

Dwarf succulent saxifragas (section *Porphyron* Engler & Irmscher).

Drobné sukulentní lomikameny ze sekce *Porphyron* Engler et Irmscher.

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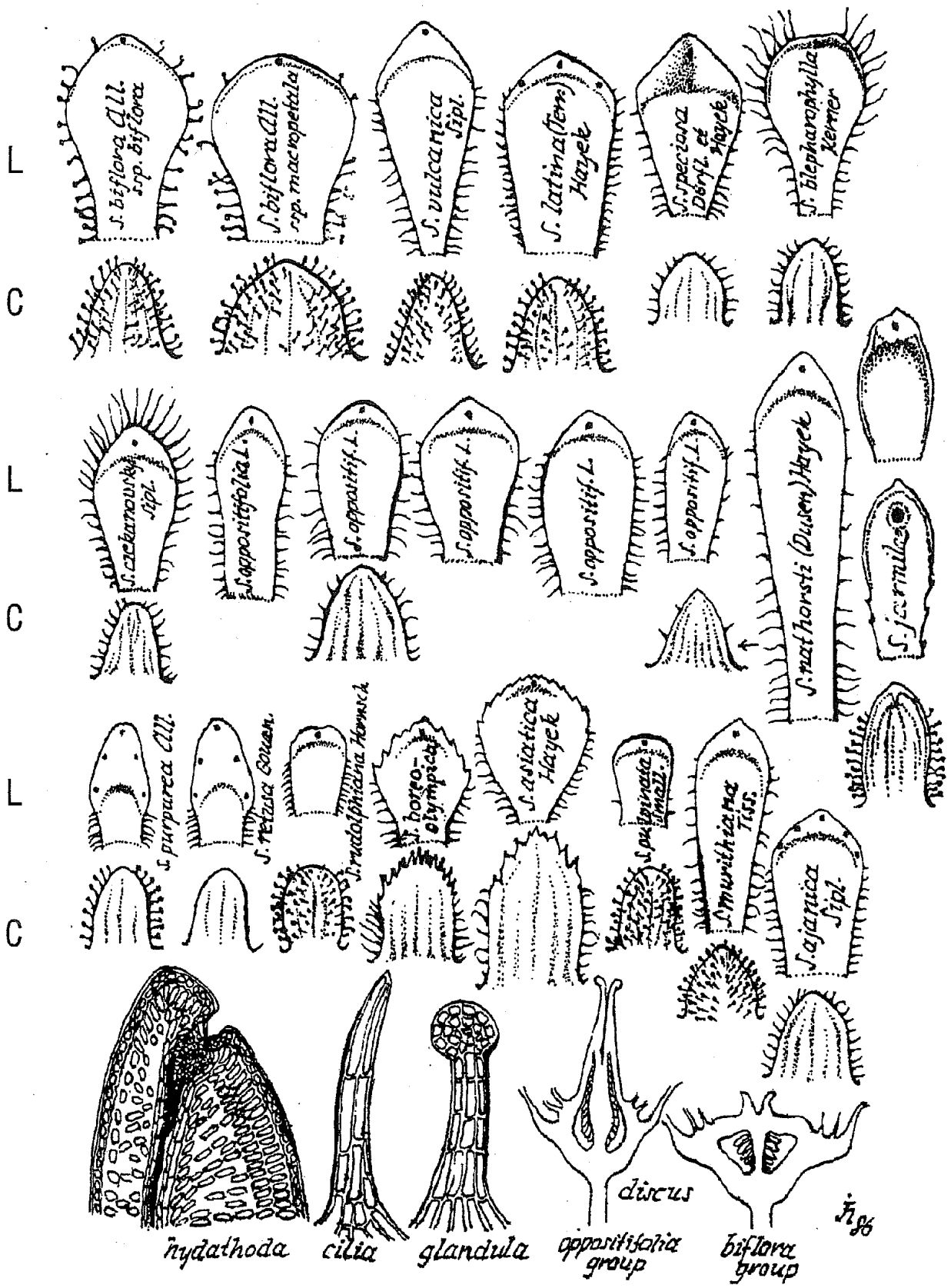
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Abstract. A revision of the section *Porphyron* Engler & Irmscher is presented. Two new species are described.

Keywords: *Saxifraga*, system, taxonomy.

Saxifragas of section *Porphyron* resemble cushion-like sedums or crassulas much more than "typical" saxifragas. Many of these are very popular rockgarden plants or are seen in special collections of winter-hardy succulents. They all inhabit different parts of the northern hemisphere, generally high elevations or the Arctic tundra. All species are perennial, herbaceous evergreens, forming very low mats or dense cushions. In nature they bloom in early spring, often when snow is melting and are one of the first blooming plants in the mountains or in the garden.

Section *Porphyron* Tausch (in some works included in the section *Porophyllum*), involves all the species which are the object of this study, and is sometimes considered a "hodge-podge" for many botanists. Distinguishing characteristics for most of the species [except only some extreme exceptions - for example *SS. retusa*, *purpurea*, *biflora*] seem to be not prominent enough at first. The presence of extreme variability and also the absence of strictly geographical correlation of these characteristics makes the introspecific system of species "*S. oppositifolia*" relatively difficult. Therefore the majority of botanists today prefer a broad understanding of the species as an aggregate complex - "typus polymorphus". Distinguished botanists such as Engler and Irmscher in their monograph of the entire genus *Saxifraga* [Das Pflanzenreich: *Saxifragaceae* 4:117 (1915)] followed this treatment as well as more recent botanists D.A. Webb, Polunin, Hulten and others. It was only after my research that I understood the importance of the work of A.v. Hayek [Monographische Studien über die Gattung *Saxifraga* 1. Die Sektion *Porphyron* Tausch. Denkschriften der kaiserlichen Akademie der Wissenschaften, Wien, 77:611-709 (1905)], who with a shocking foresight divided the "*S. oppositifolia* sensu lato" into genuine species, of which only *S. meridionalis* Hayek might seem disputable. Hayek's study does not include *S. pulvinata* Small, published 1901, which strictly corresponds with his conception. At the present time it is Siplivinskij [1972], who made serious research of Siberian populations



