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Notes on the terminology and classification of synanthropic plants; with examples from the Czechoslovak flora

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Résumé

L'auteur présente un aperçu de la classification des éléments phytogéographiques qui constituent la flore d'un pays au climat tempéré. Il définit les termes désignant ces éléments, en insistant tout spécialement sur ceux qui désignent les plantes synanthropiques. Il résume cette classification sous la forme de deux schémas. Les plantes citées en exemple pour illustrer ces définitions appartiennent à la flore de la Tchécoslovaquie.

Zusammenfassung

Eine Übersicht der phytogeographischen Einteilung der ursprünglichen und hauptsächlich der synanthropischen Flora ist zusammen mit Charakteristiken der behandelten Termini gegeben. Zugleich ein Versuch eines Klassifikatioonsschema der synanthropischen Flora ist vorgelegt. Beispielen aus der tschechoslowakischen Flora sind zu einzelnen Gruppen der ursprünglichen und der synanthropischen Flora hinzugefügt.

Summary

An analysis is made of the phytogeographical elements of a typical temperate flora, with special emphasis on an appropriate terminology; and a detailed scheme of classification of the synanthropic elements in such a flora is given. The survey is illustrated by examples from the indigenous and synanthropic flora of Czechoslovakia.

At the present time the flora of every region in Europe is under some influence of human activity; besides extinction of some plant taxa and quantitative changes in the distribution of taxa of the native fora, there is also an enrichment of the flora by taxa new for a given region, which migrated there owing to direct human activity. With increasing human influence the synan-

thropic part of the flora continues to become greater; it includes various classes, the designation and classification of which need a separate terminology and system. During the work on a unification of phytogeographic terminology – made together with Doc. Dr. V. JIRÁSEK, Praha (cf. HOLUB et JIRÁSEK 1967) – some proposals relating to the terminology and to the classification system of previous authors were taken into account. Our own proposals are accepted in the present paper with some minor corrections and supplements. The particular terms are shortly characterized in the following text and examples from the Czechoslovak flora are added to them.

From the point of view of the origin fo the flora it is possible to distinguish in the flora of a region 2 main groups:

1. **Autochthonous plants** which have arisen in that region (i. e. endemics as ortants of the region in question).

2. **Allochthonous plants** which migrated to that region from neighbouring or distant regions (migrants).

The number of real autochthonous plants is always, even in regions of Europe not much influenced by man, less than the number of allochthonous plants in the given region; only on some oceanic islands or in special regions may the percentage of endemics be relatively higher. The following taxa can be given as examples of autochthonous plants in the Czechoslovak flora: *Aconitum moldavicum* Reichenb.; *Campanula bohemica* Hruby; *C. gelida* Kovanda; *Cerastium alsinifolium* Tausch; *Daphne arbuscula* Čelak.; *Delphinium oxysepalum* Borb. et Pax; *Dentaria glandulosa* Waldst. et Kit.; *Dianthus hungaricus* Pers.; *D. nitidus* Waldst. et Kit.; *Erysimum wittmanii* Zawadski; *Jovibarba hirta* (Jusl.) Opiz subsp. *glabrescens* (Sabr.) Holub; *Koeleria tristis* Domin; *Onosma tornensis* Ják.; *Pedicularis sudetica* Willd. subsp. *sudetica*; *Plantago atrata* Hoppe subsp. *sudetica* (Pilger) Holub; *Poa granitica* Br.-Bl.; *P. riphaea* (Aschers. et Graebn.) Fritsch; *Pyrola carpatica* Holub et Křísa; *Sesleria tatrae* (Degen) Deyl; *Trifolium sarosiense* Hazsl. Further, at least some taxa of the Central-European floristic subelement belong here, as the area of their speciation (evolution) covered most probably also some parts of Czechoslovakia. As examples may be given: *Carex brizoides* Jusl.; *C. davalliana* Sm.; *Cimicifuga europaea* Šipč.; *Genista tinctoria* subsp. *tinctoria*; *Scabiosa canescens* Waldst. et Kit.; *Seseli hippomarathrum* Jacq.; *Tithymalus dulcis* (L.) Scop. subps. *dulcis*.

Allochthonous plants may be classed, according to the nature of their migration, as 1) **allochthonous spontaneous plants,** which migrated to a given territory by means of a natural, spontaneous migration, without the influence of man, and 2) **allochthonous anthropophytic plants** (aculotophytes), which reached that territory by a migration under the influence of man. Allochthonous spontaneous plants (autoimmigrants, idiochors, idiochorophytes) constitute a greater part of the Czechoslovak flora. To this group migrants from neighbouring (or rarely from distant) floristic regions belong, both as 1) members of floristic elements, subelements or conelements (incl. their penentrants, transsgressing from their floristic regions into surroundings – cf. HOLUB et JIRÁSEK 1967, 1968), limited by their distribution to a certain floristic region or to its part or to a group of floristic regions, and as 2) pluri-

regional taxa, the distribution of which does not show any distinct restriction to a certain floristic region(s).

In the following account, a survey of examples of floristic elements (from European territory) with their subelements and conelements (incl. penetrants) is given for the Czechoslovak flora:

Arctic floristic element: *Carex bigelowii* Schwein.; *C. vaginata* Tausch; *Pedicularis sudetica* Willd.; *Rubus chamaemorus* L.; *Saxifraga nivalis* L.

Boreal floristic element: *Carex chordorrhiza* Ehrh.; *Eleocharis mamillata* Lindb. f.; *Ledum palustre* L.; *Pedicularis sceptrum-carolinum* L.

