

THE GENUS *SIBBALDIA* (ROSACEAE)

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Abstract

A monographic study of the genus *Sibbaldia* (Rosaceae) is carried out. A total of 10 species are recognized of which 9 are dominantly Asian species whereas 1 species (*Sibbaldia procumbens*) is distributed in Asia, Europe and North America. Taxonomic criterion, key to the closely related genera and species along with distribution, ecological notes, specimen citation, synonyms and nomenclatural notes are also given.

Introduction

The genus *Sibbaldia* was established by Linnaeus in 1753, its name honouring the Scots botanist and Professor at Edinburgh University, Robert Sibbald (1643-1720), who was instrumental in the founding of the Royal Botanic Garden at Edingburgh in 1670. As construed in this review, *Sibbaldia* comprises of 10 species; the genus is widely distributed in Eurasia and North America. Only one species, *S. procumbens* L., occurs in the New World and in Europe, while the greatest concentration of species occurs in South East Asia. The origin of *Sibbaldia* has been referred to the upper Tertiary and its primary centre of diversification appears to have been the mountainous regions of central and western China (Muravjova, 1936).

Taxonomically, *Sibbaldia* falls within the tribe Potentillae of subfamily Rosoideae of the Rosaceae (Hutchinson, 1964). Although similar in various morphological traits to *Potentilla* L., *Sibbaldia* comprises a natural group, which is quite distinct from the other members of the Potentillae. Historically, *S. procumbens* was frequently recognized as consisting of numerous distinct taxa (varieties, sub-species or even species) based on political geography.

About 65 names are available in the genus, but only 10 species from among the previously described taxa are recognized here as constituting meaningful biological entities. The genus is of little economic importance, although Juzepczuk (1941) has reported that *Sibbaldia procumbens* is readily eaten by deer. According to McVean (1964), *Sibbaldia* is a reliable indicator of soils rich in calcium.

Taxonomic History: In the first edition of his *Species Plantarum*, Linnaeus (1753) included 2 species in *Sibbaldia* viz., *S. procumbens* and *S. erecta*, both based on plants of European origin. These he assigned to the class "Pentandria pentagynia". *Sibbaldia erecta* was later transferred to the genus *Chamaerhodos* by Bunge (1841). Seringe

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(1825) recognised *Sibbaldia* and *Potentilla* as distinct genera and included them in the Tribe *Dryadeae* Vent., and further recognized two sections in *Sibbaldia*—sect. *Platyphyllae* Ser., characterized by plants with procumbent stems, ternate leaves and obovate leaflets with a tridentate apex (two species), and sect. *Leptophyllae* Ser., which included plants with erect stems, and three-to many-fid leaves. He assigned *S. parvifolia* Wild., to his Sect. *Platyphyllae*. Endlicher (1840) described *Dryadanthe* as a new monotypic genus, based on *Sibbaldia (Dryadanthe) tetrandra* Bung., which was characterised by dioecious plants with tetramerous flowers and carpellate flowers with sub-terminal styles. However, he made no formal transfer of the type species to his new genus. Focke (1888) treated *Potentilla* and *Sibbaldia* as distinct genera, but he placed *Dryadanthe* End., under the synonymy of *Sibbaldia*. Further more, he classified *Sibbaldia* under the sub-family Rosoideae Focke, Tribe Potentilleae Juss., sub-tribe Potentillinae Focke. Hooker (1878) did not recognize *Sibbaldia* as an independent genus, but recognized it as a section of *Potentilla*, and described 7 species from British India. Muravjova (1936) described 7 species, including a new species (*S. macropetala*) and assigned them to three sections viz., sects, *Prophyranthe*, *Sibbaldia (Eusibbaldia)*, and *Decandra*. These sections were recognised on the bases of leaf characters, particularly the number of apical teeth, colour of petals, and stamen number. Chatterjee (1938), while attempting to make a complete and nomenclaturally correct list of the species of *Potentilla* and *Sibbaldia* occurring in India and China, transferred all the species of *Potentilla*, which were treated under sect. *Sibbaldia* by Hooker (1878), to *Sibbaldia*, including *Potentilla sikkimensis* Prain. Juzepczuk (1941) transferred *S. adpressa* Bunge to his new monotypic genus *Sibbaldianthe* on the bases of the following characters: stamens 10, opposite the petals, style nearly basal and fusiform. However, Hutchinson (1964), Sojak (1970), and Airy Shaw (1973) rejected the circumscription of *Sibbaldianthe* as the characters at the generic level are variable, being found in other species of *Sibbaldia* as well.

Juzepczuk (1941) also recognised two series (sers. *Procumbeates* Juz. and *Cuneatae* Juz.) for the 5 species described in the flora of the USSR. The characters used in these two series are misleading and are not based on true facts. Sojak (1970) recognised three sections in *Sibbaldia* (sects. *Piletophyllum* Sojak, characterised by imparipinnate leaves, yellow petals, 5 stamens and lateral styles; Sect. *Monophyllidium* Sojak, with simple leaves, petals unknown, stamens 5 and styles lateral; and Sect. *Mesophyton* Sojak, with ternate leaves, purple petals, 5 stamens and lateral styles. Dixit & Panigrahi (1981) provided a revision of the Indian species of *Sibbaldia* in which 12 species were placed in 7 sections of previous workers. They placed Sect. *Platyphyllae* Seringe and Sect. *Eusibbaldia* Mur., under synonym of Sect. *Sibbaldia*. The sections and series of Hooker (1878), Muravjova (1936), Sojak (1971), Dixit & Panigrahi (1981) and Juzepczuk (1941) are not recognised here in this treatment. After the critical study it has been noticed that most of the characters used in the past for the recognition of sections or series are mostly variable, hence we feel no justification in recognising them.

TAXONOMIC CRITERIA

Habit: Species of *Sibbaldia* vary from prostrate to small erect herbs, while a few species are cushion-like or moss-like in habit, a habit which is quite diagnostic for the identification of *S. tetrandra*.

Indumentum: The type and the placement of hairs or trichomes on various surfaces and the resultant appearance of the surface (vestiture of the plant organ, especially the leaves) is an important taxonomic character in *Sibbaldia*, particularly when nearly all the species have indumentum. Basically, the hairs are uniseriate and unicellular. Some species have soft, thin, usually long hairs, eg., *S. purpurea*. Others have stiff, thick walled hairs, eg., *S. adpressa*. Within a species, hair colour is quite constant and can be used as a distinguishing character. Thus, *S. sikkimensis* always has a yellowish-brown indumentum and *S. micropetala* can easily be distinguished by the vestiture of its leaves, which are snow-white abaxially. In many specimens of *S. procumbens* and in those of *S. perpusilloides*, there is a tendency for the trichomes to be spirally twisted; however, this character is not constant and can not be used alone to distinguish taxa. Great variation in the density of hairs on different plant parts occur within the genus, and in the past a few taxa were segregated from *S. procumbens* primarily on the bases of hair density on leaves.

Leaves and leaflets: Except for *Sibbaldia trullifolia*, all the species of *Sibbaldia* have compound leaves. The number of leaflets, however, varies between species but is quite constant within a taxon. Leaflet number is a useful character of great taxonomic utility; Fig.1,2 & 3 illustrates the leaf shape, the number of leaflets in each leaf, apical and marginal dentation. However, apical and marginal dentation, vestiture, and articulation at the base of the leaflets are not commonly used characters due to large variation in size and shape of leaflet within the species. However, in *S. adpressa* the shape of the lower leaflets is linear lanceolate and it is considered as an important taxonomic character. *Sibbaldia perpusilloides* has leaves with lobed margins, while the remaining species all have either dentate leaflet margins (*S. sikkimensis* and *S. micropetala*) or dentate leaflet apices with between two and nine, usually glandular teeth. The number of apical teeth is variable within a species; consequently, tooth number can not be used as a key character.

Stipules: Stipules are present in all species of *Sibbaldia* and are comprised of a basal portion (the "body") that is adnate to the base of the petiole, and upper, free portion (the "auricle"). The stipules are mostly glabrous adaxially and glabrescent or sparsely tomentose abaxially, and the bodies can range from 2-3 mm (*S. trullifolia*) up to 10-25 mm (*S. sikkimensis*) in length. The auricles have mostly acute to sharply acute apices, but obtuse or rounded apices also occur in *S. perpusilloides* and *S. micropetala*. In length, auricles range from 0.5 - 8.0 mm.

