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Rubus xanthocarpus from China, a new naturalized species in Czechoslovak flora

Rubus xanthocarpus z Číny, nový zdomácnělý druh československé květeny

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Holub J.[1]) et L. Palek[2]) (1981): *Rubus xanthocarpus* from China, a new naturalized species in Czechoslovak flora. — Preslia, Praha, 53 : 9—32.

A case of naturalization of the Chinese species *Rubus xanthocarpus* Bureau et Franch. in Central Bohemia is discussed. A description of the locality (loess ravine at Zeměchy near Kralupy, N of Prague) and established population (with c. 25,000 individuals) is given. The paper contains a detailed description of Bohemian plants; this description is compared with descriptions given in the literature as well as with herbarium material from the autochthonous distribution area and is supplemented by some observations on the morphology (e.g. inflorescence). The taxonomic position of the species (an isolated taxon in subg. *Cylactis*, belonging to a separate monotypical series) and its relationship are discussed. The autochthonous distribution area is described; the species is confined to the mountains of Central China (mostly provinces of Szechwan and Kansu). A special attention is paid to the history of its introduction, preferentially to the possible origin of the naturalized population in Central Bohemia. An earlier secondary occurrence in West Germany is mentioned. There are also notes on the particular position of *Rubus xanthocarpus* in the phylogeny of the genus.

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INTRODUCTION

An unknown species of *Rubus* was found by several botanists in an interesting locality "Rokle u Zeměch" (Ravine at Zeměchy, Central Bohemia, a nature reserve). The collected material remained undetermined in their private herbaria for a long time. The first find is perhaps that by V. Skalický on the 5th of August 1962; later he paid two visits to the same locality and collected specimens of this *Rubus*, however, for our revision only his material of 1975 was available. Another find (independent of that by V. Skalický) is by A. Roubal who studied the xerothermous flora of the locality jointly with J. Martinovský on the 27th of September 1971. The material, being collected in autumn, lacks any remnants of flowers and fruits. Because of incomplete state of the material the plant remained undetermined.

Some five years later Roubal's material was submitted to L. Palek who is concerned with the study of Bohemian native species of *Rubus*. By repeated visits to the locality in 1976 L. Palek collected sufficient amount of material both in flowering and fruiting states. In the autumn 1976 this material was determined by J. Holub as *Rubus xanthocarpus* Bureau et Franch., a Chinese species of subg. *Cylactis*. This discovery of established Chinese species in Central Europe has led us to a more detailed study of its naturalization. The locality was visited several times (especially by the

second author) and the conditions relating to the occurrence of *Rubus xanthocarpus* were studied. Literature, herbaria and accessible manuscript materials were also studied to ascertain the history of introduction of the species and to determine its autochthonous distribution area and its position in the genus. The result of this investigation is the present paper.

DESCRIPTION OF THE LOCALITY

Loc.: Bohemia centralis; ad confines distr. Praha-západ et Kladno; in abrupto loessaceo ad pagum Zeměchy, merid. a pago, c. 3,5 km occid.-merid. a statione viae ferreae Kralupy nad Vltavou, c. 200 m s. m.

The ravine at Zeměchy is situated in Central Bohemia near the town of Kralupy nad Vltavou (N of Prague) at an elevation of c. 200 m. According to the phytogeographical division of Czechoslovakia it belongs to the Thermophyticum (part Centrobohemicum), floristic district "Slánská plošina" (Plain of Slaný). By its climatic character (cf. VESECKÝ et al. 1958), the locality lies on the boundary of warm and moderately warm and dry regions. The locality is a nature reserve, noteworthy for its geological and geomorphological features (for photo see LOŽEK 1973, tab. 2, fig. 1). It is a loess ravine on arkosic sandstones (Westphalien) which crop out in close vicinity. The ravine is situated on a gentle, north-facing slope; its lower part extends from the SW to the NE, then it is curved to the north. It is about 370 meters in length. In its lower part (nearer to the village), the ravine is relatively deep and narrow, the broadest portion being c. 20 m wide (measured between the edges of the ravine). The greatest depth of the ravine is in its lower part, c. —18 m (near the most extensive colonies of *Rubus xanthocarpus*). At this point the bottom is c. 1 m wide. The ravine is waterless, but after heavy rainfalls its bottom becomes considerably waterlogged. The soil consists prevalently of loess which, in several places in the lower part of the ravine, forms characteristic perpendicular walls, from which the substratum occasionally drops off into the bottom. Because of the relief, the soil in the lower part of the ravine slopes is kept moderately moist.

The ravine, situated between fields, is covered with a tree-layer of a secondary character. In the upper part of the ravine the tree-layer is composed mostly of *Acer platanoides, A. pseudoplatanus, Fraxinus excelsior* and *Robinia pseudacacia; Tilia cordata* is rare. The shrub-layer consists mostly of *Sambucus nigra; Grossularia uva-crispa* and *Ribes rubrum* are only very scattered (the occurrence of the two latter species is secondary). The aspect of the herb-layer is given by some sciaphilous and subhygrophilous species, such as *Aegopodium podagraria, Anthriscus sylvestris, Chelidonium majus, Galium aparine, Geum urbanum* and very frequent *Urtica dioica*; solitary plants of *Dryopteris filix-mas* may be found among them. In spring *Corydalis cava, Anemone ranunculoides, Ficaria bulbifera* and sterile plants of *Allium oleraceum* as well as *Polygonatum multiflorum* and *Pulmonaria obscura* (both of them rare) may be found in this part of the ravine. From the neoindigenophytes, *Impatiens parviflora* is frequent in summer; it is dominant in extensive areas of neighbouring more or less natural forests. One sterile plant of *Helleborus* (secondary occurrence) was also found. On the upper edges of the ravine (provided they are not affected by cultivation of *Robinia pseudacacia*) a xerothermic flora occurs. Its richest locality is a patch of grassland situated immediately above the deepest point of the ravine. The following species have

been found there: *Achillea pannonica*, *Adonanthe* (= *Adonis*) *vernalis*, *Alyssum alyssoides*, *Artemisia campestris*, *Asperula cynanchica*, *Aster amellus*, *Astragalus exscapus*, *Bupleurum falcatum*, *Cerasus* (= *Prunus*) *fruticosa*, *Colymbada* (= *Centaurea*) *scabiosa*, *Crinitaria* (= *Aster*) *linosyris*, *Dianthus carthusianorum*, *Elytrigia* (= *Agropyron*) *intermedia*, *Falcaria vulgaris*, *Festuca valesiaca*, *Leopoldia* (= *Muscari*) *tenuiflora*, *Nonea pulla*, *Orthantha* (= *Odontites*) *lutea*, *Phleum phleoides*, *Polygala comosa*, *Potentilla arenaria*, *Pseudolysimachion* (= *Veronica*) *spicatum*, *Salvia pratensis*, *Scabiosa canescens*, *S. ochroleuca*, *Stipa capillata*, *S. joannis*, *S. pulcherrima*, *Taraxacum laevigatum* agg., *Tithymalus* (= *Euphorbia*) *cyparissias*, *Tragopogon orientalis*, *Trifolium montanum*, *Verbascum lychnitis*, *Veronica prostrata*.[1]) Some of these species extend to the upper part of steep slopes near the perpendicular loess walls and occur there in small continuous colonies, such as *Cerasus fruticosa*, or *Artemisia pontica* and *Aster amellus*, the latter two species growing on the opposite slope above the richest colony of *Rubus xanthocarpus*.

The colonies of *Rubus xanthocarpus* (abbreviated *R. x.* further below) are found in the lower (deeper) part of the ravine, near the village Zeměchy. This north-facing part of the ravine lacks a continuous tree-layer; this is represented by a small group of trees of *Betula pendula* on the eastern slope. The shrub-layer consists almost exclusively of *Sambucus nigra* covering the bottom and the lower parts of slopes in the whole ravine. The bottom is covered with abundant *Urtica dioica*. Three colonies of *R. x.* occur here, two of which are growing near together (vicinal on the opposite slopes) and a third colony occurring separately at the distance of some 65 m away in the direction to the upper end of the ravine. As to the size of the colonies, the first occupying an area of c. 100 sq. m contains c. 20,000 aerial stems, the second covering about 56 sq. m with c. 5,000 stems and the third has an area of c. 6 sq. m with c. 200 stems.

Common features of the colonies is their situation in the lower half of the ravine slopes, a relatively steep inclination (c. 45°) and a prevailing shade. Even though the ecotope is generally shady, *R. x.* will look out for rather open spots where the shade, caused only by trees occurring on the margins of these open places (mostly by *Betula*), is not too dense. Because of the narrowness and depth of the ravine, a full sunlight influences the locality only for a short period during the day. Otherwise the character of the plant studied suggests that it would not stand a persistent and direct sunlight.

The soil from the rhizosphere of *R. x.*, forming a layer about 20 cm thick, is moderately moist, crumby, becoming dark greyish-brown when air-dried and brick-red on ignition. It consists of a large portion of dust particles with a slight admixture of clay and finely dispersed calcium carbonate, intermixed with many rounded quartz grains of varying size (up to 2 mm in diameter). Below the rhizosphere there is a comparatively thin layer of a yellowish to greyish granular sandy soil containing an increased portion of

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[1]) In addition to the above mentioned plants, the following species were found by V. Skalický in this locality in 1962: *Bothriochloa ischaemum*, *Carex humilis*, *Cirsium acaule*, *Eryngium campestre*, *Inula hirta*, *Medicago falcata*, *Prunella grandiflora*, *Rapistrum perenne* and *Thalictrum minus*; *Picris hieracioides* occurred on the opposite slope of the ravine.

quartz grains, which appears to pass into a solid arkosic sandstone lacking calcium carbonate and apparently liable to disintegration.