Atlantic floristic subelement: *Aira praecox* L.; *Avenochloa pratensis* (L., restr. Holub) Holub; *Corynephorus canescens* (L.) P. Beauv.; *Dianthus seguieri* Vill. subsp. *glaber* Čelak.; *Festuca tenuifolia* Sibth.; *Galium hercynicum* Weigel; *G. sylvaticum* L.; *Illecebrum verticillatum* L.; *Lathyrus montanus* Bernh.; *Luronium natans* (L.) Raf.; *Pedicularis sylvatica* L.; *Polygala serpyllifolia* Hose; *Potentilla neumanniana* Reichenb.; *P. sterilis* (L.) Garcke; *Saxifraga granulata* L.; *Teesdalia nudicaulis* (L.) R. Br.; *Vulpia bromoidse* (L.) S. F. Gray.

Central-European floristic subelement: see above!

East-European floristic subelement: *Astragalus arenarius* L.; *Carex pediformis* C. A. Mey. subsp. *rhizodes* (Blytt) Lindb. f.; *Dianthus arenarius* L.; *Galium schultesii* Vest; *Jurinea cyanoides* (L.) Reichenb.; *Pulsatilla patens* (L.) Mill.

Promediterranean floristic subelement: *Calamintha officinalis* Moench em. Jord.; *Carex brevicollis* DC.; *Chrysopogon gryllus* (Torn.) Trin.; *Colutea arborescens* L.; *Convolvulus cantabrica* L.; *Cornus mas* L.; *Coronilla emerus* L.; *Cotinus coggygria* Scop.; *Crupina vulgaris* Cass.; *Danthonia alpina* Vest; *Echium italicum* L.; *Ferula sadlerana* Ledeb.; *Fumana procumbens* (Dun.) Gren. et Godr.; *Gasparrinia peucedanoides* (M. Bieb.) Thell.; *Lychnis coronaria* (L.) Desr.; *Orlaya grandiflora* (L.) Hoffm.; *Piptatherum virescens* (Trin.) Boiss.; *Potentilla micrantha* Ram.; *Sempervivum marmoreum* Griseb.; *Salvia aethiopis* L.; *Sorbus graeca* (Spach) Held.; *Stipa eriocaulis* Borb.; *S. pulcherrima* C. Koch; *Vicia sparsiflora* (Waldts. et Kit.) Ten.; *Waldsteinia geoides* Willd.; *Xeranthemum annuum* L.; *Xeroloma foetidum* (Moench) Cass.

Pontic floristic element: *Acer tataricum* L.; *Adonis vernalis* L.; *Amygdalus nana* L.; *Androsace maxima* L.; *Agropyron pectinatum* (M. Bieb.) P. Beauv.; *Astragalus austriacus* Jacq.; *Campanula sibirica* L.; *Carex stenophylla* Wahlenb.; *Crambe tatarica* Sebeok; *Echium russicum* J. F. Gmel.; *Eryngium planum* L.; *Festuca vallesiaca* Gaud.; *Iris arenaria* Waldst. et Kit.; *Linum flavum* L.; *Phlomis tuberosa* L.; *Potentilla arenaria* Borckh.; *Pseudolysimachion incanum* (L.) Holub; *P. spurium* (L.) Rauschert; *Ranunculus pedatus* Waldst. et Kit.; *R. polyphyllus* Waldst. et Kit.; *Rorippa austriaca* (Cr.) Bess.; *Salvia austriaca* Jacq.; *Spiraea crenata* L.; *Stipa dasyphylla* (Lindem). Trautv.; *S. rubens* P. Smirn. subsp. *glabrata* (P. Smirn.); *S. tirsa* Stev. restr. Martinovský et Skalický; *Taraxacum bessarabicum* (Hornem.) Hand.-Mazz.; *T. serotinum* Waldst. et Kit.; *Tithymalus pannonicus* (Host) Á. et D. Löve; *Triania ucrainica* Šišk.

Alpidic floristic element: *Androsace lactea* L.; *Avenochloa versicolor* (Vill.) Holub; *Campanula pusilla* Haenke; *Carex atrofusca* Schkuhr; *C. sempervirens* Vill.; *Festuca versicolor* Tausch; *Gentiana acaulis* L.; *G. clusii* Perr. et Song.; *Kernera saxatilis* (L.) Reichenb.; *Petrocallis pyrenaica* (L.) R. Br.; *Primula minima* L.; *Ranunculus oreophilus* M. Bieb.; *R. thora* L.; *Saussurea pygmaea* (Jacq.) Spreng.; *Sibbaldia procumbens* L.

Arcto – Alpidic conelement: *Anthoxanthum nipponicum* Honda; *Athyrium distentifolium* Opiz; *Diphasium alpinum* (L.) Rothm.; *Dryas octopetala* L.; *Luzula spicata* (L.) Lam. et DC.; *Ranunculus pygmaeus* Wahlenb.; *Selaginella selaginoides* (L.) Link; *Tofieldia pusilla* (Michx.) Pers.

Boreal – Atlantic conelement: *Juncus squarrosus* L.

Boreal – Central-European conelement: *Carex limosa* L.; *Gentiana asclepiadea* Scop.; *Gypsophila fastigiata* L.; *Juncus filiformis* L.; *Picea abies* (L.) Karst.; *Viola palustris* L.

Boreal – East-European conelement: *Conioselinum vaginatum* (Spreng.) Thell.; *Stellaria longifolia* Muehlenb.

Atlantic – Central-European conelement: *Genista pilosa* L.

Atlantic – Mediterranean conelement: *Ceterach officinarum* Lam. et DC.; *Colobium saxatile* (Lam.) Holub; *Equisetum telmateia* Ehrh.; *Lotus uliginosus* Schkuhr; *Polypodium interjectum* Shivas.

Central-European – East-European conelement: *Acer platanoides* L.; *Digitalis grandiflora* Mill.; *Galeobdolon luteum* Huds. restr. Holub; *Glyceria nemoralis* (Uechtr.) Uechtr. et Körn.; *Potentilla alba* L.

Central-European – Pontic conelement: *Melica picta* C. Koch.

Pontic – Mediterranean conelement: *Echinops ruthenicus* M. Bieb.

