosa*, *Asperula odorata* and with a low frequency of *Ranunculus lanuginosus*, *Dryopteris phegopteris*, *D. filix mas*, *Athyrium filix femina*, *Asarum europaeum*, *Senecio Fuchsii*, *Glechoma hederaceum* (?), *Symphytum tuberosum*.

#### B. *F a g e t a a l t i h e r b o s a*.

There are no sharp limits between this and some other groups; the mixed herbaceous types, described above, already form a connecting link. The clearing stages of *F a g e t u m h e r b o s u m* usual-



ly have also the character of this group. Nevertheless the characteristic types with dominating tall herbs have their own peculiar physiognomy, consisting, of course, of various sociations differing in their floristic composition as well as in their dominant species. They are much better developed in the Carpathian beech forests than in the Sudetic-Hercynian and occur on limestone, where their floristic richness culminates, and on siliceous substrata. Spruce-fir mountain forests of the Central Carpathians often have on limestone very similar undergrowth but nevertheless there are some essential floristic differences. A definite classification of the sociations and variants is, at present, not possible, therefore I shall give only some of the especially characteristic communities of this group. A sufficient moisture and a half-shade favour a vigorous growth of the respective types.

#### 9. *Cortusa* sociation (*Fagetum carpaticum Cortusae*).

This is a distinct and a very remarkable sociation of the Western Carpathian limestone mountains which I described for the first time from Mt. Choč in Velká Fatra (Věda Přírodní, vol. III, 1922) and which I also mention in my textbook on Plant sociology (<sup>8</sup>, p. 308). K l i k a also describes this type from the Velká Fatra Mts.

As a new example, I give here the growths on Mt. Šíp in the Velká Fatra Mts. where there is, on the northern slope to the very crest, a low, almost shrubby beech forest with abundantly interspersed maples (*Acer pseudoplatanus*) and with an unusually luxuriant herbaceous and flowery undergrowth. Of shrubs *Daphne mezereum* and *Lonicera nigra* are scattered. The composition of the undergrowth is as follows:

<i>Aconitum firmum</i> (rather ab.)	<i>Astrantia major</i> (ab.)
<i>Aconitum vulparia</i> (rather ab.)	<i>Athyrium filix femina</i> (rather
<i>Actaea spicata</i> (rather ab. scat.)	ab.)
<i>Adenophora liliiflora</i> (only scat.)	<i>Bellidiastrum Michellii</i> (rather
<i>Ajuga genevensis</i> (scat.)	ab.)
<i>Asarum europaeum</i> (scat.)	<i>Centaurea mollis</i> (rather ab.
<i>Asperula odorata</i> (loc. rather	scat.)
greg.)	<i>Chaerophyllum aromaticum</i>
<i>Asplenium viride</i> (scat.)	(scat.)

<i>Chrysanthemum subcorymbosum</i> (r.)	<i>Melittis melisophyllum</i> (only scat.)
<i>Coeloglossum viride</i> (sol.)	<i>Mercurialis perennis</i> (v. ab.)
<i>Convallaria majalis</i> (rather ab.)	<i>Mulgedium alpinum</i> (ab.)
<i>Coralliorrhiza trifida</i> (scat.)	<i>Neottia nidus avis</i> (v. scat.)
<i>Cortusa Matthioli</i> (scat. to ab. scat.)	<i>Orchis maculata</i> (ab. scat.)
<i>Crepis paludosa</i> (ab.)	<i>Oxalis acetosella</i> (ab.)
<i>Cypripedium calceolus</i> (scat.)	<i>Paris quadrifolia</i> (ab.)
<i>Dryopteris filix mas</i> (rather ab.)	<i>Phyteuma orbiculare</i> (only scat.)
<i>Epipogon aphyllus</i> (r.)	<i>Phyteuma spicatum</i> (scat.)
<i>Euphorbia amygdaloides</i> (rather ab.)	<i>Pimpinella magna</i> (rather ab. scat.)
<i>Festuca silvatica</i> (scat.)	<i>Pirola secunda</i> (inab.)
<i>Galium Schultesii</i> (ab. scat.)	<i>Platanthera bifolia</i> (scat.)
<i>Geranium silvaticum</i> (ab.)	<i>Polygonatum verticillatum</i> (ab.)
<i>Gymnadenia albida</i> (scat.)	<i>Polystichum lobatum</i> (ab.)
<i>Haecquetia epipactis</i> (loc. greg.)	<i>Polystichum lonchitis</i> (ab.)
<i>Heracleum sphondylium</i> (scat.)	<i>Prenanthes purpurea</i> (ab. scat.)
<i>Homogyne alpina</i> (ab.)	<i>Primula elatior</i> (ab.)
<i>Isopyrum thalictroides</i> (ab. scat.)	<i>Ranunculus lanuginosus</i> (scat.)
<i>Knautia silvatica</i> (loc. greg.)	<i>Ranunculus platanifolius</i> (scat.)
<i>Lamium luteum</i> (ab.)	<i>Rubus saxatilis</i> (ab.)
<i>Listera ovata</i> (scat.)	<i>Sanicula europaea</i> (ab.)
<i>Lunaria rediviva</i> (inab.)	<i>Senecio Fuchsii</i> (scat.)
<i>Luzula silvatica</i> (loc.)	<i>Stellaria nemorum</i> (scat.)
<i>Majanthemum bifolium</i> (scat.)	<i>Tofieldia calyculata</i> (scat.)
<i>Melandryum silvestre</i> (scat.)	<i>Trollius europaeus</i> (scat.)
	<i>Viola mirabilis</i> (only scat.)

The *Cortusa* sociation is perhaps the most beautiful limestone forest sociation of our Western Carpathian forests and surely also endemic in this region.

#### 10. *Pleurospermum-Cirsium erisisthales* sociation.

A mountain calcicole sociation developed in various variants in the Western Carpathians. For instance, it is well developed in the Slovakian Karst in the saddle of Mt. Šejba above Tisovec, in a hu-



mous beech forest that is plentiful with shrubs (*Corylus avellana* ab., *Rosa pendulina* rather ab., *Daphne mezereum* scat., *Lonicera xylosteum* scat., *Rubus idaeus* rather ab., *Ribes grossularia* scat., *R. alpinum* only scat., *Cornus sanguinea* only scat.)

The composition of the undergrowth is as follows:

<i>Actaea spicata</i> (only scat.)	<i>Melampyrum silvaticum</i> (loc. greg.)
<i>Anthriscus nitida</i> (ab.)	
<i>Aruncus silvester</i> (scat.)	<i>Melandryum silvestre</i> (scat.)
<i>Asarum europaeum</i> (rather ab.)	<i>Melica nutans</i> (only v. scat.)
<i>Asplenium viride</i> (rather ab.)	<i>Melica uniflora</i> (inab.)
<i>Bromus asper</i> (loc.)	<i>Mercurialis perennis</i> (ab.!)
<i>Cardamine impatiens</i> (scat.)	<i>Monotropa hypopitys</i> (only v. scat.)
<i>Cephalanthera alba</i> (scat.)	
<i>Cirsium erisithales</i> (v. ab.!)	<i>Paris quadrifolia</i> (loc.)
<i>Dactylis Aschersoniana</i> (ab. scat.)	<i>Petasites albus</i> (loc.)
<i>Dentaria bulbifera</i> (scat.)	<i>Phyteuma spicatum</i> (scat.)
<i>Dryopteris filix mas</i> (scat.)	<i>Pleurospermum austriacum</i> (ab. scat.)
<i>Euphorbia amygdaloides</i> (ab. scat.)	<i>Polygonatum multiflorum</i> (ab.)
<i>Galium Schultesii</i> (ab. scat.)	<i>Polygonatum verticillatum</i> rather ab. scat.)
<i>Gentiana asclepiadea</i> (scat.)	<i>Polystichum lobatum</i> (scat.)
<i>Geranium phaeum</i> (ab.)	<i>Prenanthes purpurea</i> (ab.)
<i>Hedera helix</i> (loc.)	<i>Primula elatior</i> (v. ab.)
<i>Lamium luteum</i> (ab.)	<i>Pulmonaria obscura</i> (scat.)
<i>Lamium maculatum</i> (ab. scat.)	<i>Ranunculus lanuginosus</i> (ab. scat.)
<i>Lathyrus vernus</i> (scat.)	
<i>Lilium martagon</i> (scat.)	<i>Salvia glutinosa</i> (v. ab.)
<i>Lunaria rediviva</i> (scat., loc. greg.)	<i>Senecio nemorensis</i> (ab. scat.)
	<i>Thalictrum aquilegifolium</i>

Another interesting growth I analysed on the ridge called Šance, extending out from the Muráň castle ruins. On the northern slope, there is a beautiful beech forest interspersed with old maples (*Acer pseudoplatanus*); of shrubs there are mainly *Rosa pendulina*, *Lonicera xylosteum*, *Cotoneaster tomentosa*. Of grasses, *Calamagrostis arundinacea* is fairly abundant, *Poa nemoralis* and *Melica nutans*

scattered; also *Carex alba* grows gregariously in places. Otherwise the composition of the herbaceous undergrowth is as follows:

<i>Aconitum vulparia</i> (rather ab.)	<i>Galium Schultesii</i> (scat.)
<i>Adenophora liliiflora</i> (v. ab.)	<i>Gentiana asclepiadea</i> (ab. scat.)
<i>Aquilegia vulgaris</i> (rather ab. scat.)	<i>Heracleum sibiricum</i> (ab. scat.)
<i>Arabis turrita</i> (rather ab.)	<i>Knautia silvatica</i> (ab.)
<i>Asarum europaeum</i> (only loc.)	<i>Lactuca muralis</i> (scat.)
<i>Asperula odorata</i> (only loc.)	<i>Laserpitium latifolium</i> (scat.)
<i>Asplenium viride</i> (rather ab.)	<i>Lilium martagon</i> (ab. scat.)
<i>Aruncus silvester</i> (ab.)	<i>Majanthemum bifolium</i> (only scat.)
<i>Astrantia major</i> (loc.)	<i>Melittis melisophyllum</i> (rather ab. scat.)
<i>Campanula persicifolia</i> (only scat.)	<i>Mercurialis perennis</i> (rather ab.)
<i>Campanula trachelium</i> (ab.)	<i>Myosotis silvatica</i> (only scat.)
<i>Cephalanthera alba</i> (rather ab. scat.)	<i>Pimpinella magna</i> (rather ab.)
<i>Cephalanthera rubra</i> (rather ab. scat.)	<i>Platanthera bifolia</i> (only scat.)
<i>Chrysanthemum corymbosum</i> (v. ab.)	<i>Pleurospermum austriacum</i> (rather ab.)
<i>Cirsium ersithales</i> (ab.)	<i>Polygonatum multiflorum</i> (ab.)
<i>Coeloglossum viride</i> (sol.)	<i>Polygonatum verticillatum</i> (loc. ab.)
<i>Convallaria majalis</i> (loc.)	<i>Prenanthes purpurea</i> (v. ab.)
<i>Corallorrhiza trifida</i> (only loc. scat.)	<i>Primula elatior</i> (v. ab.)
<i>Cystopteris fragilis</i> (inab.)	<i>Pulmonaria obscura</i> (only v. scat.)
<i>Dentaria bulbifera</i> (rather ab. scat.)	<i>Rubus saxatilis</i> (scat.)
<i>Dryopteris filix mas.</i> (scat.)	<i>Salvia glutinosa</i> (v. ab.)
<i>Dryopteris Robertiana</i> (only loc.)	<i>Senecio Fuchsii</i> (rather ab.)
<i>Epipactis latifolia</i> (scat.)	<i>Silene vulgaris</i> (scat.)
<i>Euphorbia polychroma</i> (only scat.)	<i>Solidago virga aurea</i> (rather scat.)
	<i>Thalictrum minus</i> (scat.)
	<i>Valeriana tripteris</i> (ab.)