Inflorescence: The inflorescence in all species of *Sibbaldia* is basically a determinate cyme, both the main and lateral axes being terminated by flowers. In about half the species the main axis is reduced and the flowers are not held well above the leaves. In the other species the main axis is sufficiently long so that the flowers are present well above the leaves. In most of the species the inflorescence are terminal, yet occasional, partial inflorescence may also be produced from the upper leaf-axils. In species with a

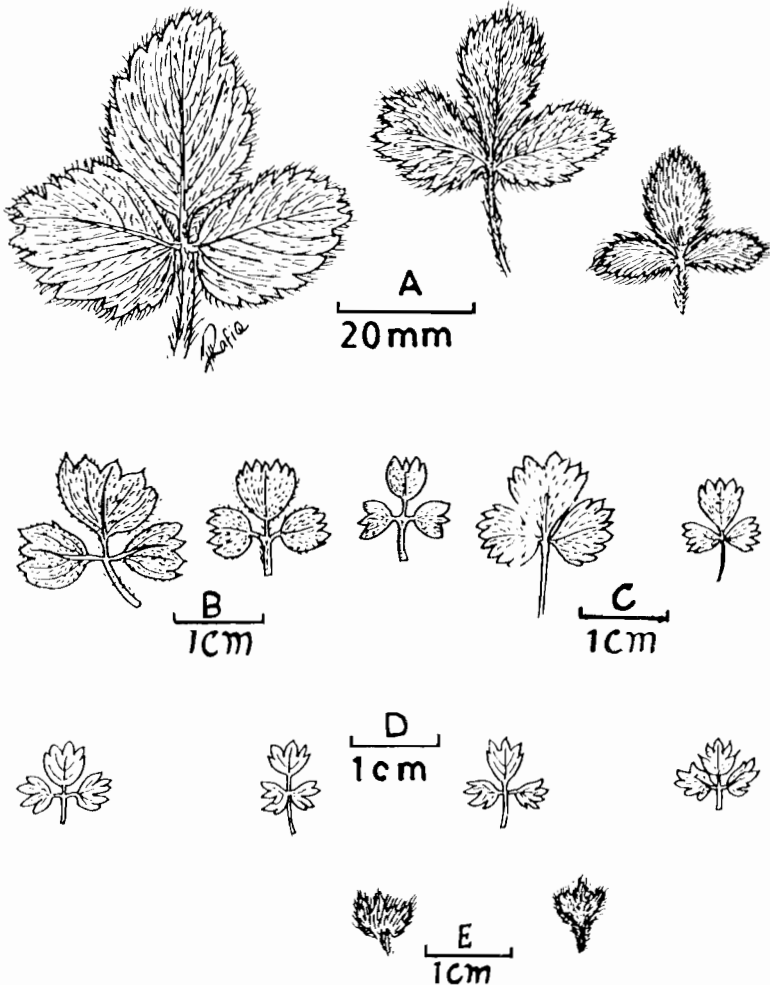


Fig.1. Leaves of *Sibbaldia* species, showing the variation in shape, size and dentation: 1-3, *S. sikkimensis*; 4-6, *S. unguiculata*; 7-8, *S. tenuis*; 9-12, *S. perpusilloides*; 13-14, *S. trullifolia*. (for vouchers see Appendix-I).

cushion-like habit, the distinction between stem and inflorescence are loose monochasia, sometimes in *S. procumbens* a loose umbel-like cyme is also produced. In *S. unguiculata* the inflorescence is congested compound dichasia, which is the characteristic feature of that species.

Flowers: All the species of *Sibbaldia* have actinomorphic flowers, which are mostly perfect and 5-merous, except in *S. tetrandra* which have both perfect and staminate flowers. Flowers of *Sibbaldia* are small to medium sized, and are without any fragrance. Generally similar to one another in the orientation of floral parts, but differ in colour and dimension of floral parts.

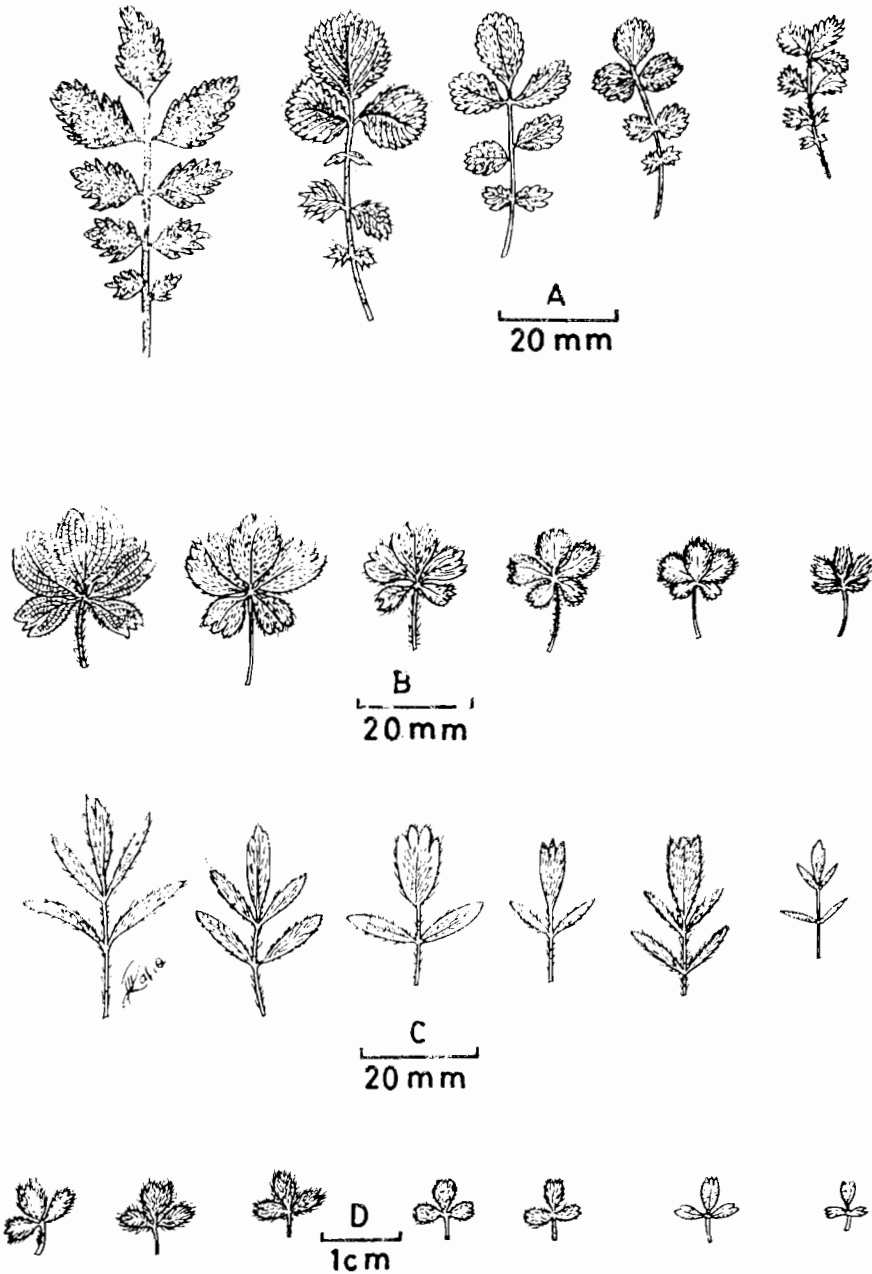


Fig.2. Leaves of *Sibbaldia* species, showing the variation in shape, size and dentation: 1-5, *S. micropetala*; 6-11, *S. purpurea*; 12-17, *S. adpressa*; 18-24, *S. tetradra* (for vouchers see Appendix-II).

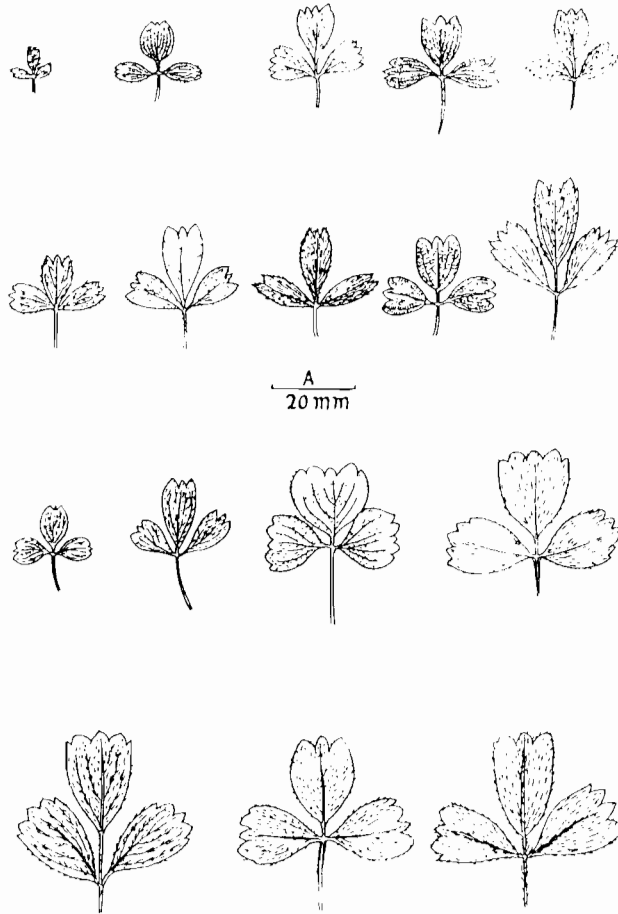


Fig.3. Leaves of *Sibbaldia procumbans*, showing the variation in shape, size and number of apical teeth. (for vouchers see Appendix-III).