The three colonies of *R. x.* differ in their phytocoenological character. The largest colony of *R. x.* occurring on the east-facing slope, in the lowest part of the ravine (with a 100 % dominance of *R. x.*), is monodominant, with only a few scattered individuals of *Campanula rapunculoides*, *Cirsium arvense*, *Coronilla varia*, *Impatiens parviflora*, *Knautia arvensis*, *Salvia verticillata*, *Urtica dioica* and *Vicia tenuifolia*. In the second colony of *R. x.* *Impatiens parviflora* and *Urtica dioica* are relatively more frequent, their stems later overtopping and covering the plants of *R. x.* The third and separate colony of *R. x.* is found at the base of a perpendicular loess wall, partly also on small ledges, and is almost devoid of other plant species. *R. x.* descends here to more shaded places under the tree- and shrub-layers (with frequent *Sambucus nigra*), where it only poorly grows in a sterile state.

Similar ecological conditions do not frequently occur in this region. Although the environment of the locality has been carefully searched, no plant of *R. x.* was detected in suitable sites. Its occurrence cannot, however, be excluded elsewhere, as it is indicated by its dispersal to a separate place in the ravine (the third colony); this fact shows the possibility of dispersal of *R. x.* in further localities, most probably by zoochory.

Rubus xanthocarpus Bureau et Franch.

Nomen: *Rubus xanthocarpus* Bureau et Franchet, Journ. Bot. (ed. Morot), Paris, 5 : 46, 1891.

Syn.: *Rubus spinipes* Hemsley, Journ. Linn. Soc., Bot., London, 29 : 306, 1893. — *R. potaninii* E. Regel, Gartenflora, Berlin, 41 : 108, 1892 (nomen invalidum).

Icones: Semenova, Trudy Priklad. Bot. Genet. Selekcii, Leningrad, Ser. 8, 1932, no. 1 : 214 usque 215, 1932. — Ejchval'd, Učen. Zap. Tartu. Gosud. Univ. 81, Trudy Bot. 2 : 100, 1959. — Kučera, Zpr. Bot. Zahr. Průhonice 6 : 101, 1971. — Iconogr. Cormophyt. Sinic. 2 : 260, no. 2249, 1972. — Preslia, 53 : 14, 15, 1981; cf. etiam tab. I.

Diagnosis: Plantae perennes, sine stolonibus supraterraneis radicantibus. Rhizomate longe repente. Caulibus annuis, breviter et disperse aculeatis; aculeis tenuibus, latitudine caulis brevioribus. Foliis ternatis, foliolo terminali foliolibus basalibus duplo longiore, omnibus in pagina superiori nitidis, in pagina inferiori spinis brevibus uncinatisque in nervo primario atque in nervibus secundariis instructis. Inflorescentia laxa, e 2—4 floribus composita; pedunculis breviter spinosis. Sepalis extus spinis brevibus rectisque instructis, post anthesim fructum iuvenilem amplectentibus, maturitatis tempore reflexis. Petalis albis, breviter puberulis. Toro post anthesim multo accrescente, conice convexo, carnose pulposo; concarpio e 5—30 drupeolis composito, drupeolis singularibus pallide aurantiacis; putaminibus distincte reticulate rugosis.

DESCRIPTION OF BOHEMIAN PLANTS

Perennials without aerial rooting stolons and stalked glands. Rhizomes straight or irregularly curved, c. 2—4 mm in diameter, stiff, fragile when dry, horizontal, far-creeping c. 10 cm below the soil surface, ramified and diverging, yellowish brown outside, whitish inside, glabrous, without distinct scales, irregularly articulated, with many adventitious roots. Stem annual, simple or sometimes with one short branch above, rarely with one branch below, (20—)30—100(—115) cm high, more or less erect or ascending when young, later intertwined in dense stands, slender, 2—4 mm in diameter, green, usually red-violet at the base, not pruinose, finely puberulent to sparsely hairy, glabrescent, obtusely angled, shallowly furrowed on sides, with few short prickles below and more above. Stem prickles slender, with

a broadened and compressed base, (1—)1.5—2.5(—3) mm long, usually shorter than the diameter of the stem, greenish, with sharp and yellowish-brown point, straight or slightly recurved, irregularly and rather sparsely dispersed, more or less confined to the angles, often considerably apart, being absent in some (especially lower) internodes. Stem leaves remote, the upper exceeding the inflorescence, all ternate, long petiolate, with a long-stalked terminal leaflet. Terminal leaflet 8—12×1.5—3.5 cm, conspicuously narrow, often more than four times as long as its petiolule, oblong-lanceolate to ovate-lanceolate, sometimes very slightly lobate in the lower part, broadest in its lower 1/4, gradually acuminate, truncate or rounded at base. Basal leaflets 3.5—6×2—2.5 cm, ovate-lanceolate (suborbicular-ovate in lower stem leaves), more or less twice shorter and nearly as wide as their terminal leaflet. All three leaflets rather tough, flat, dark green, glabrous and more or less shining above, paler and glabrous beneath except for primary and secondary veins. Primary veins of the terminal leaflet pubescent to finely hairy, with (5—)7—12(—13) irregularly scattered prickles; prickles 0.5 to 1.5(—2) mm long, declining to subuncinate, broad and compressed at base. Secondary veins less pubescent, with (0)1—3 shorter prickles of the same type. Primary and secondary veins of basal leaflets pubescent beneath, with a smaller number of shorter prickles of the same shape. Margins of leaflets irregularly serrate-dentate, with acuminate teeth, sometimes somewhat shallowly lobate in the lower part. Petiole 6—8.5(—9) cm long, shallowly sulcate in the above side, puberulent to finely hairy with prickles somewhat longer and less curved than on the primary veins of the terminal leaflet. The petiolule of the terminal leaflet more or less 1/3 as long as the petiole, sulcate above, hairy and armed like the petiole. Petiolules of basal leaflets very short, c. 1 mm long. Stipules usually narrowly or broadly lanceolate, sometimes linear and with somewhat incised margins, sessile, close or near to the base of the petiole and often associated with small ternate or trilobate leaves. Inflorescence terminal, cymose, lax, leafy, usually with (1—)2—4(—5) flowers, often also axillary with two flowers, rarely solitary flowers (rather remote from the top of the stem) develop on long pedicels from the axils of the two lower leaves. Leaves of the inflorescence smaller, their terminal leaflet often cuneate at base or variously united together with basal leaflets. Pedicel of the oldest flower in the inflorescence thick and c. 1(—1.5) cm long; pedicels of subsequent flowers thinner and longer, c. 2.5—5.5 cm long. All pedicels pale green, somewhat thickened under the calyx, often with linear-lanceolate foliaceous scales (stipules) in about their middle, with irregularly dispersed prickles in the upper part (prickles only slightly curved and often somewhat longer than the diameter of pedicels), densely covered with patent whitish hairs during flowering, later glabrescent, soon withering and falling off after the fruiting. Flowers of medium size, 2—2.5 cm in diameter, usually 5-merous, 6(—7)-merous in some plants, not fragrant. Sepals 5—7×1.5—3 mm, broadly ovate-lanceolate, shorter than petals, later long-tipped and often with a leafy appendage 7—9(—22) mm long, green, densely pubescent to felted and rather densely prickly on the outside, greenish-white-felted and finely hairy on the inside and the margins, patent in flowers, erect and closely encompassing the young fruit, patent and bent downwards in the ripe fruit; pricklets pale green, straight or curved, not dilated at base, more or less conical, 1.0—1.5mm long, yellowish in the

ripe fruit. Petals 10—12×4—6.5 mm, white even in buds, and finely pubescent on both sides, obovate to oblong spathulate, gradually tapering to a short claw (1—2.5 mm long), somewhat exceeding the sepals, entire, spaced at the time of full flowering. Stamens white, a little longer than the greenish styles, numerous, erect; filaments somewhat thick and flattened; anthers

Fig. 1. — *Rubus xanthocarpus* BUREAU et FRANCH. a — underground portion of the plant with young shoots in early spring; b — stem with prickles; c — typical stem-leaf of mature plant; d — leaf with a terminal leaflet somewhat lobate near the base; e — veins armed with prickles on the underside of a leaflet. Del. Z. Hroudová.

glabrous. Pistils numerous. Carpels slightly pubescent at apex, sometimes shortly and sparsely hairy. Receptacle considerably enlarged after flowering time, conical in fruit, orange, shining, pale yellow and pubescent near the apex, softly fleshy, withering and falling off (together with the fruit pedicel) after the fruit time. Fruit more or less globose, up to 25 mm in diameter, pale orange, juicy, sweetish, without aromatic taste, easily detachable when ripe. Druplets 5—30, 4—5 mm in diameter, more or less globose,