#### 11. *Lunaria-Urtica* sociation.

This sociation is characteristic for mountain beech forests of rather moist, humous soils, often also on talus, filled in and sometimes

even covered with a rich humus. It occurs scattered in the whole region of Czechoslovakia but it is more frequent in the Carpathians and best developed on limestone substratum. It consists of rather numerous variants, characteristic in its physiognomy because of the dominance of certain species. I present a few examples here:

**a) Phyllitis — Parietaria variant.**

This is a richly developed *Lunaria* type as we find it, for instance, on limestone of the slope of Mt. Žihlavník near Trenčianské Teplice (Slovakia) from 600 meters altitude upwards. Here, there are, on an old limestone humus-covered talus, splendid beech forests which have of the woody plants also *Acer pseudoplatanus*, *Fraxinus excelsior*, *Cornus sanguinea*, *Corylus avellana*, *Sambucus nigra*. In the undergrowth, *Phyllitis scolopendrium* is locally scattered but often very abundant and of other ferns, *Dryopteris filix mas* is very abundant, *Athyrium filix femina* scattered and *Polystichum lobatum* in beautiful vigorous clumps. The tall *Lunaria rediviva* is common and together with *Phyllitis* the principal leading plant, further *Arabis turrita* is abundant, *Asperula odorata* common and very gregarious, *Urtica dioica* (in a special variety) very abundant, *Parietaria officinalis* in great abundance, forming often closed groups or colonies, furthermore *Impatiens noli tangere* and *Mercurialis perennis* are very abundant, *Veronica montana* abundantly scattered, *Lamium luteum* abundant enough, scattered are *Melica nutans*, *Valeriana tripteris*, *Lathyrus vernus*, *Chrysosplenium alternifolium*, *Anthriscus nitida*, very abundantly scattered is *Dentaria bulbifera* together with *D. enneaphyllos*, only here and there appear *Actaea spicata*, *Pulmonaria obscura*, *Asarum europaeum* and *Polygonatum multiflorum*.

**b) The Carpathian calcicole Lunaria-Urtica variant.**

This type is, for instance, beautifully developed on Mt. Strážov in western Slovakia, at about 960 meters altitude, on a steep, humous, northern slope on limestone. It is an old, wild, virgin beech forest, rather thin but without opening; everywhere on the ground are strewn rotting trunks of fallen giants, mostly with plentiful *Poly-pori* and often covered with beautiful green moss carpets. On humous and rather moist soil, a splendid and characteristic vegetation of tall herbs, associated with smaller herbs in dense growths, is beautifully

developed. Of grasses only *Bromus asper* is abundant; the composition of the undergrowth is as follows:

<i>Ajuga genevensis</i> (scat.)	<i>Hesperis nivea</i> (loc. ab.)
<i>Arabis arenosa</i> (scat.)	<i>Impatiens noli tangere</i> (v. ab. and greg.)
<i>Arabis turrita</i> (loc. ab.)	<i>Isopyrum thalictroides</i> (scat.)
<i>Asperula odorata</i> (scat. to rather ab.)	<i>Lamium luteum</i> (ab.)
<i>Asplenium viride</i> (only scat. on mossy roots and trunks)	<i>Lunaria rediviva</i> (v. ab. and greg.)
<i>Athyrium filix femina</i> (rather ab. scat.)	<i>Melandryum silvestre</i> (v. ab. scat.)
<i>Campanula trachelium</i> (ab.)	<i>Mercurialis perennis</i> (v. ab. and greg.)
<i>Cardamine impatiens</i> (scat.)	<i>Paris quadrifolia</i> (loc.)
<i>Chrysosplenium alternifolium</i> (rather ab.)	<i>Phyteuma spicatum</i> (scat.)
<i>Circaea lutetiana</i> (ab. and greg.)	<i>Pleurospermum austriacum</i> (scat.)
<i>Dentaria bulbifera</i> (rather ab.)	<i>Polygonatum verticillatum</i> (only loc., very luxuriant)
<i>Dentaria enneaphyllos</i> (rather ab.)	<i>Polystichum lobatum</i> (v. ab.)
<i>Dryopteris filix mas</i> (v. ab.!)	<i>Prenanthes purpurea</i> (rather ab.)
<i>Epipactis latifolia</i> (scat.)	<i>Scrophularia Scopolii</i> (sol.)
<i>Galeopsis grandiflora</i> (only scat.)	<i>Stachys silvatica</i> (v. scat.)
<i>Galium Schultesii</i> (loc. rather ab.)	<i>Stellaria nemorum</i> (scat.)
<i>Glechoma hirsuta</i> (scat.)	<i>Urtica dioica</i> (on the whole ab.)

These two analyses are examples of two different, richly developed types of this sociation. Sometimes, however, we find variants variously impoverished, which are a sort of modification of these types, often with the predominance of only one or a few species. As for instance, in the shaded humous beech forest on the northern slope, below the Murán castle ruins, in the Slovakian Karst district, are developed on extensive areas, dense and very excluding growths of *Lunaria rediviva*; *Parietaria* is also present here. In the dolomitic Tematín hills, there is, in the beech forests located at the foot of the rocks below the ruins of the Tematín castle, this community developed fragmentarily with *Lunaria rediviva* and *Dentaria enneaphyllos*.

*phyllos* (see also Sillinger <sup>2</sup>) and also with *Arabis turrita*. From the Velká Fatra Mts., Koňská dolina, ravine, 1200 meters alt., north-eastern exposure, Klika (<sup>2</sup>) describes a growth with dominant *Lunaria rediviva* and *Urtica dioica*, with rather abundant *Mercurialis perennis* and *Geranium Robertianum*, with scattered *Oxalis acetosella* and only infrequent *Melandryum silvestre*.

This community may be regarded as a very impoverished type of the second variant, even though not a single species indicates the Carpathian facies of the limestone substratum. Thereby this impoverished form merges seemingly into the silicicole Hercynian facies.

### c) Sudetic-Hercynian facies.

I described (Věda Přírodní, vol. IV, 1923) a fine growth from the Českomoravská vysočina Mts. in the Štírvův důl valley near Křucemburk, in a ravine, on but slightly-limy marly limestone. In an extensive luxuriant growth we find here *Lunaria rediviva*, with it gregariously *Aconitum vulparia*, *Impatiens noli tangere* is common, *Actaea spicata* very abundant, *Urtica dioica* very gregarious, frequent are: *Polygonatum verticillatum*, *Petasites albus*, *Mercurialis perennis*, *Phyteuma spicatum*, *Oxalis acetosella*, *Asarum europaeum*, *Lamium luteum*, *Melica nutans*, *Festuca silvatica*, abundant are *Asperula odorata*, *Circaea lutetiana*, *Paris quadrifolia*, *Pulmonaria obscura*, *Geranium Robertianum* gregarious, scattered are *Aruncus silvester*, *Senecio Fuchsii*, *Dryopteris filix mas*, etc. (see Domin, l. c.). It is a more hygrophilous modification of this variant.

A. Hilitzer (<sup>1</sup>, p. 12) described another modification from the beech forests in the Český Les Mts. in the neighbourhood of Kdyně. The tree stratum is more or less mixed, since there are interspersed *Acer pseudoplatanus*, sometimes also *A. platanoides*, *Fraxinus excelsior*, *Ulmus scabra* and *Picea excelsa*, in the shrubby undergrowth are scattered *Sambucus racemosa*, *Rubus idaeus*, *Sorbus aucuparia*. In the ground vegetation vigorous, often more than one meter high, *Lunaria rediviva* completely dominates and with it are associated some other tall herbs, such as *Urtica dioica*, *Senecio Fuchsii* and some ombrophilous beech forest elements, *Asperula odorata*, *Mercurialis perennis*, *Lamium luteum*, *Geranium Robertianum*, *Impatiens noli tangere*, *Asarum europaeum*, *Epilobium montanum*, sometimes also *Hedera helix* and *Actaea spicata* and of ferns *Dryopteris*

*filix mas*. Of grasses were ascertained *Milium effusum*, *Bromus asper*, *Elymus europaeus*, *Poa nemoralis* and *Festuca silvatica*, but only with a small abundance.

d) *Urtica dioica* variant.

Nettle growths in beech forests occur here and there in the whole region, especially on humous stony places. We may regard them as a variant of this sociation, characterised by the absence of some of the leading species (especially *Lunaria*). Klika (<sup>2</sup>) describes this community from the Velká Fatra Mts. (a groove in the Žernovica valley, southern exposure, 610 meters alt.; *Urtica dioica* is dominant, *Senecio Fuchsii* rather abundant, in lesser abundance *Asperula odorata*, *Geranium Robertianum*, *Asarum europaeum*, *Lamium maculatum*, *Geranium silvaticum* and *Sambucus ebulus*.

12. *Senecio Fuchsii* sociation.

To the present it is somewhat problematic whether the *Senecio* growths represent a distinct sociation. *Senecio Fuchsii* (or sometimes *S. nemorensis*) is a common companion in beech forests but does not thrive — except on more humid places — in a deeper shade where it remains mostly sterile. On beech forest openings and clearings it often spreads and becomes dominant. The same phenomenon was observed of other rather numerous beech forest plants (see for instance Domin, <sup>4</sup>, p. 26—30) but on this basis we cannot establish sociations. Sometimes *Senecio Fuchsii* is locally gregarious in mixed herbaceous beech forest types, but even here its complexes appear only as a part of the whole undergrowth. Similarly, other species with a high sociability occur in the undergrowth in close islets. Sometimes, however, *Senecio Fuchsii* appears very gregariously with other herbs in the undergrowth, especially in lighter beech forests and determines its general aspect. A good example of this type is described by P. Sillinger (<sup>1</sup>, p. 31) from the White Carpathians on the Kobylínek ridge above Lednice. *Senecio Fuchsii* dominates in dense growths, abundantly interspersed is *Elymus europaeus*, abundantly scattered are *Bromus asper*, *Stachys alpina* and *Campanula latifolia* and also ferns are rather abundantly scattered together with scattered colonies of *Asperula odorata*, *Oxalis acetosella*, *Impatiens noli tangere* and *Aegopodium podagraria*.



