Bare-floor beech forests (Fagetum nudum and subnudum)

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 ([4], 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 ([3]) 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-

floor beech forests create less favourable edaphic conditions which manifest themselves sometimes by the fact that Hercynian (spruce) elements sometimes take a foothold on the bare-floor and form isolated colonies. In some cases I was able to ascertain the absence of the mycorrhiza layer but this question must yet be worked upon. Fagetum nudum is to be found as on limestone so on silicious substrata, on humous and loamy soils. It occurs also in virgin beech forests in a very humid climate and, therefore, deserves special attention.

For the understanding of bare-floor beech forests, I give some examples with explanatory remarks.

1. It is very easy to explain a bare-floor beech forest when the beech is introduced by forest culture (especially on originally spruce areas), or when the shade is very deep in a certain evolutionary stage of a forest where the trees are still young and very dense. On a drier locality, the absence of herbaceous undergrowth is not surprising.

2. I found an interesting and extensive Fagetum nudum in the Little Carpathians on Mt. Vysoká, above the hunting-seat Vývrat, on a rather steep slope, at an altitude from about 350 to 550 meters. It is an old, tall-trunk beech forest interspersed with abundant *Acer platanoides* and *A. pseudoplatanus*. In the broad vertical zone, 200 meters wide, there is not a single herb in the undergrowth, but instead there is such an abundance of beech seedlings and of both maples and scattered ash, that this vast number of seedlings imitates a low, green, herbaceous undergrowth. A shrubby undergrowth is missing, even young beeches and maples are scarce, so that it is apparent that the seedlings of these trees, smothered by the thick leaf-carpet, die off yearly. The explanation of this bare-floor beech forest may be looked for mainly in the substrata. That is, here we have a limestone region, where quartzite protrudes, and by its disintegration forms a yellowish brown loam. In one place, higher up on the slope where there is a smaller part of a younger beech forest (old stumps indicate that here also there originally was a high-trunk beech forest) an undergrowth is developed under more favourable light conditions. This undergrowth shows that it is a distinct beech forest sociation and quite different from the usual beech forest types on limestone, and represents a degraded type. The floor is very mossy (*Polytrichum* predominating), the undergrowth is mainly a loose Luzuletum

nemorosae with very abundant *Festuca ovina (euovina)* so that, in places, it may more properly be designated as a Festuceto-Luzuletum. Floristically, this undergrowth is extremely poor, scattered grow here *Deschampsia flexuosa, Calamagrostis arundinacea, Hieracium murorum, H. pilosella, Genista pilosa, Galium asperum*, only scattered *Poa nemoralis, Vaccinium myrtillus*, infrequently *Carex montana*, locally *Antennaria dioica*, and solitary *Platanthera bifolia*. This is, therefore, a typical undergrowth of Hercynian coniferous forests on acid soils and not a single typical beech forest plant is present. We may then observe here a certain analogy to the Hercynian deciduous woods as I have defined them from Central Bohemia. Also, in another part of the same district of the Little Carpathians, I have found, on quartzite, a local growth, belonging to Fagetum nudum, having in its upper lighter zone an undergrowth of a low Myrtilletum with very abundant *Polytrichum* and again Festucetum euovinae with *Luzula nemorosa*, but floristically even poorer.

In these cases the origin of the bare-floor beech forests is clear since we are concerned here with a special sociation brought about edaphically, the elements of which cannot tolerate complete shade and so disappear in old forest growths. Not even mosses can maintain themselves in the thick leaf carpet.

3. In the southwestern foothills of the Carpathians in the Pieštany hills as well as in the dolomitic Tematín hills, beech forests predominate and occupy especially all the northern slopes to the highest ridges. These beech forests belong to several sociations (*Carex pilosa — Asperula odorata* predominates), but we often meet here also Fagetum subnudum. In this case we cannot explain the latter by the geological substratum nor by the shade, but primarily by the dryness of the soil and by the general climate of a continental character with a low yearly rainfall and a long, warm, dry summer. The dry beech leaves decompose slowly and so form a thick leaf carpet. This very thick layer of half-decayed leaves suppresses the herbaceous undergrowth, the composition of which corresponds to the usual calcicole beech forests at lower altitudes in the Western Carpathians.

4. Even more striking is this phenomenon in the Rokoš group, in the limestone Váh River district of western Slovakia. These dolo-

mitic mountains, reaching beyond 1000 meters alt., are waterless even in the wooded valleys; the fallen leaves do not decay and form a thick leaf carpet, the soil is loamy, non humous, and the bare-floor and half-bare-floor beech forests are widely distributed, representing an impoverished calcicole type (see p. 96). Only in the highest zone of Rokoš and at the bottom of some valleys (for instance between Malé and Kamenné Zrubisko) the soil water conditions are more favourable and support the evolution of a richer herbaceous undergrowth, even of the *Petasites* (see p. 115) and fern types.