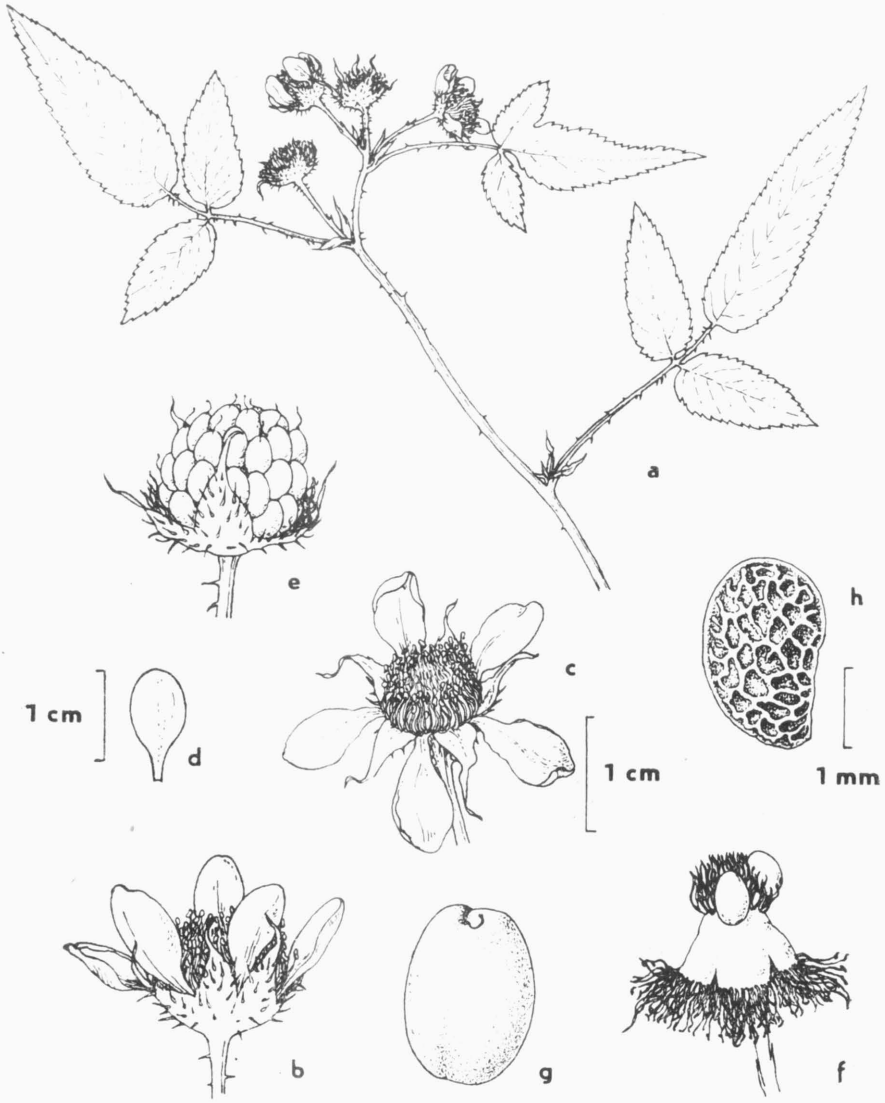

Fig. 2. — *Rubus xanthocarpus* Bureau et Franch. a — inflorescence; b — newly opened flower; c — flower at the time of full flowering; d — petal; e — fruit before maturity; f — enlarged receptacle with a few druplets at the apex; g — druplet; h — putamen. Del. Z. Hroudová.

glabrous, somewhat shining, slightly coherent; stone 2.5—3 mm long, subreniform in outline, very slightly flattened, pale yellow, prominently reticulate-rugose.

This description is based on plants from the locality at Zeměchy. We are aware that the variation of the species cannot be expressed in this way as that population is a progeny of one introduction. When comparing our plants with herbarium material and especially with descriptions of various authors, some differences were found. They are mentioned in the following paragraph. The relevant descriptions are very short and often based on scanty and incomplete material. The notes follow the sequence of characters in the above description.

In some descriptions (Bureau et Franchet 1891; Silva Tarouca et al. 1925; Dostál in Blattný 1971) *R. x.* is described as a dwarf shrub or undershrub, which is based either on erroneous observation or presumed analogy resulting from scanty material. However, it cannot be excluded that stems of *R. x.* may become moderately lignified in some cases. This is evident from herbarium material with very hard stems (e.g. plant collected by Kučera, PR; plants from the vicinity of Sigu, K). The plants are often described as being lower than our plants. Regel (1892a) reports 15—30 cm, Wehrhahn (1931) only 15 cm, Regel (1892b) 20—30 cm, Walker (1941) 30 cm. In the original description of *R. x.* Bureau et Franchet (1891) give "vix pedalis", some authors mention 20—50 cm (Dostál in Blattný 1971; Kučera 1971), or 30—50 cm, respectively (Anonymus 1972). Plants to 80 cm high were mentioned by Focke (1910). The longest stem in our plants was one measuring 115 cm. Even taller plants (to 125 cm) are given by Sargent (1917) from the vicinity of the town Tachien-lu in Szechwan, based on plants collected by Wilson in October 1910 at 2,600—3,000 m. Very low plants, on the other hand, were collected in Sungpan Hsien (K). This indicates considerable variation of *R. x.* in the length of the stem. The branching of the stem is also described in various ways. According to Focke (1910) branching may be considerable, but this has not been observed in our plants by the present authors. Regel (1892a, b), Hemsley (1893) and Kučera (1971) describe the stem as glabrous, which is at variance with our material and Bailey's description (Bailey 1927), even though the stems may often be very glabrescent. The density of the armature varies from one locality to another. It seems to be correlated with the degree of stiffness of the plant. Low plants are stiffer and have more prickles, tall plants (e.g. Wilson 4137, K) have only a spare armature. The original material of *R. spinipes* Hemsl. belongs to the more armed plants. Some authors (Regel 1892a, b; Dostál in Blattný 1971; Kučera 1971) mention also the presence of imparipinnate leaves composed of 5 leaflets; these leaves have not been found in our material at all. This type of leaves should be characteristic for the closely related *R. tibetanus* Focke (see below). The terminal leaflet is sometimes described as relatively short in comparison with its length in our plants; the original description of *R. x.* has only 5—6 cm (Bureau et Franchet 1891), authors of the Chinese Iconography (Anonymus 1972) give 5—7 cm. Similarly the leaflets are sometimes described as broader than in our plants; Bureau et Franchet (1891) describe the leaflets as ovate. The base of leaflets is mentioned also as cuneate (e.g. by Ejchval'd 1959),

this has not been found in our plants except for the leaves in the inflorescence. One of the conspicuous differences between our plants on the one hand and descriptions and herbarium materials on the other hand is the margin of the terminal leaflet. The margin may be distinctly lobate as in the illustration by KUČERA (1971; generally a rather different plant) or in the Chinese Iconography (ANONYMUS 1972), or in plants described by REGEL (1892) etc. A very strong lobate margin of the terminal leaflet was found in plants from the vicinity of Sigu in the province of Kansu (vidi in K ! JH), from which a part of the material of *R. x.* sent by the Botanical Garden in Petersbourg could have originated. Lobate terminal leaflets may frequently be found in herbarium material from the autochthonous distribution area of *R. x.* By their slightly lobate or not lobate terminal leaflets, our plants resemble somewhat *R. simplex* FOCKE (see below). However, the fact that lobate and not lobate terminal leaflets may be found in plants collected in one locality (Wilson 806; K, BM) seems to give evidence that the differences in this character are taxonomically not very important. According to the text of the Chinese Iconography (ANONYMUS 1972), the leaves of *R. x.* should be glabrous on both sides; the same is given by HEMSLEY (1883) in the description of his *R. spinipes*. This does not correspond fully to our experience; leaves are hairy on the veins beneath in Bohemian plants. In the original description of *R. x.*, BUREAU et FRANCHET (1891) mention stipules attached above the base of the petioles; in our plants stipules are usually attached to the base of the petiole. In earliest descriptions (BUREAU et FRANCHET 1891; REGEL 1892) petals are described as pubescent on the outside; contrary to this, the original description of *R. spinipes* (which belongs to *R. x.*), gives a puberulent indumentum on both sides of petals (HEMSLEY 1893), which also occurs in our plants. This difference apparently arose from insufficient observation by earlier authors. A very small size of the compound fruit, 6—9 mm in diameter, is mentioned in the Chinese Iconography (ANONYMUS 1972). The compound fruit is described as ovate by some authors (e.g. BUREAU et FRANCHET 1891). In our plants and also in some herbarium material from China it is rather globose. There are also differences in the number of druplets. In our plants the greatest number of druplets was 30. Up to 70 druplets have been found in the herbarium material from the autochthonous distribution area, and this number was also found in material from localities, which were presumably the source of introduction to this country (Wilson 806, K). The reduction of the number of druplets is remarkable in our plants and requires further study. Reports on fruits other coloured than yellow-orange (or yellow) may sometimes be found in the literature; WALKER (1941) describes the fruits as yellowish-red in native plants and WEHRHAHN (s.a.) as red in cultivated plants (however, in his later publication WEHRHAHN (1931) did not mention this colour of fruits!). The red colour is also recorded on a label in the herbarium material from the native distribution area (Chu, K; possibly a mistake ?). However, existence of colour variants cannot be excluded. There are also differences in the description of the taste of fruits; WALKER (1941) describes them as acid, DOSTÁL in BLATTNÝ (1971) as with a taste of raspberry.

Some of these differences are due to an insufficient or even imperfect observation, some to the fact, that only a portion of the variation range of the group was described, where the presence of infraspecific taxa or even

of minor species cannot be excluded. In its autochthonous distribution area, *R. x.* seems to be rather variable and represented by regional or local populations differing one from the other. The scanty material available does not allow any taxonomic decision on the variation pattern.