L ... leaves
C ... calyces

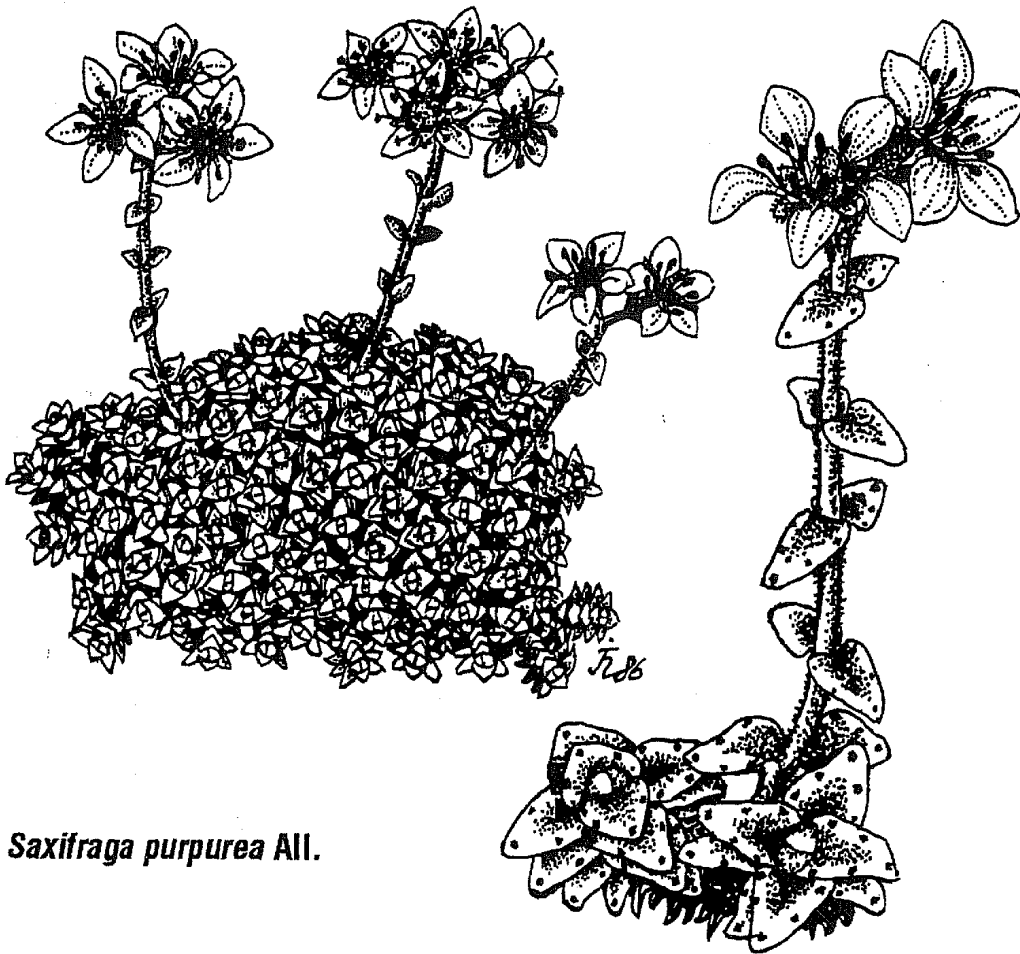
of "*S. oppositifolia*" and enriched the section by several species. I am convinced that further studies of new collections, especially from Asia, will broaden our knowledge of these extremely beautiful plants.



***S. biflora* All.** (*S. foliis imbricatis, caulibus reptantibus, bifloris* Haller, *S. rosea* Lapeyrouse, *S. oppositifolia* var. *biflora* Willdenow, *Antiphylla biflora* Haworth, *S. hornungii* Shuttleworth) is the most distant type of the whole section - the plant is covered with glandular hairs and its floral discus is notably broad. It grows in association with *S. oppositifolia*, *Campanula cenisia*, *Thlaspi rotundifolium*, *Hutchinsia alpina* etc. It is a distinctly cold loving plant which usually does not survive summer heat. It is easily propagated by seed or cuttings. In nature we find two typical subspecies:

ssp. biflora with more narrow leaves and sepals has narrow petals ca 5mm long. It comes from Central and North Alps.

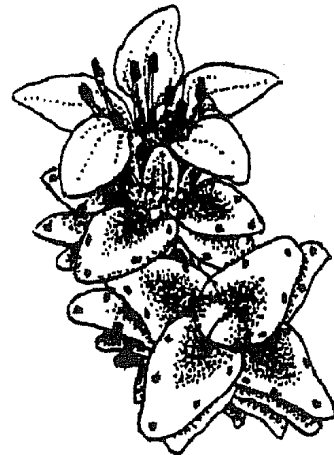
ssp. *macropetala* (Kerner) Rouy et Camus (*S. macropetala* Kerner, *S. kochii* Bluff, Nees et Schauer) with broader leaves and sepals [approx. twice as broad as ssp. *biflora*] has broader petals up to 10mm long. It comes from Central and East Alps. Both subspecies are more interesting than beautiful.



***Saxifraga purpurea* All.**

***S. purpurea* All.** (*S. retusa* Gouan var. *angustana* Vaccari, *S. imbricata* Lamarck, *S. oppositifolia* var. *purpurea* Willdenow, *Antiphylla retusa* Haworth) grows on limestone and dolomite in alpine zone in SW Alps. It forms loose mats of dark green glossy leaves 3-4mm long, with 5 hydathodes and cilia only on lower part of the leaf-blade. It blooms on 30-80mm long stems, bearing 2-6 flowers. Sepals are glandular-hairy in contrast with *S. retusa*, which is glabrous; rose or purple petals are in their lower parts suddenly constricted, so it seems to end in the periphery of calyx, which is typical for both species.

