



Translation

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Materials on Morphology and Systematics of Salicaceae. XII.***Salix purpurea* L. and Related Species**

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The complex of species related to *Salix purpurea* is one of those groups within the genus *Salix* L. that are the most challenging for understanding. So far there is neither consensus, nor sufficient clarity in interpretations of this group in the literature. The situation with the species from East Asia is the most uncertain: at least 14 species have been named there by different authors in addition to *S. purpurea*. These are *S. integra* Thunb., *S. leipdostachys* Seemen, *S. gilgiana* Seemen, *S. makinoana* Seemen, *S. savatieri* Camus, *S. sapporoënsis* Lévl., *S. gymnolepis* Lévl. & Vaniot, *S. mongolica* Siuzew, *S. dahurica* Turcz. ex Laksch., *S. tenuifolia* Turcz. ex Wolf (non *S. tenuifolia* Smith), *S. koryanagi* Kimura ex Goerz, *S. gracilior* Nakai, *S. linearistipularis* Hao, *S. haoana* W.P.Fang, and *S. sungkianica* Y.L.Chou & B.V.Skvortzov. It is true that some of these species (*S. leipdostachys*, *S. makinoana*, *S. savatieri*, *S. sapporoënsis*, and *S. gymnolepis*) have already been reduced to synonyms by Japanese authors. Yet upon subtraction of these five, there still remain 11 East Asian species whose relationships have been insufficiently clarified.

Upon consideration of a very large number of specimens in herbaria and natural populations, I believe I succeeded in arriving at an acceptable level of understanding of this complicated group of species.

My observations in nature took place in a number of locations in Transcarpathia; in Latvia; in Moscow, Lipetsk, and Volgograd Oblasts; in the vicinity of Irkutsk and the Selenga R. delta; in many locations within the southern Maritime Province; and in Transcaucasia (Aragva R., rivers of northern Armenia, and Voghji R. in southwestern Azerbaijan).

I have studied the herbarium material pertaining to the complex in question at the following depositories of this country: Botanical Institute of the USSR Acad. Sci. in Leningrad; Moscow State Univ.; Tomsk Univ.; Botanical Institute of the Ukrainian Acad. Sci. in Kyiv; Lviv Museum of Natural History; Far East Branch of the USSR Acad. Sci. in Vladivostok; Sakhalin Compl. Sci. Res. Institute in Novo-Alexandrovsk; Botanical Institutes of Armenian, Georgian, and Azerbaijani Acad. Sci. (in Yerevan, Tbilisi, and Baku, respectively); as well as in a number of institutions abroad: National Museum in Prague (holdings from Central and Southern Europe); Herbarium Centrale Italicum in Florence (all holdings); Hausknecht Herbarium, Univ. Jena (holdings from Balkan Pen. and Asia Minor); Royal Botanic Gardens, Edinburgh (holdings from Asia Minor); Natural History Museum in Vienna (holdings from Iran); and United States National Herbarium (holdings from Asia). I am deeply grateful to all colleagues in charge of the named herbaria, who provided an opportunity for me to work with the preserved specimens and on many occasions also mailed the requested material. I am greatly indebted to Prof. Bolòs (Barcelona) and professors and curators of EMU (Eastern Mediterranean University, Skopje, Macedonia). I'd like to thank N.P. Vinogradov and S.V. Golitsyn (Voronezh State Univ.), who gifted me some specimens from regions of major geographical importance. I am particularly thankful to my co-worker M.D. Golysheva for her scrupulous labor of measuring stomatae, preparation of anatomical slides of leaves, and producing sketches of these slides.

Macro-characters that are easily observed, such as the shape and size of leaves, colour of shoots, size of bracts and presence of pubescence on them, etc., have turned out to be rather variable for each species, yet showing parallel variability in all species of *S. purpurea* complex (which is as well true for a number of other willow groups). On the other hand, stable characters, those we are forced to rely upon for species determination, often tend to be rather subtle, fine ones from our subjective human standpoint. In particular, the anatomical structure of the leaf has proved to be rather stable. This was studied in six species (those numbered 1 to 3 and 5 to 7 here below). Every species was represented by a few (3–10) samples originating from various geographic areas. All the samples attributed to each of the species showed similar anatomical structure, which allows to conclude with enough confidence that these anatomical differences are truly species-specific rather than random individual traits. Most remarkably, our slides of *S. purpurea* demonstrated full similarity in every minute detail with images published by A. Camus and E.-G. Camus (1904–1905: Tabl. 4, Fig. 37) and by Alexandrov and Miroslavov (1962).

Of course, the perspective of relying on fine characters, and especially on anatomical ones, does not look too bright. Some samples, for instance, shoots with young, not yet fully developed leaves that don't yet exhibit the structures crucial for identification, may turn out to be not identifiable. Yet if our goal is finding the objective species limits rather than marking these limits arbitrarily, then there is no other choice. However, in practice, the task of species identification within the group in question is drastically facilitated by the fact that look-alike species are typically geographic vicariants, while those that occur together usually can be well differentiated morphologically. A very certain geographic range of each of the "small" species accepted here provides another proof of their real existence. On the contrary, one cannot assign any particular geographic range to *S. purpurea* sensu latissimo.

As it turned out, the species akin to *S. purpurea* form a rather natural and compact group, fairly distinct from the other groups of Sect. *Helix* Dum. It makes sense to segregate the complex in question in the rank of subsection. The rest is going to be a review of this subsection.

Subsect. Purpureae Hayek

Hayek, 1908, Fl. Steierm. 1: 154.

The only species Hayek included in this subsection was *S. purpurea* L.; hence this is the species to be accepted as the type for the subsection. The subsection contains a total of 10 species, which populate forest and steppe temperate-climate regions of Eurasia, nearly never reaching the boreal taiga forest, neither the arid regions of Central Asia. The subsection (as well as the entire section) appears to be not represented in the Western Hemisphere.

KEY TO SPECIES

1. Leaves of well-developed (not suppressed) shoots typically opposite, on petioles 1–2 (3) mm long, rather wide (length-to-width ratio 2–4), blade base wide, often cordate; if on occasion length-to-width ratio reaches 5, then leaf blade oblong, of about same width along its entire length. Anatomical structure of leaf clearly bilateral: adaxial epidermis considerably thicker than abaxial—at least closer to leaf margins; upper columnar layers of mesophyll considerably taller than lower (Fig. 3). 2

— Petioles of well-developed leaves 3–8 mm long; leaves narrower (length-to-width ratio 5–15), mostly cuneate at base (never cordate), mostly alternate. In case leaves opposite, then either their length-to-width ratio 6–8 or more or anatomical structure approaches isolateral, with adaxial and abaxial epidermis identical and all layers of cells about the same height (Fig. 2, 1). 3

2. Adaxial epidermis drastically differs from abaxial only near blade margin. Blade margin symmetrical relatively to horizontal plane (Fig. 3, 1). Mesophyll contains 5 cell layers; upper layer constitutes about one-third of mesophyll total height. Plants from the Balkans and Asia Minor. **6. *S. amplexicaulis*** Bory & Chaub.