REMARKS ON MORPHOLOGY

Morphologically, *R. x.* is a quite different from Central European species of *Rubus*, especially in having the herbaceous character. This brings it near to another representative of subg. *Cylactis*, the native *R. saxatilis* L., from which it differs in lacking aerial rooting stolons. This character divides members of subg. *Cylactis* into two groups which are not very closely related to each other. A very characteristic feature of *R. x.* is the richly branching and far-creeping rhizome, producing numerous shoots. This enables *R. x.* to occupy a certain place persistently and to produce dense colonies (polycormones). According to SEMENOVA (1932), new shoots of *R. x.* may grow out from the rhizome at a distance up to 2 meters from the original place per annuum; this shows great rapidity of its vegetative propagation (in cultivation). *R. x.* is a rhizomatous geophyte (to hemicryptophyte). Its regeneration buds at the base of the last year's stems are 2—3 cm or sometimes less under the soil surface. Short vertical branches of the rhizome (? xylopodium, cf. IVANOVA in GATCUK et al. 1974) should be studied whether they in reality are not basal parts of aerial stems. This would be interesting especially in connection with the statement by IVANOVA (1968b) who had found lower parts of aerial stems of *Rubus humulifolius* not to be annual as in other members of subg. *Cylactis*, but with two-years' function. Stems are armed with prickles enabling the plant to lean against surrounding plants as a climber (prop liana). There is a considerable difference in the form of lower and upper leaves; two lowest leaves have the terminal leaflet much shorter and their basal leaflets are nearly round; terminal leaflets of upper cauline leaves are very long (very conspicuous in plants illustrated by KUČERA 1971) and basal leaflets are ovate to oblong-ovate. A noticeable feature of *R. x.* is the characteristic luster on the upper surface of the leaves, which is striking especially in the later part of the vegetation period, soon after the fall of fruits. At that time the upper surface of leaves appears as if varnished. It would be interesting to study the inflorescence or the arrangement of flowers. The inflorescence is very poor and it is very difficult to classify it with a certain group of classificatory schemes of inflorescences. It is terminal, including also some cauline leaves. Usually it is composed of a terminal flower and two adjoining axillary flowers. The third axillary flower is found at a distance from the latter in the axil of a normal cauline leaf. The terminal flower, usually lacking a subtending leaf, has a shortened and thick acladium and opens the first of all flowers. It is overtopped by adjoining axillary flowers (or at least by one of them). Each of the axillary paracladia bears usually one flower or sometimes a small inflorescence (2—3 flowers). There are many deviations from this structural scheme, leading to impoverished types with three, two and very rarely only one flower. In prolongated pedicels of collateral flowers (and sometimes also in acladium of the terminal flower) two pairs of green scales may be found in about the half of their length, which represent the

stipules of undeveloped subtending leaves. Unlike more or less glabrous stipules of normal leaves, those of the paracladia are densely hairy. In an inflorescence a well developed fruit is formed from the terminal flower, but often also two other flowers may give fruits. The receptacle is very showy. It increases considerably during the ripening of the fruits; only a relatively small number of druplets is attached to it in our plants. In ripe fruit, sepals are bent downwards and a yellow-coloured surface of the receptacle may be seen. Druplets are only very slightly coherent. This type of the compound fruit is not of the same character as that of blackberries or that of raspberry, though it has close relationship to the latter type. An interesting phenomenon is that fruit pedicels wither quickly and fall off very soon after the fruiting stage, so that from the August no traces of inflorescence may be found, even though the plants persist until late autumn.

TAXONOMY, VARIATION, AFFINITY

R. x. belongs to subg. *Cylactis* (RAFIN.) FOCKE, including herbs (excl. *R. humulifolius* C. A. MEY.) with hermaphrodite flowers. Other herbaceous species of *Rubus* are referred to two of twelve subgenera of the genus: *R. chamaemorus* to the monotypical subg. *Chamaemorus* (plants dioecious) and *R. lutescens* FRANCH. as the only herbaceous type to subg. *Idaeobatus*. According to the monograph by EJCHVALD (1959), subg. *Cylactis* contains 16 species (it is not clear, however, whether they all belong here !). Some (five to six species) have extensive distribution areas and are members of the boreal flora, but the majority (at least ten) are endemics with more or less restricted areas in central and southwestern China, Himalaya, Japan and northwestern part of North America. *R. x.* belongs to the latter group. Species of subg. *Cylactis* are classified by EJCHVALD (1959) into 5 series: *Saxatiles* (7 species), *Humulifolii* (1), *Fragarioides* (3), *Arctici* (3) and *Xanthocarpi* (2). The isolated position of *R. x.* is obvious in this classification. EJCHVALD (l.c.) included the Japanese *R. minusculus* LÉV. et VANIOT into the series *Xanthocarpi* FOCKE as its second member. This classification is very uncertain, as admitted by EJCHVALD himself. In our circumscription, ser. *Xanthocarpi* is limited to *R. x.* and closely allied taxa. If *R. x.* is circumscribed in a broader sense, the series is virtually monotypical. This circumscription includes also *R. tibetanus* FOCKE Spec. Ruborum 1 : 29, 1910. Regarding the fact that an earlier valid use of the same species name (spelled "*thibetanus*") was validly published by FRANCHET, FOCKE (1910 : 117) changed his invalidly published *R. tibetanus* to *R. sitiensis* FOCKE. Later FOCKE (1914 : 17) classified this taxon as *R. x.* var. *sitiensis* (FOCKE) FOCKE. With respect to some differences in morphology, EJCHVALD (1959) accepted this taxon as *R. x.* var. *tibetanus* (FOCKE) EJCHVALD l. c. 101. With regard to Focke's var. *sitiensis*, Ejchvald's combination is superfluous; it is also invalid, being based on an invalidly published name (not accepted by Focke himself). Sterile stems of this taxon are described as creeping, fertile stems as ascending. The imparipinnate leaves are composed of 5 leaflets. This taxon was described from the proximity of Ta Tsien Lu (= Ta chien lu) in west Szechwan (not from Tibet), a region adjacent to the autochthonous distribution area of *R. x.* or being a part of it. No material has been seen by the present authors and the taxon is therefore kept separate. It is evidently a closely related minor species or a conspecific taxon with *R. x.* Another

species described from this group — *R. spinipes* HEMSL., Journ. Linn. Soc. Bot., London, 29 : 306, 1893, based also on material from Szechwan, was treated as probably identical with *R. x.* by FOCKE (1910). This was confirmed by the first of the present authors who examined the original material deposited in K. Some difference in the form of petals (obovate, with a short claw) and the glabrous character of the plant seems to indicate its somewhat separate position within the variation range of *R. x.* A certain amount of variation within *R. x.* is obvious from the comparison of descriptions by other authors and by us, and of some illustrations — cf. Chinese Iconography (ANONYMUS 1972) and KUČERA (1971). Kučera's material was studied by the present authors in PR. It differs in having narrower, tapering and acute terminal leaflets, distinctly lobate in the lower part, and in its much more armed stems (the prickles occur frequently also in the lower internodes of the stem). According to M. Kučera, his plants originated from Průhonice and should therefore be of the same origin as the naturalized, morphologically different population of Zeměchy (see below). It cannot be excluded that the difference is due to unsuitable environmental conditions (cultivated plants at Průhonice were hampered by competition of grasses). The plentiful herbarium material is very uniform and indicates a possibility of some morphological divergence in the progeny of the same introduction.

In the literature *R. x.* was compared with the following species either for some similarity or for occurring together in the same area: *R. sikkimensis* HOOK. f., *R. rosifolius* SM. and *R. minusculus* LÉV. et VANIOT. *R. sikkimensis* HOOK. (subg. *Idaeobatus*) has been compared with *R. x.* by BUREAU et FRANCHET (1891) and HEMSLEY (1893) for its similar leaves and partly overlapping distribution area. REGEL (1892a) considered *R. rosifolius* SM. to be related to *R. x.* However, this species of subg. *Idaeobatus* has nothing to do with the species under study. EJCHVALD (1959) included the Japanese *R. minusculus* LÉV. et VANIOT into the series *Xanthocarpi;* this species is also quite unrelated to *R. x.*

Of the other species resembling somewhat (e.g. by some characters etc.) *R. x.*, two following may be mentioned: *R. delavayi* and *R. simplex*. *R. delavayi* FRANCH. from Yunnan has similar leaves, sepals with pricklets and armed petioles. *R. simplex* FOCKE is more similar to *R. x.* It occurs in China (provinces of Hupeh and Szechwan — herbarium material from the latter province seen by the first author in K; for its illustration see HOOKER Icon. Plant., ser. 3, 10 : tab. 1948, 1890) and belongs to subg. *Cylactis* (FOCKE 1910; EJCHVALD 1959). It has a very similar armature of sepals but it differs from *R. x.* in the following characters: leaves with appressed hairs above; leaflets ovate, long acuminate at apex; terminal leaflet of equal size as the basal ones, stipules adnate in their lower part, fruits red. Leaflets are not lobate and in this character *R. simplex* approaches plants of *R. x.* cultivated and established in Bohemia.

DISTRIBUTION OF *RUBUS XANTHOCARPUS*

R. x. is native in Central China and occupies a relatively small area. Several localities are known in the provinces of Szechwan (especially in its western part) and Kansu (central and eastern parts). This distribution area is shown in Ejchvald's monograph (EJCHVALD 1959). Two other provinces

Shensi and Tsinghai have recently been added (ANONYMUS 1972), both vicinal to Kansu, where the distribution area of *R. x.* perhaps only partly transgresses. This fact shows that the distribution of *R. x.* is up to the present time poorly known and requires further investigation by Chinese botanists. The following list of localities from K and available literature is arranged according to the provinces.