***S. retusa* Gouan** (*S. wulfeniana* Schott, *S. baumgartenii* Schott, *S. oppositifolia* var. *sturmiiana* Reichenbach, *S. perporosa* Schur, *S. wulfeniana* Nyman, *S. scrobiculata* Schur, *Antiphylla retusa* (Gouan) Haworth) of East and Central Pyrenees, Alps, Carpathians, Pirin and

***Saxifraga retusa* Gouan**

Rila Planina is strictly acidophile in nature, choosing cold habitats in deep crevices on northern sides of peaks, by with it strongly resembles the habitats of *S. boreo-olympica* in the Olympics. Leaves are similar to as *S. purpurea*, notably waxy lustrous creating dense mats till 0.5m in diameter. Flowers are single, sessile, with petals varying from light rose to violet. Cold loving species, that grows in the highest elevations. Easily propagated by seeds, cuttings or divisions.

The above mentioned species are from the most distant relatives of *S. oppositifolia sensu lato*. Now let us procede to *S. oppositifolia* itself. **What is it?** Linnaeus described *S. oppositifolia* from Spitzbergen [number 575-32-34 Linn. in his herbarium] and this as a type plant I as well as Hayek, took as a starting point for my study. Linnaeus plant is loosely caespitose, we should say "classical" *S. oppositifolia*, mostly considered by botanical writers as a *S. oppositifolia* ssp. *oppositifolia*. This plant has leaf-margin [with the exception of apex] more or less ciliate and so the sepals. After thorough study I came to the conclusion, that justify the following three cathegories as most important for distinguishing mutual relationship.

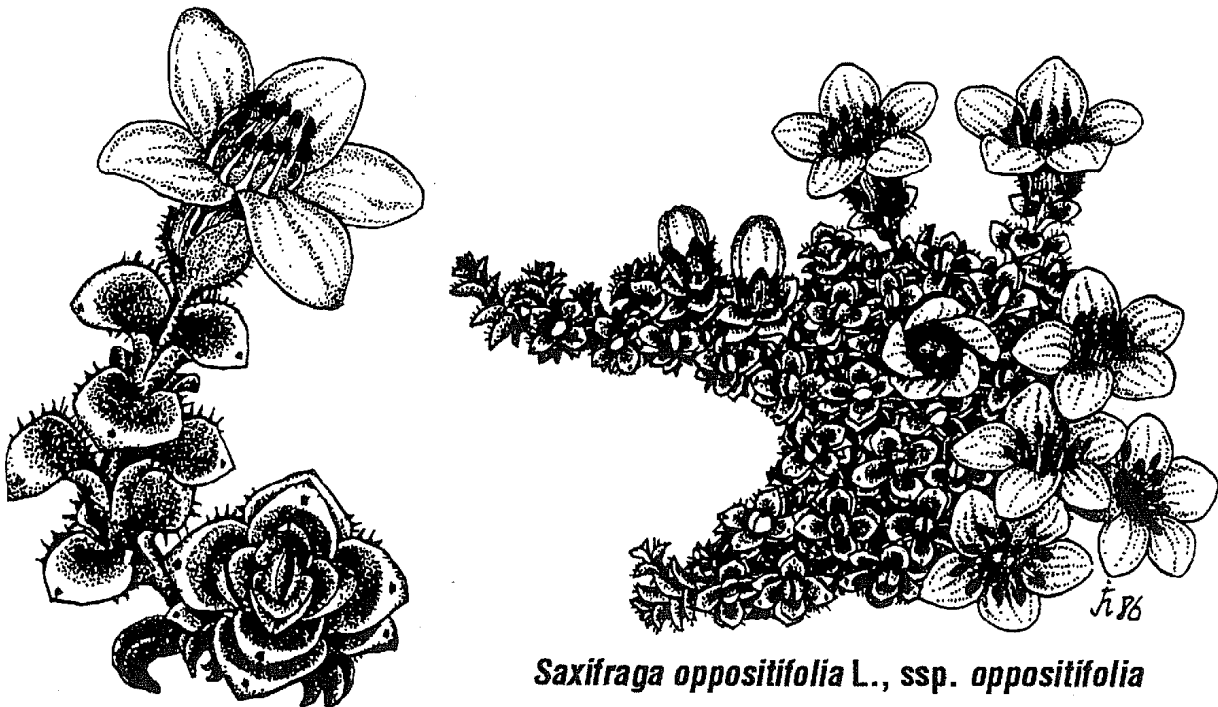
a/ cathegory around ***S. oppositifolia*** allways with ciliate sepals.

b/ cathegory around ***S. rudolphiana*** allways with glandular sepals.

c/ cathegory around ***S. asiatica*** with dentate margins of sepals and apical part of leaves.

Separate species of above mentioned cathegories cannot be mixed up, as the presence or absence of glands or cilia is constant, unchangeble mark.

S. oppositifolia L. ssp. ***oppositifolia*** (*S. coerulea* Persoon, *S. biflora* Fuss, *S. kochii* Fuss, *S. rudolphiana* Schur, *S. oppositifolia* var. *imbricata* Seringe, *S. oppositifolia* ssp. *typica* Vaccari, *Antiphylla coerulea* (Pers.) Haworth, *Antiphylla oppositifolia* (L.) Fourn., *S. oppositifolia* L. ssp. *eu-oppositifolia* Engl. et Irmsch., *S. oppositifolia* ssp. *arcto-alpina* Braun-Blanquet and probably *S. meridionalis* Hayek), is well known circumpolar species with a vast areal. It is a species in wild as well as culture very "hardy" growing from the subalpine elevations up to the highest ridges of Alps or Carpathians and could be found in the North far beyond the Polar Circle. Leaves varying in shape and leght (2.5-5mm). Its cushions or clumps may be laxe or dense and also the shape



Saxifraga oppositifolia L., ssp. *oppositifolia*

and color of petals are greatly variable. Grows mainly on the rocks or stonefields in exposed habitat and dislikes moist places. As all the species of the section can be easily propagated by cuttings, seeds or division. In culture they are varies cultivars that can be distinguished by color or size of petals ('Alba', 'Grandiflora', 'Minuta') or rosetts. One can hardly find a uniform population on one natural habitat, so different are individual plants.