— Adaxial epidermis drastically differs from abaxial across the entire leaf blade. Blade margin asymmetrical: collenchima reaches onto the adaxial surface farther than underneath (Fig. 3, 2). Mesophyll contains 4 cell layers; upper layer constitutes nearly half of mesophyll total height. Plants of the Far East. **7. *S. integra*** Thunb.

3. Floriferous buds large (7–12 × 2.5–4 mm), mostly ovoid, glabrous (only young ones occasionally pubescent at their very base). (Fig. 1). Leaves always alternate, their petioles 4–12 mm long, with narrowly lanceolate or subulate stipules 3–12 mm long, persistent till the end of summer. Leaf blade completely glabrous, with abundant stomata on the adaxial surface. Leaf margins sharply serrate to the very blade base, considerably callous in mature leaves. **5. *S. miyabeana*** Seemen

— Floriferous buds smaller (1.5–3 mm broad), either glabrous or pubescent. Leaves either without stipules or with very small ones (1–4 mm long). Leaf margins serrulate, mostly without callus. 4.

4. Shoots rather coarse, hardly flexible, 1–2 mm diam. (measured between 3rd and 4th bud counting from tip of twig), often short tomentose; young shoots usually densely short tomentose. Buds mostly gray tomentose. Leaves widest at about mid-blade, young ones more or less pubescent. Styles 0.3–0.5 mm tall.

- Shoots very flexible, slender, 0.7–1.4 mm diam., young ones glabrous or very sparsely pubescent. Buds glabrous or slightly puberulent. Leaves broadest considerably closer to apex. Styles 0–0.25 mm tall. 7.
5. Leaves opposite. **10. *S. haoana*** W.P.Fang
- Leaves alternate. 6.
6. Buds long-ovoid. leaves large (70–120 × 10–20 mm), with conspicuous teeth. **8. *S. gilgiana*** Seemen
- Buds ovoid. Leaves smaller (30–60 × 7–10 mm), their teeth tiny. **9. *S. taoënsis*** Goerz
7. Young shoots, petioles, and buds dark red. All leaves narrowly oblanceolate (length-to-width ratio 6–10), opposite, on petioles 3–5 mm long, strikingly two-coloured: dark green on adaxial surface, nearly white beneath. Has been known only in cultivation in the Far East. **4. *S. koriyanagi*** Kimura ex Goerz
- Characters differ. 8.
8. Medium-sized shrub (1–2.5 m); shoots mostly light yellow, distally often blotted scarlet. Floriferous buds 4–7 mm long, ovoid or ellipsoid, their sides convex, lateral carinas mostly inconspicuous. Leaves alternate, with multiple stomata 18–21 µm long on their adaxial surface. Leaf thickness 190–210 µm; anatomical structure very close to isolateral; mesophyll mostly of 6 cell layers. **2. *S. vinogradovii*** A.Skv.
- Tall shrubs or small trees (up to 5–6 m tall). Floriferous buds often up to 9–11 mm long, ellipsoid, their sides nearly parallel to each other, lateral carinas mostly conspicuous in mature buds, apices often depressed or noticeably bent toward twig. Leaves without stomata on adaxial surface or with scattered stomata 12–17 µm long. Leaf blade 140–170 µm thick, mesophyll of 4–5 cell layers. 9.

9. Shoots yellowish tawny or, not infrequently, dark red or reddish fulvous. Floriferous buds often up to 9–11 mm long. Leaves alternate. The tallest layer in the leaf mesophyll is the first one. Catkin pedicels up to 15 mm long in fruiting catkins and up to 6 mm in pollen ones, with a few small leaflets, which are usually glabrous beneath. Bracts in fruiting catkins quite different from those in pollen catkins: the former usually light-coloured or not coloured at all, occasionally tawny (very rarely black), puberulent, 0.6–1.0 mm wide; the latter mostly black, densely pubescent (especially on inner surface), 1.0–1.5 mm wide. Capsules subacute, sessile or occasionally on pedicels 0.2–0.3 mm long. Dry anthers 0.5–0.6 mm long.**3. *S. elbursensis*** Boiss.

— Shoots light-coloured, grayish or brownish yellow. Floriferous buds 6–12 mm long. Leaves not infrequently opposite. The tallest cell layer in mesophyll is the second. Catkin pedicels up to 5 mm in fruiting catkins and up to 3 mm in pollen ones, with poorly developed leaflets (cataphylls), which are usually silky sericeous beneath. Bracts in fruiting catkins not much different from those of pollen catkins. Capsules obtuse, sessile. Dry anthers 0.3–0.4 (rarely 0.5) mm long. **1. *S. purpurea*** L.

Series 1. **Purpureae** A.Skv. ser. nov. — Folia alterna vel opposita, glabra, (lineari-)oblanceolata (long. : lat. = 5–15), basi cuneata, petiolis (3) 4–8 mm lg.

Typus: *S. purpurea* L.

Leaves either alternate or opposite, (narrowly) oblanceolate (length-to-width ratio 5–15), glabrous; petioles 4–8 mm long.

Type: *S. purpurea* L.

1. *Salix purpurea* L., 1753, Sp. Pl.: 1017; Ledeb., 1851, Fl. Ross. **3**, 2: 502, p.p.; Wimmer, 1866, Sal. Eur.: 29; Seemen, 1909, in Aschers. & Graebn. Syn. Mitteleur. Fl. **4**: 192; Nasarov, 1936, Fl. SSSR [Fl. USSR] **5**: 153, p.p.; Vicioso, 1951, Sal. Espan.: 67; Beldie, 1952, Fl. Roman. **1** : 290; Rech. f., 1957, in Hegi, Ill. Fl. Mitteleur. Ed. 2, **3**, 1: 123; Maire, 1961, Fl. Afr. nord. **7**: 67. — *S. helix* L. op. cit.: 1017; Smith, 1804, Fl. Brit. **3**: 1040. — *S. lambertiana* Smith, 1804, Fl. Brit. **3**: 1041; ejusd. 1804, Engl. Bot. **19**: 1359. — **Exs.:** Herb. Russ. Fl. n°n° 789, 2342, 2343; Toepffer, Sal. Exs. n°n° 241, 544; Fl. Exs. Bavar. n°n° 124, 125, 213, 214,

755, 874; Fl. Hung. Exs. n° 131; Fl. Ital. Exs. n° 2639; Todaro, Fl. Sic. Exs. n° 485; Reverchon, Pl. Cors. n° 183; Braun-Bl. Fl. Rhaet. Exs. n° 939; Hayek, Fl. Stir. Exs. n°n° 331, 332; Reichb. Fl. Germ. n° 1141; Seringe, Sal. Helv. n°n° 89–91; Baenitz, Herb. Dendr. n° 1276; Fl. Roman. Exs. n° 388.