Szechwan:

Herb.: 1. Sungpan Hsien, on grassy slopes, 16. Sept. 1928, leg. Fang.
2. Western Szechuan Arnold Arboretum Exped. China 1907—1909, no 806, leg. Wilson. V, VIII, 1908. [One sheet also in BM].
3. West Szechuan and Tibetan Frontiers; chiefly near Tachienlo, no 209, no 345, leg. Pratt.
4. Western Szechuan, Arnold Arboretum Second Exped. China 1910—1911; no 4137, leg. Wilson.
5. Szechuan; nos. 8969, 8969 bis; II., 1890 A. Henry. [Original material of *R. spinipes* HEMSL.].
6. Szechuan; Pao-Hsing-Hsien, 4000 m; no 3568; leg. K. L. Chu, 12. Aug. 1936. [Note on the label: red fruits].

Lit.: 1. Province de Se-tchuan, dans les montagnes qui separent le Se-tchuan du Yun-nan. — BUREAU et FRANCHET, Journ. Bot. (ed. MOROT), Paris, 5 : 47, 1891. [The type locality of *R. x.*].
2. Western Szech'uan: Min Valley, Meo-chou, stony places, alt. 1200—2700 m, 1908, no 800. — SARGENT, Plant. Wilson. 1 : 49, 1913. [This is a more accurate description of the locality given above as Szechwan, Herb. 2].
3. Western Szech'uan: Roadsides around Tachien-lu; alt. 2600—3000 m; 1910, no 4137. — SARGENT, Plant. Wilson. 3 : 423, 1917. [A more accurate description of the locality given above as Szechwan, Herb. 3].

Kansu:

Herb.: 1. Central Kansu; Lien Hoa Shan; in meadows along stream of Ha Kon valley; alt. 9000 ft.; [leg. ?].
2. In prov. Kansu orientali prope oppidum Sigu; 23. VI. 1885, leg. Potanin.
3. In provincia Kansu orientali in vico Katapu; 18. VI. 1885, leg. Potanin.

Lit.: Shih Men [in the Tibetian language = Jarganan; Min Shan range]; no 893. — WALKER, Contrib. U. S. Nat. Herb. 28 : 633, 1941.

Shensi:

Lit.: Iconogr. Cormophyt. Sinic. 2 : 260, 1972.

Tsinghai:

Lit.: Ibid.

Records on the occurrence of *R. x.* in Yunnan may be found in BAILEY (1927), DOSTÁL (in BLATTNÝ 1971) and FOCKE (1914). No precise localities are known, however. It seems that the original record by BUREAU et FRANCHET (Szechwan, near the border of Yunnan) was misinterpreted in the above case; phytogeographically the occurrence of *R. x.* in Yunnan is probable.

In addition to the locality of *R. x.* at Zeměchy, the secondary distribution area includes also a locality in West Germany. It was found after finishing this paper in the not inserted herbarium material in PRC. There are two sheets with four plants determined originally as *Rubus arcticus* L.; this determination was corrected later to *Rubus xanthocarpus* BUR. et FR. The plants were collected as introduced at the goods station Köln-Sülz in 1932 (on 27th June and 19th July). No information is available to the present authors about the publication of this discovery and the state of this occurrence. The texts on labels are given below. Regarding the habitat, the plant should be designated as an epoecophyte. (See an additional note, p. 31!).

A list of herbarium specimens from Bohemia and West Germany (cultivated, adventive and naturalized plants) follows:

1. *Rubus* tzv. Čajomalina, prý výpěstek Böhmův z Blatné; kultury fy Böhm v Blatné, 1946, leg. I. Klášterský. [*Rubus* so called Tea-Raspberry; a hypothetical novelty by Böhm in Blatná; plots of the gardening firm Böhm in Blatná.] — PR — 2 plants.
2. dtto, leg. R. Veselý. — PR — 1 plant.
3. Jižní Čechy, Blatná, pěstovaný u fy Böhm a zaslaný mně kol. R. Veselým ze Soběslavi k určení; VI. 1953, PR ex herb. Šourek. [South Bohemia, Blatná, cultivated by the gardening firm Böhm and sent me for determination by colleague R. Veselý from Soběslav.] — PR — 2 plants.
4. Kunratice, školka; 15. VI. 1964; 10. VIII. 1964; VI. 1965; leg. M. Kučera. [Plants from a nursery.] — PR — 12 plants.
5. Bohemia centralis, distr. Mělník, pag. Zeměchy prope opp. Kralupy n. Vlt.; in fundo faucis loessaceae supra (ad merid. versus) pago, planta advena; 15. VII. 1975, leg. V. Skalický (olim 5. VIII. 1962). — Herb. Skalický. — 1 plant.
6. Zeměchy prope Kralupy, 1971, leg. A. Roubal. — PRC 710927. — 10 plants.
7. Zeměchy prope Kralupy, 1976—1977, leg. L. Palek. — Herb. L. Palek — 154 plants.
8. dtto, 23. VI. et 9. VIII. 1977; leg. J. Holub. — Herb. J. Holub — 43 plants.
9. a) *Rubus arcticus* L. [corrected to *Rubus xanthocarpus* Bur. et Fr.]; Köln, Sülzer Bahnhof; 19. 7. 1932; Früchte gelb, verwildert und eingeschleppt; H. Hupke (Köln). — b) Köln-Sülz, Gütersbahnhof, 27. 6. 1932. — PRC — 4 plants.

ECOLOGY AND BIOLOGY OF *RUBUS XANTHOCARPUS*

Ecological data from the native distribution area are very scanty. According to the Chinese Iconography (Anonymus 1972), the species occurs on stony slopes in mountain valleys in wet places with a thicker layer of soil. It may be inferred from the literature (e.g. Walker 1941) and from the data on herbarium labels that *R. x.* is a mountain species occurring in somewhat wet places along mountain rivulets or on grassy slopes. It is clearly an oreophyte; in Central Kansu it occurs at an altitude of c. 3,000 m. Wilson collected it in Szechwan at 2,000—3,000 m, Pratt at the border of Tibet at 3,000—4,500 m, Chu at 4,000 m. This means that within a relatively small distribution area the species has a rather limited ecological range. Therefore its relatively easy introduction to various regions of the temperate zone of the northern hemisphere and its naturalization in Central Bohemia is rather surprising. It seems that the extent of autochthonous distribution area is given rather by the history of the species or by a complex of historical and ecological conditions than only by purely ecological influences. In Central Bohemia *R. x.* became naturalized in a region with warm climate and at a low altitude, though the local conditions of the ravine may be to a certain degree similar to some ecotope conditions in the autochthonous distribution area. The photophilous character of *R. x.* in our locality corresponds to the conditions in China, where the species is reported from treeless habitats. For a short description of ecological conditions of our locality see p. 10.

No data on the biology of *R. x.* are available from its native distribution area. In Raunkiaer's system of life forms, *R. x.* belongs virtually to geophytes, as its aerial stems wither completely in the late autumn and the plants survive the winter only by its rhizomes. Innovation buds are usually 2—3 cm below the soil surface. *R. x.* belongs therefore to rhizomatous geophytes and only in some cases it might be designated as a hemicryptophyte. It reproduces vegetatively (by an intensive growth of rhizomes and their frequent branching) as well as by seeds. Vegetative reproduction in our locality is so intensive, that each of the two large colonies of *R. x.* may

be only one polycormone. But in spite of that it comes here certainly also to the reproduction by seeds, even though no seedlings have been observed at Zeměchy. Possibly the seeds cannot germinate or the seedlings cannot survive in dense stands of *R. x.* The separated third small colony of *R. x.* with plants occurring on narrow ledges of the disintegrating loess wall, gives evidence of this type of reproduction. Seeds must have been transported here by birds. In the largest colony fertile stems prevail. The neighbouring colony on the opposite side of the ravine, contains, however, mostly sterile stems and in the separated colony sterile plants predominate. It follows from this observation that the number of flowering plants is influenced to some extent by the light. The flowering period is relatively short and flowers are pollinated by hymenoptera, e.g. by honey bees. Only two, at most three flowers per inflorescence give rise to the fruits. The compound fruits of our plants are relatively poor in druplets (to 30), in herbarium material up to 70 unripe druplets in one fruit from China were found. It is not clear whether the low fertility is a result of unsuitable conditions or whether it developed during the process of introduction. Ripe druplets fall off very easily and perhaps only a small part of them are eaten by birds on the plant. Diseases or attacks by caterpillars were not observed in our plants. A brief description of the phenology of *R. x.* in the Central Bohemian locality is as follows: First shoots at the beginning of April; flowering time 20 June to 5 July; fruiting time 20 July to 5 August; fall of fruits and withering of fruit pedicels at the end of August; withering of aerial parts of the plant at the end of November and the beginning of December. For a view of the ecotope of the richest colony of *R. x.* during the time of the vegetation rest, see photo (plate II.); only whitish dead stems lying on the slope may be seen. Our evidence that aerial stems of *R. x.* cannot survive the winter is at variance with the affirmation by SEMENOVA (1932); according to her statement *R. x.* overwinters with green leaves under a snow cover.

Ecological and biological problems of the occurrence of *R. x.* in the Central Bohemian locality have not been sufficiently studied and further investigation is necessary.