### *C. Fageta subhygrophila.*

Above already, we became acquainted with rather hygrophylous beech forest types, occurring chiefly on mountains and in more humid valleys. Into this category, however, I put only the particularly characteristic types, of which especially the *Petasites* type is fairly distributed and has its analogue in spruce and mixed coniferous forests. This type represents a well-defined sociation with some variants, whereas the *Impatiens* type, though physiognomically very marked, is not so very characteristic sociologically.

#### 13. *Petasites albus* sociation.

This sociation occurs chiefly on mountains or at lower altitudes in damp humous valleys and has several variants, some of which I shall give here.

##### a) **Sudetic-Hercynian facies.**

Because beech forests of this region are frequently disturbed by antropical influences, principally by forest culture, this type is also often more or less changed. Nevertheless, even in spruce forests introduced by forest culture on the place of original beech forests, we can usually distinguish the *Petasites* type of the beech forests and that of the spruce forests according to their accompanying species. In the Bohemian Ohře River district, I analysed in 1914 the forest communities in the valley of the Krondorf creek. In places there are spruce forests, either pure or interspersed with beeches, in places, however, small beech forests are preserved as a relic of the original dominant beech forests, which we may recognise by the undergrowth of the cultivated spruce forests. On more humid places locally the *Petasites albus* type predominates, accompanied by *Mercurialis perennis*, *Impatiens noli tangere*, *Lamium luteum*, *Asperula odorata*, *Oxalis acetosella*, *Chrysosplenium alternifolium*, *Prenanthes purpurea*, *Senecio Fuchsii*, *Chaerophyllum hirsutum*, *Milium effusum* etc. In the Českomoravská vysočina Mts., in the neighbourhood of the so-called Ranská Jezírka, are humid forests chiefly spruce, in places also with rather abundant beeches which trees seem formerly to have had a wider distribution. There is a luxuriant hygrophilous undergrowth in which *Petasites albus* forms extensive

growths, with it is *Asarum europaeum* gregarious and locally the high *Bromus asper* is very gregarious. Also *Asperula odorata* is present, *Melica nutans*, *Actaea spicata*, and *Daphne mezereum* are frequent, *Euphorbia dulcis* is abundantly scattered, *Neottia nidus avis* and *Lathyrus vernus* are scattered. In the other places these *Petasites albus* growths are besides accompanied by *Athyrium filix femina*, *Circaea alpina*, *Oxalis acetosella*, *Prenanthes purpurea*, *Lactuca muralis*, *Paris quadrifolia*, *Lamium luteum*, *Senecio Fuchsii*, *Sanicula europaea*, *Carex silvatica*, *Impatiens noli tangere*, *Viola Riviniana*, *V. silvatica*, *Milium effusum*, etc.

Beautifully developed and on extensive areas is the *Petasites albus* sociation in the well-known virgin forest of the Boubínský Prales, in the Šumava Mts. (D o m i n <sup>(3)</sup>). Detailed analysis of this virgin forest, the tree stratum of which I have already described (p. 72), shows that the promiscuity of its undergrowth is only seeming and corresponds to the mosaic of habitat conditions. Disregarding the colonies of Hercynian species of acid soils, it is possible to distinguish three types here according to the degree of humidity, the first typical for marshes and swamps, the second for moist and damp places in the forest, and the third for places of medium humidity and of drier places. In this last type, *Petasites albus* does not grow, in the first it is common but not gregarious to such a degree as in the second type, which may rightly be designated as *Petasitetum albi* as far as the undergrowth is concerned. It is accompanied especially by the following species:

<i>Athyrium filix femina</i> (scat.)	<i>Polygonatum verticillatum</i> (v. scat. only loc. rather ab.)
<i>Festuca gigantea</i> (scat.)	
<i>Luzula silvatica</i> (ab. scat.)	<i>Ranunculus lanuginosus</i> (inab.)
<i>Lysimachia nemorum</i> (scat.)	<i>Ranunculus platanifolius</i> (inab.)
<i>Melandryum silvestre</i> (scat.)	<i>Soldanella montana</i> (scat.)
<i>Milium effusum</i> (scat.)	<i>Thalictrum aquilegiifolium</i> (only loc.)
<i>Oxalis acetosella</i> (loc.)	
<i>Paris quadrifolia</i> (scat.)	

These species are joined by some elements of the two other types, the analyses of which I have published l. c.

b) **Western Carpathian facies.**



In the Western Carpathians, the *Petasites* type is rather frequent. It is interesting that it is locally developed even in the beech forests of the dolomitic Rokoš group, comparatively dry and without flowing water. My analysis was done on a rather steep, southwestern slope at an altitude of about 830 meters. The ground is non-mossy, covered by a dry beech-leaf carpet, the soil is only at the very surface slightly humous. Of the woody plants in the undergrowth are infrequent *Fraxinus excelsior*, *Acer pseudoplatanus*, *Corylus avellana*, *Rubus idaeus*, *Rosa pendulina*. The growth of *Petasites albus* governs the aspect, is fairly equally distributed, not grassy, mixed-herbaceous of the following composition:

<i>Aconitum vulparia</i> (scat.)	<i>Petasites albus</i> (v. ab.!!)
<i>Astrantia major</i> (v. ab.)	<i>Polygonatum verticillatum</i> (only
<i>Cirsium erisithales</i> (scat.)	scat.)
<i>Dentaria bulbifera</i> (only scat.)	<i>Prenanthes purpurea</i> (ab.)
( <i>Epipactis latifolia</i> )	<i>Primula elatior</i> (scat.)
<i>Euphorbia amygdaloides</i> (v. ab.)	<i>Ranunculus nemorosus</i> (only
<i>Hacquetia epipactis</i> (scat.)	scat.)
<i>Heracleum sphondylium</i> (only	( <i>Rubus saxatilis</i> )
scat.)	<i>Senecio Fuchsii</i> (rather ab.
<i>Listera ovata</i> (only scat.)	scat.)
<i>Melittis melisophyllum</i> (scat.)	<i>Symphytum tuberosum</i> (only
<i>Mercurialis perennis</i> (ab. scat.)	scat.)
<i>Orobanche flava</i> (rather ab.	<i>Valeriana tripteris</i> (only scat.)
scat.)	

Higher up on Mt. Rokoš (at 970 meters altitude), on the northern slope on non-mossy, slightly humous soil, covered by a half-decayed leaf carpet, there occurs in an old, rather thin beech forest with the usual woody plants in the undergrowth, a somewhat different type which, according to its dominants, can be designated as a *Petasites albus-Asperula odorata-Hacquetia* type. This type is evidently less hygrophilous and forms a transition to the mixed herbaceous wood-ruff types. Its composition is as follows:

<i>Aconitum vulparia</i> (scat.)	<i>Asperula odorata</i> (ab. scat.!)
<i>Aquilegia longisepala</i> (only	<i>Astrantia major</i> (rather ab.
scat.)	scat.)
<i>Asarum europaeum</i> (only scat.)	

<i>Campanula rapunculoides</i> (rather ab. scat.)	( <i>Paris quadrifolia</i> ) <i>Petasites albus</i> (v. ab. scat.!)
<i>Cirsium erisithales</i> (only scat.)	( <i>Phyteuma spicatum</i> )
<i>Dentaria bulbifera</i> (scat.)	<i>Pleurospermum austriacum</i> (scat.)
<i>Euphorbia amygdaloides</i> (scat.)	<i>Polygonatum verticillatum</i> (v. ab.!)
<i>Festuca silvatica</i> (ab. scat.!) ( <i>Heracleum sphondylium</i> )	<i>Prenanthes purpurea</i> (rather ab. scat.)
<i>Lactuca muralis</i> (only scat.)	<i>Primula elatior</i> (rather ab. scat.)
<i>Laserpitium latifolium</i> (only scat.)	<i>Pulmonaria obscura</i> (only scat.)
<i>Melitis melisophyllum</i> (only scat.)	<i>Senecio Fuchsii</i> (scat.)
<i>Mercurialis perennis</i> (ab. scat.)	<i>Valeriana tripteris</i> (scat.)

c) **Eastern Carpathian facies.**

The beech forests with *Petasites albus*, which I described from Subcarpathian Russia (see <sup>4</sup>, p. 12, 13, 10), cannot be united in a single type. I distinguish principally a typical non-mossy and an atypical variant.

d) **Non-mossy variant.**

As an example, I cite an old virgin beech forest, only slightly mixed (maple, elm, ash) in the upper part of the Bilina valley (Svidovec), at an altitude of about 820 meters, on a southeastern slope above a gully-like cut. The forest is shady, the soil moderately moist, non-mossy, the undergrowth rich and herbaceous, and *Petasites albus* in a loose group dominating the aspect. In this herbaceous undergrowth grow:

<i>Aruncus silvester</i> (ab. scat.)	<i>Ranunculus lanuginosus</i> (only scat.)
<i>Circaea lutetiana</i> (scat.)	( <i>Rubus idaeus</i> )
<i>Dentaria bulbifera</i> (only scat.)	<i>Salvia glutinosa</i> (ab. scat.!)
<i>Doronicum austriacum</i> (ab. scat.!)	<i>Scrophularia nodosa</i> (only scat.)
<i>Epilobium montanum</i> (scat.)	<i>Senecio nemorensis</i> (ab. scat.!)
<i>Geranium Robertianum</i> (scat.)	<i>Solidago virga aurea</i> (ab. scat.)
<i>Impatiens noli tangere</i> (rather ab.!)	<i>Stachys silvatica</i> (scat.)
( <i>Paris quadrifolia</i> )	<i>Symphytum cordatum</i> (scat.)

e) **Mossy variant.**

The same locality as above on Flysch substratum, but on the opposite slope with a southwestern exposure (influence of the exposure is evident in the shady virgin forest with the same soil humidity).

The floor is rather mossy. Of bryophytes were ascertained: *Atrichum undulatum*, *Anomodon viticulosus*, *A. longifolius*, *Brachythecium laetum*, *Eurhynchium striatum*, *Fegatella conica*, *Homalothecium sericeum*, *Hypnum nemorosum*, *Isothecium myurum*, *Leskea polycarpa*, *Madotheca platyphylla*, *Metzgeria conjugata*, *Mnium punctatum*, *M. undulatum*, *Plagiothecium denticulatum*, *P. silvaticum*, *Pseudoleskea atrovirens* and *Pylaisia polyantha*.