Typus: "In Europae australioribus" (LINN, non vidi).

S. purpurea is a common plant across all Central and Western Europe, also considerably common in Southern Europe, growing on the river alluvium and in moist meadows of river valleys. In the USSR, it is very common in Moldova, the Carpathians, and western parts of Latvia and Lithuania, reaching the vicinity of Pskov (Cheryokha R.) at the northeast. It ascends to 1,300–1,400 m in the Carpathians; to 2,200–2,300 m in the Alps; to 2,000 m in the mountains of Spain; to 2,500 in North Africa; and to 1,450 m in England.

In the Scandinavian countries, it probably occurs only in cultivation and as an escapee from cultivation. According to Christiansen (1953: 148), the northern limit of its natural range crosses Schleswig-Holstein. The whereabouts of its natural limit on the British Isles remain unclear: the range boundary has been drastically obscured due to cultivation from time immemorial. The southern boundary runs across northern Albania, southern Serbia, and northern Bulgaria. It is absent in Greece, Macedonia, and in most of Albania and Bulgaria.

Among plants of the southwestern (Mediterranean) part of the range, there commonly occur ones with extremely slender (6–8 mm) shoots and tiny leaves and buds. In particular, all samples from Corsica, Sardinia, and Catalonia that were available to me had this habit. The question arises whether the Mediterranean populations are to be segregated in a distinct taxon. This has been, in a way, already suggested for the plants of Sardinia (var. *eburnea* Borzi 1885: 140), Spain (var. *hispanica* Goerz 1926: 387), and Corsica (*S. corsica* Gandoger 1881: 331). However, I could not find any sufficiently reliable, constant characters that would justify segregation of these populations in a separate species. Besides, samples from Algeria, Sicily, and Calabria are not at all that petite, which would make their separation from the rest of the European material even more challenging.

The species' representation in the Herbarium Centrale Italicum produces an impression of a range gap in southern Italy; however, according to Moggi (1963: 66), this part of Italy has been surveyed to a much lesser extent as compared to the rest of the country, so it is quite possible that in reality there is no gap.

2. *Salix vinogradovii* A.Skv. sp. nov. — *S. purpurea* auct. fl. ross. p.p. non L. —

Frutescens, 1–3 m alt. (arboream nunquam vidi). Rami vetustiores cortice extus plus minusve laeto citrino. Ramuli annotini autumnno 0.7–1.4 mm crass. (inter gemmas ab apice 3-am et 4-am), glaberrimi, eburneo-brunnei, saepe cum maculis cinnabarinis. Gemmae generativae ovatae vel ovaes, $4-7 \times 2-2.8 \times 1.8-2.2$ mm magnae, maturae haud applanatae et carinis lateralibus inconspicuis (Fig. 1, 1), perula saepissime tota cinnabarina, hieme saepe partim emarcescens et nigrescens. Folia petiolis 3–5 mm lg., estipulata, alterna, (lineari-)oblanceolata, plus minusve manifeste discoloria, glaberrima (rarissime juvenilia plus minusve sericea), ca. 200 μ crass., supra dense stomatifera, stomatibus 18–21 μ lg. Mesophyllum fere isolaterale: stratis cellularum sub-aequalibus vulgo 6 (Fig. 2, 2). Amenta praecocia, sessilia vel pedunculis cataphyllatis brevissimis (in ♀ ad 5–6, in ♂ ad 3 mm lg.), elongato-cylindrica. Bractee in amentis masculis et femineis similes, ca. $0.8-1.5 \times 0.6-1.0$ mm dimentientes; apice atro obtuso vel rotundato. Nectarium 1, ca. 0.3–0.5 mm lg. Filamenta perfecte connata, lutea vel aurantiaca, ad basin tantum pubescentia; antherae vacuae in sicco 0.4–0.6 mm lg. Capsula sessilis vel saepius pedicello 0.2–0.5 mm lg., ovata, obtusa vel subacuta, stylo (sub-)nullo, stigmatibus parvis bilobis in vivo purpureis. (Fig. 2).

Typus: URSS, prov. Lipetzk, al fl. Don, in reservato "Galitschja Gora," 9 V 1963, S. Golitsin (MW).

Affinitas. *S. purpureae* L. valde affinis, differt gemmarum florigerarum forma et dimensionibus (cf. Fig. nostrae, 1, 1, 2, 3); foliis semper alternis, paginis superioribus dense stomatiferis, structura anatomica discrepante (Fig. 2, 1, 2; cf. etiam clavem analyticam), antheris majoribus, capsulis acutiusculis vulgo breviter pedicellatis.

Habitat in pratis (saepe subsalsuginosis) convallium et in alluviis fluviorum zonae silvatico-stepposae et stepposae planitiei Rossicae necnon Sibiriae Occidentalis et Kazakhstaniae borealis.

Speciem hanc nomine indagatoris excellentissimi florum centrali-rossicae amicissimi N.P. Vinogradovii ornamus.

A shrub 1–3 m tall. Bark on old branches coloured bright lemon yellow on the outside. Shoots of current year 0.7–1.4 mm diam. (measured in autumn, between 3rd and 4th bud counting from tip of twig), glabrous, their colour ivory or more or less brownish, often blotted cinnabar red. Floriferous buds ovoid or ellipsoid, $4-7 \times 2-2.8 \times 1.8-2.2$ mm, mature ones not depressed, their lateral carinas nearly inconspicuous; bud scales mostly entirely red, partially dying off and blackening in winter. Leaves exstipulate, on petioles 3–5 mm long, alternate, (linear-)oblanceolate, more or less two-coloured, glabrous (very rarely young ones more or less

silky sericeous), about 0.2 mm thick, with copious stomata 18–21 μm long on adaxial surface. Mesophyll nearly isolateral on cross-section, consisting mostly of 6 nearly identical cell layers. Catkins precocious, either sessile or on short (to 5–6 mm long in ♀ and to 3 mm in ♂) pedicels, long cylindrical. Bracts similar in ♂ and ♀ catkins: 0.8–1.5 \times 0.6–1.0 mm, with dark, obtuse or rounded apex. Nectary solitary, 0.3–0.5 mm long. Stamen filaments quite connate, yellow or orange, pubescent only at base; dry anthers 0.4–0.6 mm long. Stigmas small, two-lobed, purple when alive. Capsules sessile or, more often, on pedicels 0.2–0.5 mm long, obtuse or subacute, (nearly) without styles. (Fig. 2).

Type: SSSR, Lipetsk Obl., bank of Don R., in "Galichya Gora" Reserve, 9 V 1963, S.V. Golitsyn (MW).