HISTORY OF DISCOVERY OF *RUBUS XANTHOCARPUS*, ITS INTRODUCTION AND UTILITY

R. x. was first collected in the province of Kansu by Potanin in 1885. In addition to dried plants, fruits were also collected from which plants were raised in the botanical garden in Petersbourg (now Leningrad). REGEL (1892) described these cultivated plants as a new species and named it in honour of the collector *R. potaninii*. However, he failed to publish this name validly and a description of the species had been published under the name *Rubus xanthocarpus* by BUREAU et FRANCHET (1891). Their description was based on plants collected by Prince d'Orleans and Bonvalet in Szechwan, not far from the border of Yunnan, in 1890. A more complete description was given by FOCKE (1910, 1914). The botanical garden in Petersbourg was most probably the first place from where *R. x.* was distributed by seed exchange. Plants cultivated in the botanical gardens of Soviet Baltic area have certainly originated from Potanin's plants from Kansu (for an illustration, see EJCHVALD 1959). The Department of Agriculture introduced *R. x.* into the U.S.A. (via N. E. Hansen) in 1898 (BAILEY 1927). The source

of this introduction was probably also the seed material sent by the botanical garden in Petersbourg. Further material for introduction was collected by Wilson in Szechwan in 1908. A part of it was received by C. K. Schneider and Silva Tarouca at Průhonice. It gave rise to plants cultivated at Austro-Hungarian Empire and perhaps elsewhere in Central Europe, and possibly also to the plants naturalized at Zeměchy (more detailed data see below). *R. x.* appeared to show full tolerance and vitality, so that it might become, owing to its vegetative reproduction and dense stands, a troublesome weed in gardens. It produces fruits with viable seeds. According to Kučera (1971) it cannot bear competition of weeds (at Průhonice it reportedly became extinct for this reason in the sixties) and its aerial part suffer also from frosts (which, however, does not hamper the underground part of the plant). It is mainly cultivated in botanical gardens, but not very often, at least at the present time. In the fifties *R. x.* was cultivated in U.S.S.R. in Leningrad, Moscow, Tartu and in the Byelorussia (Lozina-Lozinskaja 1954 : 590). Among c. 400 examined seed list of botanical gardens from 1978, only six lists offered *R. x.*: Tartu and Riga (Soviet Union), Mainz (West Germany), Leipzig (East Germany), Lublin (Poland) and Stockholm (Sweden). As a result of cultivation in botanical gardens, *R. x.* is comparatively the best known species of the rare members of subg. *Cylactis*.

In China fruits of *R. x.* are eaten either fresh or pickled in vinegar (Anonymus 1972). The species was introduced to North America for fruits (Bailey 1927). However, regarding a reduced fruit-setting ability and loosely coherent druplets, the species has never become a fruit-plant. It was also cultivated in Lithuania (see Focke 1910), perhaps for experimental purposes only. Data on cultivation of *R. x.* in the U.S.A. and U.S.S.R. (Dostál in Blattný 1971) are nothing else than a mention of former efforts to introduce *R. x.* into experimental cultivation. The species remains therefore only in botanical gardens. Its ability to fix soil and banks and to cover uncovered soil surface has not been examined. It may also be used as an ornamental (with regard to formation of dense stands), however, its armature and intensive vegetative reproduction may be a disadvantage. The latter feature (which made possible its extensive naturalization at Zeměchy) attracted the attention of horticulturists long ago (see Silva Tarouca et C. K. Schneider 1922).

HISTORY OF THE INTRODUCTION OF *RUBUS XANTHOCARPUS* IN CZECHOSLOVAKIA AND AN ATTEMPT TO EXPLAIN ITS NATURALIZATION

Our discovery of naturalized population of *R. x.* at Zeměchy is the first and also the only record of establishment of this species and its occurrence in more or less natural phytocoenoses outside its autochthonous distribution area. At present *R. x.* is not cultivated in this country, so that its naturalization is most surprising. A study of literature, herbaria and archives could furnish some facts enabling us to reconstruct the possible course of naturalization of *R. x.* in Bohemia. The species was first mentioned in the literature by Silva Tarouca (1909), and later by P. Svoboda et al. (1966) and Kučera (1971); all these reports refer to cultivation at Průhonice. Silva Tarouca (1909) mentioned *R. x.* in only a short note (p. 12: *Rubus xanthocarpus*, near the rock garden [in German]), i.e. that it was cultivated in the Průhonice park in a place adjacent closely to the rock garden. P. Svoboda et al. (1966 : 218) give the following data: ST 1909 (alp.); DS 1910 Wilson-Sar-

gent; DS 1922—1932; PP 1927. The first abbreviation refers to Silva Tarouca's record of 1909; the second means the beginning of the cultivation of plants from the consignment of Wilson and Sargent in the garden of the (Austro-Hungarian) Dendrological Society; the third means the cultivation of *R. x.* in the gardens of the Society in 1922—1932. The fourth abbreviation shows the presence of *R. x.* in the species list of 1927, when Count Silva Tarouca sold the Průhonice park to the Czechoslovak State. Kučera (1971) in his study of the collection of cultivated brambles in the Průhonice park reports that a number of *Rubus* species was cultivated in the garden of the Dendrological Society, originating from the collections made by Wilson in China. According to this information (l.c., p. 83), *R. x.* was cultivated in the garden of the Dendrological Society and in the Průhonice park; at the time, when Kučera's paper was compiled, *R. x.* was also grown in the locality "Táborka" in a collection of *Rubus*. Illustrations of the plants are provided according to the herbarium material deposited in sufficient amount in PR. As mentioned already above, the material is not fully identical with our naturalized plants. Kučera's herbarium material did not come from the Průhonice park, but from his earlier private collection of *Rubus* at Kunratice near Prague, where they were collected in 1964 and 1965. According to the personal information, Kučera received them from Průhonice. At the end of the sixties *R. x.* at Průhonice became extinct.

The process of the introduction of *R. x.* in Průhonice may be very well followed on the basis of records from the archives of the former Austro-Hungarian Dendrological Society at Průhonice, which were made available to us by courtesy of A. M. Svoboda. *R. x.* is listed here as 56/1909. This record refers to the seeds collected by Wilson under the number 806 in China (plants from this collection were studied by the first of the present authors in K and BM) and were sent to Průhonice by Sargent in February 1909. They were sown on the 9th of March 1909 and 10th of October 1911 (possibly from another lot). Germination is recorded on the 8th of June 1909 (first sowing) and 27th of April 1912 (second sowing). It is thus to be noted that 80 plants were cultivated in 1910, 124 plants in 1911, and in 1914 the number of plants increased to 1,200. A great number of plants enabled the Society to distribute 300 plants of *R. x.* to its members. In 1912 the species was collected for herbarium of the Society (one sterile plant). It was redetermined in August 1913. According to the files by A. M. Svoboda (08/77, 1930 : 39) "*R. x.* covers large places and may become a troublesome weed"; this had been mentioned earlier by Silva Tarouca et C. K. Schneider (1922) and Wehrhahn (1931). Plants from Zeměchy correspond morphologically very well to those collected by Wilson in China in 1908 (no 806). This connection seems to be supported by the distribution of Wilson's plants to several members of the Dendrological Society in 1915. It is interesting to note that Silva Tarouca reported *R. x.* from near the rock garden of the Průhonice park as early as in 1909, when only seedlings from Wilson's seeds existed in Průhonice at that time. It is not clear whether this record should be taken as a certain anticipatory "enrichment" of the assortment (according to the conviction of A. M. Svoboda, personal information) or whether *R. x.* had been cultivated there earlier from another source (i.e. from Petersbourg). In subsequent years *R. x.* was also for sale from Průhonice, cf. Silva Tarouca et al. (1925); the selling price was 3 or 5 Czechoslovak

crowns per young plant. At that time the species could easily come to other gardening firms (for instance to Böhm at Blatná, see below).

Further information concerning the history of the introduction of *R. x.* in Bohemia originates from herbaria. Herbarium material deposited in PR indicates that *R. x.* was collected by Klášterský and Veselý in 1948 (and later by Veselý even as late as 1953) in the grounds of the gardening firm at Blatná (South Bohemia). This material was not determined, but provisionally designated as "*Rubus* sp., prý Čajomalina" (i.e. "*Rubus* sp., reputedly Tea-raspberry"). These plants show a very close correspondence with those naturalized at Zeměchy. In the garden of the firm Böhm this species was cultivated as nameless. Several collections made at that time show that it must have been growing there in some quantity. It was advertised for sale to a large extent by Böhm in the forties as a tea-substitute (which might meet with successful results, especially in war-time). Several gardening publications by Böhm (of commercial, not scientific character) were examined by the first author to answer the question whether the "Tea-raspberry" (Čajomalina) is identical with *R. x.* According to descriptions by Böhm the real "Čajomalina" (or "Mičurinova Čajomalina", respectively) has nothing in common with *R. x.* It may, however, not to be excluded that *R. x.* could be sent to customers as "Čajomalina" as follows from Klášterský's note on the label. In one publication by Böhm (1941a : 52), a Mitschurinian "Lemomalina" (= "Citrus-raspberry") is mentioned, which Böhm stated to have yellow fruits, aerial stems freezing to the soil surface and fertile annual stems; it was also recommended as a fruit-plant. All the features (except for a rich fruit-setting ability) are in good agreement with *R. x.* which probably was sent to customers under the name "Lemomalina" (or sometimes as "Čajomalina" — see above) either by request or as a gift of the firm. At that time the cultivation of *R. x.* could spread in this country. Later, however, it disappeared from the gardens. Possible reasons of this disappearance were: There were no need for tea-substitutes after the war; the plant has shown as an unfit fruit-plant; it has proved to be a very aggressive weed, especially in small gardens. The origin of plants cultivated by the firm Böhm might perhaps be traced to Průhonice. The possibility of an import from the U.S.S.R. from Mičurin's collection cannot be excluded, because Böhm had some connection with him.

At Zeměchy *R. x.* may have become established either in the period after 1915, when the plants of *R. x.* were distributed to the members of the Dendrological Society (and later sold to other customers), or in the period following the time, when they were distributed by the firm Böhm in the forties. *R. x.* might have been introduced there either by birds or rather by living plants from the site at which thrown-out plants had been dumped. The latter possibility is more probable, as the lower part of the ravine seems to have served as a dumping ground. Regarding the extent of the colonies, the number of aerial stems, and considering the history of cultivation of *R. x.* in this country, the age of Zeměchy introduction may by estimated at 30—50 years. This long period of naturalization and the occurrence in seminatural vegetation makes it possible to classify *R. x.* as a new neoindigenophyte of the European flora. Among the European neoindigenophytes it is perhaps the first case of establishment of a species from the mountains of Central China.