As examples of **pluriregional** taxa, i.e. taxa not limited to a certain floristic region or to a group of floristic regions, the following species can be given: *Agrostis canina* L.; *Botrychium lunaria* L.; *Chamerion angustifolium* (L.) Holub; *Cypripedium calceolus* L.; *Equisetum arvense* L.; *Huperzia selago* (L.) Schrank et Mart.; *Juncus bufonius* L.; *Lotus corniculatus* L.; *Luzula multiflora* (Retz.) Lej.; *Majanthemum bifolium* (L.) F. W. Schmidt; *Pteridium aquilinum* (L.) Kuhn; *Typha latifolia* L.

According to the way in which the occurrence of a plant taxon is related to man's influence, 2 groups can be distinguished in the flora of a territory, viz. hemerophilous and hemerophobous plants. **Hemerophilous plants** (= synanthropophytes) are indigenous or alien plants, the occurrence of which in the territory is supported by the economic activity of man; **hemerophobous plants** are represented only by indigenous (native) plants, the occurrence of which is harmed by man's activity. As a result of such a process **anthropofugous relics** may originate, i.e. taxa, the distribution-area of which has been largely minim-

ized under man's influence (e. g. *Thesium ebracteatum* Hayne). Hemerophilous plants are of two kinds: **apophytes** (indigenous hemerophilous plants) and **anthropophytes** (immigrated hemerophilous plants). LINKOLA (1916) distinguished in addition to the two groups mentioned above a further one, i.e. **hemeradiophores** – indigenous species the occurrence of which in the territory in question is not distinctly influenced by human activity either in the positive or the negative sense; to class a species with this "neutral" group is difficult, if possible at all, and it requires in every case many years' experience of the taxon in the territory under consideration. To designate the various degrees of hemerophily, the following terms (on a rising progression) can be used: ahemerophilous (plants are not affected by man), oligohemerophilous, mesohemerophilous, euhemerophilous, and panhemerophilous (the occurrence of such plants is wholly dependent on man's activity). As to their content identical terms were proposed by JALAS (1955) – panhemerophobous, euhemerophobous, mesohemerophobous, oligohemerophobous, and ahemerophobous, and later also by FALIŃSKI (1966) – praesynanthropic, protosynanthropic, polysynanthropic, metasynanthropic, and pansynanthropic.

Autochthonous and spontaneous allochthonous plants constitute the group of **indigenous** (native) **plants**. According to the relation of their occurrence to human activity, indigenous plants can be divided into proanthropophytes, apophytes and hemeroapophytes. The occurrence of **proanthropophytes** is related (in the territory in question) to natural and seminatural ecotopes and their distribution does not markedly increase or decrease under man's influence; this group corresponds to the hemeradiophores mentioned above. When classifying taxa in this group the intensive and long-term-influence of man on the landscape has to be appreciated especially, when new ecotopes have been formed, often with an indigenous flora (for example, pastures with xerothermic flora, derived from local wood-steppe phytocoenoses; fish-ponds with an aquatic flora from natural waters in the neighbourhood; quarries with a flora from neighbouring rocks and screes, etc.). Such examples are justifiably classified with the spontaneous flora and spontaneous vegetation; the term "semi-natural" can be used for their designation (see also later). Taxa of such a spontaneous flora may be justifiably considered as proanthropophytes. The group of **apophytes** includes autochthonous and spontaneous allochthonous taxa which moved from natural and seminatural ecotopes in a given territory to distinctly secondary, i. e. artificial ecotopes formed under the influence of man (e. g. fields, gardens, waste places in towns, roadsides, etc.). **Hemeroapophytes** (cultivated indigenous plants) include plants taken over by man from the local flora into cultivation.

The process of **apophytisation** (i. e. the formation of an apophyte) varies from species to species. In some species it has reached such a degree that they occur in certain parts of their distribution-area (or even over their whole range) only in secondary, artificial ecotopes; in other species the extent of their occurrence in natural and seminatural ecotopes and that in artificial ecotopes is very similar; in another species the occurrence in artificial ecotopes is very rare and they occur predominantly in natural or seminatural ecotopes. Apophytes which occur in a territory both in artificial and in natural or seminatural ecotopes are called **autapophytes** (facultative apophytes). The autapophytes of a certain territory can be divided with respect to the degrees of the apophy-

tisation (i. e. their adaptation to artificial ecotopes shown by an increasing proportion of their localities in articificial habitats) into **micro-** (rare occurrence in artificial ecotopes), **meso-** (± equal occurrence in natural or seminatural ecotopes and in artificial ones) and **macroautapophytes** (= euapophytes PREUSS 1930 – occurrence mainly in artificial ecotopes.) The ultimate degree of the apophytisation process is a **deuteroapophyte** (obligatory apophyte), the occurrence of which in the given territory is confined to artificial ecotopes only.

As examples of autapophytes the following species can be given from the Czechoslovak flora: *Androsace elongata* L.; *Cerastium holosteoides* Fr.; *Elytrigia repens* (L.) Desv.; *Equisetum arvense* L.; *Salsola iberica* Sennen et Pau; *Veronica sublobata* M. Fischer. Examples of individual stages of the apophytisation process: microautapophytes: *Acinos arvensis* (Lam.) Dandy; *Carduus crispus* L.; *Ceterach officinarum* Lam. et DC.; *Phyllitis scolopendrium* (L.) Newm.; *Potentilla norvegiva* L.; *Sagina saginoides* (L.) Karst.; mesoautapophytes: *Alliaria petiolaris* (M. Bieb.) Cavara et Grande; *Arenaria serpyllifolia* L.; *Cerinthe minor* L.; *Chamerion dodonaei* (Vill.) Holub; *Chelidonium majus* L.; *Geum urbanum* L.; *Gypsophila muralis* L.; *Hippochaete ramosissima* (Desf.) Bruhin; *Lappula squarrosa* (Retz.) Dum.; *Linum austriacum* L.; *Nonea pulla* (L.) DC.; *Puccinellia distans* (Jacq.) Parl.; *Rorippa sylvestris* (L.) Bess.; *Tanacetum vulgare* L.; *Torilis japonica* (Houtt.) DC.