Related Species. It differs from *S. purpurea* in size and shape of floriferous buds (cf. Fig. 1, 1, 2, 3), consistently alternate leaves, their adaxial side densely dotted with stomata, and also in the anatomical leaf structure (see key to species here above and Fig. 2, 1, 2), larger anthers, and more pointed, often short-pedicellate capsules.

Habitat. It occurs in river valley meadows (occasionally somewhat saline) and on the river alluvium in the forest steppe and steppe belt of the East European Plain, West Siberia, and Northern Kazakhstan.

Etymology. The species' name commemorates N.P. Vinogradov, the renowned researcher of the forest steppe flora of the central chernozem belt in this country.

When I was studying willows of the Central European Russia during the wintertime some 15 years ago, I noticed that buds of *S. purpurea* from the Moskva R. and western part of Moscow Obl., where *S. purpurea* sporadically occurs, were matching the descriptions and images in the West European literature; yet at the same time samples from Oka R., which I had collected myself, and those from the upper reaches of the Don R., which had been generously sent to me by N.P. Vinogradov, displayed buds of completely different size and shape. Due to lack of other material at the time, I had to attribute these differences to infraspecific variation and provide some intermediate, generalizing description and image for *S. purpurea* (Skvortsov 1955).

Later on, however, I came to the understanding that all plants from the Moskva R. with their buds of West European type were definitely alien naturalized individuals: they always occurred as solitary specimens, never demonstrating any geographical or ecological affinity, all of them representing the same clone, identical with willows in an old plantation on the bank of

the Moskva R. upstream from the mouth of Ruza R. Multiple field trips which I then undertook along other rivers of Moscow, Smolensk, and Kaluga Oblasts revealed a complete absence of any natural populations of *S. purpurea* there. Furthermore, the analysis of label information pertaining to herbarium samples of *S. purpurea* from the rest of the forest belt within the European Part of the USSR (except for the Baltic Republics and Southeast) demonstrated that those few preserved samples had been collected from cultivated plants or, otherwise, had doubtful identifications.

Hence a huge gap 600–800 km wide, reaching south at least to Kyiv in the range of "*S. purpurea*" revealed itself instead of a continuous northern boundary running from the Gulf of Riga or Lake Chudskoye [Lake Peipus] to the City of Gorky [Nizhny Novgorod]—the way it had been depicted, for example, on Schmucker's map (Schmucker 1942: Map 132), in Pravdin (1951: Fig. 33), and as it had been generally presented in the *Flora of the USSR*.

West of this newly surfaced gap, plants were characterized by obloid-cylindrical buds; east of it, plants had ovoid buds. Later, when more critical characters were added to these differences (leaf arrangement, size and position of stomata, leaf anatomical structure), it became completely obvious that plants in the steppe and forest steppe belt of this country are not *S. purpurea* but another, distinct, yet undescribed species, which has received its name only now.

Judging from the leaf thickness, size of stomata, and size of anthers, one may speculate that the new species, *S. vinogradovii* might have an enlarged chromosome number, as compared to *S. purpurea* (?).

Around the Southern Buh, the ranges of *S. purpurea* and *S. vinogradovii* meet; they might even partially overlap. Due to lack of pertaining material, I have not been able so far to indicate the exact species' boundaries. What can be stated for sure is that *S. purpurea* occurs around Vinnytsia and along the Dniestr R. all the way down to its reed beds (*plavni*); while around Mykolaiv and at the lower Dnieper, there is *S. vinogradovii*. I did not see any samples from the steppe surrounding Syvash, neither from the rest of the Crimea steppe. As to the Mountainous Crimea, it is *S. purpurea* that occurs there.

3. *Salix elbursensis* Boiss., 1853, Diagn. Pl. Or. **12**: 117, err. typogr. "*elbrusensis*." — *S. roopii* (Goerz) Grossh. 1945, Fl. Kavk. Ed. 2, **2**: 23. — *S. ledebourana* auct. non Trautv.: Goerz, 1930, Feddes Repert. **28**: 128; ejusd. 1934, op. cit. **36**: 239. — *S. tenuijulis* auct. non Ledeb.: Goerz, 1930, in Grossh. Fl. Kavk. **2**: 10; ejusd. 1930, Feddes Repert. **28**: 128; ejusd.

1934, op. cit. **36**: 239. — *S. purpurea* auct. omn. fl. cauc. necnon iran. non L. — **Exs.**: Goerz, Sal. As. n°n° 65, 66 ("*S. tenuijulis*"); Goerz, It. Anatol. n° 428.

Typus: "In monte Elburs prope Derbend, 15 V 1843, T. Kotschy, Pl. Pers. Bor. n°154" (G, non vidi, isotypi LE!, JE!, W!).

Boissier, who described the species, later rejected it (Boissier 1879, Fl. Or. 4: 1186), identified it with *S. tenuijulis* Ledeb. and *S. pallida* Ledeb. (= *S. ledebourana* Trautv.), and placed it in *S. purpurea* as a variety. However, the identification of Caucasian plants with the European species *S. purpurea* could not fully satisfy later authors. Andersson (1868: 307) segregates two new varieties (var. *pallescens* and var. *virescens*); Goerz tries to identify these plants with *S. tenuijulis* and *S. ledebourana*; and Grossheim describes a new species. At the same time, all of these authors also acknowledged the presence of *S. purpurea* in its typical form in the Caucasus, which prevented them from recognizing the true state of things.

I investigated in detail a number of "*S. purpurea*" populations in the Caucasus, and was able to make a decisive conclusion: there is only one species, which looks like *S. purpurea*, yet at the same time differs from it. Herbarium material testifies to the same. By no means the Tian-Shan species *S. tenuijulis* is present at the Caucasus, nor the Mongolian *S. ledebourana*; besides, these species belong to totally different series in other subsections.

4. *Salix koriyanagi* Kimura ex Goerz, 1931, Sal. As. **1**: 17; ejusd. 1933, Feddes Repert. **32**: 119; Makino, 1940, Ill. Fl. Jap.: 672; Ohwi, 1953, Fl. Jap.: 406; Kimura, 1954, Sci. Rep. Tohoku Univ. Biol. **20**, 3: 209. — *S. purpurea* L. var. *japonica* Nakai, 1928, Bull. Soc. Dendr. Fr. **66**: 14; ejusd. 1930, Fl. Sylv. Kor. **18**: 117; Liou Tchen-ngo, 1955, [Illustrated Flora of Ligneous Plants of Northeast China]: 185.

Typus: "Japonia, Sendai, cult. 28 III et 3 VII 1930, A. Kimura" (= Goerz, Sal. As. Exs. n° 18) (non vidi, isotypi LE!, US!, TAK!).