The herbaceous growth is abundant, but unequal, locally of a *Petasites* aspect, in other places it could be designated as a *Lunaria-Impatiens* type; on light places *Urtica dioica* is frequent. The composition of the undergrowth is as follows:

<i>Asperula odorata</i> (scat.)	<i>Lunaria rediviva</i> (rather ab. scat., loc. greg.)
<i>Athyrium filix femina</i> (only scat.)	<i>Oxalis acetosella</i> (scat.)
<i>Chaerophyllum aromaticum</i> )	<i>Petasites albus</i> (only scat., loc. rather greg.)
<i>Chrysosplenium alternifolium</i> (rather ab.)	<i>Polystichum Braunii</i> (only scat.)
<i>Circaea alpina</i> (loc.)	<i>Polystichum lobatum</i> (only scat.)
<i>Circaea lutetiana</i> (loc.)	<i>Ranunculus lanuginosus</i> (scat.)
<i>Dryopteris filix mas</i> (scat.)	( <i>Rubus idaeus</i> )
( <i>Festuca gigantea</i> , more ab. only in the creek-cut)	( <i>Sambucus nigra</i> )
( <i>Galeopsis grandiflora</i> )	<i>Senecio nemorensis</i> (scat.)
<i>Geranium Robertianum</i> (scat.)	<i>Stellaria nemorum</i> (scat.)
<i>Impatiens noli tangere</i> (rather ab. to ab.)	<i>Symphytum cordatum</i> (only scat.)
<i>Lamium luteum</i> (rather ab. scat.!)	<i>Urtica dioica</i> (scat.)
	<i>Veronica urticifolia</i> (scat.)

**14. *Petasites albus-Mercurialis* — *Chaerophyllum hirsutum* sociation.**

Locality: Svidovec mountain group (Subcarpathian Russia), a side ravine joining the Velký Trostinec valley behind Mt. Kečírka, at

about 710 meters, on Flysch substratum, an old mixed beech forest interspersed with maple, ash, spruce and fir, with an open canopy at the bottom of the ravine. The herbaceous undergrowth is luxuriant and abundant, continuous towards the creek, *Mercurialis* and *Petasites* are dominants, shrubs are rather plentiful (especially *Lonicera nigra* and *Rosa pendulina*, less *Rubus idaeus*). On mossy boulders, ferns grow here and there — *Cystopteris sudetica*, *C. fragilis*, *Asplenium trichomanes*, *Polypodium vulgare*. The composition of the undergrowth is as follows:

<i>Caltha palustris</i> (ab.)	<i>Paris quadrifolia</i> (only scat.)
<i>Carex remota</i> (rather ab. scat.)	<i>Petasites albus</i> (ab.!)
<i>Carex silvatica</i> (scat.)	<i>Polystichum lobatum</i> (scat.)
<i>Chaerophyllum hirsutum</i> (ab.)	* <i>Pulmonaria Filarszkyana</i> (ab.)
<i>Cirsium oleraceum</i> (ab. scat.)	<i>Sanicula europaea</i> (only scat.)
<i>Crepis paludosa</i> (ab. scat.)	<i>Salvia glutinosa</i> (ab. scat.)
<i>Glechoma hirsuta</i> (ab.)	<i>Stachys silvatica</i> (ab. scat.)
* <i>Helleborus purpurascens</i> (rather ab. scat.)	* <i>Symphytum cordatum</i> (ab. scat.)
<i>Impatiens noli tangere</i> (rather ab., loc. ab.)	<i>Thalictrum aquilegiifolium</i> (ab. scat.)
<i>Mercurialis perennis</i> (ab.!)	<i>Valeriana tripteris</i> (ab. scat.)
<i>Myosotis palustris</i> (ab. scat.)	* <i>Veronica urticifolia</i> (scat.)

This community (the Eastern Carpathian species are marked with an asterisk ) has a good many hygrophilous species accompanying usually creeks and swamps but mostly lacking in the forests of the *Petasites* type. As these growths repeat themselves elsewhere, also under similar habitat conditions, we may regard them as a distinct sociation.

#### 15. *Impatiens noli tangere* sociation.

*Impatiens noli tangere* is common in the somewhat humous and moist beech forests and forms, in its own way, islets and closed colonies. Under sufficient humidity, it can stand shade better than most of the other plants of the beech forest undergrowth. It forms, then, extensive dense growths, very excluding and in the summer aspect often seemingly pure, though a detailed analysis shows that some, to rather numerous, characteristic beech forest plants are present. If

we ascend, for instance, to the summit ridge of Žihlavník (limestone) near Trenčianské Teplice, we find in old beech forests a quite continuous, dense undergrowth. Vast growths are formed here by the light green, slightly glaucous *Impatiens* and into them, in places, penetrates abundantly *Mercurialis perennis*, which sometimes can predominate alone; as a third dominant *Urtica dioica* is associated and as a fourth *Aconitum vulparia*. Very abundant in this virgin beech forest is *Asperula odorata*; grasses, however, are missing, only *Elymus europaeus* grows in scattered groups. Further, more or less scattered are *Senecio Fuchsii*, *Asarum europaeum*, *Dentaria bulbifera*, *D. enneaphyllos*, *Stachys alpina* and *S. silvatica*, *Actaea spicata*, *Anthriscus nitida*, very abundant are *Circaea lutetiana* and *Glechoma hirsuta*, fairly abundant are *Galeopsis grandiflora*, *Geranium Robertianum*, *Lamium maculatum* and *L. luteum*, *Stellaria nemorum*, here and there appears *Arabis turrata*, only scattered *Polygonatum verticillatum* and infrequently *P. multiflorum*, locally *Circaea lutetiana* and *Heracleum sphondylium*, of ferns are scattered *Dryopteris filix mas*, *Athyrium filix femina*, *Polystichum lobatum*.

The fully developed *Impatiens* type corresponds, therefore, to the mixed herbaceous woodruff types with a striking dominance of *Impatiens*. Detailed analyses of beech forests with such undergrowth were described by P. Sillinger (<sup>1</sup>, p. 27—31), from the white Carpathians. Hercynian facies of the *Impatiens* type are floristically impoverished similarly as the respective woodruff types.

Under sufficient humidity, *Impatiens* growths may thrive (just as *Petasites* growths, see *Cirsieto-Petasitetum albi*, Domin <sup>4</sup>, p. 11) even on open places and independently of the forest. Such an open *Impatientetum* I described, for instance, from Subcarpathian Russia (<sup>4</sup>, p. 12) in the Svidovec group behind Mt. Kečirka (720 meters alt.), on a small meadow, with a creek, among beech forests. The soil is wet, in places even swampy, but non-mossy or only in places slightly mossy. *Impatiens* forms a very extensive and dense growth, composed of:

<i>(Athyrium filix femina)</i>	<i>Chaerophyllum hirsutum</i> (ab.!)
<i>Bupthalmum speciosum)</i>	<i>Chrysosplenium alternifolium</i>
<i>Caltha palustris</i> (loc. scat.)	(scat.)
<i>Cardamine amara</i> (scat.)	<i>Circaea lutetiana</i> (scat.)

<i>Cirsium oleraceum</i> (only v. scat.)	<i>Ranunculus lanuginosus</i> (only scat.)
<i>Crepis paludosa</i> (only scat.)	
<i>Festuca gigantea</i> (scat.)	<i>Ranunculus repens</i> (rather ab. scat.)
<i>Galeopsis grandiflora</i> (only scat.)	
<i>Geum urbanum</i> (only v. scat.)	<i>Rumex obtusifolius</i> (scat.)
<i>Glechoma hirsuta</i> (scat.)	<i>Salvia glutinosa</i> (rather ab. scat.)
( <i>Matteucia struthiopteris</i> )	
<i>Myosotis palustris</i> (ab.)	<i>Stachys silvatica</i> (ab. scat.)
( <i>Petasites albus</i> )	<i>Stellaria nemorum</i> (scat.)
( <i>Plantago major</i> )	<i>Symphytum cordatum</i> (scat.)
<i>Pulmonaria Filarszkyana</i> (scat.)	<i>Valeriana tripteris</i> (scat.)
<i>Pulmonaria obscura</i> (only scat.)	

Already from this analysis we see that this community comes closer of the preceding sociation, than to the normal *Impatiens* growths of the beech forests.

#### D. *Fageta filicina*.

Ferns rather often determine the aspect of the beech forests by their considerable dominance, especially on stony ground and talus, sometimes also on humous soils with a loamy subsoil. Various mixed fern types we have already seen above. In this category, I put only those sociations in which ferns have physiognomically a leading role.

#### 16. *Athyrium filix femina* (*Fagetum athyriosum*) sociation.

Here belongs the *Fagetum athyriosum filicis feminae* described by Zlatník (<sup>1</sup>), from the Krkonoše Mts. with the following constant species: *Athyrium filix femina*, *Lactuca muralis*, *Gentiana asclepiadea*, *Lamium luteum*, *Dryopteris pulchella*, *D. austriaca* + *spinulosa*, *D. filix mas*, *D. phegopteris*, *Oxalis acetosella*, *Prenanthes purpurea*, *Senecio nemorensis* + *Fuchsii*.

An allied variant ***Dryopteris pulchella*-*Oxalis*** from the same mountains which was described by Zlatník as *Fagetum nephrodiosum dryopteridis* shows an even closer approach to the spruce forests. With a constance 5 appear in it *Picea excelsa*, *Athyrium filix femina*, *Dryopteris pulchella*, *D. austriaca* + *spinulosa*, *Oxalis acetosella*, *Prenanthes purpurea*, with a constance 4 *Lac-*



*tuca muralis*, *Homogyne alpina*, *Dryopteris filix mas*, *D. phegopteris*, *Senecio nemorensis* + *Fuchsii*.

b) Non-mossy Eastern Carpathian variant.

Two interesting, non-mossy fern types I described (<sup>4</sup>, p. 14—16) from the Svidovec Mts. in Subcarpathian Russia on loamy and humous soils. The first locality is on the slope above the Koleček creek, at an altitude of 1000 meters. Here is an old, shady beech forest, not very dense, interspersed with spruce and with scattered fir; maple (*A. pseudoplatanus*) is, of course, present, but a shrubby undergrowth is missing. The floor — with the exception of stumps and trunks — is non-mossy, not stony, but mostly loamy with a moderately thick humus layer, only here and there stones are scattered; it is covered by a carpet of half-decayed beech (and maple) leaves. The herbaceous undergrowth is abundant though not entirely continuous, the ferns determine the aspect. The undergrowth consists of:

<i>Anemone nemorosa</i> (scat.)	<i>Geranium Robertianum</i> (ab.)
<i>Asperula odorata</i> (ab. to v. ab., does not form dense growths)	<i>Homogyne alpina</i> (only scat.)
<i>Athyrium filix femina</i> (v. ab.! in vigorous clumps)	<i>Lactuca muralis</i> (rather ab. scat.)
<i>Chrysosplenium alternifolium</i> (loc.)	<i>Lamium luteum</i> (ab. to v. ab.!) <i>Oxalis acetosella</i> (v. ab.!) ( <i>Paris quadrifolia</i> )
<i>Circaea alpina</i> (only scat.)	<i>Polystichum Braunii</i> (rather ab. scat.)
<i>Dentaria bulbifera</i> (scat.) ( <i>Dryopteris austriaca</i> )	<i>Polystichum lobatum</i> (ab. scat., immense clumps)
<i>Dryopteris filix mas</i> (ab. scat.!) ( <i>Dryopteris pulchella</i> )	<i>Ranunculus dentatus</i> (scat.)
( <i>Epilobium montanum</i> )	<i>Rubus</i> sp. (rather ab. scat.)
( <i>Euphorbia carniolica</i> )	<i>Symphytum cordatum</i> (ab.!)