S. oppositifolia ssp. *amphibia* (Suendermann) Braun-Blanquet (*S. oppositifolia* var. *amphibia* Suendermann) grows in grasslands in lower elevations near Bodensee (Boden Lake) in Central Alps. It differs by leaves with 3 hydathodes without lime secret.

S. ajanica Siplivinsky comes from Okhotsk coast in Eastern Siberia and by shape of leaves is close to broad-leaved forms of *S. oppositifolia*, but the apex of leaves has five or sometimes 3 hydathodes. It is not in culture.

S. nathorsti (Dusen) Hayek (*S. oppositifolia* L. var. *nathorsti* Dusen) from southern Groenland is from the closest kinship of *S. oppositifolia*. It differs mainly by suddenly sharpend, almost cilialess sepals and large leaves that reach the legth up to 15mm (usually to 12mm) with cilia gradually elongates towards their bases. I suppose that this species presently is not in cultivation.

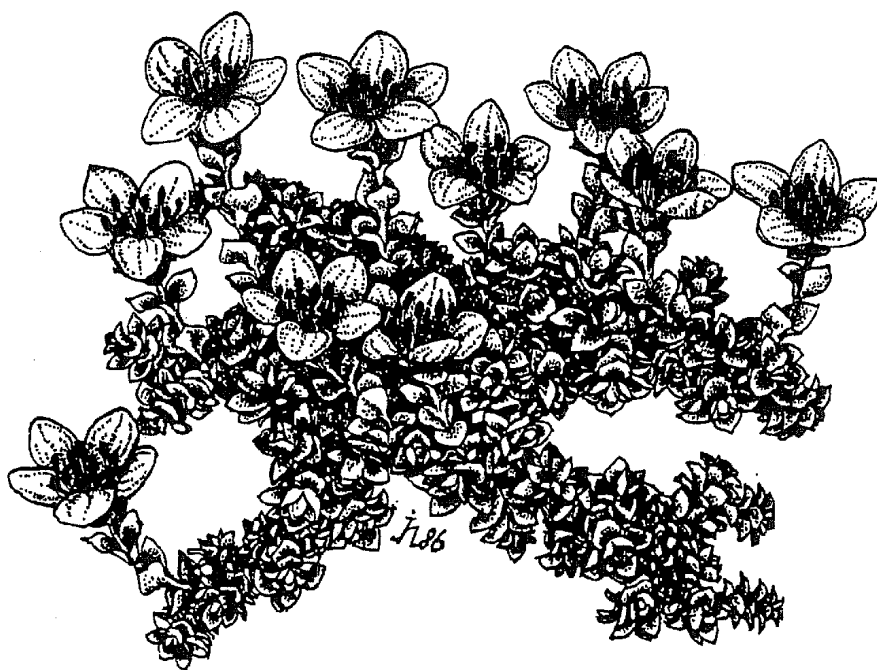
S. blepharophylla Kerner ex Hayek (*S. oppositifolia* L. ssp. *blepharophylla* (Kerner ex Hayek) Engler et Irmscher, *S. oppositifolia* Maly, *S. kochii* Gassner, *S. kochii* Maly, *S. biflora* Maly) from Austrian Alps differs mainly by large (4-6mm) spatulate leaves, their cartilaginous margin is

hardly noticable and cilia are elongating towards apex (up to 2mm long). Very ornamental, easily cultivated species.

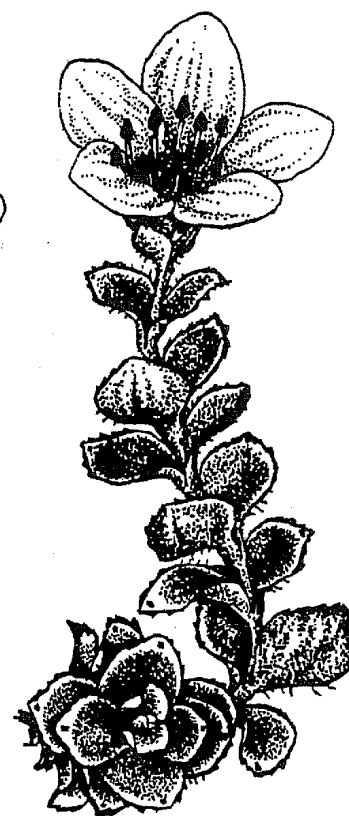
S. czekanovskyi Siplivinsky in Novitates systematicae plantarum vascularium 8:147 (1971).

This species comes from Siberia [Czekanovsky's Range in Yakutsk district] and differs by its broad cartilaginous margin of leaves along its whole periphery, but mainly on the apex where they are densely concentrate. Sepals are small, shortly densely ciliate. I have never tried to grow it and according to my knowledge it is not in culture.

S. speciosa Doerfler et Hayek (*S. oppositifolia* Moretti p.p.) from Abruzzen in Italy, with leaves obovate, nearly rhomboid. Cartilaginous margin reaches more than 1/3 of blade, cilia only in its lower parts. Ovoid sepals sporadically ciliate on the margin. Easy in culture, very ornamental.