The autapophytes occurring in secondary habitats ecologically very similar to natural or seminatural ecotopes (as in roadsides, ruins, walls, lawns (may be designated after PREUSS (1930) as **hemiapophytes**. Examples: *Agrostis stolonifera* L.; *Chamerion angustifolium* (L.) Holub; *Chaenorrhinum minus* (L.) Lange; *Poa compressa* L.; *Prunella vulgaris* L.; *Ranunculus bulbosus* L.

SIMMONS (1910) divided autapophytes with respect to the character of their secondary habitats into **kenapophytes** (autapophytes occurring on neopedon, i. e. new anthropogenous soils), **leimapophytes** (anthropogenous meadows and lawns), **ergasioapophytes** (fields, gardens) and **chomapophytes** (waste places). This classification does not exhaust all possible cases; for example autapophytes of cultivated woods and those of mountains have been not at all mentioned; perhaps the terms **deuterohyloapophytes**, and **oreoapophytes** respectively, may be used in these cases. Many apophytes are not limited only to one type of artificial habitat in a region and therefore the use of SIMMONS's classification is suitable only in individual cases when the taxon in the territory in question is limited to a certain type of secondary or artificial ecotope.

As examples of deuteroapophytes (deuterophytes; chomapophytes; chomaphytes) the following species can be given: *Arctium minus* (Hill) Bernh.; *Asperugo procumbens* L.; *Ballota nigra* L.; *Capsella bursa-pastoris* (L.) Med.; *Chenopodium ficifolium* Sm.; *Ch. glaucum* L.; *Lamium purpureum* L.; *Leonurus cardiaca* L.; *Marrubium vulgare* L.; *Poa annua* L.; *Stachys arvensis* L. Sometimes it is very difficult to decide whether a species in a certain region is an ancient introduction or whether it represents a deuteroapophyte. Also, distinguishing primary and secondary occurrence is very difficult in species which have become deuteroapophytes under the influence of a strong apophytisation near the limits of their natural occurrence (e. g. at the limit to North); examples: *Eragrostis pilosa* (L.) P. Beauv.; *Tragus racemosus* (L.) All.; *Tribulus terrestris* L.

Some authors (PREUSS 1930; WIDDER 1947) used the term "seeming apophytism" (as "Scheinapophytie") for cases where a plant persists as a relic of previous natural or seminatural phytocoenoses in a new artificial ecotope by means of its underground organs (e. g. *Epipactis helleborine* (L.) Cr., *Orobanche elatior* Sutton, *Phragmites communis* Trin. and *Stachys palustris* L. in fields). The term **pseudo-apophyte** may be used in these cases; sometimes in the subsequent evolution of the vegetation it is, however, not possible to distinguish such cases precisely from real apophytism (for example in *Phragmites communis* and *Stachys palustris*).

Examples of hemeroapophytes (cultivated indigenous plants); *Carum carvi* L.; *Pastinaca sativa* L.; *Pinus cembra* L.; *P. pumilio* Haenke; *Scorzonera hispanica* L. Hemeroapophytes can be divided into **oekiophytes** (plants directly cultivated, e. g. plants of *Carum carvi* in a field; new cultures of *Pinus cembra* in Tatra-mountains), **oekiophygophytes** (naturalized, escaped oekiophytes, e. g. *Armoracia lapathifolia* Usteri, *Polemonium coeruleum* L., *Sorbus domestica* L., *Viola odorata* L.) and oekiolipophytes (relics of cultures of oekiophytes, for example some ornamental plants as *Galanthus nivalis* L., *Leucoium vernum* L., etc.). The occurrence of *Libanotis montana* Cr. and *Valeriana officinalis* L. s. l. in the neighbourhood of old castles may perhaps originate from the latter group.

In some cases the term **holapophytes** may be used to designate plants native in the region in question which occur only as weeds of cultivation, their primary distribution-area not having been preserved, or to designate plants which have arisen de novo in the cultures (for example linicolous weeds).

Allochthonous anthropophytic plants (or shortly anthropophytes) can be divided according to the type of their immigration to a region into *a)* allochthonous cultivated plants, *b)* plants which have escaped from cultivation and *c)* introduced plants. Allochthonous cultivated plants are grown by man intentionally and originate from alien regions; escaped plants are derived from cultures of allochthonous cultivated plants; introduced plants have been brought into a region by human activity unintentionally, for example by transport, trade, war, etc.

According to the ways in which anthropophytic plants ("aliens") have been introduced into a territory, they can be divided into 2 main groups: hemerophytes and xenophytes. **Hemerophytes** include plants which originally were brought into the region in question from other regions by man intentionally, and the subgroups of plants derived from this original group (see later). **Xenophytes** (adventive plants) are represented by plants which were introduced by man unintentionally.

Hemerophytes come to a region as plants for growth in cultivation (utility plants, ornamental plants, etc.), for which man has created special ecotopes. Such plants are designated as **ergasiophytes**. The following examples can be given: utility plants – *Beta vulgaris* L.; *Fragaria ananassa* Duch.; *Papaver somniferum* L.; spices – *Foeniculum vulgare* Mill.; *Levisticum officinale* Koch; *Majorana hortensis* Moench; fodder plants – *Medicago sativa* L.; *Trifolium pratense* L.; bee-keeping plants – *Leonurus quinquelobatus* Gilib.; *Phacelia tanaceti-*

folia Benth.; plants for soil improvement – *Lupinus polyphyllus* Lindl.; *Sarothamnus scoparius* (L.) Wimm.; ornamental plants – *Calystegia pulchra* Brummitt et Heywood; *Forsythia suspensa* (Thunb.) Vahl; *Fritillaria imperialis* L.; *Gingko biloba* L.; *Impatiens glandulifera* Royle; *Paeonia officinalis* L.; *Primula hortensis* Wettst., etc.