This is a very peculiar plant of a rather ornamental habit. It has been known only as pistillate specimens and only in cultivation. One might assume this could either be some hybrid or a drastically deviating form of a closely related species. However, there are no convincing arguments in favor of either assumption. No similarly looking clones of the European *S. purpurea* have been known; besides, it is highly improbable that any European plant would have had become so widespread in cultivation in Japan as early as the first half of the 19th century (specimens of *S. koriyanagi* were collected by von Siebold!). *S. koriyanagi* definitely

would not fit within the variability range of *S. integra*, either. If one assumes that it is a hybrid of *S. integra* and *S. miyabeana*, then its characters would be intermediate between the two, and yet they are not.

Perhaps the most plausible hypothesis is that *S. koriyanagi* constitutes a narrow Korean or Japanese endemic whose natural populations are yet to be discovered. Some old collections (Siebold: Prov. Tajima; Maximowicz: Nagasaki, in horto Sieboldiano) contain both pistillate and staminate samples. The latter may belong to the same species, yet it is impossible to reliably exclude *S. integra* without considering mature leaves.

Even though the constantly opposite leaves make *S. koriyanagi* resemble representatives of the series *Amplexicaules*, in general this species is closer to *S. purpurea*, and so it makes more sense to place it in the series *Purpureae*.

In cultivation *S. koriyanagi* occurs nearly all across Japan and Korean Peninsula; here and there in Northeastern China; and in this country on the southern Sakhalin I. and southern Kurile Is. (this is the first report of this species' presence anywhere within the USSR territory).

5. *Salix miyabeana* Seemen, 1896, Bot. Jahrb. Beibl. **53**: 50; ejusd. 1903, Sal. Jap.: 57; Tokubuchi, 1896, Bot. Mag. Tokyo **10**: 69; C.K. Schn. 1916, in Sarg. Pl. Wils. **3**: 166; Kimura, 1934, in Miyabe & Kudo, Fl. Hokk. a. Saghal. **3**: 435; Hao, 1936, Feddes Repert. Beih. **93**: 113; Ohwi, 1953, Fl. Jap.: 406. — *S. purpurea* var. *stipularis* Franch. 1884, Pl. David. **1**: 284; Rehd. 1923, Journ. Arn. Arb. **4**: 144. — *S. lepidostachys* Seemen, 1896, op. cit.: 51; ejusd. 1903, op. cit.: 58; C.K. Schn. op. cit.: 166; Kom. & Alis. 1931, Opred. rast. Dalnevost. kraya [Field Guide Pl. Far East Prov.] **1**: 425; Nasarov 1936, Fl. SSSR [Fl. USSR] **5**: 175; Lious Tchen-ngo, 1955, [Ill. Fl. Ligneous Pl. NE China]: 186.—*S. tenuifolia* Turcz. ex Wolf, 1903, Acta Horti Petropol. **21**, 2 : 145; Laksch. 1914, Spisok rast. Gerb. Russk. fl. [Checklist of Plants in Herb. Russ. fl.] **8**, 50: 52 (n°n° 2497, 2498); Nasarov. 1936, op cit.: 154; ejusd., 1937, Fl. Zabaik. [Fl. Transbaikalia] **3**: 222; Lious Tchen-ngo, op. cit.: 182; M. Popov 1959, Fl. Sr. Sib. [Fl. Centr. Siberia] **2**: 798; non Smith, 1792. — ? *S. makinoana* Seemen, 1905, Feddes Repert. **1**: 173, p.p. — ? *A. sapporoënsis* Lévl. 1909, Bull. Soc. Bot. Fr. 56 : 302, p.p. — *S. mongolica* Siuzew, 1912, Tr. Bot. Muz. Acad.. nauk [Proc. Bot. Mus. Acad. Sci.] **9**: 90, 135; ejusd. 1914, Feddes Repert. **13**: 328; Kom. & Alis. 1931, op. cit.: 423; Nasarov. 1936, op cit.: 156; Kitag. 1939, Lin. Fl. Mansh.: 160; Lious Tchen-ngo, op. cit.: 179. — *S. dahurica* Laksch. 1914, Sched. Herb. Fl. Ross. **8**, 50: 51 (n° 2496); Nasarov. 1936, op. cit.: 155; ejusd., 1937, op. cit.: 220; Lious Tchen-ngo, op. cit.: 185; M. Popov. op. cit.: 798. — *S. linearistipularis* Hao,

op.cit.: 102. — *S. gracilior* (Siuzew) Nakai, 1936, Rep. First Sci. Exped. Manch. sect. 4, **4**: 7. — *S. mongolica* f. *gracilior* Siuzew, 1912, op. cit.: 90. — *S. sungkianica* Y.L.Chou & B.V.Skvortzov. 1955, in Lious Tchen-ngo, op. cit.: 552. — *S. purpurea* auct. non L.: Turcz. 1854, Fl. Baic.-Dah. **2**, 2: 375; Kom. 1904, Tr. Peterb. bot. sada [Proc. Peterb. Bot. Gard.] **22**: 27; C.K. Schn. op. cit.: 167; Hao, op. cit.: 114; Steward, 1958, Man. Pl. Yangtze: 72. — *S. pupurea* var. *smithiana* auct. non Trautv.: Nakai, 1930, Fl. Sylv. Kor. **18**: 115; Kitag. op. cit.: 161; Lious Tchen-ngo, op. cit.: 185. — *S. rubra* auct. non Huds.: Turcz. op. cit.: 376. — **Icon.**: (specim. auth.): Tokubuchi, op. cit.; Seemen, 1903, Lious Tchen-ngo, op. cit.: tab. 13A–E; Hao, op. cit.: fig. 86. — **Exs.**: Herb. Russ. Fl., n°n° 2496 ("*S. dahurica*"), 2497, 2498 ("*S. tenuifolia*").

Typus: Japonia, "Yezo, prov. Ishikari, Sapporo, a. 1891, Y. Tokubuchi" (SAP, B, non vidi).

Just considering the abundance of synonyms, one can conclude that *S. miyabeana* is very polymorphous. This polymorphism is most pronounced in leaf sizes: some individuals feature well developed (but not overgrown) leaves sized up to 100 × 15 mm, while others have mature leaves sized only 60 × 6 mm. However, such characters as leaf shape, marginal teeth, or presence of stipules on well-developed twigs are rather invariable. Gynoecium is more variable as compared to that in other species of this subsection: in particular, a conspicuous style may often develop.

The ecological amplitude of the species is also rather wide, its habitats ranging from new sand deposits in rivers to wet meadows, occasionally even somewhat paludal. The plant also occurs in depressions amidst hilly sands. Its geographical range is as well rather broad (Fig. 4).

Nakai (1930: 207) understood its range even broader, including in it the basins of the Amgun and Uda Rivers, but this must have been a mistake. On the other hand, M.G. Popov (1959: 798) mistakenly excluded the vicinity of Irkutsk from the species' range, while in the Botanical Institute in Leningrad there is a number of samples from the Irkut R. (all the way to Turan Settlement). I also observed the species being present and abundant at the lower Kitoy R.