5. Especially interesting are the bare-floor beech forests in Subcarpathian Russia where they appear even in old virgin beech forests. An instructive example of such a virgin forest I described in detail ([4], p. 18—20) from the head of the Velký Trostinec valley, on the slope of Mt. Rivni (730—1000 meters alt.). The virgin forest here is without firs and spruces, only huge maples *(Acer pseudoplatanus)* are rather abundantly scattered. The virgin forest is not very dense, since windfalls and lightning provide for its thinning and old giants, with internally rotten trunks, at times break and fall. Strewn everywhere on the ground are fallen trunks of trees, centuries old; they quickly decompose under the continuous green moss carpet, and finally disappear, merging into the forest soil. The beech (and maple) leaf carpet covers the floor continuously, there are neither mosses nor lichens, only trunks and stumps are more or less overgrown with mosses. On vast areas of this virgin forest, in spite of the very humid climate, there is not a single herb, in other places again we find only a sparse undergrowth. *Lamium luteum* is the most abundant and the leading plant of the undergrowth, when the latter is developed at all. Besides there is a little of *Oxalis acetosella*, only rarely appear *Circaea alpina*, *Epilobium montanum*, *Athyrium filix femina* (in a small form), *Scrophularia nodosa*, but that usually is all. When a little of *Asperula odorata* occurs locally, it is already an approach to a richer type. In places, the scattered *Oxalis* is more abundant than *Lamium luteum* and rarely present are *Dryopteris pulchella* (small colonies), *Anemone nemorosa*, *Dentaria glandulosa*, in the higher zone also *Dentaria bulbifera*, *Viola silvatica*, and especially the characteristic *Ranunculus dentatus*.

The insufficient herbaceous undergrowth and mostly its total absence cannot be explained by the too deep shade, since the shade

on the one hand is not so very deep (the virgin forest is rather thin and in the spring bare), and on the other hand even in the openings we see only naturally seeded young beeches and with them a very sparse to almost no herbaceous undergrowth. Similarly the insufficiency of soil moisture is not the cause explaining the absence of an undergrowth, since we observe that the stumps and logs disappear rapidly and, further, I have found a furrow with a creek, certainly permanent, and yet even in this more humid furrow the higher moisture did not produce a more copious herbaceous growth; only a strip of a blackened leaf carpet indicated the edges of the creek and nearby grew only scattered *Lamium luteum!* In this case, the thick leaf carpet prevents a growth of herbs even in the humid climate (I would estimate the yearly rainfall at 1200 mm at least) and in such a manner an impoverished *Oxalis-Galeobdolon* type arises, decreasing to a complete suppression of any herbaceous undergrowth.

I described ([4], p. 20—22) also other instances of bare-floor and half-bare floor virgin beech forests from Subcarpathian Russia which seem to confirm the above explanation. There is, for instance above the head of the Bilina potok valley at an altitude of 1000 meters, such a virgin forest, in parts without any undergrowth and in other parts developed as a Fagetum nudum of the *Asperula-Galeobdolon-Oxalis* type; *Asperula odorata* is more abundant here than the two other leading species of approximately the same dominance. Of course, bare places, covered by a beech-leaf carpet, predominate; ground mosses are lacking, in the undergrowth young beeches and maples *(Acer pseudoplatanus* and *A. platanoides)* are scattered, together with rare *Sorbus aucuparia, Daphne mezereum* and *Rubus* sp. Besides, there are:

(Actaea spicata)
Adoxa moschatellina (only loc.)
Anemone nemorosa (only scat.)
Athyrium filix femina (rather ab. scat.)
(Doronicum austriacum)
(Dryopteris filix mas)
Dryopteris phegopteris (loc.)
Dryopteris pulchella (loc. scat.)
Epilobium montanum (only scat.)
Euphorbia carniolica (only scat.)
(Lactuca muralis)
(Paris quadrifolia)
(Polygonatum verticillatum)
(Polystichum lobatum)
(Pulmonaria obscura)
Ranunculus dentatus (loc. scat.)

(Salvia glutinosa, only in scat. col.)

Stellaria nemorum (scat.)
Symphytum cordatum (scat.)