In the continuation of the extensive growth analysed, the following species were found in addition: *Adoxa moschatellina* (only scattered), *Prenanthes purpurea* (scattered), *Pulmonaria Filarzkyana* (loc.), *Stellaria nemorum*. Locally appear small insertions of *Luzula silvatica*, most often with spruce. Higher up on the slope (from 1100 meters upwards, N to NE by N exposure) is an old beech forest, almost pure, denser and therefore with a deeper shade. The soil is

loamy, with humus, non-mossy. *Athyrium* is again very abundant and ferns in general have a decided influence upon the aspect, although somewhat less so than in the lower, lighter beech forest. The undergrowth is, on the whole, similar, inabundantly appears *Daphne mezereum*, abundant are young beeches and scattered young maples. (*Acer pseudoplatanus*). The composition of the undergrowth is given in detail in my cited paper (<sup>3</sup>, p. 15).

**c) Eastern Carpathian mossy facies.**

I present an example of this type from the Svidovec Mts. (Mt. Kečírka in the Velký Trostinec valley, at about 720 meters alt., on Flysch). It is an old mixed beech forest, in more open places (half-shade) on coarse talus on a slope. The ground, really stony, is very mossy; the mossy carpet is formed by *Hylocomium splendens*, *H. Schreberi*, *Thuidium tamariscinum*, *Eurhynchium striatum*, *Lophozia barbata*.

The herbaceous undergrowth is abundant, ferns predominate, of these *Athyrium* is the most abundant in vigorous clumps. Of shrubs, *Ribes grossularia* is abundantly scattered, *Lonicera nigra* and *Rubus idaeus* scattered. The undergrowth is composed of:

<i>Athyrium filix femina</i> (v. ab.!, dominates)	<i>Dryopteris phegopteris</i> (only scat.)
<i>Chrysosplenium alternifolium</i> (rather ab. scat.)	<i>Glechoma hirsuta</i> (ab. scat.!)
<i>Circaea alpina</i> (rather ab.)	<i>Galeopsis grandiflora</i> (inab. scat.)
<i>Dryopteris austriaca</i> (rather ab. scat.)	<i>Geranium Robertianum</i> (scat.)
<i>Dryopteris filix mas</i> (only v. scat., in vigorous clumps)	<i>Impatiens noli tangere</i> (ab. scat.)
	<i>Oxalis acetosella</i> (only scat.)
	<i>Polystichum Braunii</i> (only inab. scat.)
	<i>Urtica dioica</i> (ab. scat.!)

In the neighbourhood where the forest thins out, on coarse talus in light places, shrubby loose to dense growths of *Rubus idaeus*, *Lonicera nigra* and *Ribes grossularia* predominate, accompanied by the above named species of the *Athyrium* type, growing here, however, with only a low frequency so that the aspect is governed by shrubs. This community is, therefore, only a stage of the described variant caused by the increased light intensity.

### 17. *Dryopteris Robertiana* sociation.

As an example, I give the Western Carpathian limestone facies from the slope of Mt. Žihlavník near Trenčianské Teplice. In the lower beech forest zone, on old talus, completely covered by humus, a mixed fern-woodruff type predominates; of ferns here grow *Dryopteris Robertiana* (v. ab.), *D. filix mas*, *Athyrium filix femina*, *Polystichum lobatum*, *Cystopteris fragilis*, *Asplenium trichomanes*, further *Asperula odorata*, *Asarum europaeum*, *Arabis hirsuta*, *A. arenosa*, *Cardamine impatiens*, *Circaea lutetiana* (v. ab.), *Cephalanthera rubra*, *Dentaria enneaphyllos* (ab.), *Epipactis latifolia*, *Galium Schultesii*, *Geranium Robertianum*, *Hedera helix*, *Hieracium murorum*, *Lactuca muralis*, *Oxalis acetosella*, *Prenanthes purpurea*, *Pirola secunda*, *Sanicula europaea*, *Senecio Fuchsii*, *Stachys silvatica*, *Torilis anthriscus*.

### 18. Eastern Carpathian *Mercurialis-Phyllitis* sociation.

The beech forest community which I described (4, p. 23) from Subcarpathian Russia as the *Mercurialis-Phyllitis* type, differs essentially from the Western Carpathian limestone types by the abundant *Phyllitis*, and can be more rightly classified as a fern type, although it shows certain affinities with the Carpathian woodruff types with abundant *Glechoma hirsuta*. It occurs, for instance, in the Svidovec Mts. on Mt. Kečirka in the Velký Trostinec valley (on Flysch, at about 720 meters alt.) on a coarse talus, filled in with humus, and with the bryophytes as enumerated under sociation no. 16 c. It is an old, shady virgin forest with abundant, locally even predominant maples (*Acer pseudoplatanus*), with scattered old elms, solitary also ash, *Acer platanoides*, spruce, fir and high-trunk hazel. The tree-stratum is therefore decidedly mixed. The undergrowth is rich; the abundantly scattered *Phyllitis* (together with the gregarious *Mercurialis* and the abundant *Urtica*) is its leading plant. It consists of:

<i>Asperula odorata</i> (only in scat. col., loc. lacking)	<i>Circaea lutetiana</i> (scat.) ( <i>Daphne mezereum</i> )
<i>Athyrium filix femina</i> (scat.)	<i>Dryopteris austriaca</i> (loc. scat.)
<i>Cardamine impatiens</i> (loc. scat.)	<i>Dryopteris filix mas</i> (scat.)
<i>Circaea alpina</i> (scat.)	( <i>Epilobium montanum</i> )

<i>Geum urbanum</i> (scat.)	<i>Polystichum Braunii</i> (rather ab. scat.)
<i>Glechoma hirsuta</i> (ab.!)	
<i>Impatiens noli tangere</i> (ab.)	<i>Polystichum lobatum</i> (inab., vigorous clumps)
<i>Lactuca muralis</i> (only scat.)	
<i>Mercurialis perennis</i> (v. greg.!) ( <i>Oxalis acetosella</i> )	<i>Salvia glutinosa</i> (loc. col.)
<i>Phyllitis scolopendrium</i> (v. ab. scat..!)	<i>Urtica dioica</i> (v. ab.!)

#### *E. F a g e t a c a r i c i n a.*

Two characteristic sociations brought about by the gregarious *Carex pilosa* or *C. alba*, both Carpathian, belong to this group. Especially the former is widely distributed in many variants in our Carpathians. Sometimes *C. silvatica* — especially on more humid places — appears gregariously in beech forests, but it appears to me that its growths do not represent a distinct sociation.

#### 19. *Carex pilosa* sociation (*Fagetum carcinium pilosae*).

It is rather a group of allied sociations, distributed in the Carpathians, especially at lower mountain altitudes, on limestone as well as on various silicious rocks, in Subcarpathian Russia, on Flysch (the Eastern Carpathian facies with some regional species). Zlatník (<sup>4</sup>, p. 411) designates this type as the most widely spread in the beech forests of Subcarpathian Russia in the lower zone up to 600 meters altitude. It is interesting that this *C a r i c e t u m p i l o s a e*, without *Asperula odorata*, but with a very similar sociological structure, penetrates even beyond the beech forest region to the lower and warmer Carpathian foothills where it occurs in mixed *C a r p i n e t a* and *Q u e r c e t a* (as for instance in the andesitic Kováčov hills along the Danube at an altitude of only 120 meters).

P. Sillinger (<sup>4</sup>, p. 25) considers this *Carex pilosa* type as most characteristic for the beech forests of the White Carpathians where it is extensively spread from the lower hills to the mountain situations, on sandstone slopes with apparently rather nutritious soils of moderate humidity. *Carex pilosa* usually forms here a more or less equal, sometimes very dense to a seemingly quite closed growth into which other beech forest species penetrate in various abundance. On poorer and drier, less humous, soils (light-grey and yellow-grey soils)

the undergrowth has a characteristic sedge physiognomy and beech forest herbs and grasses are comparatively sparsely scattered among the dominating *Carex pilosa*. On apparently more humous and nutritious soils (greyish-brown to blackish-brown), as long as they are humid enough, we find, in company with *Carex pilosa*, a rich undergrowth with an abundance of beech forest elements. Thus, in the White Carpathians for instance, the undergrowth is usually a combination of *Carex pilosa-Hacquetia*, *Carex pilosa-Asperula odorata*, rarely *Carex pilosa* — *Allium ursinum*.

As examples, I present some variants: \*

a) The Strážné valley near Pieštany, at 285 meters alt., N. E. slope, has a mixed high-trunk beech forest, rather thin, with abundant hornbeam (*Carpinus betulus*) and scattered maple (*Acer pseudoplatanus*). The forest floor is without mosses, open spots are always covered by a carpet of decaying leaves. *Carex pilosa* forms a continuous and dense, therefore very excluding growth in which beech seedlings show the highest dominance. The soil is loamy to a great depth and humous on the surface. Here and there are maple seedlings and solitarily also oak (*Quercus sessilis*) seedlings, otherwise the floristic composition is very poor. *Lathyrus vernus* is abundant, *Pulmonaria officinalis* and *Viola silvatica* are scattered, only sparsely scattered are *Oxalis acetosella*, *Hedera helix*, *Melica uniflora*, also a little of *Asperula odorata*, solitarily appear *Dactylis Aschersoniana* and *Campanula trachelium*, quite isolated are *Epilobium montanum* and *Luzula nemorosa*.

b) As an illustration of an impoverished type, I mention a high-trunk beech forest from the lower part of the Strážnice valley near Moravany in the Pieštany hills on a N. to NE. by N. exposure. The non-mossy soil is covered by a thick layer of beech leaves, on it grow very abundantly young beeches, and *Carex pilosa* forms a very loose, rather evenly distributed undergrowth. Grasses are entirely lacking, solitarily appear oak seedlings (*Quercus sessilis*); the floristic composition is very poor: scattered is *Lathyrus vernus*, only scattered *Pulmonaria officinalis* and *Oxalis acetosella* (here and there in small colonies), very little of *Asperula odorata*, only quite solitary appear: *Lactuca muralis* (ster.), *Melittis melisophyllum*, *Symphytum tuberosum*, *Lamium luteum*, *Dryopteris filix mas*, *Ajuga*

*genevensis*, *Impatiens noli tangere*, *Luzula nemorosa* (only along the margin).

It seems that the undergrowth is held back by the leaf carpet so that in places the beech forest has the aspect of a half-bare-floor forest; the shade here is also rather deep.