Pedicels: The pedicels length varies from 1.5-19 mm, the length of the pedicel is not a useful taxonomic character in *Sibbaldia* since the pedicel tends to elongate as the flowers and fruits are developed.

Bract and Bracteole: In all the species of *Sibbaldia* the pedicels are subtended by a single bract, the bracts are mostly simple, but sometimes bracts have stipule. Except in 3 species (*S. perpusilloides*, *S. unguiculata* and *S. trullifolia*) all the other species of *Sibbaldia* have single or a pair of bracteole on pedicel, and their length ranges from 0.7-4.5 mm, which are mostly linear or linear-oblong, rarely linear-lanceolate.

Epicalyx and calyx: Both epicalyx and calyx consists of mostly 5, or rarely 4 or 6, more or less triangular lobes, which are connate at the base, otherwise free to the apex. Lobes are always tomentose outside, and glabrous inside, but in a few species e.g. *S. sikkimensis* the lobes are sometimes sparsely tomentose on the inner surface. In a few

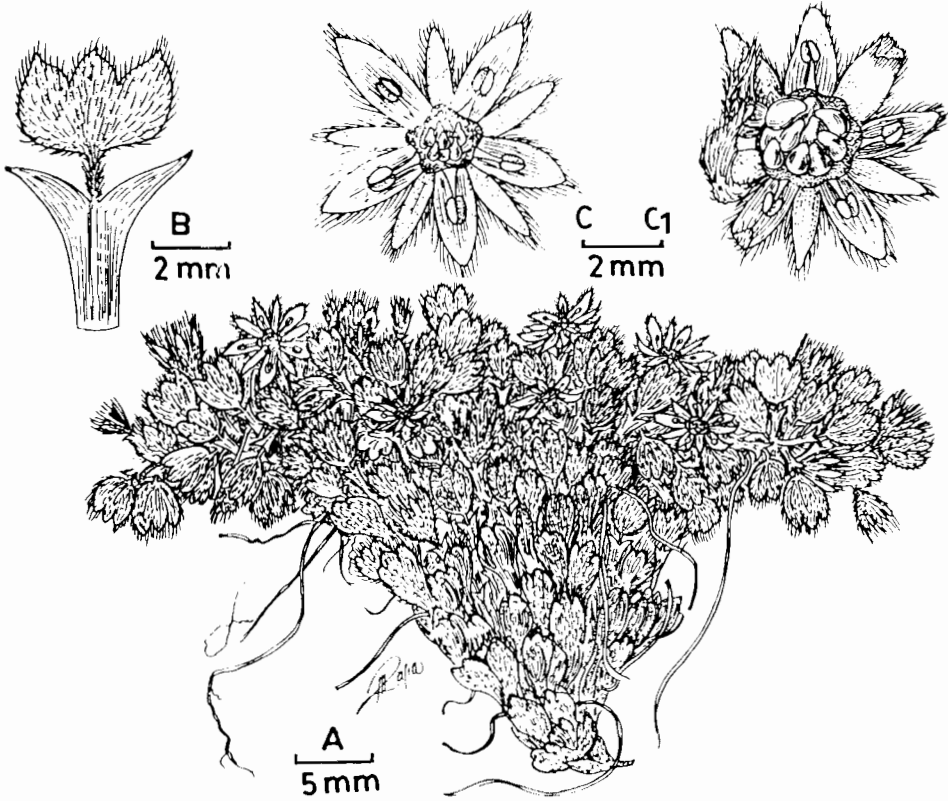


Fig.4. *S. trullifolia*: A, habit; B, Leaf with stipule; C, Flower (ventral view); C1, Flower with achene.

specimens of *S. procumbens*, the tips of the sepals on the inner surface are also tomentose, but due to the non consistency this character is not used in the identification of the species. In almost all the species of *Sibbaldia* the tips of sepals and epicalyx lobes are glandular.

Corolla: The corolla is always apopetalous and deciduous, and mostly consists of 5 petals, except *S. tetrandra*, which have 4 petals. The corolla is most often creamy-white or yellowish white. In *S. tenuis* it is somewhat pinkish. *S. sikkimensis* has purple corolla. Whereas *S. purpurea* has purple to creamy-white flowers, even in one single biomass both types of flowers are found. As our study is mainly based on direct herbarium specimens, and due to considerable variation of colour within the taxa, the colour of corolla is not used as a distinguishing character. In *S. trullifolia* the petals are small (0.4 - 0.5 mm long), that one can easily miss them, perhaps that could be the reason that most of the earlier workers, Chatterjee (1938), Dixit & Panighari (1981) and even the original author of the species, Hooker (1878) has mentioned that petals are not seen.

Stamens: The flowers of most of the species of *Sibbaldia* have 5 stamens, except *S. tetrandra* (4 stamens), *S. adpressa* and *S. perpusilloides* (10 stamens). Because of the

consistency of stamen numbers, this character is considered as a useful taxonomic character. This is a very important taxonomic character, and it is used in separating *Sibbaldia* and *Potentilla*. Stamens are always antisealous and are inserted at the outer edge of the disc, which is mostly brown and lobed.

Receptacle: It is mostly saucer-shaped, and mostly hairy, on which carpels are inserted. In *S. tetrandra* and *S. perpusilloides* the receptacle are mostly glabrous, and it can be used as an important attribute in recognition of those species along with other characters.

Gynoecium: In perfect flowers the gynoecium consists of 4-23 carpels. The carpel number is always variable, even in a single specimen the number of the carpels is not constant. *S. tetrandra* which beside perfect flowers, have also staminate flowers, in which the carpels are completely absent. Styles are always glabrous, mostly lateral or sometimes subterminal in position. The position of style is also an important character and it has been used in separating *Sibbaldia* and *Potentilla*. In *S. perpusilloides* style is more or less flat and very short ± 0.2 mm long, and which is not terminated by a distinct stigma. The maximum length of style is noticed in *S. adpressa* which is 2.7-3.0 mm long.

Fruit: Fruits of all the species of *Sibbaldia* are achenes, which are smooth and glabrous, except at the base which is sometimes hairy. The fruits of this genus have little taxonomic importance, except *S. micropetala*, which have small folds or ribs with distinct colliculate pattern. This is a quite useful character in the identification of that particular species.

Method of specimens citations: Specimens from the following herbaria A,B,BM,E,GH,K,KUH, KYO, PE, RAW, RGN and US, were annotated during the course of this study, at the Arnold Arboretum of Harvard University U.S.A., and Reading University, University herbarium U.K. About 4000 specimens from Asia, Europe and America were examined. In the citation of the specimens abbreviation of institutions/herbaria is followed after the sixth edition of index Herbariorum (Holmgren & Keuken, 1974). In the citation of the specimens, 2-5 specimens from each political unit are cited depending upon size of the political unit. Generally those specimens are cited which have duplicates in different herbaria of the United States. In case of U.S.A. only two specimens from each State are cited.

Distribution Maps: The distribution maps of all the species are completed. In most of the early collection the specimens are located only to country or province, due to that, resulting maps are uniform in meaning, we have examined a fair amount of collection whose localities are not located. Beside this we have also annotated the specimens, whose labels are written in Russian and were unable to read, that is why you may find only a few dots on the maps.

Classification

Family:	Rosaceae Juss.
Sub-family:	Rosoideae Focke.
Tribe:	Potentilleae Juss.

Key to closely related Genera

- 1. Epicalyx present.
 - 2. Stamens 20 or more ----- *Potentilla* L.
 - 2. Stamens 10 or less.
 - 3. Style terminal, articulated at the base; filaments divaric. petaloid -----
----- *Hookelia* Cham. & Schlecht.
 - 3. Style lateral or rarely subterminal, not articulated at the base, filaments
filiform or subulate, not petaloid ----- *Sibbaldia* L.
- 1. Epicalyx absent ----- *Chamaerhoda* Bunge.

Lexicomic Treatment: *Sibbaldia* L., Sp. Pl., 1: 284 (1753) & Gen. Pl., 5: 137 (1754).

Type species: *Sibbaldia procumbens* L., selected by Rydberg, Fl. N. Am., 22: 4: 365 (1908).