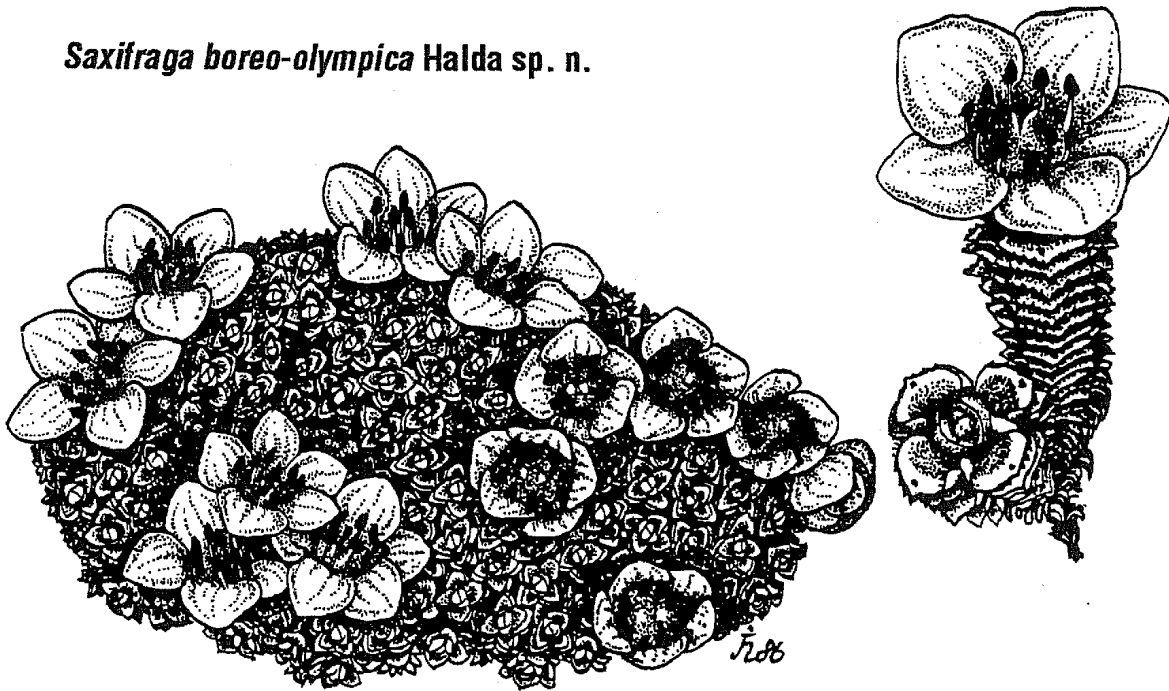
***Saxifraga asiatica* Hayek**



S. asiatica Hayek (*S. oppositifolia* Karelina et Kirillova). Its habitat is very large - Sayan Mts., Transbaicalian Mts., Saur, Altai, Stanovoye nagorye, Dzhungarian Alatau, Tienshan, Pamiroalai, Southern Tibet, Himalaya. From *S. oppositifolia*-group differs by dentate margin in the upper part of leaves and sepals. It forms moreless compact cushions or clumps comparable with *S. oppositifolia*, with flowers on leafy stems. Color of petals is varying from pale rose to violet and plant is very ornamental. This species I meet very often in the mountains of Siberia as well as in Central Asia, where it ascends high up to alpine zone reaching compact forms with rounded

leaves. In cultivation is as easy as *S. oppositifolia*. By its dentate margins of leaves and sepals creates *S. asiatica* convergence with *S. boreo-olympica*, it means that the margin of sepals and leaves is similar. It differs by its general habitus as the growth of *S. asiatica* corresponds to *S. oppositifolia*, while *S. boreo-olympica* resembles European species *S. retusa* or *S. rudolphiana*.

***Saxifraga boreo-olympica* Halda sp. n.**



***Saxifraga boreo-olympica* J. J. Halda species nova:**

Planta compacte pulvinatim caespitosa, caudiculis columnaribus densissimis. Folia succulenta, columnarum quadri-radiata, densissime congesta, parva, cca 2-3mm longa, 1.5-2mm lata, margine [apice curvato excepto] ciliis 0.1-0.3mm longis, pluribus praedita, obovato vel subrotundato-rhomboida, obtusa, apice dentata, 1-foveolata. Flores solitarii, sepala cca 3.5mm longa, margine ciliis 0.1-0.4mm longis instructa, apice rotundata, cartilaginea, dentata vel denticulata [i.e. eciliata], intus efoveolata [i.e. sine hydathodo]. Petala lata, ovata, rosea vel violacea, cca 10-12mm longa.

Typus: USA, Washington state, Olympic Mts., Mt. Townsend, in saxosis septentrionalis. Leg. J. J. Halda 20.7. 1986 (JJH86076130). PRG.

This newly described succulent species is endemic to the mountains in NW USA. It differs from the closest relative - *S. asiatica* Hayek, thousands miles distant sister from Siberia, Central Asia and Himalaya - by its smaller pulvinate habitus, tiny columnary-arranged leaves and sessile flowers with small, different calyx. (I would have never thought, it possible that so geographically distant species might be so much akin. It was for me an incentive to an idea to compare other pairs of species such as glandulate *S. rudolphiana* and *S. pulvinata* - european with siberian-american, european *S. blepharophylla* with Siberian *S. czekanovskyi* or *S. murithiana* and

S. vulcanica with similar relations. Than was not so difficult to assort them in identificational key - and the system was here! I spent a pretty autumn working on it, examining more than 10.000 herbarium specimens). This very interesting and beautiful plant is known in american literature as *S. oppositifolia* L. It grows on very cold North faced cliffs and gorges, never on the sunshine, on very similar conditions as european *S. retusa*.

In the third category are species with glandulous calyx.

S. latina (Terr.) Hayek (*S. oppositifolia* L. var. *latina* Terraciano, *S. adnosepala* Hayek, *S. oppositifolia* Moretti) from Italy [alpine zone of Apenins and Apuan Alps] differs from all other of the group by three hydathodes on cartilaginous margin of leaves. It belongs to very ornamental species of this group, grows easily and also its propagation is no problem. Has been in cultivation for a long time.

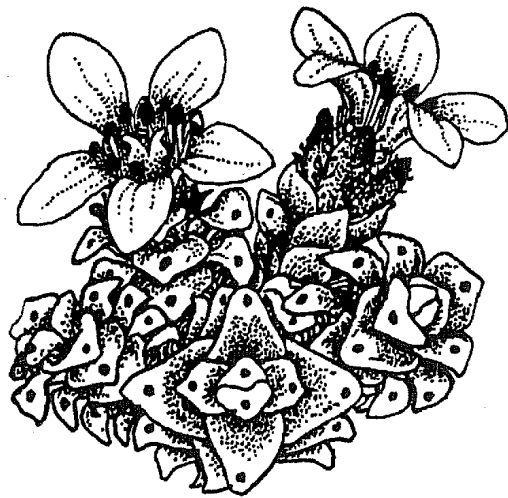
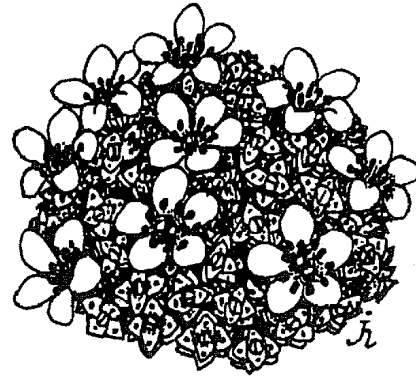
Saxifraga rudolphiana Hornsch