**c) *Carex pilosa* — *Dentaria bulbifera*-*Staphylea* variant.**

On the Plešina ridge in the Pieštany hills, at an altitude of 430 meters on rather level land, there is a younger, mixed, very dense beech forest with a non-mossy soil, covered by a thick leaf carpet. The *Carex pilosa* undergrowth is equally distributed but loose. The composition of the tree stratum is somewhat irregular, in fact, in places the beech does not dominate. It is in reality a type peculiar to the mixed forests on ridges, in which are scattered *Fraxinus excelsior*, *Ulmus scabra* (abundantly enough scattered), *Acer platanoides* (chiefly young trees in the undergrowth), less so *A. campestre*, *A. pseudoplatanus*, *Quercus sessilis*. Tall hazels (*Corylus avellana*) are rather abundantly scattered, of shrubs, besides young trees, are mainly *Staphylea pinnata* and *Evonymus verrucosa* abundantly enough scattered, less so *Cornus sanguinea*, solitary is *Sorbus aria* (also in tree form). *Carex pilosa* is accompanied by very abundant *Dentaria bulbifera*, further *Isopyrum thalictroides* (very abundantly scattered), *Mercurialis perennis* (locally in loose colonies), abundant enough are *Asarum europaeum* and *Pulmonaria officinalis*, and only very scattered *Hedera helix*, *Viola mirabilis*, *Galium aparine*, *Orchis pallens*, *Bromus asper*, *Melica uniflora*, solitary *Lamium luteum*, *Lathyrus vernus*, *Viola silvatica*, *Geum urbanum*.

**d) *Carex pilosa*-*Hacquetia* — *Cephalanthera rubra* variant.**

In the dolomitic Rokoš group on the Janko hill above Uhrovec on the northern slope in the zone from 350 to 500 meters altitude are younger, continuous, shady beech forests which can be considered, according to their physiognomy, as *Fagetum subnudum* because the herbaceous undergrowth is very thin to almost none. The loamy, rather dry soil has no distinct humus layer and is covered everywhere by a thick layer of very slowly-decaying leaves. Here and there are scattered hornbeams (*Carpinus betulus*) or oaks (*Quercus sessilis*, *Quercus cerris*), scattered *Sorbus torminalis* and soli-



tary also *S. aria*, *Corylus avellana*, *Fraxinus excelsior*, but shrubby beeches are mostly lacking. Sociologically, we may characterise these beech forests by *Carex pilosa* which sometimes grows quite alone in extensive areas, of course only scattered among the dryleaf carpet and never forming dense growths. In addition, there are:

<i>Arabis hirsuta</i> (scat.)	<i>Hacquetia epipactis</i> (inab.)
<i>Asarum europaeum</i> (rather ab.)	<i>Hedera helix</i> (ab. scat.)
<i>Asperula odorata</i> (rarely, in scat. col.)	<i>Hypericum montanum</i> (only scat.)
<i>Brachypodium silvaticum</i> (only scat.)	<i>Lactuca muralis</i> (only scat.)
	<i>Lathyrus niger</i> (inab.)
	<i>Lathyrus vernus</i> (scat.)
<i>Carex digitata</i> (only scat.)	<i>Melica uniflora</i> (scat. in small. col.)
<i>Carex pilosa</i> (v. ab. scat.)	
<i>Carex silvatica</i> (loc.)	<i>Neottia nidus avis</i> (sol.)
<i>Cephalanthera alba</i> (scat.)	<i>Oryzopsis virescens</i> (only quite loc.)
<i>Chrysanthemum corymbosum</i> (only scat.)	<i>Paris quadrifolia</i> (quite loc.)
<i>Clematis vitalba</i> (only scat.)	<i>Pulmonaria officinalis</i> (only scat.)
<i>Dactylis Aschersoniana</i> (only scat.)	<i>Sanicula europaea</i> (quite loc.)
<i>Epipactis latifolia</i> (inab.)	<i>Senecio Fuchsii</i> (only scat.)
<i>Epipactis microphylla</i> (only loc. scat.)	<i>Symphytum tuberosum</i> (only scat.)
	<i>Vincetoxicum officinalis</i> (scat.)
<i>Galium Schulthesii</i> (scat.)	

This, of course, is not a usual sociological analysis, but rather a list of species found in this beech forest in a vertical zone of 150 meters width.

#### e) *Carex pilosa* — *Luzula nemorosa* variant.

This type is characteristic for drier habitats, usually in the neighbourhood of oak forests, not seldom in beech forests interspersed with oak. It is chiefly spread on the eruptive rocks of middle Slovakia. As an exemple I mention a beech forest on the southern slope of Mt. Bílá Skála, above Nová Báně on the Hron River (trachyte). The beech forest spreads here above the oak-forest zone and is, in its lower part, rather abundantly interspersed with hornbeam (*Carpinus betulus*) and solitarily oaks (*Quercus cerris*). The soil is humous, non-mossy, and covered with decayed leaves. An analysis at an altitude of about 550 meters shows a predominance of *Carex*

*pilosa* in the undergrowth, abundant enough is *Luzula nemorosa*, abundantly scattered is *Carex digitata*, here and there are colonies of *Asperula odorata*, scattered are *Dactylis Aschersoniana* and *Poa nemoralis*, otherwise inabundant are *Cephalanthera rubra*, *Epilobium montanum*, *Galium Schultesii*, *Hieracium sabaudum*, *Lactuca muralis*, *Lathyrus niger*, *L. vernus*, *Melittis melisophyllum*. In general the undergrowth is very poor floristically.

R. Mikyška<sup>(1)</sup>, in his paper on the forest types in the Štiavnické Středohoří Mts., describes in beech and oak forests the *Carex pilosa* type with two subtypes, namely *Carex pilosa* proper and *Carex pilosa* — *Luzula nemorosa*, which belongs here. In general, he designates beech (and oak) forests with dominant *Carex pilosa* as a hemixerophytic type, physiognomically uniform by its sedge undergrowth in which species, otherwise with a great sociability (for instance *Asperula odorata*, *Galium Schultesii*), grow more or less isolated. The cause of this he sees in the great expansibility of both dominants (*Carex pilosa*, *Luzula nemorosa*). Notwithstanding that the vegetation covers an average of 80% of the surface, of the species more abundant in the woodruff type especially the following decrease: *Melica uniflora*, *Paris quadrifolia*, *Geranium Robertianum*, *Mercurialis perennis*, *Primula elatior*, and *Sanicula europaea*. Both named dominants are constant species in this territory just as *Dentaria bulbifera* and *Asperula odorata*; *Melica nutans* is the only differential species with regard to the other beech forest types. *Carex pilosa* type occurs in the Štiavnické Středohoří Mts. on comparatively drier soils and is customary mainly in somewhat cut-out forests. The tree stratum is rather uniform, composed of beech, more rarely of oak (*Quercus robur*).

This *Luzula* variant is, in a certain sense, an already degraded type of our sociation, caused by a drier soil (especially on eruptive rocks) and by a mixing-in of oak.

## 20. *Carex alba* sociation (*Fagetum caricinum albae*).

This type, occurring in the Carpathians (especially in the southwestern), is, however, nowhere in its continuity as widely distributed as the preceding one. Very often I have seen in beech forests only small local growths of *Carex alba*, and I have the impression, that

rarely — if at all — it is possible to consider this type as a permanent community. Many of its accompanying species differ according to the habitat conditions and according to the vegetation of the neighbouring beech forests. An interesting type is to be found, for instance, in the dolomitic Rokoš group on the northern slope of the rocky ridge Malé Zrubisko, near the crest, at an altitude of 590 meters (analyses done by P. Sillinger). It is a thin beech forest where the woody plants besides the absolutely dominant beech, are: *Acer pseudoplatanus*, *Fraxinus excelsior*, *Daphne mezereum*, *Cornus mas*, *Sorbus aria*, *Frangula alnus*, *Berberis vulgaris*, *Lonicera xylosteum*, *Viburnum opulus*, *Cotoneaster tometosa*. The undergrowth consists of:

<i>Ajuga reptans</i> (scat.)	<i>Hedera helix</i> (scat.)
<i>Allium ochroleucum</i> (rar.)	<i>Hieracium murorum</i> (scat.)
<i>Aquilegia longisepala</i> (scat.)	<i>Hypericum montanum</i> (scat.)
<i>Asarum europaeum</i> (rather ab. scat.)	<i>Laserpitium latifolium</i> (rather ab. scat.)
<i>Asperula tinctoria</i> (ab. scat.)	<i>Lilium martagon</i> (scat.)
<i>Brachypodium pinnatum</i> (scat.)	<i>Melittis melisophyllum</i> (scat.)
<i>Calamagrostis varia</i> (ab. scat.)	<i>Mercurialis perennis</i> (scat.)
<i>Campanula rapunculoides</i> (scat.)	<i>Origanum vulgare</i> (rather ab. scat.)
<i>Campanula rotundifolia</i> var. (scat.)	<i>Phyteuma orbiculare</i> (scat.)
<i>Carex alba</i> (v. ab.)	<i>Pimpinella magna</i> (scat.)
<i>Carex humilis</i> (sol.)	<i>Pirola secunda</i> (sol.)
<i>Chrysanthemum corymbosum</i> (scat.)	<i>Platanthera bifolia</i> (only scat.)
<i>Cirsium erisithales</i> (scat.)	<i>Prenanthes purpurea</i> (scat.)
<i>Convallaria majalis</i> (sc.)	<i>Primula officinalis</i> var. <i>canescens</i> (scat.)
<i>Dentaria bulbifera</i> (scat.)	<i>Pulmonaria officinalis</i> (scat.)
<i>Dryopteris Robertiana</i> (scat.)	<i>Ranunculus nemorosus</i> (scat.)
<i>Epipactis rubiginosa</i> (scat.)	<i>Sesleria calcaria</i> (rather ab. scat.)
<i>Euphorbia amygdaloides</i> (rather ab. scat.)	<i>Solidago virga aurea</i> (scat.)
<i>Galium Schultesii</i> (rather ab. scat.)	<i>Teucrium chamaedrys</i> (ab. scat.)
<i>Hacquetia epipactis</i> (scat.)	<i>Valeriana tripteris</i> (rather ab. scat.)
	<i>Vincetoxicum officinalis</i> (scat.)
	<i>Viola mirabilis</i> (scat.)

I recorded this community with the dominant *Carex alba* as the first example, even though it is sociologically very atypical, because this heterogeneity, as shown in the above list, often characterises the more extensive growths of this sociation. If we know the vegetation of the territory where the analysis is done, we recognise in it elements of various neighbouring sociations, partly from the normal beech forests (these, however, are not numerous and even *Asperula odorata* is missing), partly from oak forests, and especially from the *Seslerieta* and *Cariceta humilis*, here customary. Although this community shows a certain stability, its elements form a mixture in which the local habitat conditions permitted the dominance of *Caricetum albae*. This dominance, likely to last a longer time, will, however, not be permanent.