Dryadanthe Endlicher, Gen. Pl., 1242 (1840). Type species: *Dryadanthe tetrandra* (Bunge) Juzepczuk (= *Sibbaldia tetrandra* Bunge). *Potentilla* L. Sub-Genus *Sibbaldia* (L.) Syllae in Smith & Sowerby, English Botany, 3: 3:149 (1864). *Potentilla* L. Sect. *Sibbaldia* (L.) Hocker f., Fl. Brit. India., 2: 345 (1878). *Sibbaldia* St. Lag. in Ann. Soc. Bot. Lyon., 8: 177 (1881). *Sibbaldianthe* Juzepczuk in Fl. USSR, 10: 171 (1971) (English Edition). Type species: *Sibbaldianthe adpressa* (Bunge) Juzepczuk (= *Sibbaldia adpressa* Bunge).

Mostly tomentose or glabrescent perennial small erect or cushion-like herb, with short caespitose from a prostrate woody root stocks. The branches at the base clothed with persistent remains of leaf bases. The stipule adnate to the petiole bases; stipule bodies membranous mostly veined; stipule auricles membraneous rarely obsolete, acute, obtuse or acuminate, mostly veined.

Leaves alternate, mostly stipulate, digitately 3 or 5 foliate or sometimes imparipinnate compound, rarely simple, mostly petiolate. Leaflets sessile or petiolulate, articulated or non-articulated at the base, mostly tomentose on both surfaces or rarely glabrescent, margin entirely dentate or apically toothed; the apical tooth 2 to 9, mostly glandular, veined, mid-veined sometimes raised above the surface on abaxial surface. Inflorescence determinate; flowers are sparsely arranged on short branches or sometimes arranged in loose umbell-like cyme or rarely in congested compound dichasia. The flowers are borne on bracteate or ebracteate pedicels, mostly 5-merous, rarely 4-merous, mostly perfect, rarely staminate; bracts mostly leaf-like and sometimes stipulate; the bracteole mostly single or sometimes 2 together or sometimes absent. Epicalyx and calyx consist of mostly 5, rarely 4 or 6 or very rarely 10 sepals and epicalyx lobes, which are connate at the base, apex glandular or non-glandular, tomentose outside, mostly glabrous inside or rarely sparsely tomentose inside. Corolla apopetalous, deciduous, and mostly consist of 5 petals rarely 4 or 6 petals are also found, often creamwhite or yellow rarely purple or red or pinkish. Always glabrous or very sparsely tomentose on margins. Stamens mostly 5, rarely 4 or 10, antisepalous, inserted at the edge of the disc. Carpels 4 to 24, inserted mostly on hairy or sometimes glabrous receptacle. Ovary glabrous, rarely hairy at the base, mostly ovoid or globose, style mostly lateral, rarely sub-terminal; stigma minute glabrous, capitate. Achene glabrous



Fig.5. Distribution of *Sibbaldia* species, ●—*S. micropectata*, ○—*S. purpurea*, ■—*S. purpurea*, ▲—*S. trulliflora*.

or sometimes hairy at the base mostly smooth, rarely with minute ribs or folds. Flowering period May to October.

Distribution: A genus of 10 species occurring in Asia (China, India, Afghanistan, Kashmir, Pakistan, Taiwan and Japan), North America (Greenland, Canada, Mexico and USA) and Europe (Turkey, USSR, Great Britain, Scotland, Norway, France, Sweden and Switzerland).

Key to the species of *Sibbaldia*

- 1. Leaves simple ----- 1. *S. trullifolia*
- * 1. Leaves compound
 - 2. Lower leaflets (except terminal) linear or linear-lanceolate, leaflet margin always entire ----- 9. *S. adpressa*
 - * 2. Lower leaflets (including terminal) never linear or linear-lanceolate, leaflets margin always dentate or lobed entirely are apically.
 - 3. Stamens 10, leaflet lobed, mostly glabrescent ----- 2. *S. perpussilloides*
 - * 3. Stamens mostly 5 rarely 4, leaflets dentate apically or entirely, mostly tomentose.
 - 4. Flowers usually 4 - merous; receptacle mostly glabrous. ----- 3. *S. tetrandra*
 - * 4. Flowers 5 - merous: receptacle mostly hairy.
 - 5. Leaves consists of 3 leaflets.
 - * 5. Leaves consist of 5 or more leaflets.
 - 6. Petals dark purple or red, leaflets margin entirely dentate ----- 7. *S. sikkimensis*
 - * 6. Petals yellow-cream white or pinkish, leaflets margin apically dentate.
 - 7. Inflorescence congested compound dichasium; style 1-1.8 mm long; petals clawed ----- 4. *S. unguiculata*
 - * 7. Inflorescence loose monochasium or umbell-like cyme; style 0.5 - 0.9 mm long; petals not clawed.
 - 8. Petals obovate- elliptical, yellow-cream-white; auricles sharply acute; inflorescence consist of 5 to many flowers ----- 6. *S. procumbens*
 - * 8. Petals linear or linear-oblong, pinkish; auricles acuminate; inflorescence consists of 1-2 flowers ----- 5. *S. tenuis*
- 9. Leaves palmately compound, leaflets articulated at the base; margin with 2-3 apical teeth ----- 8. *S. purpurea*
- * 9. Leaves imparipinnately compound, leaflets not articulated at the base; margin entirely dentate ----- 10. *S. micropetala*

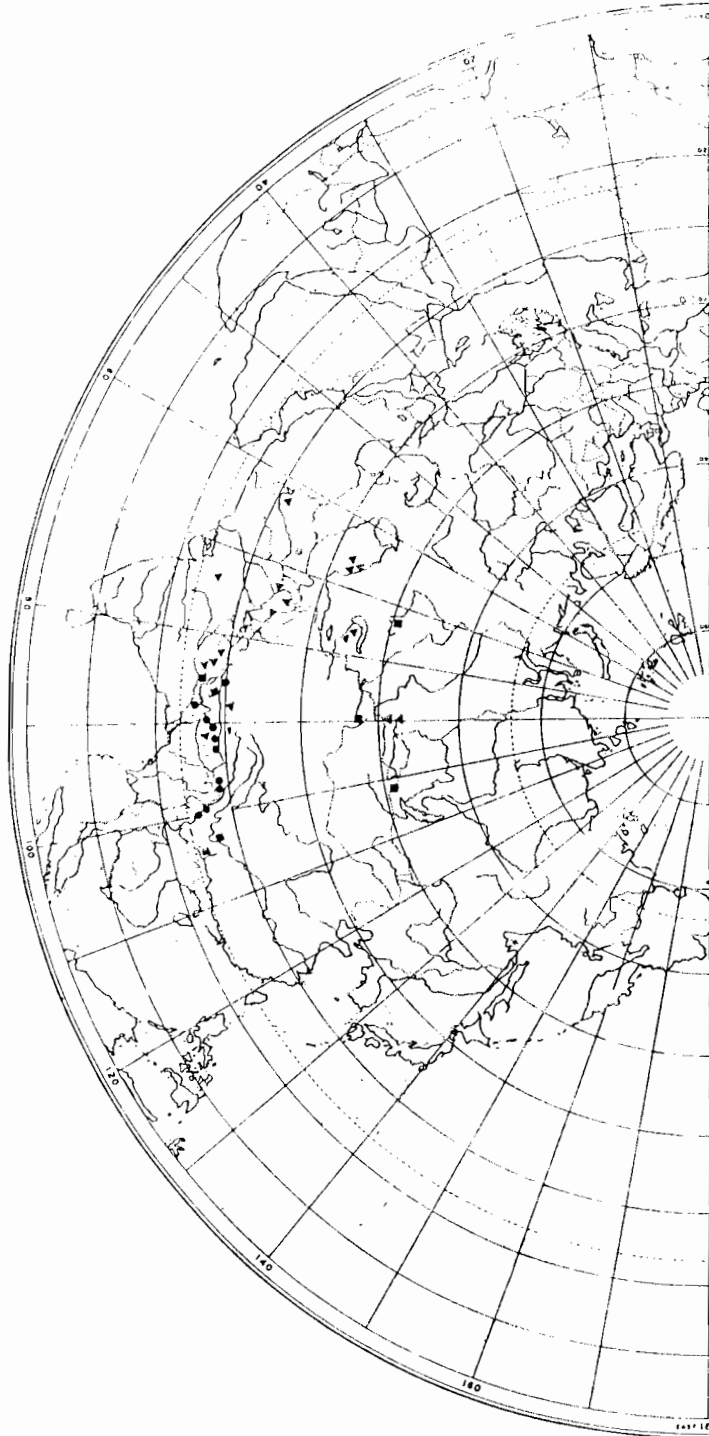


Fig.6. Distribution of *Sibbaldia* species. ● *S. perpusilloides*, ▲ *S. tetrandra*, △ *S. unguiculata*, ■ *S. adpressa*.

1. *Sibbaldia trulliflora* (Hooker, f.) Chatterjee, Notes Roy Bot. Gard Edinburgh 19: 327 (1938). **Basionym:** *Potentilla trulliflora* J.D. Hooker, Fl. Brit. India, 2: 345 (1878).

Type: Sikkim, alt. 1100 - 1400 ft., J.D. Hooker s.n. (holotype K!, isotypes, BM!, E!).