Rubus is very rich in species. To estimate the number of species is dependent on the classificatory approach in the group *Eubatus* (= subg. *Rubus*) and for that reason it is widely different. In a broader circumscription (FOCKE 1910; EJCHVALD 1959), the genus contains twelve subgenera: *Malachobatus*, *Orobatus*, *Dalibardosperma*, *Anoplobatus*, *Idaeobatus*, *Lamprobatus*, *Rubus* (= *Eubatus*), *Comaropsis*, *Chamaebatus*, *Dalibarda*, *Cylactis* and *Chamaemorus*. At present, it is hardly possible to decide whether this circumscription is taxonomically natural or whether some groups should be excluded. Herbaceous types belong mostly to two subgenera, *Cylactis* and *Chamaemorus*, differing in the sexuality of flowers (*Cylactis:* hermaphrodite; *Chamaemorus:* unisexual, dioecious). The herbaceous *R. lutescens* FRANCH. belongs to the subg. *Idaeobatus* and is perhaps its only herbaceous member. In comparison with very large subgenera *Malachobatus*, *Idaeobatus* and *Rubus* (each including over 100 species), *Cylactis* and *Chamaemorus* are poor in species — *Cylactis* has c. 16 species, *Chamaemorus* is monotypical.

Subg. *Cylactis* contains low plants with annual (excl. *R. humulifolius*), erect or procumbent stems and creeping rhizomes. Regarding the species of *Rubus*, which are to be considered as evolutionarily most primitive members of the genus, *Cylactis* is clearly derived. Phylogenetically basal groups are represented by very large subgenera *Rubus*, *Malachobatus* and *Idaeobatus*. By its distribution (confined to S. E. Asia and adjacent Pacific) and by some morphological features (for instance by several-years' thick aerial stems, evergreen leaves, etc.), subg. *Malachobatus* is perhaps the most closely related to the original type of the genus among the above three subgenera. Subg. *Cylactis* is related to subg. *Idaeobatus* (IVANOVA in GATCUK et al. 1974), with which (and even with *Anoplobatus*) it was combined by FOCKE (1910 : 12) to a very broadly circumscribed subgenus. According to EJCHVALD (1959), the evolutionary centre of the genus (if considering the present occurrence of primitive types) seems to be in S. E. Asia (subtropical China and adjacent areas). Original types were close to the present group *Malachobatus*, had a richer armature of stems and large evergreen leaves; the compound fruits resembled those of the raspberry, or they consisted rather of separate druplets, not adnate to the receptacle. Primitive types were probably small, very branched trees or shrubs and gave rise to prickly climbers. From the latter type a herbaceous biomorph, typical of subg. *Cylactis*, evolved by a regressive evolution (cf. IVANOVA 1968a; IVANOVA in GATCUK et al. 1974). This life form evolved as an adaptation to unfavourable climatic conditions during the migration of *Rubus* species from the subtropical regions to the temperate and arctic zones. According to IVANOVA (in GATCUK et al. 1974), herbs evolved in *Rubus* in several evolutionary lines. The transition from woody plants to herbs was accompanied in (at least some) *Cylactis* species by formation of bud scales protecting the main axis of seedlings; such bud scales lack, for instance, in *Rubus idaeus* which has an open crown bud surrounded by small green leaves (IVANOVA 1968a). The evolution from woody climbers to herbs advanced very quickly owing to the loss of ligneous character of the stem. No important progress in the generative organs has occurred. The original primitive type of the compound fruit has been retained. The whole group *Cylactis* and especially *R. x.* are a good example of mosaic-like

evolution (heterobathmy in the sense of Tachtadžjan). In the majority of members of subg. *Cylactis* a reduction (in some cases almost total) of prickles took place. The beginning of that process may be observed in *R. x.* where the prickles of the typical "bramble" type are retained in the upper part of the plant, not only on the stem, but also on the petioles and on veins on the lower surface of leaves. In having this armature *R. x.* differs from other members of the subgenus and should be therefore classified as a separate group within *Cylactis*. A special biomorph should be accepted for it (as proposed by EJCHVALD 1959) closely linked up with more primitive subtropical woody climbers of *Rubus*, climbing by means of prickles. By this reduction a rhizomatous hemicryptophyte or geophyte has arisen. By its distinct armature *R. x.* is the most primitive type in subg. *Cylactis*. This statement is supported also by the type of vegetative propagation (branching of the underground stem); another group in *Cylactis* propagating vegetatively mostly by rooting of aerial stems seems to be derived. However, further study is required, whether these two groups have more close relationship to various groups within *Idaeobatus* than to one another.

Occurrence within the distribution area of many primitive plants, a rather restricted distribution area and some primitive features suggest that *R. x.* is an important taxonomic relic ("restant"), illustrating a part of the evolutionary process in *Rubus*.

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SUMMARY

In a loess ravine at the village Zeměchy (near Kralupy nad Vltavou, Central Bohemia), an interesting species of *Rubus* was collected by several botanists, which was later determined as *R. xanthocarpus* BUREAU et FRANCH., a native from China. The species occurs there in a semi-natural vegetation of a rather nitrophilous character; there are three colonies containing about 25,000 plants.

As the available descriptions of *Rubus xanthocarpus* (*R. x.*) are rather short, a detailed description of naturalized plants is given. When comparing these plants with descriptions of other authors and herbarium material, some minor differences were found. They are due to insufficient or incorrect observation or they are caused by description of only portion of the variation range in its native distribution area. Characteristic features of naturalized Bohemian plants are the slightly lobate margin of the terminal leaflet and a smaller number of druplets in the compound fruits.

R. x. is interesting from the morphological viewpoint. It is a rhizomatous geophyte with a much branched rhizome which can produce extensive polycormones. The prickles enable the herbaceous stems to lean against neighbouring plants and to behave like a prop climber. Flowers are arranged in an interesting type of inflorescence with the terminal flower on a short pedicel, overtopped by the neighbouring flowers from the axils of leaves; the terminal flower opens the first. The receptacle increases in fruit, becomes soft and orange-coloured; that is in particular conspicuous after fruiting time when the druplets fall off. Druplets are very slightly coherent and the compound fruit corresponds to that characteristic of *R. saxatilis*. Fruit pedicels wither very soon and fall off, too.

R. x. is the only member of the series *Xanthocarpi* FOCKE of the subg. *Cylactis* (RAFIN.) FOCKE (including 16 species). In its broadest circumscription *R. x.* includes *R. sitiensis* FOCKE from Szechwan, having imparipinnate leaves with 5 leaflets; its taxonomy is uncertain at present.

The Japanese *R. minusculus* LÉV. et VANIOT, considered to be the closest relative of *R. x.*, does not probably belong even to subg. *Cylactis*. Some similarity to *R. x.* may be found in *R. simplex* FOCKE (occurring also in China, provinces of Hupeh and Szechwan). The position of *R. x.* in subg. *Cylactis* is rather isolated.

R. x. is confined to Central China, mostly to the provinces of Szechwan (from where it was described) and Kansu, extending to Shensi and Tsinghai. It is an oreophyte occurring from 2,000 to 4,000 m in open and somewhat wet places on stony slopes. In spite of its relatively small distribution area, it is capable of introduction and, as may be seen in Bohemia, it may become established. Both in the field and cultivation it produces large colonies by means of intensive vegetative propagation.

R. x. was first collected in Kansu in 1885 and somewhat later in Szechwan in 1890. From Kansu it came to the botanical garden in Petersbourg and from there by seed exchange also to other countries, e.g. to U.S.A. in 1898. Another introduction was from seeds collected by Wilson in Szechwan in 1908. A portion of the seeds came to Průhonice (Bohemia) and from there it was distributed by the Austro-Hungarian Dendrological Society to other places (after 1915). Wilson's herbarium material referring to this introduction (K, BM) is very similar to the plants naturalized in Bohemia.

Wilson's plants from Szechwan, cultivated and propagated at Průhonice in 1909—1915, gave most probably origin to the naturalized population at Zeměchy. In the twenties *R. x.* was sold from the Dendrological Society and probably got to other gardening firms. The next step in the process of introduction may be traced in the herbarium material of PR. There are plants collected in the gardens of the firm Böhm in Blatná (South Bohemia), where they were designated by trade names "Čajomalina" or "Lemomalina". At the beginning of the Second World War they were offered and certainly also distributed to customers as plant giving a substitute for tea or as a fruit-plant. In those years the plants probably occurred more frequently in cultivation, but their insignificant practical importance as a fruit-plant (fruits only few, small, easily disintegrating, without any distinctive taste), great vitality making it a difficult weed, especially in small gardens, and no need for tea-substitutes in the post-war period were the primary cause of their decrease. During cultivation (i.e. probably between 1920 and 1950), the naturalized population at Zeměchy could originate either by the dispersal of stones by birds or direct transfer of living plants. The age of Zeměchy population may be estimated at 30—50 years. *R. x.* is perhaps the only neoindigenophyte in the European flora native of the mountains of Central China. The origin of plants from the second locality of *R. x.* in Europe — Köln (West Germany) — is not known; the species was collected there at a goods station in 1932 and the present state of this occurrence is unknown.