S. rudolphiana Hornsch. (*S. oppositifolia* L. var. *rudolphiana* (Hornsch.) Engler, *S. oppositifolia* L. ssp. *rudolphiana* (Hornsch.) Engler et Irmscher) from Austrian Alps and East Carpathians is the tiniest species of Porphyron section and, perhaps, the smallest one. The leaves are hardly 2mm long. Its tiny rosettes form absolutely economical arranged hard cushion, resembling more moss than saxifraga. Sessile flowers are substantially smaller than those of other species and their color is variable from nearly white to violet. In culture is easy and very ornamental. The best method of propagation is by division or cuttings as the seedlings are very tiny and more sensitive.

S. jarmilae J. J. Halda species nova.

Planta dense pulvinatim caespitosa, caudiculis columnaribus plus minus densis. Folia succulenta, columnarum quadri-radiata, densissime congesta, parva, cca 1-2mm longa,

*Saxifraga jarmilae* Halda sp. n.

1-1.5mm lata, oblongo-ovata, cartilagineo marginata, mucronata, 1-foveolata, hydathodo grande. Flores solitarii, sepala 3-4mm longa, margine glandulosa; petala obovata, alba, 6-9mm longa.

Typus: SW China, Yunnan, Yulongshan, in saxosis orientalis, cca 4300m alta. Leg. J.J. & J. Halda 14.7. 1990 (JJH 9007315). PRG.

This newly described species is endemic to the mountains in SW China, where I discovered it together with my wife Jarmila. It differs from the closest relative *S. rudolphiana* Hornsch. by bigger habitus, white flowers, mucronate leaves and calyx and the huge hydathode. This beautiful plant grows on East and North faced cliffs and rocks often together with *Paraquilegia anemonoides* and *Solmslaubachia pulcherrima*. In the culture needs much cooler conditions than *S. oppositifolia*. Propagation by seeds or cuttings.

S. pulvinata Small (*S. oppositifolia* L. subvar. *smalliana* Engler et Irmscher, *S. oppositifolia* L. ssp. *smalliana* [Engl. et Irmsch.] Hulten).

Originally was described from Arctic North America, but its areal spreads from vast area of Eastern Siberia to North America (from Lena river to Yukon). It is the closest relative of European *S. rudolphiana* from which it differs mainly by long stemmed capsules and elongated leaves nearly without any cilia. Forms dense cushions with nearly sessile purple flowers 10-20mm in diameter. After pollination the stems under capsules elongate up to 20-50mm of lengths. It is an interesting plant from limestones, which is hardly in culture.

S. murithiana Tiss. (*S. imbricata* Lamarck, *S. oppositifolia* L. ssp. *glandulifera* Vaccari, *S. oppositifolia* L. var. *distans* Ser., *S. rudolphiana* Greml, *S. hegetschweileri* Bruegger) from vast area of mountain regions of SW Europe (Sierra Nevada and Pyrenees, West Alps), with lanceolate leaves, sparsely ciliate, sepals apiculate, densely glandulose. Flowers are pink or purple. It is an easy, beautiful species.

S. vulcanica Siplivinsky from Kamtschatka, Aleutes and Comodore Islands, where inhabits steep cliffs in tundra, is characteristic by its cuneiform leaves, that suddenly taper at their

bases, and sharply apiculate and densely glandulose sepals. Has large flowers of lively violet color. I don't know, if is in cultivation.

All species of the section *Porphyrium* are extremely interesting and ornamental garden plants. In the culture they need a cooler, good drained place (crevices or scree, eventually cold greenhouse) which are never quite dry, not so heavy soil mix and a rough top-dressing (gravels or bark-mulch). Propagation by seeds, cuttings or divisions.

Key to the section *Porphyrium* Tausch.

- 1a Leaves in upper part glandulose on margins; discus* broad; styles short *S. biflora*
- 1b Leaves ciliate* on margins; discus narrow or none; styles long 2
- 2a Sepals glabrous or glandulose* 3
- 2b Sepals ciliate on the margin 9
- 3a Cartilaginous leaf-margin reaches approx. 1/2 of leaves, mostly with 5 hydathodes* .. 4
- 3b Cartilaginous leaf-margin reaches approx. up to 1/3 of leaves, with 1-3 hydathodes ... 5
- 4a Flowers 1-2, sessile, sepals glabrous *S. retusa*
- 4b Flowers 2-9, with elongated stems; sepals glandulous *S. purpurea*
- 5a Leaves with 3 hydathodes; margin of sepals glandulose-hairy *S. latina*
- 5b Leaves with 1 hydathoda 6
- 6a Tufts cushion-like or matted, leaves small, to 2.5mm long 7
- 6b Tufts not cushion-like, leaves 3-7mm long 8
- 7a Leaves obovate; flowers and fruit sessile 16
- 7b Leaves elongated; fruit long-stemmed *S. pulvinata*
- 8a Leaves oblanceolate, 3-5mm long *S. murithiana*
- 8b Leaves cuneiform, 6-7mm long *S. vulcanica*
- 9a Leaves with 3-5 hydathodes *S. ajanica*
- 9b Leaves with 1 hydathoda 10
- 10a Cilia changing towards the apex to dents 11
- 10b Cilia not changing toward the apex to dents 12
- 11a Densely cushioned plants; flowers and fruit sessile;
leaves 2-3mm long *S. boreo-olympica*
- 11b Caespitose plants; flowers and fruit ascendent; leaves to 4.5mm long *S. asiatica*
- 12a Leaf-apex rounded up to retuse 13
- 12b Leaf-apex acute 14
- 13a Cilia on leaf-margin notably elongate towards the apex, leaf-margin slightly
cartilaginous; flowers sessile *S. blepharophylla*
- 13b Cilia on leaf-apex densely concentrated, leaf-margin notatably cartilaginous;
flowers on 30-50mm long stems *S. czekanovskyi*