Greyish tomentose herbs forming dense, moss-like cushions from woody root stocks, the numerous branches clothed with persistent, dark brown leaf bases. Leaves simple, the petioles 1-2 mm long, glabrescent to tomentose; stipule bodies membranaceous, 2-3 mm long, ca. 1 mm wide, veined, tomentose centrally on the abaxial surfaces, glabrous on adaxial surfaces; stipule auricles 2-2.5 mm long, sharply acute, veined, glabrous except on veins or near margins on abaxial surfaces. Leaf blades 3-4.5 mm long, 3-4 mm wide, broadly obovate to suborbicular, apex truncate, with 3 broadly triangular obtuse - acuminate glandular teeth, veins distinct, densely tomentose on both surfaces, with long spreading hairs. Flowers solitary or 2 or 3 together, borne terminally on short leafy branches, perfect, 5 - merous, the pedicels 2-3 mm long, tomentose; bracts 2-2.5 mm long, ca. 0.7 mm wide, tomentose abaxially, glabrous adaxially; bractioles absent. Epicalyx lobes mostly 5, rarely 6, 1.5 - 2.0 mm long, 0.2 - 0.4 mm wide, linear, acute, distinctly veined, tomentose abaxially, glabrous adaxially. Sepals 5 or 6, 2 - 2.5 mm long, 0.7 - 0.9 mm wide, linear - oblong, tomentose with long stiff grey hairs on the abaxial surface, glabrous adaxially. Petals 5, creamy white, very small, 0.4 - 0.5 mm long, ca. 0.2 mm wide, obovate, obtuse, distinctly veined. Rudiments of 5 stamen filaments seen, antisepalous, anther not seen; disc circular - lobed, brown, ca. 2-4 mm across; carpels 10-12, inserted on a tomentose receptacle; ovary 0.4 - 0.5 mm long, reniform, somewhat broader at the apex; style basal - lateral, 0.6-0.7 mm long, tapering towards the base; stigma \pm capitate, \pm 0.1 mm across. Achene 1-1.2 mm long, 0.7 - 0.9 mm broad, blackish - brown.

Distribution and Ecology: Known only from the type locality, Sikkim, India. Growing in alpine region at an altitude 1100-1400 ft. Flowering period not known.

Discussion: *Sibbaldia trulliflora* is quite different from all other species of *Sibbaldia*, in producing simple leaves and flowers with very small petals. It shows morphological resemblance with *S. tetrandra*, but it can be separated from that species by its leaves which are simple and flower petals, which are 0.4-0.5 mm long (verses leaves compound and petals 2.4-3.0 mm long). The flowers which we have examined from the type collection include petals, but they are so small that one can easily miss them. Perhaps this fact explains why in the original description Hooker (1878) mentioned that petals were not seen. There is also confusion about the number of stamens, which is used as a delimiting character between *Sibbaldia* and *Potentilla* but from the rudiments of filaments number can be recognised as five.

2. *Sibbaldia perpusilloides* (W.W. Smith) Handel-Mazzetti, Symb. Sin. 7: 520 (1933).

Basionym: *Potentilla perpusilloides* W.W. Smith, Rec. Bot. Surv. India, IV. 5: 188 (1911).

Type: India Sikkim, Zemmu Valley, 4270 meters alt., 13 July, 1909, Smith & Cave 1383a (lectotype, CAL).

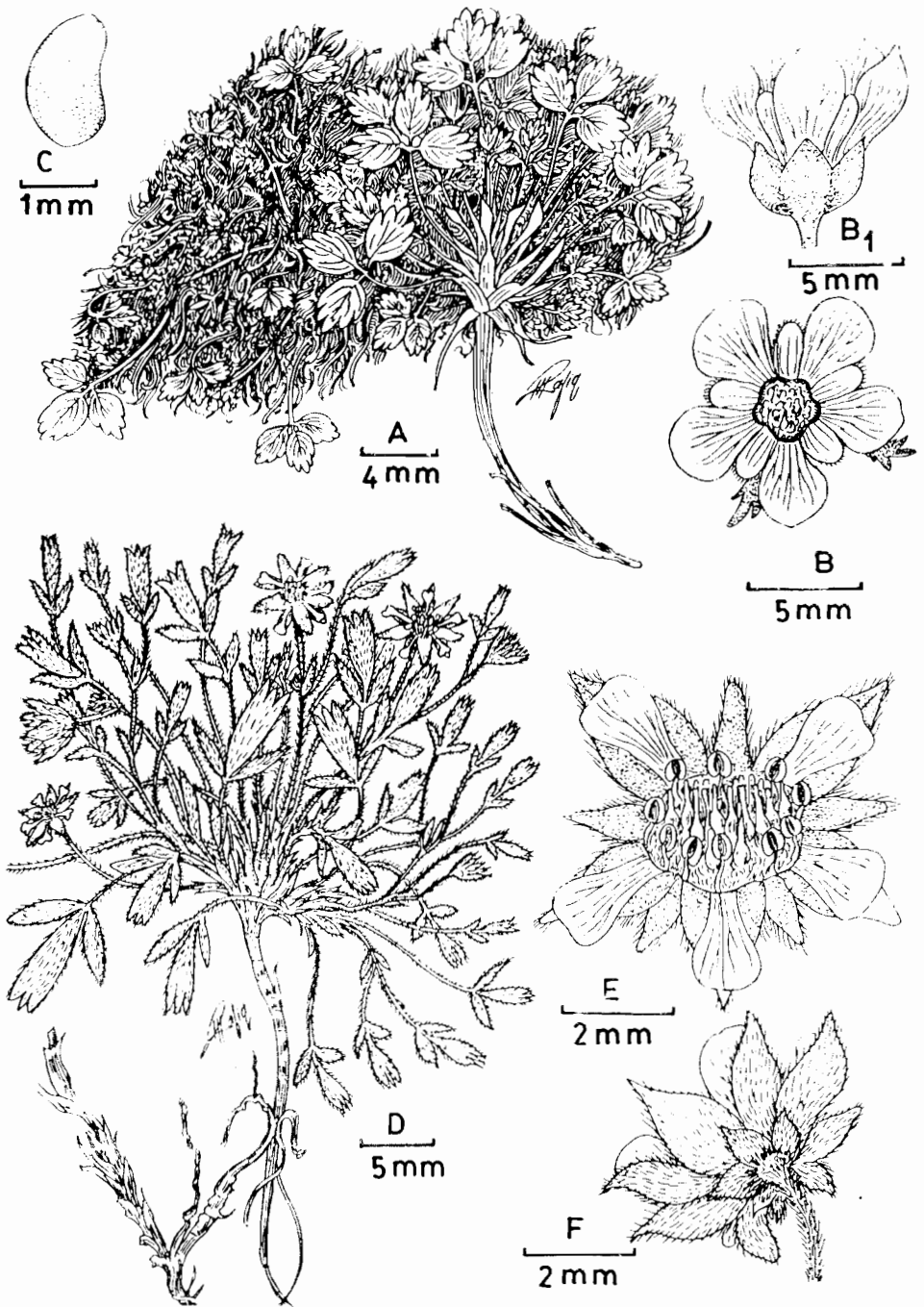


Fig.7. *S. perpusilloides*: A, habit; B, Flower (ventral view); B₁, Flower (side view); C, an achene; *S. adpressa* D, habit; E, Flower (Ventral view); F, Flower (dorsal view).

Sibbaldia glabriuscula T. T. Yu & C. L. Li in Acta Phytotax. Sin., 19: 4: 516 (1981). Type: Yunnan, Nushan (Mekong-Salwin-Divide) alt. 3800 m. T. T. Yu 22265 (PE 305305!). Type material is loosely held in an envelope and had a mixture of two taxa, the one which had flowers is in fact *S. perpusilloides*. Other material appears not a *Sibbaldia*.