S. miyabeana has most probably been present only in cultivation in the northern provinces of China: Shanxi, Shaanxi, Hebei (south of Beijing), Henan, Shandong, and Jiangsu. This must be also true for the central part of Honshu in Japan.

Of all members of the Series *Purpureae*, this species is the most isolated and could be segregated in a separate series.

Series 2. **Amplexicaules** A. Skv. ser. nov. — Folia saepissime opposita et basi cordata, lata: obovata vel oblongo-obovata (long.: lat. = 2–4, raro ad 5), petiolis 1–2, raro ad 3 mm lg.

Typus: *S. amplexicaulis* Bory & Chaub.

Leaves usually opposite, cordate at base, wide: oblanceolate or oblong-oblanceolate (length-to-width ratio 2–4 rarely to 5), on petioles 1–2, rarely 3 mm long.

Type: *S. amplexicaulis* Bory & Chaub.

6. *Salix amplexicaulis* Bory & Chaub., 1832, Expéd. Sci. Morée **3**, 2: 277; ejusd. 1838, Nouv. Fl. Pelop.: 64; Dieck, 1893, Garten-flora **42**: 673, 727; Halacsy, 1904, Consp. Fl. Graec. **3**: 138; Soška, 1938, Glasn. Skopsk. nauchn. drushtva **18**: 223; ejusd. 1939, op. cit. **20**: 35, 167; Rech. f. 1943, Fl. Aegaea: 95. — *S. purpurea* var. (vel subsp.) *amplexicaulis* auct.: Boiss. 1879, Fl. Or. **4**: 1186; Hayek, 1924, Prodr. Fl. Balc. **1**: 87; Goerz, 1930, Feddes Repert. **28**: 128; Stojan. & Stef., 1948, Fl. Bălg.: 317. — **Exs.:** Toepffer, Sal. Exs. n° 729; Goerz, Sal. As. n° 64 ("*S. purpurea* f. *genuina*").

Typus: Graecia, "Morea, J.B.M. Bory" (P?, non vidi).

This is a rather characteristic species of the southern Balkan Peninsula and northwestern Asia Minor; it also occurs in Calabria. There must be an enclave area fragment in southeastern France. At least I cannot help but place the specimen "Pont du Chateau, 530 m, alluvions. VIII 1958, La Moselle et Cusset" (MW) with *S. amplexicaulis*. However, it is difficult to decide if the species really occurs in a natural habitat there and how widely it is spread: I have succeeded to obtain only some meager material from that region, and there is no clarity regarding this question in the French literature.

From the ecological standpoint, the species appears to be not that much different from *S. purpurea*. In the mountains, it ascends to 1,100 m in Greece and to 1,600 m in Asia Minor. According to observations made by Dr. V.B. Kuvaev in northern Albania (pers. comm.) and Dr. V.I. Velchev in Bulgaria (pers. comm.), in these countries, *S. amplexicaulis* and *S. purpurea* occur at different altitudes: the former species is restricted to low and medium altitudinal zones; the latter—only to high altitudes.

7. *Salix integra* Thunb., 1784, Fl. Jap.: **24**; Sieb. & Zucc. 1846, Fl. Jap. **2**: 211; Nakai, 1930, Fl. Sylv. Kor. **18**: 113; Kom. & Alis., 1931, Opred. rast. Dalnevost. kraya [Field Guide Pl. Far East Prov.] **1**: 425; Kimura, 1934, in Miyabe & Kudo, Fl. Hokk. a. Saghal. **4**: 434; Nasarov, 1936, Fl. SSSR [Fl. USSR] **5**: 179; Ohwi, 1953, Fl. Jap.: 406; Lious Tchen-ngo, 1955, [Ill. Fl. Ligneous Pl. NE China]: 173. — *S. purpurea* subsp. *amplexicaulis* var. *multinervis* (Franch. & Savat.) C.K. Schn. 1916, in Sarg. Pl. Wils. **3**: 168. — *S. multinervis* Franch. & Savat., 1876, Enum. Pl. Jap. **2**: 1, 504; Kom., 1903, Tr. Peterb. bot. sada [Proc. Peterb. Bot. Garden] **22**: 25; Hao, 1936, Feddes Repert. Beih. **93**: 114. — *S. savatieri* Camus, 1904, Saul. Fr.: 326. — *S. purpurea* auct. non L.: Franch. & Savat., 1875, Enum. Pl. Jap. **1**: 462; Seemen, 1903, Sal. Jap.: 55, p.p. — *S. purpurea* subsp. *amplexicaulis* auct. non Boiss.: Koidz., 1913, Bot. Mag. Tokyo **27**: 92. — **Exs.**: Nat. Sci. Mus. Tokyo Fl. Jap. n° 1047.

Typus: "Japonia. Thunberg" (U, non vidi).

Externally this species is practically indistinguishable from *S. amplexiculis*. It is only their geographic distribution far apart and some small differences in the leaf anatomy (Fig. 3, 1, 2) that justify recognition of two different species.

It is rather widespread in the southern part of our Maritime Province, in low wet meadows. It appears not to populate river alluvia, at least not fresh ones. In this country, it does not ascend to mountains—probably due to absence of suitable habitats. In Liaoning Prov. of China, it has been reported from up to 800 m a.s.l. (Fig. 5).

Series 3. **Gilgiana** A.Skv. ser. nov. — Rami robustiores (nec tenues flexibili-viminei), ut etiam folia (juveniles saltem) breviter plus minusve dense puberuli. Folia saepissime elongato-elliptica, latitudine maxima ad medietatem. Stylus conspicuus (0.3–0.5 mm lg.).

Typus: *S. gilgiana* Seemen.

Shoots comparatively thick, at least at young age with short dense pubescence (as well as leaves). Leaves usually elongate-elliptic, their maximal width at about mid-blade. Style conspicuous (0.3–0.5 mm long).

Type: *S. gilgiana* Seemen.

8. *Salix gilgiana* Seemen, 1903, Sal. Jap.: 59; C.K. Schn., 1916, in Sarg. Pl. Wils. **3**: 169; Nakai, 1930, Fl. Sylv. Kor. **18**: 112, p.p.; Kimura, 1934, in Miyabe & Kudo, Fl. Hokk. a. Saghal. **4**: 437; Ohwi, 1953, Fl. Jap.: 407; Makino, 1956, Ill. Fl. Jap.: 671. — ? *S. makinoana* Seemen, 1905, Feddes Repert. **1**: 173, p.p. — *S. gymnolepis* Lévl. & Vaniot, 1906, Feddes

Repert. **3**: 22; Makino & Nemoto, 1925, Fl. Jap.: 1124. — *S. pupurea* var. *sericea* auct. non Wimm.: Seemen, op. cit.: 56; Koidz., 1913, Bot. Mag. Tokyo **27**: 92; C.K. Schn., op. cit.: 167.