In the deep shade of the beech forest, these foreign elements disappear and only the beech forest species remain. In the same region on the ridge above the Studená studňa valley towards Mt. Kanišová skála, I analysed a beech forest on the northwestern slope at about 600 meters altitude. Along the ridge is a strip of an old, half-bare-floor beech forest and below it, on a comparatively large area, is a rather continuous *Caricetum albae*, in the growth of which is a large quantity of decayed leaves, while mosses are missing. The composition of the undergrowth because of the excluding habit of *Carex alba* is floristically poor.

( <i>Arabis hirsuta</i> )	<i>Dentaria bulbifera</i> (scat.)
<i>Asarum europaeum</i> (ab. scat.)	( <i>Epipactis latifolia</i> )
<i>Asperula odorata</i> (v. little)	( <i>Epilobium montanum</i> )
( <i>Campanula rapunculoides</i> )	( <i>Lactuca muralis</i> )
<i>Cephalanthera alba</i> (only scat.)	( <i>Viola silvatica</i> )
<i>Cephalanthera rubra</i> (ab. scat.)	

In the beech forest only young shrubs of *Fraxinus excelsior*, *Acer platanoides*, *A. pseudoplatanus*, *Sorbus aria* are present, of the true shrubs *Rubus idaeus* and *Lonicera xylosteum* are rare; in places, however, there is a shrubby, dense, and rather tall young-beech growth, but here *Carex alba* does not penetrate and the floor is covered only by dry leaves.

This type of beech forest with *Carex alba* is more uniform and normal, since it is not mixed with foreign elements, and we cannot

assume that it would undergo a change in the future, provided the succession is not disturbed.

*Carex alba* is remarkable because of its plasticity, since it grows, as already the above examples show, in rather deep shaded as well as in light thin forests. Its growths are of a more xerophytic nature than the normal *Carex pilosa* type and therefore they occupy often the upper drier zone (especially below ridges) and this even on a shallow soil. We observe this, for instance, on the northern slope of Mt. Klepáč above Trenčianské Teplice where *Carex alba* forms, in the upper zone, whole growths and with it we find sometimes some of the species belonging to the lower zone, also *Cephalanthera rubra* and *Epipactis microphylla*. Rather often *Caricetum albae* penetrates even into secondary forests, as for instance into somewhat dry spruce forests (on limestone) where the *Carex alba* growth, because of the lowered competition, spreads with great intensity (thus for instance on the foot of Mt. Strážov in the valley of Bjeli potok).

J. K l i k a <sup>(2)</sup> writes about the *Carex alba* type in the Velká Fatra and he considers it as typical of thinned forest growths on limestone, chiefly at lower situations but attaining sometimes an altitude of 1000 meters, and there especially where the stony, often more or less taluslike substratum, with only a thin layer of humus, shows its influence.

#### F. *F a g e t a l u z u l i n a*.

Types of our beech forests with dominating *Luzula nemorosa* in the undergrowth belong usually to the impoverished (degraded) types or appear as stages of antropic succession. On the other hand, *F a g e t u m l u z u l i n u m* is a natural mountain type of a restricted distribution in our beech forests; *Luzuletum silvaticae* as an undergrowth of mountain spruce forests on acid humous soils is much more widespread but differs in its accompanying species.

#### 21. *Luzula silvatica* sociation (*Fagetum luzulinum silvaticae*).

As an example of this sociation I give the two following strikingly different variants from our Carpathians.

##### a) **Eastern Carpathian Flysch facies.**

I described a typical example from Subcarpathian Russia, Svido-

vec Mts., Bilina potok valley (820 meters alt.), in an old, shady, virgin beech forest which is but slightly mixed, without a shrubby undergrowth, only on places with rather abundant young beeches. The ground is non-mossy, the soil scantily humous, a fine talus, with only slightly infiltrated loam, penetrates to the surface which is covered by only a small amount of dry leaves since most of them were washed away by water. The very luxuriant *Luzula silvatica* completely dominates the aspect and forms, on an extensive area, a continuous undergrowth, or sometimes is divided into large, closely grouped complexes. The boundaries between this and the neighbouring types are absolutely sharp. The composition of this *Luzuletum* is rather poor, because of the very excluding habit of the dominant:

<i>Asperula odorata</i> (scat.)	<i>Galeopsis grandiflora</i> (only v. scat.)
<i>Athyrium filix femina</i> (only scat.)	<i>Lamium luteum</i> (v. ab. scat.!)
<i>Carex silvatica</i> (only loc. scat.)	<i>Oxalis acetosella</i> (only scat. in small. col.)
<i>Doronicum austriacum</i> (rather ab. scat.!)	<i>Salvia glutinosa</i> (scat.)
<i>Dryopteris filix mas</i> (only scat.)	<i>Senecio nemorensis</i> (scat.)
<i>Dryopteris phegopteris</i> (only scat.)	<i>Solidago virga aurea</i> (ab. scat.!)
<i>Epilobium montanum</i> (only v. scat.)	<i>Stachys silvatica</i> (only scat.)
	<i>Veronica urticifolia</i> (ab. scat.)

On some mossy stones, settled colonies of *Circaea alpina* are present.

#### b) Western Carpathian limestone facies.

In the Western Carpathians sometimes there is developed a quite different mountain calcicole variant (*F. luzulinum silvaticae calcicolum*) which approaches the limestone mountain calcicole beech forests of the Western Carpathians but differs by the high dominance of *L. silvatica*. Here must be added «*Fagion carpaticum Cortusae* facie with *Luzula maxima*», which KLIKA (2) describes from the Velká Fatra Mts. in a thin mixed beech forest (with spruce and *Ribes grossularia* infrequent in the shrubby stratum) in a mountain kettle on the slope of Smrekovice near Močidlo (1100 meters alt.). The great dominance of *L. silvatica*, forming a whole growth, is said by the author to be due to the long-lying snow



cover, to the thinned forest, and to the high humidity. Mostly, but with a slight dominance, there grow in this community: *Adenostyles alliariae*, *Anemone ranunculoides*, *Aquilegia vulgaris*, *Chrysosplenium alternifolium*, *Dentaria bulbifera*, *D. enneaphyllos*, *Isopyrum thalictroides*, *Mercurialis perennis*, *Oxalis acetosella*, *Paris quadrifolia*, *Petasites albus*, *Polystichum lonchitis*, *Primula elatior*, *Rumex arifolius*, *Thalictrum aquilegifolium*, *Veratrum Lobelianum*.

## 22. *Luzula nemorosa* sociation (*Fagetum luzulinum nemorosae*).

Beech forests with abundant *Luzula nemorosa* in the undergrowth frequently belong to the degraded types and arise particularly in the Sudetic-Hercynian region as a consequence of forest culture. Sometimes, however, *Luzula nemorosa* may penetrate even into typical beech forests, especially in the neighbourhood of Hercynian spruce or oak forests on siliceous substrata. Sillinger (<sup>1</sup>, p. 25) also mentions this type from the beech forests in the more northern part of the White Carpathians on drier and more acid soils. From Subcarpathian Russia, I described (<sup>1</sup>, p. 17—18) the *Luzula nemorosa* type in the virgin beech forests of the Gropjenec creek valley below the shepherd settlement Gropa, S. E. slope at about 1120 meters alt. It is an interesting phenomenon that these local *Luzula* growths repeat themselves fairly regularly under old spruces interspersed in the beech forest, whereas they are not present under beeches. I analysed, for instance, such a fairly extensive *Luzuletum nemorosae* under two old spacious spruces where the floor, in as far as it was free, was covered by a dry leaf carpet, without mosses. The composition was as follows:

( <i>Anemone nemorosa</i> )	<i>Lactuca muralis</i> (scat.)
<i>Aposeris foetida</i> (scat.)	<i>Lamium luteum</i> (scat.)
( <i>Asperula odorata</i> )	( <i>Lilium martagon</i> , ster.)
( <i>Campanula abietina</i> )	<i>Oxalis acetosella</i> (scat.)
( <i>Epilobium montanum</i> )	<i>Rubus</i> sp. (scat.)
<i>Galium vernum</i> (scat.)	( <i>Salvia glutinosa</i> , ster.)
<i>Geranium Robertianum</i> )	<i>Valeriana tripteris</i> (ab. scat.!)
( <i>Glechoma hirsuta</i> )	( <i>Veronica urticifolia</i> , ster.)

The influence of the spruce is evident here.

### *G. Fageta graminosa.*

In thinned beech forests and on beech clearings a luxuriant vegetation usually comes in, sometimes shrubby, as for instance raspberry (*Rubus idaeus*) clearings, and sometimes herbaceous, or mixed (grassy-herbaceous). Under a sufficient humidity some grasses can spread, especially *Bromus asper*, *Elymus europaeus*, *Festuca silvatica*, sometimes also *Brachypodium silvaticum* or on drier soil *Poa nemoralis*, whereas the ombrophilous *Melica uniflora* does not tolerate a direct light well without the protection of shrubs. Here we are concerned only with types with grasses dominating in the beech forest itself. There are some such types but their distribution in our beech forests is not very great since herbaceous, respectively fern or sedge types, evidently predominate. Of special interest are the following types:

#### 23. *Melica uniflora* sociation.

This sociation is the most abundant of the grassy types of our beech forests. The leading grass is very abundant also in the woodruff and other types but can so increase that finally it forms continuous dense growths, decidedly excluding. I cite here two variants of this sociation, much more abundant in the Carpathian region than in the Hercynian, one calcicole and the other silicicole.

##### a) Western Carpathian calcicole variant.

On Mt. Vysoká in the Little Carpathians, there is, below the first rocky group on the ridge (on limestone, at about 650 meters altitude, western slope), a thinned beech forest the undergrowth of which is mostly a continuous *Melicetum uniflorae* of the following composition:

<i>Arabis turrata</i> (ab. scat.)	<i>Glechoma hirsuta</i> (ab. scat.)
<i>Asperula odorata</i> (rather greg.)	<i>Hesperis nivea</i> (ab. scat.)
<i>Campanula trachelium</i> (scat.)	<i>Mercurialis perennis</i> (v. scat. col.)
<i>Dactylis Aschersoniana</i> (scat.)	<i>Poa nemoralis</i> (scattered)
<i>Geranium Robertianum</i> (ab. scat.)	<i>Parietaria officinalis</i> (rather ab.)
	<i>Sisymbrium strictissimum</i> (ab.!)
<i>Geum urbanum</i> (scat.)	

On light places locally are colonies of *Lithospermum purpureo-coeruleum*.