Glabrous or slightly tomentose, cushion-like perennial herbs, caespitose from prostrate, woody root stocks, the branches clothed with persistent remains of leaf bases. Leaves trifoliolate and palmate; petioles 3-15 mm long, tomentose; stipule bodies membranaceous, 1.5-5.0 mm long, 1.5-3 mm wide, 3-5 veined, mostly glabrous or sparsely tomentose at the margins; stipule auricles sometimes absent, when present membranaceous, 1-1.5 mm long, ca. 1 mm wide, obtuse to round at the apices, veined, glabrous or slightly tomentose. Leaflets, 3-6 mm long, 2-4 mm wide, sessile or petiolulate, the petiolules to 1 mm long, not articulated at the base, the blades obovate with (4) 5, (or 6) glandular tipped teeth, the blades rough, tomentose with spreading hairs when young, becoming glabrescent at maturity, veins distinct. Flowers solitary, 5-merous, perfect, borne on ebracteate pedicels, the pedicels 3-5 mm long, tomentose with soft spreading hairs. Epicalyx lobes 5, 1.5-2.2 mm long, ca. 0.3 mm wide, linear to oblong-lanceolate, acute, tomentose with spreading hairs on margins. Sepals 5, broadly deltoid, 2-2.2 mm long, 1.2-1.6 mm wide, acute or acute-acuminate, venation distinct, the apices glandular, the surfaces glabrous adaxially, glabrous or sparsely tomentose abaxially. Petals 5, white to creamy 2.7-4 mm long, 2.5-3.2 mm wide, elliptical to spatulate, with rounded to emarginate apices, surfaces with many distinct veins. Stamens 10, antiseptalous, inserted at the edge of the disc; filaments subulate 0.5-0.8 mm long; anthers elliptical, ± 0.5 mm long, ± 0.3 mm broad. Disc lobed to circular, 2.5-3.0 mm across. Carpels 19-22, \pm obovoid, glabrous ± 0.5 mm long, ± 0.3 mm broad, style flattened, ca. 0.2 mm long, lateral, usually not terminated by a capitate stigma. Achenes, 1.2-2.0 mm long, 1-1.2 mm broad, brown, reniform to ovoid, glabrous, with a rough to smooth surface (Fig.7A-C).

Specimens examined: Afghanistan: Wanasgul valley W. Thesiger 1570a (BM). Burma: Western flank of the N Maikha-Salwin divide, north of Chimi-li, 20°35'N, 98°48' E, Forrest 2636 (BM, US). China: Yunnan: Mekong-Salween Watershed, Rock 10087 (E, US); N.W of Yunnan and east of Tibet, Kingdon-Ward 838 (E); Mekong-Salwin Divide, T.T. Yu 22366 (A). Tibet: Ata Kang La, Zayul, Kingdon-Ward 10569 (BM), Sang La, (29°35'N, 94°43'E), Ludlow, Sherriff & Taylor 5059 (BM); Source of the Irrawaddy adung Valley (28°20'N, 97°E), Kingdon-Ward 9756 (BM); Mekong Salwin divide (28°20'N, 97°E), Kingdon-Ward 9756 (BM); Mekong Salwin divide (28°40'N), Forrest 16756 (9BM,E). Himalayas: chakung chu sikkiu, Cooper 930 (E); Lampokri umb. Ribu & Rohmoo 888 (E); Cho 1a, Ribu & Rohmoo 7005 (A). Nepal: Inukhu Khola, Naulekh Muni (27°30'N 86°45'E), D. McCosh 379 (BM); Bhutan: Shingbe (Mela) N.E. Bhutan, Ludlow, Sherriff & Hicks 21097 (BM); Cheska 1a upper pho cleu, Ludlow, Sherriff & Hicks 16646 (BM); Bumtang telegang Chu, Bowes Lyon 3404 (BM); Shingbe Me La N.E. Bhutan, Ludlow, Sherriff & Hicks 20757 (BM).

Distribution and Ecology: Afghanistan, Burma, Bhutan, Nepal and China in the provinces of Tibet and Yunnan (Fig.6). On rocky or stony alpine slopes and meadows alt. 1300-1500 m. Flowering period June-October.

Discussion: *Sibbaldia perpusilloides* can be distinguished from other species of *Sibbaldia* by its almost glabrous nature and its habit. It shares a moss or cushion like habit with *S. tetrandra* but *S. tetrandra* is densely tomentose plant with mostly 4-merous flowers.

Sibbaldia perpusilloides was lectotypified by Dixit & Pamgrah (1981), who selected the Smith & Cave collection cited above with location data that coincides with the location given by Smith when he published *Potentilla perpusilloides*. We have followed their choice, although the specimens at CAL has not been examined.

3. *Sibbaldia tetrandra* Bunge, Mem. Acad. Imp. Sci. St. Petersburg Divers Savans, 2: 539 (1835). *Potentilla tetrandra* (Bunge) J.D. Hooker, Fl. Brit. India, 2: 347 (1878): *Dryadanthe tetrandra* (Bunge) Juzepczuk, Fl. USSR, 10: 171, (1941/1971) English ed. Type: fide Juzepczuk, 1941, USSR., mountain tops along the Chuya River (holotype LE).

Sibbaldia procumbens L. var. *thibetica* J.D. Hooker F.L. Brit. India, 2: 346 (1878). Type: Tibet, Alt 14-1800, T. Thomson Sn (K!).

Dryadanthe bungeana Karelin & Kirilov, Bull. Soc. Imp. Naturalistes Moscow, 15: 342 (1842). Type: In rupibus summarum alpinum Alatau frequens (Type specimens not located).

Tomentose, procumbent perennial herbs from woody root stocks, forming dense moss-like cushions, the numerous branches clothed with persistent brown leaf bases. Leaves trifoliolate and palmate; petioles 5-8 mm long, tomentose with soft, silky, spreading hairs; stipule bodies membranaceous, 3-5 mm long, 2.5-3.5 mm wide, distinctly veined, slightly tomentose along or near the veins on the abaxial surfaces, glabrous adaxially except apices which are slightly tomentose; stipule auricles 2-3.5 mm long, sharply acute, distinctly veined, mostly glabrous except at the apices on abaxial surfaces. Leaflets sessile, usually articulated at base, 4-7 mm long, 2-4.5 mm wide, oblong-elliptical or cuneately obovate, the blades often folded longitudinally when dried and the middle one larger than the lateral ones, the middle blades with 3 glandular, apical teeth, the middle tooth generally smaller than the 2 lateral ones, the lateral blades with 2 equal glandular teeth at the apex; veins distinct on the lower usually obscure on the upper surfaces, tomentose on both surfaces with non-glandular, whitish, soft, spreading hairs. Flowers solitary or 2 or 3 together at the ends of short bracteolate branches or in the axils of levae. 4-merous, mostly staminate or sometimes perfect (and the plants staminate or polygamous); pedicles 1-1.5 mm long, tomentose; bracts 3-4 mm long, 0.5-0.8 mm wide, linear-oblong, entire, acute; bract stipules 1.5-2.0 mm long, 1-1.2 mm wide, bracteoles linear, 0.7-1.0 mm long, ca 0.5 mm wide, tomentose abaxially, glabrous and veined adaxially. Epicalyx lobes 4, sometimes 5, 1.2-1.7 mm long, 0.2-0.4 mm wide, tomentose abaxially, glabrous adaxially, the venation not distinct. Sepals 4, 2-2.5 mm long, 0.8-1.8 mm wide, oblong-deltoid, acute, tomentose abaxially, glabrous adaxially with 3 distinct veins. Petals 4, pale yellow, 2-3.5 mm long, ca. 1 mm wide, oblong-obovate, obtuse or emarginate, distinctly veined, the perfect flowers usually with larger petals. Stamens 4, or sometimes 5, antisepalous, inserted at the edge of the lobed disc; filaments 0.5-1.1 mm long, linear, usually longer in staminate flowers; anthers ca. 0.2 mm long and broad, rounded-elliptical; disc lobed,

1.1-1.5 mm across, with a slit-like opening in the middle, the receptacle, in staminate flowers mostly glabrous or very rarely hairy inside. Carpels 5 or 6, inserted on the glabrous receptacle, absent in the staminate flowers, ovary 0.8-1.3 mm long, oblong-obovate, glabrous; style lateral, 1-1.3 mm long, lower half light brown, upper half dark purple, stigma ca. 0.2 mm in diameter, capitate. Achene oblong orbicular, smooth, brown; 1.2 mm in diameter (Fig. 8 A-D).

Specimen examined: Afghanistan: 55.6 miles of Herat road to Khandahar, Grey-Wilson & Hewer 533 (E). China: Tibet: Pen la Kingdom-Ward 11700 (BM); Trigu dzomy (91°07'N 28°08'E), Ludlow, Sherriff & Elliot 12453 (BM). India: Lal Pir, Baltistan, Koelz 9535 (A); Kashmir: Satpura pass above Skardu, Stewart 20198 (A); Buriji La Deosai side, Stewart 20162 (A); Burjila 14500, C.B. Clark 29854 (B); Taklung la, Koelz 6496 (A, US); Gonaji Rupshu, Kashmir, Koelz 2117 (US); Above chortren chen, Ladak, Kashmir, Koelz 26/3 (US). Nepal: Mukdem Khola chharkabbot, Polunin, Sykes & Williams 1188 (A, BM); Dhudkund, 6 miles E of Timure, Polunin 823 (A) & 824 (BM); Kamila (29°0'N 83°41'E) Dobremez DBR NEP Nc 2947 (BM). Pakistan: Charesa Glacier Base Camp, 13 miles east of Nagar, Polunin 6130 (BM, E). USSR: Prov. semiretschje Dist Kopal in mountibus Alatau dschun gariensis in trajectu, Lipsky 1501 (A, B, E); Turkestan, Korshinsky s.n. (B).