According to the origin and time of introduction, it is possible to distinguish among ergasiophytes 2 groups: **archaeoergasiophytes** (old cultivated plants) and **neoergasiophytes** (plants cultivated recently). Among archaeoergasiophytes, primary and secondary archaeoergasiophytes may be distinguished. **Primary archaeoergasiophytes** are plants which have long been in cultivation and whose origin has not been adequately explained until the present time; they consist in part of **anthropogenous relics** (plants brought into cultivation by man from natural habitats where they no longer occur). Examples of primary archaeoergasiophytes: *Cucurbita pepo* L.; *Nicotiana tabacum* L.; *Papaver somniferum* L.; *Persica vulgaris* Mill.; *Triticum aestivum* L.; *Zea mays* L. **Secondary archaeoergasiophytes** are cultivated plants which have arisen from weeds of cultures of primary archaeoergasiophytes, e. g. *Avena sativa* L.; *Camelina sativa* (L.) Cr.; *Secale cereale* L. As examples of neoergasiophytes (some of them no longer extensively cultivated in Czechoslovakia) following species can be mentioned: *Eucommia ulmoides* Oliv.; *Euonymus verrucosa* Scop.; *Pinus strobus* L.; *Pseudotsuga menziesii* (Mirbel) Franco; *Taraxacum bicorne* Dahlst.

In the region of their cultivation ergasiophytes can escape; such plants may be designated as **ergasiophygophytes**; as examples of ephemeral, but repeatedly escaping plants, the following species may be mentioned: *Avena sativa* L.; *Secale cereale* L.; *Zea mays* L. More persistent escapes are: *Ailanthus altissima* (Mill.) Swingle; *Calystegia pulchra* Brummitt et Heywood; *Civerbita macrophylla* (Willd.) Wallr.; *Cotinus coggygria* Scop.; *Cymbalaria muralis* Gaertn., Meyer et Scherb.; *Digitalis purpurea* L.; *Fagopyrum esculentum* Moench; *Heracleum mantegazzianum* Somm. et Lev.; *Humulus lupulus* L.; *Impatiens glandulifera* Royle; *Kochia scoparia* (L.) Schrad.; *Laburnum anagyroides* Med.; *Leonurus quinquelobatus* Gilib.; *Lolium multiflorum* Lam.; *Melissa officinalis* L.; *Parthenocissus quinquefolia* (L.) Planch.; *Physocarpus opulifolius* (L.) Maxim.; *Platycladus orientalis* (L.) Franco; *Pyrethrum parthenium* (L.) Sm.; *Reynoutria japonica* Houtt.; *Rudbeckia laciniata* L.; *Sarothamnus scoparius* (L.) Wimm.; *Sedum spurium* M. Bieb.; *Solidago canadensis* L.; *S. pitcheri* Nutt. s. l.; *Sorbus domestica* L.; *S. intermedia* (Ehrh.) Pers.; *Spiraea salicifolia* L.; *Symphoricarpus rivularis* Suksd.; *Syringa vulgaris* L.; *Veronica filiformis* Sm.; *Vinca minor* L.

Some allochthonous cultivated plants have persisted in a region after their cultivation has ceased; they are designated as **ergasiolipophytes**. Such occurrence represent in fact relics of previous cultivation. From various districts of Czechoslovakia the following examples can be given: *Asclepias syriaca* L.; *Brunnera macrophylla* (M. Bieb.) Johnst.; *Borago officinalis* L.; *Cardamine chelidonia* L.; *Cicerbita macrophylla* (Willd.) Wallr.; *Collomia grandiflora* Dougl.; *Elsholtzia ciliata* (Thunb.) Hyl.; *Glycyrrhiza glabra* L.; *Isatis tinctoria* L.; *Lycium halimifolium* Mill., etc. The possibility is not excluded that some species considered at present as more or less indigenous members of our flora may also have originated in this way more previously, as for example: *Agrimonia*

procera Wallr.; *Crocus albiflorus* Kit.; *Echinops sphaerocephalus* L.; *Malva alcea* L.; *Nasturtium* × *sterile* (Airy Shaw) Oefelein; *Rumex patientia* L.; *Smyrnium perfoliatum* L.; *Spiraea salicifolia* L., etc.

From populations of acclimatized ergasiophytes a further extension of their secondary distribution-area can proceed, often independent of human activity; at the same time some of them penetrate into phytocoenoses of natural and seminatural ecotopes; by this process the natives flora is enriched by new and persistent species. This process of naturalisation of hemerophytes brings them very close to the neoindigenophytes, which have originated from xenophytes; in many individual cases the differences in origin between naturalized (= subspontaneous) plants can hardly be defined, and therefore it seems to be most convenient to designate such naturalized plants which have originated from hemerophytes (with respect to their occurrence in natural or seminatural phytocoenoses of the local flora) also as neoindigenophytes and to limit the use of the terms ergasiophygophyte and ergasiolipophyte only to the quite clear cases of escaped ergasiophytes, and to relics of the cultivation of ergasiophytes. As a common term for ergasiophygophytes and ergasiolipophytes, **apohemerophytes** can be used.

A special group of synanthropic plants (ergasiophytes) is represented by taxa, which were intentionally (for romantic reasons) sown or cultivated in natural or seminatural phytocoenoses in order to enrich the native flora. In Bohemia *Linum austriacum* L. belongs here; this species has later become widely distributed in the hill-country České Středohoří. Other such species have persisted in a particular locality for a long time – e. g. *Psephellus dealbatus* (Willd.) C. Koch and *Chionodoxa luciliae* Boiss. in the hill Velká Hora near Karlštejn; *Astrodaucus orientalis* (L.) Drude at the village Chuchle near Prague, etc. The occurrences of *Rhododendron* sp. div. in various Czechoslovak mountains are of similar origin.

Xenophytes (= colonists, adventive plants), i. e. plants not intentionally introduced to the region in question, can be divided – according to the period of their introduction into 2 groups: archaeophytes and neophytes.