#### b) Western Carpathian silicicole variant.

On Mt. Zlatý vrch near Piešťany on a steep eastern slope on Permian quartzites, there is a broad zone of a mixed oak forest (*Quercetum sessilis* with abundantly scattered *Carpinus betulus*), below which beeches increase and mixed beech forests are formed. A vast and quite close *Melicetum uniflora* is characteristic for the oak forest but penetrates also into the beech forest. Abundantly scattered everywhere is *Asperula odorata*, scattered are *Symphytum tuberosum*, *Hieracium sabaudum*, only scattered *Melittis melisophyllum*, locally *Galium Schultesii*, very rarely *Lactuca muralis*, *Pulmonaria officinalis*, *Solidago virga aurea*, *Lathyrus vernus*, *Cephalanthera ensifolia*, *C. alba*, *Polygonatum multiflorum*, *Poa nemoralis*, *Bromus asper*, *Dactylis Aschersoniana*. A shrubby undergrowth is lacking, sparsely only appear *Ligustrum vulgare* and *Acer campestre*.

*Melica uniflora* sociation can combine itself also with either *Asperula odorata* or *Carex pilosa* sociations (for instance in the White Carpathians, Sillinger<sup>1</sup>, p. 25).

R. Mikyška<sup>(1)</sup>, describes from the Štiavnické Středohoří Mts. the *Poa nemoralis* — *Melica uniflora* subtype of his *Poa nemoralis* type which shows evident affinities with oak forests into which *Melicetum uniflora* penetrates, just as in the mixed *Carpineta* outside of the beech forest region.

In general, we may say that the *Melica uniflora* sociation is not a climax type but often only a stage of woodruff types in thinned beech forests. Quite correctly Sillinger<sup>(2)</sup> writes that this sociation, widely distributed in the Western Carpathians, develops chiefly on drier habitats with a higher light intensity and that it only represents, in part, stages of the succession, the spread of which is greatly aided by forest culture. It is interesting that this sociation, just as the *Carex pilosa* sociation, spreads out beyond the beech forest limit into mixed oak, and hornbeam forests.

#### 24. *Dactylis Aschersoniana* sociation.

*Dactylis Aschersoniana*, clearly one of the leading plants of our beech forests, is but scattered to abundantly scattered in the undergrowth and usually does not dominate the aspect in the forest shade. In the Little Carpathians on the foot of Mt. Vysoká, beginning along

the forest road leading to the hunting-seat Vývrat, I analysed a somewhat thinned but shady, tall-trunk beech forest of the *Dactylis Aschersoniana* — *Melampyrum nemorosum* type with the following composition: *D. Aschersoniana* forms a nearly continuous and dense undergrowth and *Melampyrum nemorosum* is quite common as a lower layer and abundant; otherwise, of grasses, *Poa nemoralis* is rather abundant but is lost in the aspect by the dominance of *Dactylis*; *Melica nutans* is scattered, while others are:

( <i>Ajuga reptans</i> )	<i>Lathyrus niger</i> (rather ab. scat.)
<i>Asperula odorata</i> (loc. in col.)	<i>Lathyrus vernus</i> (scat.)
( <i>Astragalus glycyphyllos</i> )	( <i>Lilium martagon</i> )
<i>Campanula persicifolia</i> (scat.)	<i>Melittis melisophyllum</i> (only
<i>Campanula trachelium</i> (scat.)	scat.)
<i>Convallaria majalis</i> (scat.)	( <i>Myosotis silvatica</i> )
( <i>Daphne mezereum</i> )	<i>Pimpinella magna</i> (only scat.)
<i>Euphorbia amygdaloides</i> (rather	<i>Pulmonaria officinalis</i> (scat.)
ab. scat.)	<i>Salvia glutinosa</i> (scat.)
( <i>Genista tinctoria</i> )	<i>Sanicula europaea</i> (rather scat.)
<i>Heracleum sphondylium</i> (only	<i>Solidago virga aurea</i> (only scat.)
scat.)	<i>Veronica chamaedrys</i> (ab. scat.)
<i>Hieracium barbatum</i> (only scat.)	<i>Veronica officinalis</i> (scat.)
<i>Hieracium murorum</i> (only scat.)	<i>Viola silvatica</i> (only scat.)

This type also cannot be regarded as a climax community; it appears to me, that the influences of oak and, perhaps also, of forest culture manifest themselves here.

## 25. *Sesleria calcaria* sociation (*Fagetum sesleriosum*).

I know this type only from the limestone Western Carpathians where it occurs in places in the zone just below the ridges, normally on the northern slopes. Open *Seslerieta calcariae* here in the beech forest region are frequent on the northern slopes, even in the foothills of the southwestern Carpathians, and penetrate not seldom also into thin beech forests. We find, however, loosened *Seslerieta*, mixed with elements of woodruff and mixed herbaceous beech forest types, in a narrow strip, below the ridges, as for instance in the dolomitic Tematín hills and the Rokoš group. Also *Festuca amethystina* is often scattered here.

Sillinger <sup>(2)</sup> gave, for the first time, a detailed description and explanation of these *Sesleria* beech forests often with scattered to rather abundant *Quercus sessilis*. I am convinced that these mixed *Sesleria* beech forests, in a narrow strip below the ridges, are a climax community, since the habitat conditions often prevent any further succession here. There, where these beech forests developed as a succession stage of an open *Seslerietum* (respectively of the sociation *Calamagrostidetum variae* or *Calamagrostideto — Festucetum amethystinae*), it is, of course, possible that they will lead in the final succession to some of the usual beech forest types. Often, however, the character of the habitat is of such a kind that we have to consider these *Sesleria* beech forests as stable communities. Sillinger <sup>(2)</sup> correctly emphasises their sociological individuality which I, myself, can confirm as regards the dolomitic districts of Tematín hills and Rokoš. *Sesleria calcaria* dominates and often forms dense to almost continuous undergrowth with numerous herbs which represent a mixture of *Seslerietum* (resp. of *Calamagrostidetum variae*) elements and of beech forest elements. *Festuca amethystina* is a characteristic species of the highest degree. Sillinger records further, as fairly characteristic for the Tematín hills, also *Laserpitium latifolium*, *Chrysanthemum leucanthemum*, *Pimpinella magna*, *Aquilegia longisepala*, *Digitalis ambigua*, to some degree *Epipactis rubiginosa*, and of dealpines *Bupleurum longifolium* and *Pleurospermum austriacum*, whereas the other species (such as *Brachypodium pinnatum*, *Melampyrum cristatum*, *Primula officinalis* var. *canescens*, *Cytisus nigricans*, *Chrysanthemum corymbosum*, *Asperula tinctoria*) this sociation has in common with the *Quercetum lanuginosae* of the southern slopes. The beech forest species are not numerous, with a greater constancy appear *Asarum europaeum*, *Melittis melisophyllum*, *Lathyrus vernus*, *Lilium martagon*, less so *Mercurialis perennis* and *Symphytum tuberosum*.

Regarding the biological spectrum of this sociation, as well as further details, I refer to Sillinger's paper <sup>(2)</sup>.

## 26. *Festuca silvatica* sociation.

A mountain type, present here and there, chiefly on talus filled in with humus. In a deeper shade, *Festuca silvatica* is usually only

abundantly scattered but reaches a higher dominance in thinned beech forests and on clearings just as *Bromus asper* and *Elymus europaeus*.

The usual mountain type with abundant or abundantly scattered *F. silvatica* can be better joined to the mountain beech forests with abundant tall herbs. Hilitzer (1, p. 19) records it as a distinct type from the beech forests in the neighbourhood of Kdyně in the Český Les Mts., on summits or on southwestern slopes, often in a very thin forest mixed with spruces and maples (*Acer pseudoplatanus*). *Festuca silvatica* is dominant, *Dryopteris filix mas* and *Mercurialis perennis* show a considerable dominance, whereas other species play a minor role (*Asarum europaeum*, *Asperula odorata*, *Bromus asper*, *Cardamine impatiens*, *Epilobium montanum*, *E. angustifolium*, *Geranium Robertianum*, *Hepatica triloba*, *Majanthemum bifolium*, *Oxalis acetosella*, *Poa nemoralis*, *Polygonatum multiflorum*, *Senecio Fuchsii* etc.) Also in the highest zone of Čerchov (Český Les) *Festuca silvatica* is very gregarious.

#### 27, 28. *Milium effusum* and *Brachypodium silvaticum* sociations.

These two types, although physiognomically very characteristic, are sociologically distinct. From the Šumava Mts. I know dense to almost closed growths of *Milium* which, however, can better be considered as variants with local dominance of this grass, than as a well-marked type. Hilitzer (1, p. 15) records the *Milium effusum* type from the beech forests in the neighbourhood of Kdyně (Český Les) on summits with higher light intensity, and states that this type is parallel to the *Festuca silvatica* type but differing in the leading grass. Floristically this type does not essentially differ from the herbaceous beech forest types, the quantitative and physiognomical differences, however, are striking. Beech forest species (*Asarum europaeum*, *Asperula odorata*, *Melica nutans*, *Mercurialis perennis*, *Oxalis acetosella*, *Senecio Fuchsii* etc.) are often present, the *Milium* growth is never completely closed.

The *Brachypodium silvaticum* type occurs only very scattered but combines mostly with some of the above mentioned types (in the Carpathians also with the *Carex pilosa*).



### 29. *Poa nemoralis* sociation.

This type belongs mostly to the transitional oak-beech forest types, sometimes also to the beech-hornbeam forests, may, however, also occur in drier and lighter beech forests (see p. 75).

### 30. *Calamagrostis arundinacea* sociation.

I know this type chiefly from degraded beech forests. Zlatník (<sup>1</sup>, p. 411) records it as characteristic for beech forests of the higher zone of Subcarpathian Russia, on drier places. The *Calamagrostis arundinacea* — *Dryopteris filix mas* type, which Zlatník (<sup>3</sup>) described from the České Středohoří Hills, belongs to basaltic talus, but occurs not only in beech forests but also in a mixed *Quercus-Tilia* forest.

## XII. Bare-floor beech forests (*Fagetum nudum* and *subnudum*).

Beech forests with a non-mossy soil, covered by a thick layer of decaying leaves, without herbaceous undergrowth or with an undergrowth so thin that it is lost in the general aspect, are certainly an interesting ecological problem. The shrubby undergrowth in the bare-floor beech forests is also usually missing or only very scarce, sometimes, however, there is a rich shrubby growth of naturally seeded young beeches. Bare-floor and half-bare-floor beech forests occur very frequently, they even predominate in some of our areas, but in my opinion they cannot be considered as due to a single ecological factor. Sociologically, these bare-floor beech forests are not a distinct sociation, but only a stage of some other sociation or variant, for some reason impoverished in such a manner that the beech remained practically alone. My own experiences seem to favour the idea that the suppression of the herbaceous undergrowth corresponds above all to the thick layer of dry beech-leaves especially when slowly decomposing. This, of course, does not yet explain why this layer remains preserved. Dry and not nutritious (acid) soils as well as shade are also of consequence but in a very unequal manner. The layer of fallen leaves, every season enriched by a new contribution, is a hindrance to the germination of seeds and of spores of bryophytes and to the occasional young seedlings; only fungi can grow here. Bare-