Distribution and Ecology: Afghanistan, China, Pakistan, Nepal, Kashmir and former USSR (Fig. 6). Growing among boulders and in scree, forming compact mats, at an altitude 1700-4500 ft. Flowering period - April.

Discussion In almost all previously published descriptions of this species, the plant is described as dioecious and flowers as unisexual. We have examined specimens of *Sibbaldia tetrandra* and it is noticed that both staminate and perfect flowers are found even on a single shoot, which clearly indicates that the plants are not always dioecious and flowers are not always imperfect. Endlicher (1840) described the monotypic genus *Dryadanthe* based on *Sibbaldia tetrandra*, recognized on the basis of its 4-merous flowers, its ovaries provided with short stalks, and its terminal styles. However, Endlicher made no formal transfer of the type species to his new genus, and the characters used in defining the genus are found in other species of *Sibbaldia* e.g., *S. purpurea* Royle. For more detail see the discussion under that species. Moreover a variation has also been noticed in the number of epicalyx lobes, which are not always four but sometimes five.

4. *Sibbaldia unguiculata*: Rajput, Spongberg & Husain, Bot. J. Linn. Soc., 119:117-121, 1996. Type: Pakistan, Lahul District, Chenab Valley, 13000 ft., Erica Clark s.n. 2-VIII-1980 (Holotype, BM 013168!). Compact, moss-like, tomentose perennial herbs from woody root stocks. Leaves trifoliolate and palmate; petioles 4-5 mm long, tomentose with spreading hairs; stipule bodies membranaceous, 3-7 mm long, 2.5-3 mm wide, distinctly veined, mostly glabrous except for a few hairs at the margins; stipule auricles membranaceous, 2-3.5 mm long, ca. 1 mm wide, sharply acute at the apices, distinctly veined, glabrous. Leaflets sessile or with petiolules to 3 mm long, not articulated at the base, 4-7.5 mm long, 3-6 mm wide, obovate-elliptical, the apices with 2-5 glandular-tipped teeth, tomentose on both surfaces with spreading glandular hairs, the veins distinct. Inflorescence a congested compound dichasium. Flowers 5-merous,

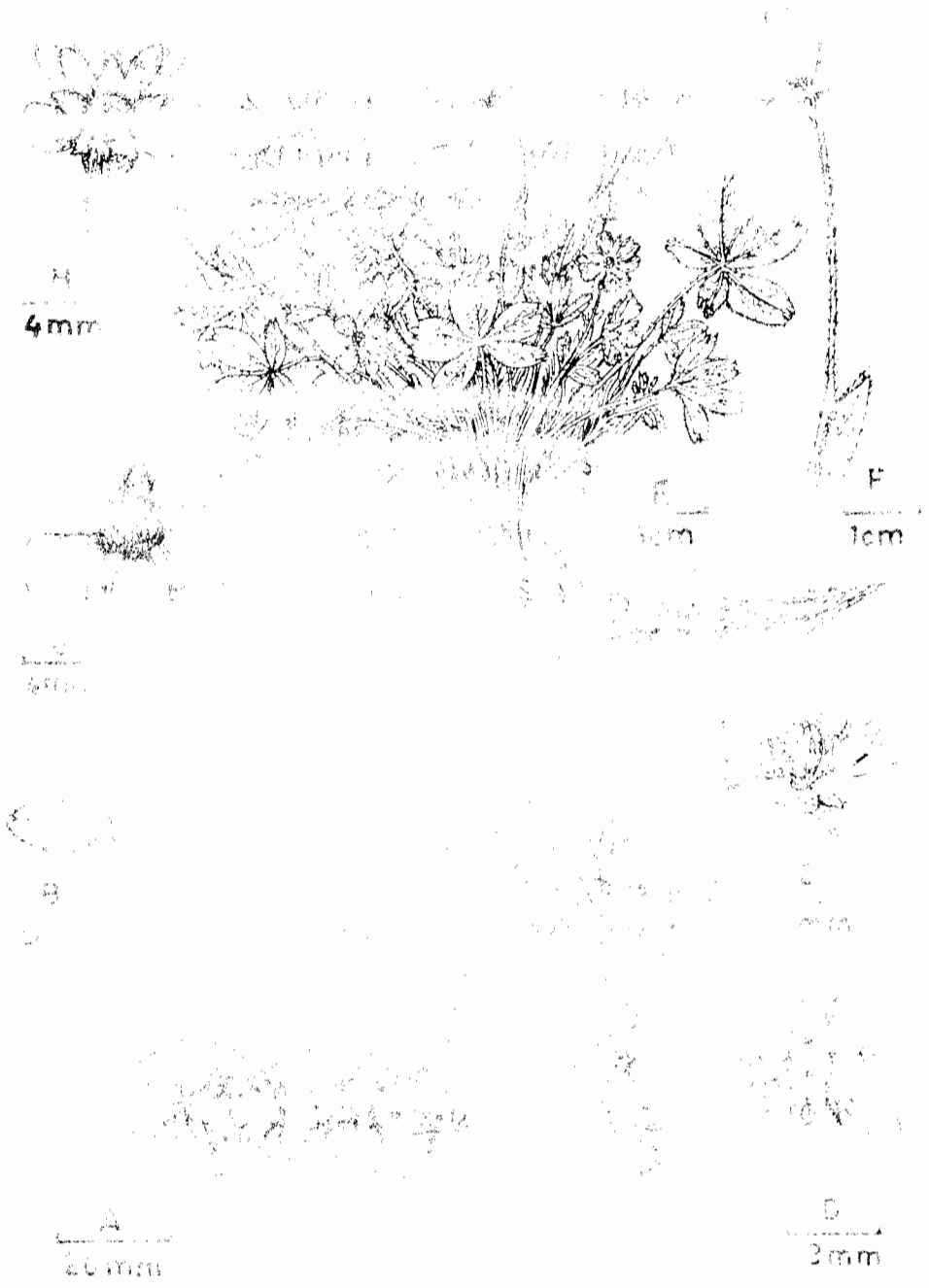


Fig. 1. Ranunculus repens L. (1) - whole plant; (2) - detail of the root system; (3) - detail of the basal leaves; (4) - detail of the flowering stem; (5) - detail of the flowers; (6) - detail of the fruit; (7) - detail of the stem; (8) - detail of the leaves; (9) - detail of the flowers; (10) - detail of the fruit.

perfect, borne on branches; stem 1-2 m tall, tomentose; bracts 2, opposite and leaf-like, with a stem-like base; sepals 5, greenish, ovate-lanceolate, 2.2 mm long, ca. 1.5 mm wide, marginally ciliate; petals greenish-purple, 4-4.5 mm long, 1-1.5 mm wide, clawed, hairy at the base, distinctly veined, densely tomentose abaxially, sparsely tomentose adaxially, distinctly veined. Petals 5, clawed, thick, 3-4.5 mm long, 1-1.5 mm wide, veined, slightly hairy at the margins, yellow to creamy white; filaments 5, unisepalous, filaments ca. 0.5 mm long; anther ca. 0.5 mm long, ca. 0.7 mm broad, oblong-elliptical; disc not prominent. Carpels 7-9, the central carpel usually smaller, inserted on a slightly tomentose receptacle; ovary 1.5-1.7 mm long, oblong, narrower at the base; style subterminal, 1-1.8 mm long, mostly purple, glabrous; stigma ca. 0.1 mm across, capitate (Fig.9 A-E).

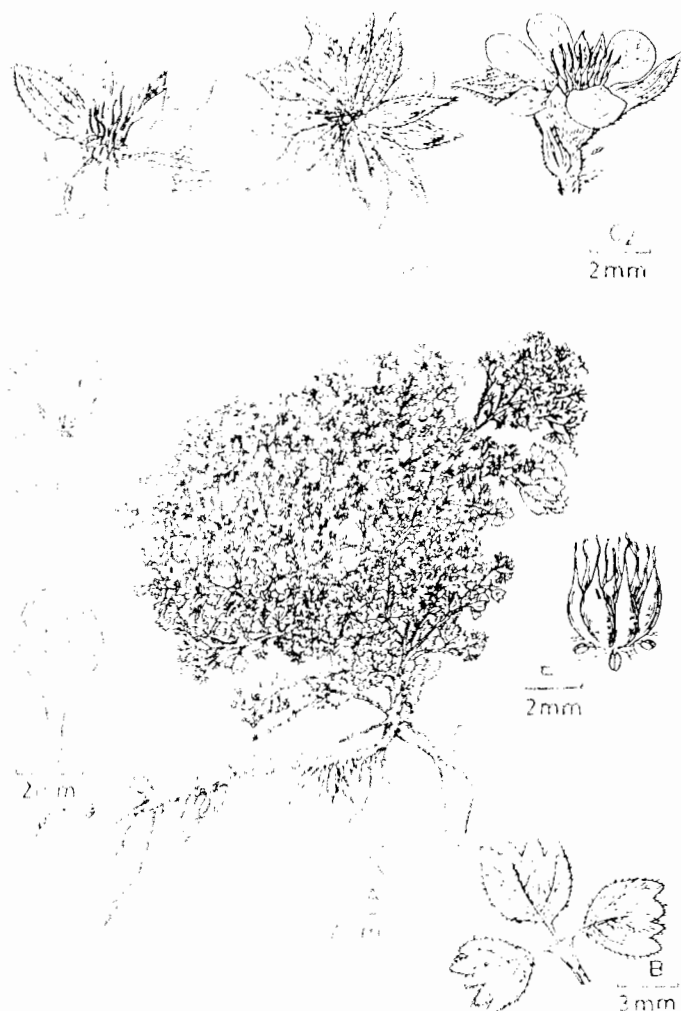


Fig.9. *S. angulata*: A. habit; B. detail of leaf; C1, C2. Flower (dorsal view); C2. Flower (side view); D. Petal; E. Styles, filaments and stigmas.