Typus: "Japonia, Nippon, Yedo, 15 III, 23 IV, 8 VI 1874, Hilgendorf" (KYO, isotypus B?, non vidi).

The species populates wet meadows and stream sides. Geographical range: Japan (Hokkaido and northern half of Honshu), apparently not very common; Korean Pen. Distribution across Korean Pen. is insufficiently known. Nakai (1930: 212) provided a number of localities in the southern part of Soviet Maritime Province, while in reality this species is not present there. The species had not been reported by Japanese authors from the Kuril Is.; however, it has been recently collected on Zelenyy [Green] I. (N. Popov & A. Chernyaeva, 1960), though near an abandoned homestead.

9. *Salix taoënsis* Goerz, 1932, Journ. Arn. Arb. **13**: 401.

Typus (lectotypus): Tao River, Choni, VI 1925, ♀, n° 12265, J.F. Rock (A!, isotypi S!).

Even though Goerz proposed the binary name, he believed *S. taoënsis* to be a hybrid of *S. myrtilleacea* Anderss. and *S. wilhelmsiana* Bieb. However, my investigation of just a part of material that was at Goerz's disposal (and I also saw Rock's specimens n°n° 12099, 12103, 12105, 13921, and 13930) made me conclude that this approach was not justified: *S. taoënsis* is a completely distinct species with the affinity to *S. gilgiana*. A small collection of specimens from Gansu Province preserved in Bot. Inst., Leningrad (Potanin 5, 14, 22 VI 1885 and Przewalski 21 IV 1880) also testifies in favor of its distinctness.

Lectotype has been designated by me from a large series of paratypes cited by Goerz.

10. *Salix haoana* Fang, 1945, Journ. West China Border Res. Soc. ser. B, **15**: 178.

Regretfully, I have not been able to see the type, neither the original species' description. However, I studied two specimens from the vicinity of Chengdu (W.K. Hu, n°n° 7652, 9221, US), which provided me with a concept of the species—an incomplete one, yet sufficient for the placement of the species in the taxonomic system.

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FIGURES

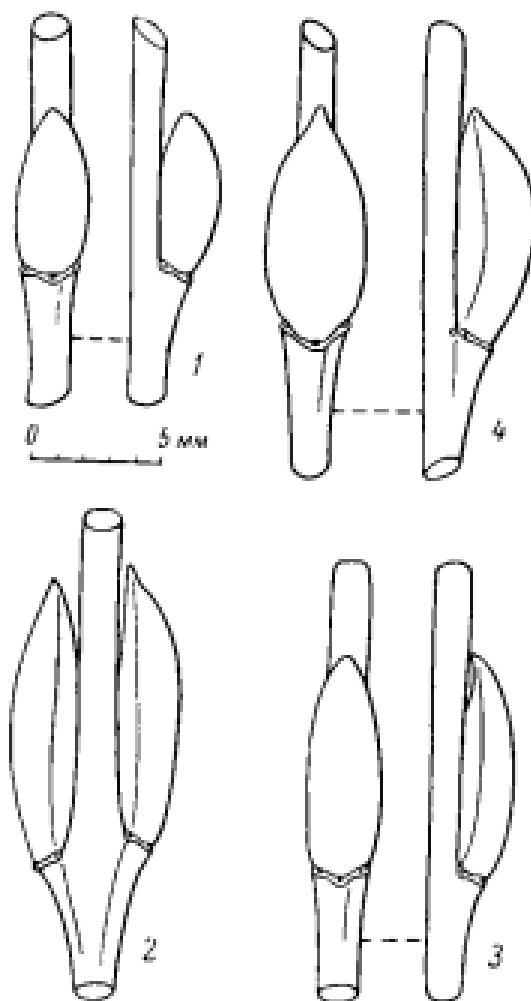


Fig. 1. Floriferous buds of some species in the genus *Salix* L.: 1 — *S. vinogradovii* A.Skv., 2, 3 — *S. purpurea* L., 4 — *S. miyabeana* Seemen

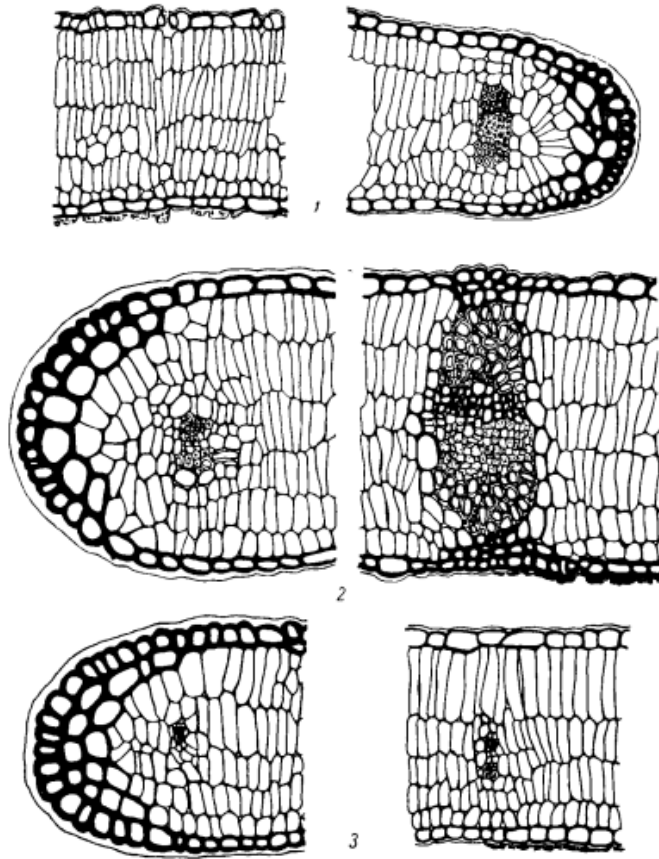


Fig. 2. Leaf cross-section (at margin and about mid-blade) of some species in the genus *Salix* L.: 1 — *S. purpurea* L., 2 — *S. vinogradovii* A.Skv., 3 — *S. elbursensis* Boiss.

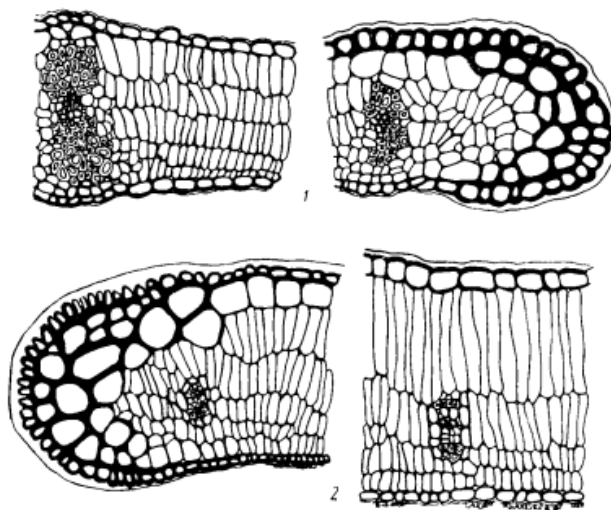


Fig. 3. Leaf cross-section (at margin and about mid-blade) of some species in the genus *Salix* L.: 1 — *S. amplexicaulis* Bory & Chaub., 2 — *S. integra* Thunb.