Archaeophytes (archaeosynanthrops, archaeosynanthropophytes) are plants which were brought into a region in prehistoric times and have become well-established (naturalized). These species are mostly weedy, e. g. *Agrostemma githago* L.; *Bromus secalinus* L.; *Camelina macrocarpa* Andrz.; *Cuscuta epilinum* Weihe; *Cyanus segetum* Hill; *Fallopia convolvulus* (L.) Á. Löve; *Galium tricornutum* Dandy; *Kickxia elatine* (L.) Dum.; *K. spuria* (L.) Dum.; *Lithospermum arvense* L.; *Lolium temulentum* L.; *Papaver rhoeas* L.; *Portulaca oleracea* L.; *Vaccaria hispanica* (Mill.) Rauschert, etc.

Neophytes (neosynanthrops, neosynanthropophytes, agroneophytes) are xenophytes introduced in historical times (usually in the period after the 15th century), often quite recently; in the region of their secondary distribution they are either well-established or they occur only temporarily, as ephemerals. They can be divided into 3 groups, as follows, according to the constance of their occurrence and the character of their occurrence in artificial or natural or seminatural phytocoenoses.

1. **Ephemerophytes** (passants): plants introduced usually into secondary ecotopes where their occurrence, because of various unfavourable conditions, is only transitory. Examples: *Abutilon theophrastii* Med.; *Acrolophus diffusus* (Lam.) Á. et D. Löve; *Brassica persica* Boiss. et Hohen.; *Bromus briziformis* Fisch. et Mey.; *Brunnera macrophylla* (M. Bieb.) Johnst.; *Camelina rumelica* Velen.; *Consolida loscosii* (Costa) Holub; *Ecballium elaterium* (L.) A. Rich.; *Echinochloa hostii* (M. Bieb.) Link; *Ellisia nyctelea* L.; *Gypsophila perfoliata* L.; *Helminthia echioides* (L.) Gaertn.; *Hirschfeldia incana* (Jusl.) Lagr.-Ross.; *Lobularia maritima* (L.) Desv.; *Nicotiana rustica* L.; *Parentucellia viscosa* (L.) Caruel; *Sinapis dissecta* Lag.; *Xanthoxalis corniculata* (L.) Small, etc.

Ephemeral occurrences can be found also in species of our native flora (e. g. *Lathyrus aphaca* L.; *Wolffia arrhiza* (L.) Wimm.), in escaped ergasiophytes (for example in annual cereals mentioned above), in microautapophytes, etc. These cases should, however, not be designated as ephemerophytes.

2. **Epoecophytes**: plants introduced in a region in secondary ecotopes, which persist in these habitats as long as they are under man's influence. As examples of this very rich group of Czechoslovak flora, the following may be quoted: *Amaranthus albus* L.; *A. blitoides* S. Watson; *A. chlorostachys* Willd.; *A. crispus* (Lesp. et Thév.) Terrac.; *Ambrosia elatior* L.; *Artemisia annua* L.; *A. sieversiana* Willd.; *Atriplex nitens* Schkuhr; *Bunias orientalis* L.; *Cardaria draba* (L.) Desv.; *Chenopodium botrys* L.; *Ch. pumilio* R. Br.; *Consolida orientalis* (Gay) Schrödinger; *Cuscuta campestris* Yuncker; *C. trifolii* Babingt.; *Elsholtzia ciliata* (Thunb.) Hyl.; *Erucastrum gallicum* (Willd.) O. E. Schulz; *E. nasturtiifolium* (Poir.) O. E. Schulz; *Galinsoga ciliata* (Raf.) Blake; *G. parviflora* Cav.; *Iva xanthifolia* Nutt.; *Lepidium virginicum* L.; *Matricaria matricarioides* (Less.) Porter; *Orobanche cumana* Wallr.; *O. ramosa* L.; *Rumex patientia* L.; *R. triangulivalvis* (Danser) Rech. f.; *Senecio vernalis* Waldst. et Kit.; *Silene dichotoma* Ehrh.; *Stenactis annua* (L.) Nees; *S. strigosa* (Muehlenb.) DC.; *Vicia pannonica* Cr.; *Virga strigosa* (M. Bieb.) Holub; *Xanthoxalis dillenii* (Jacq.) Holub, etc.

The occurrence of some epoecophytes in a region is very constant, as secondary ecotopes have become constant because of the increasing degree of man's influence on the landscape.

3. **Neoindigenophytes** (xenoagriophytes): this group includes taxa well-established and naturalized in the given region which occur in artificial ecotopes and phytocoenoses and which penetrate from there into natural or seminatural ecotopes. Some of these species occur only in natural or seminatural phytocoenoses (e. g. *Sisynrichium montanum* agg.; water plants). Examples: *Allium paradoxum* Don, *Azolla filiculoides* Lam.; *Bidens frondosus* O.; *Conyza canadensis* (L.) Cronq.; *Cuscuta campestris* Yuncker; *Echinocystis lobata* (Michx.) Torr. et Gray; *Elodea canadensis* (Michx.) L. C. Rich.; *Epilobium adenocaulon* Hausskn.; *Erechthites hieraciifolium* (L.) Raf.; *Erica tetralix* L.; *Geranium pyrenaicum* Burm. f.; *Helianthus decapetlus* L.; *Impatiens glandulifera* Royle; *I. parviflora* DC.; *Malcolmia africana* (L.) R. Br.; *Mimulus guttatus* DC.; *Sicyos angulata* L.; *Sisyrinchium montanum* agg.; *Stenactis annua* (L.) Nees; *S. strigosa* (Muehlenb.) DC.; *Veronica filiformis* Sm.; *Xanthium canadense* agg.; *Xanthoxalis fontana* (Bunge) Holub, etc. Kornaś (1968) divided agriophytes (which cor-

respond to neoindigenophytes of this paper) into **holoagriophytes** (occurring in natural ecotopes) and **hemiagriophytes** (in seminatural ecotopes). However, this division seems unnecessary to the present author.