- 14a Leaves 6-12mm long, acute; cilia elongate toward the base; sepals suddenly tapering towards apex, nearly without cilia *S. nathorsti*
- 14b Leaves up to 5mm long, ciliate, apart their apex along their whole margin 15
- 15a Cartilaginous leaf-margin not convexed, reaches appr. 1/5 of the leaf; sepals elongate-ovate *S. oppositifolia*
- 15b Cartilaginous leaf-margin triangular, prominently convexed, reaches appr. 1/2 of the leaf; sepals broadly ovate *S. speciosa*
- 16a Leaves and calyx obtuse; perianth purple-pink *S. rudolphiana*
- 16b Leaves and calyx acuminate; flowers always white *S. jambilae*

Brief communication.

In June, 1991 my wife and I were collecting seed of *Androsace bryomorpha* (which is endemic to the Central High Pamir in Tadjikistan) and we found a new and different succulent species of *Saxifraga* from section *Porophyllum*. It was found growing in tri-colored marble on verticle cliffs in east facing crevices. The moss-like cushions were up to one foot across and were dark green. The term *bryomorpha* in Greek means moss-like in appearance. I named the plant *Saxifraga bryomorpha* because it is moss-like and was growing among cushions of *Androsace bryomorpha*. The individual rosetts are about 5 to 8 mm across on columnar stems. The leaves are glabrose, 2 to 5 mm long, widely lanceolate with blunt tips. The flowers are white or pale pink, single or up to 5 flowers per stem. The stem, stem leaves and calyx are branchely- glandulose pubescent. Seeds are dark brown, ribbed periform about 0.5 mm long.

Saxifraga bryomorpha J. J. Halda species nova.

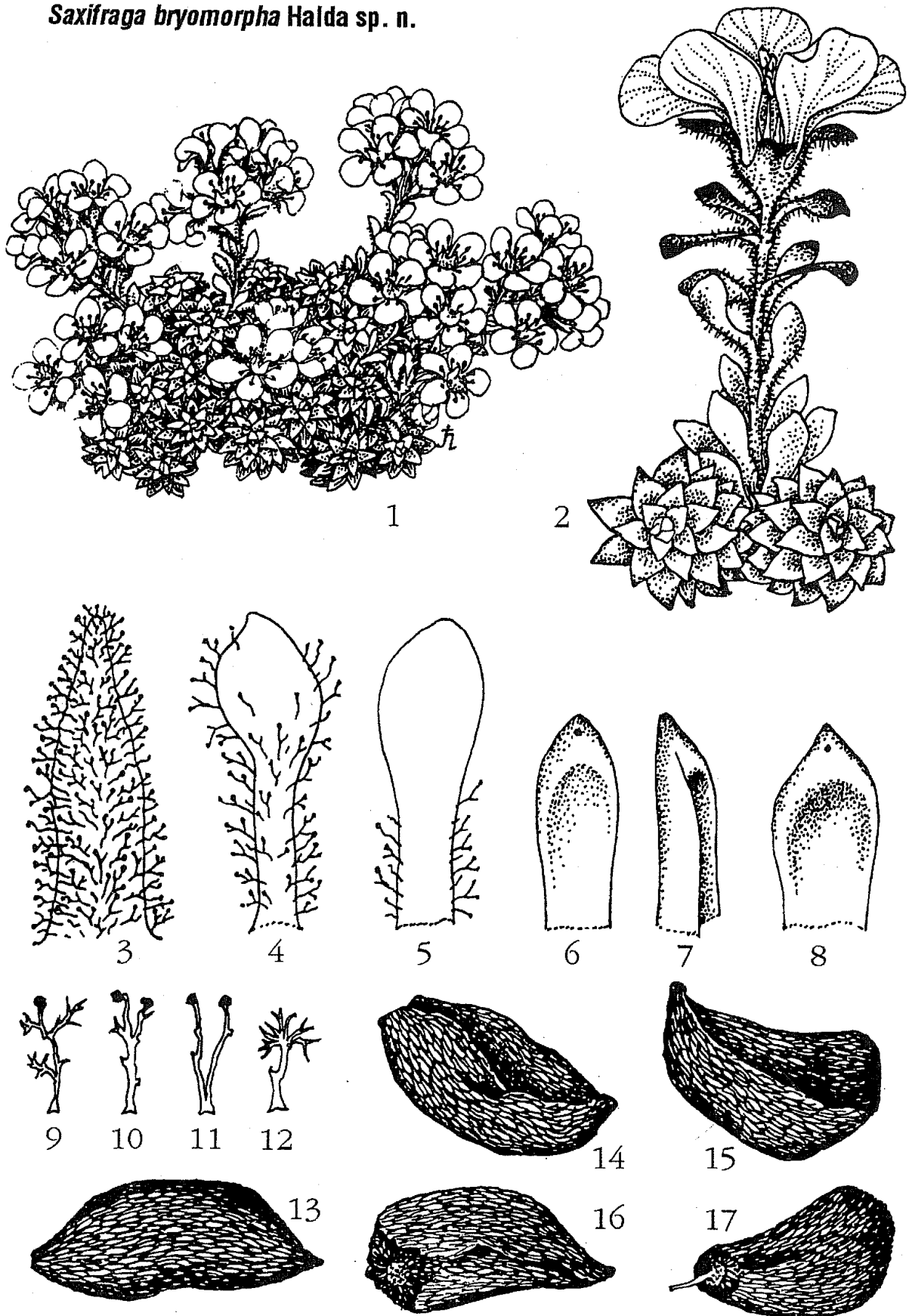
Planta densem pulvinata, caudiculis columnaribus densis. Folia basalis glabra, succulenta, 2-5mm longa, 0.5-1.2mm lata, late lanceolata, acuminata, cartilagineo-marginata, 1-foveolata. Folia superiora alternantia, cochleata, racemoso-glandulosa. Inflorescentia paniculata, 1-5-flora; sepala, caules et pedicelli valde racemoso-glandulosi. Sepala lanceolata, apiculata. Petala ovata, 4-6mm longa, 3-5mm lata, in unquem longum attenuata, alba vel rosea. Capsula oblongo-ovata, 2-3mm longa. Semina nigra, periformo-ribbosa, cca 0.5mm longa.