6. There, where in a bare-floor beech forest a shrubby growth of young beeches is developed in larger or smaller groups, the continuous thick leaf carpet becomes disturbed and under the protection of these thickets a somewhat richer herbaceous undergrowth is formed. Some such instances I described from Subcarpathian Russia. For example, above the shepherd settlement, Stereša, at an altitude of about 1240 meters, I observed in these beech thickets usually the following species: *Asperula odorata* (rather abundantly scattered), *Anthriscus nitida* (scattered), *Euphorbia carniolica*, *Lamium luteum* (rather abundantly scattered), *(Lilium martagon)*, *Oxalis acetosella* (rather abundantly scattered), *Paris quadrifolia* (only scattered), *Polygonatum verticillatum* (only scattered), *Pulmonaria Filarszkyana* (col.), *Rubus* sp. (scattered), *(Rumex arifolius)*, *Stellaria nemorum* (scattered), *Symphytum cordatum* (scattered) and *Thalictrum aquilegiifolium* (abundantly scattered).

In the virgin beech forest of Mt. Rivni (see p. 142) we find in the young beech thickets, besides *Oxalis acetosella*, *Lamium luteum* and *Dryopteris pulchella*, also *Anemone nemorosa*, *Ranunculus dentatus*, *R. lanuginosus*, *Rubus* sp., *Salvia glutinosa*, *Symphytum cordatum*, and rarely *Actaea spicata* and *Paris quadrifolia*.

In the shrubby beech growth, loose to rather dense, in a half-bare-floor virgin beech forest above the head of the Bilina potok valley at an altitude of about 1000 meters, the following species were present: *(Actaea spicata)*, *Anemone nemorosa* (scattered), *Asperula odorata* (scattered), *Athyrium filix femina* (scattered in a small form), *(Circaea alpina)*, *(Doronicum austriacum)*, *Dryopteris filix mas* (scattered), *D. phegopteris* (scattered), *D. pulchella* (scattered), *Epilobium montanum* and *Lamium luteum* (scattered), *Oxalis acetosella* (scattered), *Polygonatum verticillatum* (scattered), *Polystichum Braunii* (only scattered), *Prenanthes purpurea* (scattered), *Rubus idaeus* (scattered), *(Rubus* sp.), *(Senecio nemorensis)*, *Stellaria nemorum* (scattered), *Veronica urticifolia* (scattered), only scattered is young *Acer pseudoplatanus*.

7. On the Mt. Velký Trábec near Nitra, from the 635 meters point up to the summit (829 meters alt.), pure beech forests, exceedingly poor and mostly without any ground vegetation, everywhere predomi-

nate. The causes for the absence of the herbaceous undergrowth are — not to speak of the leaf carpet — sundry: a) poor soil with but a little humus, b) great dryness of the slope, c) a rather deep shade, and d) game destroying the undergrowth. Fungi are abundant, often present are *Strobilomyces*, *Craterellus*, *Hydnum repandum* and many others; on dead trunks *Polyporus fomentarius* grows in great abundance. The herbaceous undergrowth mostly is entirely lacking; I came across some green vegetation only in one lighter place, close to some uprooted trunks, full of *Polipori*. *Sambucus nigra* grows here as well as *Stachys alpina*, *S. silvatica*, *Impatiens noli tangere*, *Senecio Fuchsii*, *Paris quadrifolia*, *Monotropa hypopitys* var. *hypophegea*, rarely *Asperula odorata*, scattered *Dentaria bulbifera*, but further in the dense beech forest we see again only a bare leaf carpet, only in the highest beech forest zone the ground vegetation increases but consists mainly only of *Mercurialis perennis* which occurs here very gregariously, and scattered are *Calamagrostis arundinacea* and *Glechoma hirsuta*.

We recognise this bare-floor beech forest, therefore, as a very impoverished stage of the woodruff sociation.

8. Also on the eruptive, comparatively dry soils of middle Slovakia, bare-floor or half-bare-floor beech forests are very frequent. R. M i k y š k a (1) describes them from the Štiavnické Středohoří Mts. and states that, on an average, more than 90% of the floor is devoid of any ground vegetation. Many species grow here with a diminished prosperity and occur usually isolated, only exceptionally in small clans *(Asperula odorata, Asarum europaeum, Mercurialis perennis, Oxalis acetosella)*. The individuals of these bare-floor beech forests usually occupy large areas in this territory; they occur mostly on sloping grounds covered by a thicker continuous leaf carpet, and on drier soils; but exceptions are not very rare. Even though the floristic composition seems to be more or less casual, it is evident that they are only impoverished types of beech forests common in the Štiavnické Středohoří Mts.

XIII. Degraded and spurious beech forests.

A detailed study of the beech forests in various parts of our state shows that normal beech forests under favourable conditions, even