For alien plants which have escaped from cultivation or have become naturalized in a region the term **subspontaneous** has often been used.

The term neophyte originally used by THELLUNG (1915) for naturalized plants not lately introduced in a certain region has been sometimes used for neoindigenophytes. For the concept of neophyte as accepted in the present paper KORNAŚ (1968) created a new term – **kenophyte**. Neophytes (as mostly naturalized plants) were recently divided from a biological-phytocoenological point of view by FALIŃSKI (1968) into four groups, viz. proneophytes, euneophytes, paraneophytes and postneophytes. **Proneophytes** are represented by plants not well-established in natural or seminatural ecotopes, with not a complete reproduction-cycle (such plants correspond mainly to our ephemerophytes); **euneophytes** are plants well-established in natural or seminatural ecotopes, with a complete reproduction-cycle; **paraneophytes** are also well-established in natural or seminatural ecotopes, bu they propagate only by vegetative means; **postneophytes** are plants completely established, and which have changed original coenoses into new ones. Such phytocoenoses may be designated, following Faliński's proposal (FALIŃSKI 1968, 1969) as **xenospontaneous**. This highest degree of naturalisation of some neoindignenophytes is related to their aggressiviness; examples of such aggressive neoindigenophytes are: *Aster* sp. div.; *Echinocystis lobata*; *Helianthus* sp. div.; *Impatiens glandulifera*; *Veronica filiformis,* etc.

Epoecophytes and neoindigenophytes may be grouped together, in contrast to ephemerophytes, as **statophytes**.

In compiling this classificatory scheme the following facts have been considered: the influence of man's activity; the native character of the occurrence of plants in the region studied; the adaptation of plants to artificial ecotopes; the penetration of alien plants into spontaneous vegetation; the degree of naturalisation. It must be pointed out that some divisions of the classification accepted here are very close together and that some taxa can belong, in various parts of their secondary area (or even in various localities of the same district), or in various periods of their migration history, to various groups. So for example the historical stages of the occurrence of *Impatiens glandulifera* Royle, *Solidago pitcheri* Nutt. s. l. or *Veronica filiformis* Sm. in some parts of Central Europe can be designated as follows: ergasiophyte, ergasiophygophyte, ergasiolipophyte; in other regions as: (ephemerophyte), epoecophyte, neoindigenophyte. Water and marsh plants can immediately become neoindigenophytes.

A contrast to the process of apophytisation of plants in the area of their native occurrence is the process of adaptation of alien plants in their secondary distribution-area leading to the full naturalisation in particular regions. The

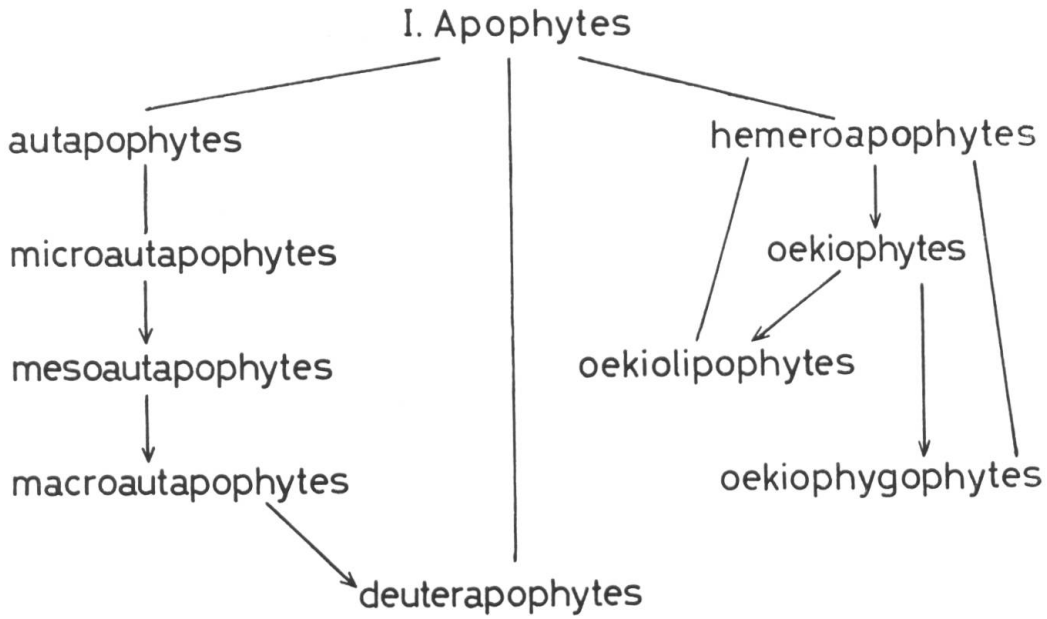
process of naturalisation usually passes gradually from a casual escape (ephemerous ergasiophygophytes), through a rather persistent occurrence in artificial ecotopes (epoecophytes; archaeophytes; ergasiophygophytes; ergasiolipophytes) to a permanent establishment in the region in question (epoecophytes; neoindigenophytes; archaeophytes; ergasiophygophytes; ergasiolipophytes). The naturalisation of a xenophyte can be designated as a **xenonaturalisation**, that of a hemerophyte as a **hemeronaturalisation** (= acclimatisation).