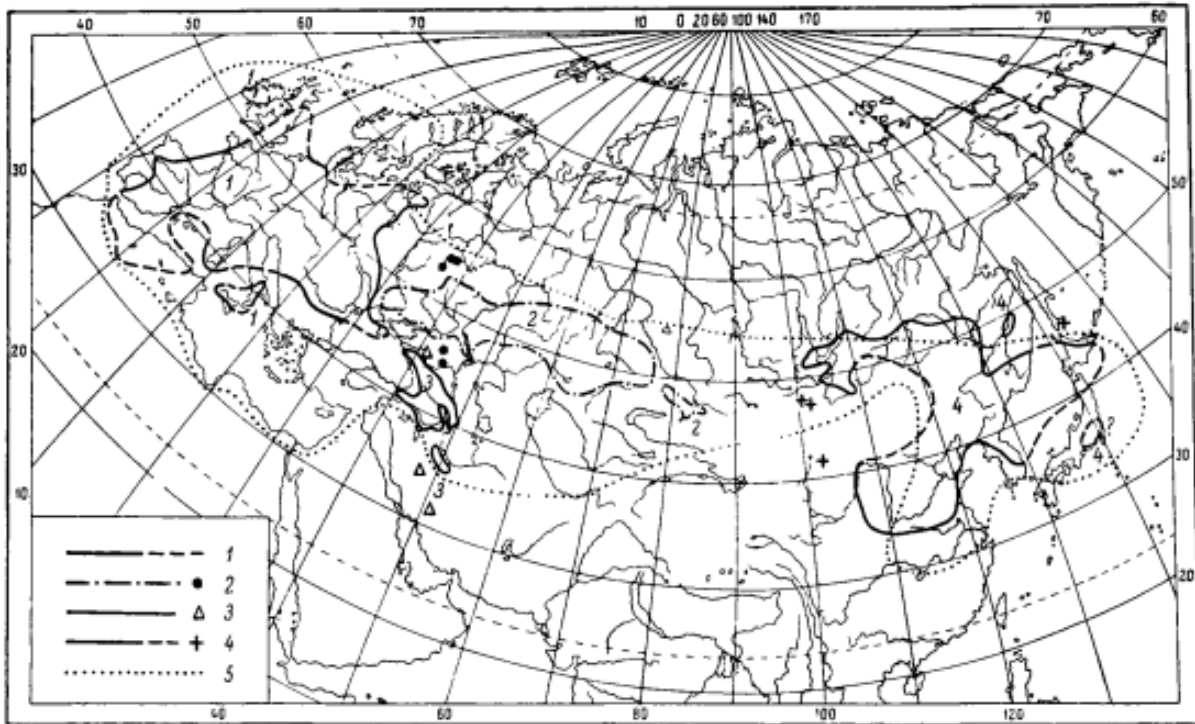


Fig. 4. Geographical ranges of species from the series *Purpureae* A.Skv. of the genus *Salix* L.:
 1 — *S. purpurea* L., 2 — *S. vinogradovii* A.Skv., 3 — *S. elbursensis* Boiss., 4 — *S. miyabeana* Seemen, 5 — range of *S. purpurea* L. according to Schmucker (1942) and Pravdin (1951).

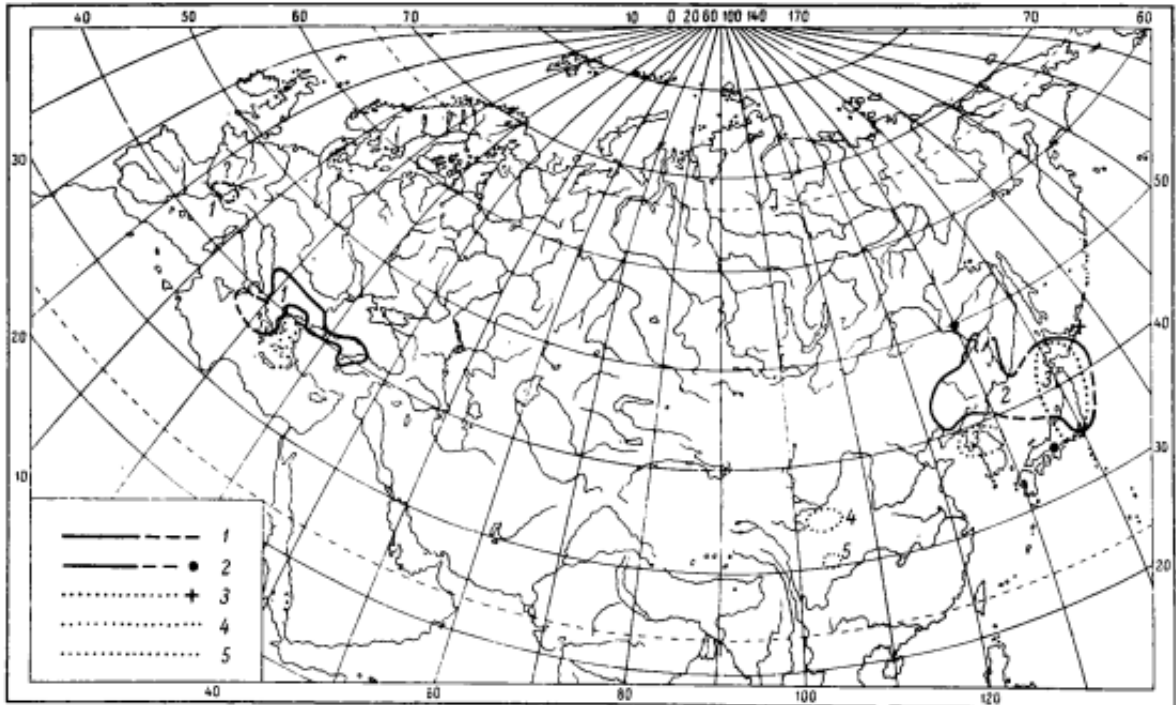


Fig. 5. Geographical ranges of species from the series *Amplexicaules* A.Skv. and *Gilgianae* A.Skv. of the genus *Salix* L.: 1 — *S. amplexicaulis* Bory & Chaub., 2 — *S. integra* Thunb., 3 — *S. gilgiana* Seemen, 4 — *S. taoënsis* Goerz, 5 — *S. haoana* Fang. Due to lack of material, the ranges of the latter three species drawn approximately.