Phylogenetically *R. x.* is a noteworthy species in which some primitive features (especially structure of the fruit) are preserved, even though it attained the herbaceous life form. The armature of the prop climber consisting of prickles has been preserved also in the herbaceous body of the plant. *R. x.* belongs to the most primitive types of subg. *Cylactis* and is a pertinent example of a taxonomic relic ("restant").

SOUHRN

V rokli u Zeměch nedaleko od Kralup n. Vlt. byl v posledních dvaceti letech nalezen různými sběrateli (V. Skalický, A. Roubal) pozoruhodný ostružiník, jenž byl později určen J. Holubem jako *Rubus xanthocarpus* BUREAU et FRANCH., pocházející z Číny. Vzhledem k zajímavosti nálezu byla tomuto druhu věnována speciální pozornost. Druh se zde vyskytuje ve zvláštních ekologických podmínkách (sprašová strž se sekundární vegetací spíše nitrofilního charakteru v sousedství xerotermní vegetace); roste zde ve 3 koloniích s celkovým počtem asi 25 000 rostlin. Pro potřebu našich botaniků uvádíme stručný diagnostický popis:

Byliny vytrvalé, bez nadzemních kořenujících výhonků. Oddenky horizontální, dlouze plazivé, silně rozvětvené. Lodyhy jednoroční, většinou jednoduché, 30—100 cm vysoké, krátce a řídce ostnité; ostny tenké, přímé až srpovité, 1,5—2,5 mm dl. Listy trojčetné, na líci na podzim lesklé, na řapíku, řapíčcích a na rubu na hlavním i druhotných nervech krátce háčkovitě ostnité; koncový lístek 8—12 × 2,5—3,5 cm velký, 2× delší než bazální lístky. Květenství řídké, s 2—4 květy; stopky krátce ostnité. Květy 2—2,5 cm v průměru. Kališní lístky na vnější straně s krátkými, přímými, žlutavými osténky, po odkvětu uzavírající plod, za zralosti plodu dolů sehnuté; korunní plátky bílé, pýřité; nitky tyčinek zploštělé. Lůžko květní po odkvětu značně zveličelé, konicky vyvýšené, dužnaté, oranžově zbarvené. Souplodí s 5—30 peckovičkami, velmi málo soudržné, za zralosti snadno opadavé; peckovičky světle oranžové, pecičky vynikle síťované.

Při srovnání našich rostlin s popisy jiných autorů a herbářovými doklady z původního areálu byly zjištěny menší rozdíly, jež zčásti padají na vrub buď nedostatečného nebo přímo chybného

pozorování, zčásti pak vycházejí z popsání jen výseku variačního rozpětí celého taxonomického okruhu, jenž v původním areálu vykazuje určitou variabilitu. Zvláště charakteristickými znaky našich rostlin jsou nepatrná laločnatost terminálního lístku a menší počet peckoviček v souplodí.

Rubus xanthocarpus (dále *R. x.*) je zajímavý druh i z hlediska morfologického. Jde o oddenkového geofyta, s velmi větveným podzemním stonkem, jenž může vytvořit i dosti rozsáhlé polykormonové kolonie. Rostlina, ač bylinného typu, má ostny, jež jí umožňují opírat se o sousední rostliny jako vzpěrná liána. Květy jsou v charakteristickém chudém květenství s terminálním květem na krátké stopce, převýšeným sousedními květy, vyvinutými v paždí listů; terminální květ se rozvíjí nejdříve. Velmi zajímavý útvar u *R. x.* je plodní lůžko, které při zrání plodu se silně zvětšuje, dužnatí a zbarvuje se oranžově; nápadné je zvláště po opadání peckoviček. Peckovičky jsou navzájem málo soudržné a jejich souplodí odpovídá typu plodu, jenž je charakteristický pro dalšího zástupce podrodu *Cylactis* v naší květeně — *R. saxatilis* L. Stopky plodní brzo odumírají a rychle opadávají.

R. x. patří do podrodu *Cylactis* (Rafin.) Focke (s ca 16 druhy), kde vytváří ± monotypickou serii *Xanthocarpi* Focke. K našemu druhu v širším pojetí patří ještě s'čchuanský taxon *R. sitiensis* Focke, mající 5-četné lichozpeřené listy; jeho taxonomická hodnota není zatím jistá. Japonský druh *R. minusculus* Lév. et Vaniot, řazený některými autory do blízkého příbuzenství *R. x.*, sem nepatří (a snad ani vůbec do podrodu *Cylactis*). Bližší vztah k *R. x.* vykazuje *R. simplex* Focke, pocházející též z Číny (Chu-pej a S'čchuan). Celkové postavení *R. x.* v podrodu *Cylactis* je však dosti izolované.

Původní rozšíření *R. x.* se omezuje na střední Čínu, a to převážně na provincie S'čchuan (odkud byl tento druh popsán) a Kan-su; odtud přesahuje do provincií Šen-si a Čching-chai. V anglickém textu jsou uvedeny studované herbářové položky (převážně v Kew) a dostupné literární údaje. V původním areálu se *R. x.* chová jako oreofyt, vyskytující se ve výškách od 2000 do 4500 m n. m. na vlhčích místech kamenitých, lesem nezarostlých svahů. Přes svůj úzký areál může být tento druh snadno introdukován, a jak se ukazuje u nás, i úspěšně zdomácnět. Na svých lokalitách i v kultuře vytváří rozsáhlé kolonie pomocí vegetativního rozmnožování.

R. x. byl poprvé sbírán v Kan-su v r. 1885 a pak později v r. 1890 v S'čchuanu (odkud byl popsán pod svým platným jménem). Z Kan-su se dostal do botanické zahrady v Petrohradě a odtud výměnou semen i do jiných zemí, např. již v r. 1898 do USA. Další introdukce pochází ze S'čchuanu, ze semen sbíraných Wilsonem v r. 1908. Část semen se dostala v r. 1909 do Průhonic a odtud prostřednictvím Dendrologické společnosti v r. 1915 a později do dalších míst. Wilsonovy položky vztahující se k této introdukci (uložené v Kew) se velmi podobají našim zdomácnělým rostlinám.

Rostliny ze S'čchuanu pěstované a rozmnožené v letech 1909—1915 v Průhonicích, se staly nejpravděpodobněji základem zjištěného zdomácnělého výskytu u Zeměch. Ve 20. letech byl tento druh prodáván Dendrologickou společností a dostal se tak pravděpodobně i do sortimentu jiných zahradnických firem. Další historii introdukce *R. x.* můžeme sledovat v herbářích PR, kde existují položky sbírané na pozemcích firmy Böhm v Blatné; zde se tato rostlina pěstovala pod (nesprávným) jménem „čajomalina" a dále též jako „lemomalina" a na počátku 2. světové války byla nabízena a jistě i rozesílána zájemcům jako rostlina poskytující náhražku čaje či rostlina poskytující ovoce. V těchto letech mohl být tento druh v kultuře u nás více rozšířený, ale jeho nepatrný praktický význam jako rostliny poskytující ovoce (plody malé, nečetné, snadno rozpadavé, bez nějaké význačnější chuti), velká vitalita a agresivita (jež z něj mohly učinit plevel zvláště v malých zahrádkách), jakož i dostatek pravého čaje po válce, způsobily asi vymizení jeho kultury. V uvedeném období kultury (tj. v letech 1920—1950) mohlo dojít k uchycení tohoto druhu v rokli u Zeměch buď přenosem peciček ptáky nebo přímým přenesením rostlin se zahradním odpadem. Stáří zdomácnění výskytu *R. x.* u Zeměch lze tedy odhadnout na 30—50 let. *R. x.* je snad jediným neoindigenofytem v evropské květeně pocházejícím z hor střední Číny.

Z hlediska fylogenetického jde o zajímavý druh, u něhož se zachovaly primitivní znaky (plod), i když vývoj dospěl až k vytvoření byliny. Zároveň se zde dobře zachovala ostnitost opěrné liány i na bylinném těle rostliny. V podrodu *Cylactis* patří *R. x.* k vývojově nejpůvodnějším typům. Je vhodným příkladem restanta (taxonomického reliktu).

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See also plates I—II in the Appendix.

Additional note:

After finishing the manuscript two data referring to the occurrence of *Rubus xanthocarpus* in West Germany have been found in the literature, both published by H. Hupke, collector of the two herbarium sheets deposited in PRC. The relevant texts are as follows:

1. Decheniana 21 : 196, Bonn 1935:

Rubus Hawaiensis Asa Gray — Sandwich Inseln — 1932 auf dem Bahnhof Sülz von E. Schwarz entdeckt. Da an der betreffenden Stelle vor Jahren Schrebergärten waren, ist anzunehmen, dass die Pflanze ein Überbleibsel jener Gärten ist. Die Pflanze steht an sehr

geschützter Stelle; sie hat sich in den Jahren 1933 und 1934 sehr üppig entwickelt und gefruchtet. Die grossen gelben Früchte haben einen sehr angenehmen zitronenähnlichen Geschmack. Det. A. Ade.

2. Fedde Repert. Spec. Nov. Regni Vegetab., Beih. 101 : 131, Dahlem 1938:

Rubus xanthocarpus BUR. et FRANCH., Orangegelbe Brombeere. — China in den Provinzen Kansu, Szetschuan und Yünnan. — Wird in Deutschland hier und da in Gärten kultiviert; früher bei Haage und Schmidt in Erfurt erhältlich. Schon seit mehreren Jahren ein grosser Bestand auf dem Personenbahnhof Köln-Sülz. Fruchtet jedes Jahr reichlich. Diese Art wurde in meinem 1. Nachtrag irrtümlich als *R. Hawaiensis* bezeichnet, da sie von Ade so bestimmt worden war.