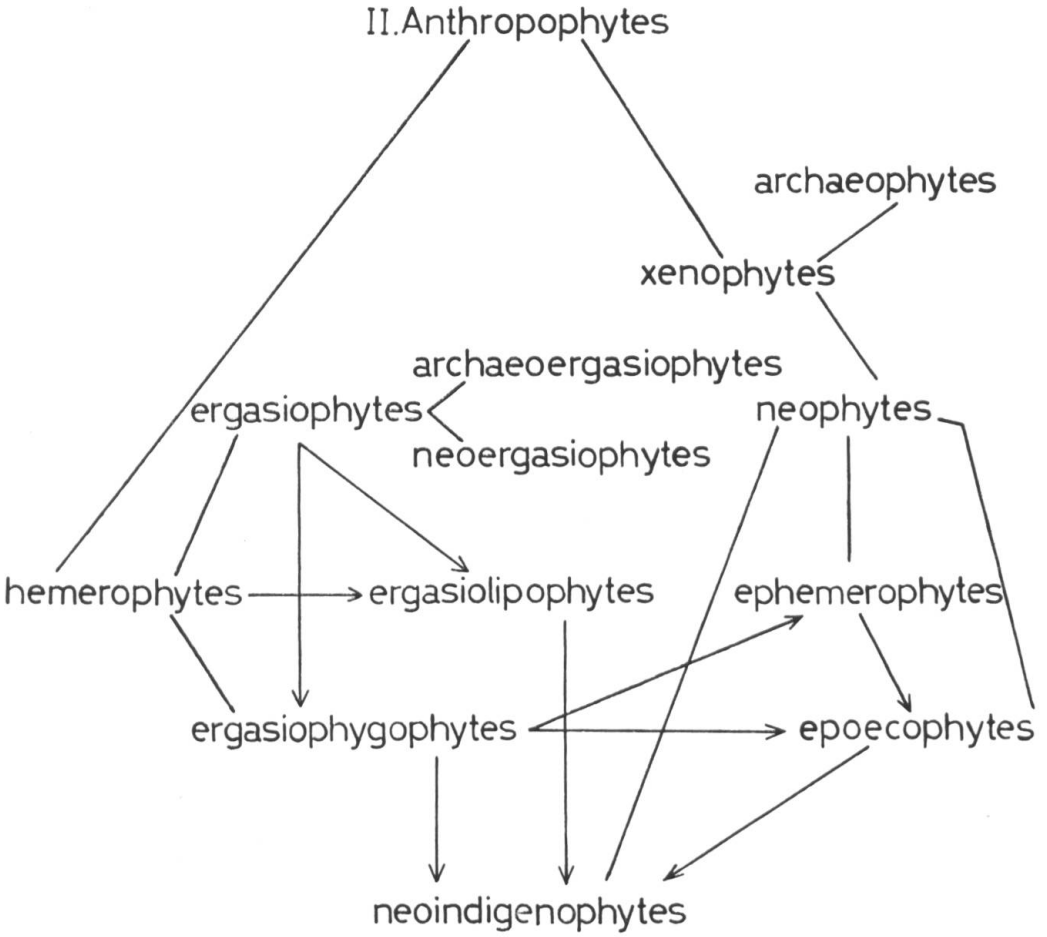
In cases of the constant occurrence of a synanthropic species in a region, but in temporary ecotopes, the term **vagant** may be used for its designation (e. g. *Hyoscyamus niger* L.).

According to the character of the ecotopes of synanthropic plants 2 groups may be distinguished, viz. **segetals** (occurring in corn-fields; = agrophytes, agrestals; examples: *Adonis aestivalis* L.; *Consolida regalis* S. F. Gray; *Galium parisiense* L.; *G. tricornutum* Dandy, etc.) and **ruderals** (occurring in waste places in the neighbourhood of man's settlements, i. e. in places under intensive human influence, but not with a cultivated soil; = chersophytes, chomophytes; examples: many species of *Amaranthus* L., *Atriplex* L., *Chenopodium* L., etc.). According to the mode of survival of seeds during winter, segetals may be divided in some cases into **agrochimophytes** (segetals persisting in the locality by diaspores in the soil) and **tameiochimophytes** (segetals with diaspores which survive the winter period mixed with seed of the crop to be sown). For segetal plants occupying a position between archaeophytes and neophytes the term **hemiagroneophyte** has been sometimes used.

Because it is necessary in order to classify plants in some of the above groups, to consider whether their occurrence is in natural, seminatural, or artificial ecotopes (or phytocoenoses), same clarification of the terminology is necessary. **Natural** (or **primary**) ecotopes are those without any distinct influence of man – for example rocks, some types of woods (virgin woods), localities in the alpine belt, etc. The phytocoenoses of such ecotopes correspond to various types of climax-phytocoenoses. All other ecotopes (phytocoenoses) are **secondary**. Among secondary ecotopes two main types should be distinguished: seminatural and artificial ecotopes; the distinction between them lies mainly in the degree and constancy of human influence. If this influence is persistent and results in changes of the flora by introduction or by bringing in plants of alien origin, such ecotopes should be designated as **artificial** (e. g. fields, gardens, waste places, roadsides, cultivated woods, etc.). But if new ecotopes which have originated under human influence have been spontaneously colonised by a native flora and human influence is temporary and not fundamental (as it is for example in wood-clearings, pastures, meadows), such ecotopes can be designated as **seminatural**. The phytocoenoses of seminatural ecotopes represent mainly characteristic substitute phytocoenoses of the given natural phytocoenoses.

To conclude the following survey of classification of synanthropic plants can be given:


I. Apophytes
autapophytes
microautapophytes
mesoautapophytes
macroautapophytes
deuterapophytes
hemeroapophytes
oekiophytes
oekiolipophytes
oekiophygophytes


II.Anthropophytes
archaeophytes
xenophytes
archaeoergasiophytes
ergasiophytes
neoergasiophytes
neophytes
hemerophytes
ergasiolipophytes
ephemerophytes
ergasiophygophytes
epoecophytes
neoindigenophytes

For special purposes, the anthropophytic flora can be classified from several different points of view:

according to the type of introduction: hemerophytes and xenophytes

according to the age of introduction: archaeophytes (+ archaeoergasiophytes) and neophytes (+ neoergasiophytes)

according to persistence of the introduction: ephemerophytes and statophytes (+ archaeophytes)

according to the character of the ecotopes: epoecophytes and neoindigenophytes.

For statistical purposes the anthropophytic flora can be divided into the 5 following groups: ergasiophytes, archaeophytes, ephemerophytes, epoecophytes and neoindigenophytes.

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