Typus: Asia Centralis, Tadjikistan, Pamirus Centralis, Jazgulem Mts. in saxosis orientalis et septentrionalis, cca 3000m alta. Leg. J.J.Halda 10.8. 1991 (JJH 9108 3006). PRG.

Closest relative is *Saxifraga alberti* Rgl. et Schmalh., which differs by obtuse, mucronate leaves with 3-5 hydathodes, oblong-oval ciliate margined calyx and with mostly single glands on whole inflorescence except corolla-lobes.

In culture this species needs a similar condition as *Saxifraga spruneri* or *S. alberti*. This plant can be grown in a crevice with a minimum of soil and with good protection against overwatering facing north or northeast. Propagation by seed or by cuttings.

Saxifraga bryomorpha Halda sp. n.



1, 2 - whole plant; 3 - sepal; 4, 5 - cauline leaves; 6, 7, 8 - basal lobes; 9-12 - glandulae; 13-17 - seeds

Bibliography:

- ALLIONI, C. (1785): *Flora Pedemontana*, vol. 2. Turin.
- ARIETTI, N. & FENAROLI, L. (1960): Cronologia dei reperti e posizione sistematica della *Saxifraga presolanensis* Engler, endemismo orobico. *Quaderni dell' Instituto botanico dell'Universita e Laboratorio crittogamico di Pavia* 15:5-28.
- BAUHIN, C. (1620): *Pinax theatri botanici*. Basel.
- BERTOLONI, A. (1819): *Amoenitates italicae*. Bologna.
- BIASOLETTO, B. (1841): *Relazione del Viaggio nell'Istria, Dalmazia e Montenegro, 1838*. Trieste.
- BOCHER, T. W. (1983): The allotetraploid *Saxifraga nathorstii* and its probable progenitors *S. aizoides* and *S. oppositifolia*. *Meddelelser om Gronland: Bioscience* 11:1-22.
- BROWN, S. (1907): *Alpine flora of the Canadian Rocky Mountains*. New York.
- BURNAT, E. (1901): *Flore des Alpes Maritimes*, vol. 3. Geneva.
- COSTE, H. (1902): *Flore descriptive et illustree de la France*, vol. 2. Paris.
- DON, D. (1822): A monograph of the genus *Saxifraga*. *Transactions of the Linnean Society of London*, 13:341-452.
- ENGLER, H. G. A. (1867): Beitrage zur Naturgeschichte des Genus *Saxifraga* L. *Linnaea* 35:1-124.
- ENGLER, H. G. A. (1869): Index criticus specierum atque synonymorum generis *Saxifraga*. *Verhandlungen der zoologisch-botanischen Gesellschaft in Wien* 19:513-556.
- ENGLER, H. G. A. (1872): *Monographie der Gattung Saxifraga* L. Breslau.
- ENGLER, H. G. A. (1891): Saxifragaceae in H. G. A. Engler & K. A. E. Prantl. (eds): *Die natuerlichen Pflanzenfamilien III, 2a:41-93*. Leipzig.
- ENGLER, H. G. A. & IRMSCHER, E. (1916, 1919): Saxifragaceae: *Saxifraga*, *Das Pflanzenreich* 67, 69 (IV:117):1-448 (1916); 449-709 (1919). Leipzig.
- FERGUSON, I. K. (1972): Notes on the pollen morphology of *Saxifraga nathorstii* and its putative parents, *S. aizoides* and *S. oppositifolia*. *Kew Bulletin* 27:475.
- GALLOE, O. (1910): Saxifragaceae, 2. The biological leaf anatomy of the Arctic species of *Saxifraga*. *Meddelelser om Gronland* 36:237-94.
- GESNER, K. (1541): *Historia plantarum et vires*. Basel.
- GORNALL, R. J. (1986): Trichome anatomy and taxonomy of *Saxifraga* (Saxifragaceae). *Nordic Journal of Botany* 6:257-75.
- HARA, H. (1979): Saxifragaceae in H. Hara & H. J. Williams (eds): *An enumeration of the flowering plants of Nepal* 2:149-56. London.
- HAWORTH, A. H. (1821): *Saxifragearum enumeratio*. London.
- HAYEK, A. (1905): Monographische studien ueber die Gattung *Saxifraga*, I. Die Sektion *Porphyrium* Tausch. *Denkschriften der kaiserlichen Akademie der Wissenschaften*, Wien 77:611-709.
- HITCHCOCK, C. L. & CRONQUIST, A. (1961): *Vascular plants of the Pacific Northwest*, part 3. Seattle.
- HULTEN, E. (1968): *Flora of Alaska and neighbouring territories*. Stanford, California.

- KHOKRJAKOV, A. (1979): *Saxifraga* L. sectionis *Trachyphyllum* Gaud. Asiae boreali- orientalis. *Novitates systematicae plantarum vascularium* 15:157-64.
- KURT, J. (1929): Ueber die Hydathoden der Saxifrageae. *Beihefte zum botanischen Centralblatt* 46:203-46.
- PAN, J. T. (1978): The genus *Saxifraga* in Qing-Zang plateau. *Acta Phytotaxonomica Sinica* 16(2): 11-35.
- SCHMIDT, H. (1930): Zur Funktion der Hydathoden von *Saxifraga*. *Planta* 10:314-44.
- SERINGE, N. C. (1830): Saxifragaceae in A. P. De Candolle (ed.): *Prodromus systematis naturalis regni vegetabilis* 4:17-47. Paris.
- SMITH, H. (1958): *Saxifraga* of the Himalaya. 1. Section *Kabschia*. *Bulletin of the British Museum (Natural History) (Botany)* 2:85-129.