Distribution and Ecology: Known only from the type locality (Fig.6) Altitude 13000 ft Flowering period August.

Discussion: In attempting to pinpoint the type locality on a map, it became apparent that an error had been made. Lahul of Lahul District and Chenab Valley are both in Northern India, not Pakistan (as mentioned on type specimen). Lahul or Lahaul is a town of Kangra District of Himachal Pradesh state of India, which is bordered by the Chamba (upper Chenab) on the west, Kashmir on the north, Spiti valley in the east, and Kulu in the south. Moreover Lahul comes under Himalayan Valley, drained by the Chandra (upper Chenab) river. Morphologically *Sibbaldia unguiculata* is allied to *S. procumbens*, but it can be separated from that species by its congested inflorescence, a compound dichasium, sepals tomentose on both surfaces, distinctly clawed petals tomentose on the margins, and its elongated ovary with long style. By its compact moss-like habit it also shows resemblances with *S. tetrandra*, but *S. tetrandra* has 4-merous flowers whereas in this species flowers are 5-merous.

5. *Sibbaldia tenuis* Handel-Mazzetti, Acta Hort, Gotoburg., 8: 330 (1939). Type: China, Sichuan Province, Donrergo, in Prato alpino, 4300-4400 m., 20 July, 1922. Harry Smith 3806 (holotype: presumably at W, isotypes A!, BM!).

Diminutive tomentose herbs, 1.5-3.0 cm high, mostly with solitary flowering scapes, the basal portion of stems clothed with persistent petiole bases. Leaves trifoliate and palmate; petiole 4-21 mm long, sulcate, tomentose with appressed to spreading hairs; stipule bodies membranaceous, 3.5-5.5 mm long, 2-2.2 mm wide, brown, with 3 distinct, unbranched veins; stipule auricles membranaceous, 0.5-1.0 mm long, 0.7-1.0 mm wide, unvened, acuminate, essentially glabrous, except on the adaxial surfaces at the apices. Leaflets sessile or petiolulate, the petiolulate to 0.5 mm long, blades not articulated at the base; blades 4-9 mm long, 4-7 mm wide, obovate to elliptical, all equal in size, distinctly veined, tomentose on both surfaces, with short, appressed, stiff hairs, the margins with 5-8, ± equal glandular tipped teeth. Flowers solitary or 2 together, perfect 5-merous, borne on bracteate pedicels, the pedicels 3.5-7.0 mm long, densely tomentose; bracts 2, opposite, 1.5-3.0 mm long, 0.8-1.2 mm wide, cup shaped, tomentose abaxially with short stiff hairs, glabrous adaxially, with 2-6 long glandular teeth at the apex; bracteole 1.5-2.5 mm long, ca. 0.8 mm wide, linear, ± membranaceous, with 2-5 sharply acute teeth, the surfaces glabrous adaxially, tomentose abaxially. Epicalyx lobes 5 or 6, 0.7-0.8 mm long, ca. 0.3 mm wide, linear or linear-lanceolate, somewhat succulent or thickened, cupshaped, the unvened apices glandular, tomentose abaxially, glabrous or slightly tomentose near apex on adaxial surface. Sepals 5 or sometimes 6, 1.2-1.6 mm long, ca. 1 mm wide, deltoid or triangular, faintly veined, acute, apices glandular, abaxially sparsely tomentose, adaxially glabrous or slightly tomentose near the apex. Petals 5, ± pinkish, 1.5-2.1 mm long, 0.5-0.8 mm wide, linear-oblong, obtuse, faintly veined. Stamens 4 or 5, antisepalous, inserted at the edge of the disc; filaments ca. 0.3 mm long, linear, 1.5-2.2 mm across. Carpels 9-12, inserted on the tomentose receptacle; ovary ca. 0.5 mm long and broad, ovoid hairy at the base, otherwise glabrous; style 0.6-0.8 mm long, subterminal; ± 2-lipped, 0.2 mm across. Achene not seen.

Specimen examined: Known only from the type collection.

Ecology and distribution: China, Sichuan Province, at an altitude between 4300-4400 m (Fig.5). Flowering period in July.

Discussion: *Sibbaldia tenuis* exhibits many characters that indicate a close affinity with *S. procumbens*. These include the number of leaflets, type of indumentum, and the number of apical leaflet teeth. However, *S. tenuis* can be distinguished from *S. procumbens* on the basis of its petals that are distinctly linear or linear-oblong, and their somewhat pinkish colour. In *S. procumbens* the petals are yellow or creamy white and obovate in shape. Moreover, the stigma in *S. tenuis* is \pm 2-lipped.

6. *Sibbaldia procumbens* L., Sp. Pl., 1: 284 (1753). Type: (O.E: Lapland specimen No 111 (Inst. France, Paris): 401.1 (Linn.); cited figure; Linnaean specimen in Stockholm (fiche 135.11).

Sibbaldia aphanopetala Handel-Mazzetti, Acta Hort. Gotoburg, 13: 327 (1939). Type: China, Sikang, Kangting (Tachienlu) District, Yulingkong, montes Yachiagan, in prato alpino, c. 3500 m, 24 July, 1934, H. Smith 10625 (holotype: presumably at W; isotypes, A! BM!).

Sibbaldia cuneata Kunze, Linnaea, 20:59 (1847). Type: no specimens cited. *Sibbaldia cuneata* Edgeworth, Trans. Linn. Soc. London 20: 44 (1846). Type: "Hab. Himalayas in supibus clatis alt. ped. 1100-14,000," P.M. Edgeworth. (holotype K!) *Potentilla sibbaldia* Hallier f. var. *micrantha* J.D. Hooker, Fl. Brit. India, 2: 346 (1878). *Sibbaldia cuneata* Kunze var. *micrantha* (J.D. Hooker) R.R. Stewart, Annot. Cat. Vasc. Pl.W. Pakistan & Kashmir, 269 (1972). Type: Western Tibet; Tibetan region of Sikkim & Alt. 16,000 ft. Thomas Thomson (lectotype: K!)

Sibbaldia macrophylla Turcz. in Scheel., Cfr. Addenda 9: 456 (1941). Type: Dahuria, USSR (holotype LE).

Sibbaldia olgae Juzepczuk & Ovczinn, Addenda, 9: 456 (1941). Type: Tadzhikistania (Karategin, ad fontes, Fl. Mynbulak) in Herb. Inst. Bot. Ac. Sc. USSR. Conservation (holotype LE).

Sibbaldia parvifolia Wild., Neue Schrift. d. Naturf. Ges. z. Berl., 11: 125 (1799). Type: Cappadocia (holotype ?; isotypes, A! BM!).

Sibbaldia parvifolia var. *micrantha* (Hook.f.) Dixit & Panigrahi, in Proc. Indian Acad. Sci., Pl. Sc., 90: 3: 264 (1981). Type: Western Tibetan region of Sikkim, Zankar 15,000 ft. 23-6-1848, J.D. Hooker sn. (K! Photo A!).

Sibbaldia parvifolia var. *semiglabra* Trautv. in Act. Horti. Petropolitani, 5: 1: 430, (1877). Types syn: In ossetiae monte Kasbek (R), Nec. Non ad. Lacum Tabizchuri districtus rossiei Achalziek (R anno 1875). (not traced).

Sibbaldia var. *pilosior* Trautv., Act. Hort. Petropolitani 5:1: 430 (1877). Types syn: In ossetiae Monte Kasbek Dre G. Radde; In Tuschetiae monte Borbalo Dre. G. Radde (not traced).

Sibbaldia perpusillia (Hook. f) Chatterjee in Notes Bot. Gard. Edinb., 19: 236 (1938). Type: Tibetan region of Sikkim, Alt. 16,000 ft. J.D. H. (Lectotype K!).

Sibbaldia procumbens var. *Orientalis* Somm et. Lev., Acta Horti. Petropolitani 16: 159 (1900). Type: In jugo mamisson, Lojka (not traced).

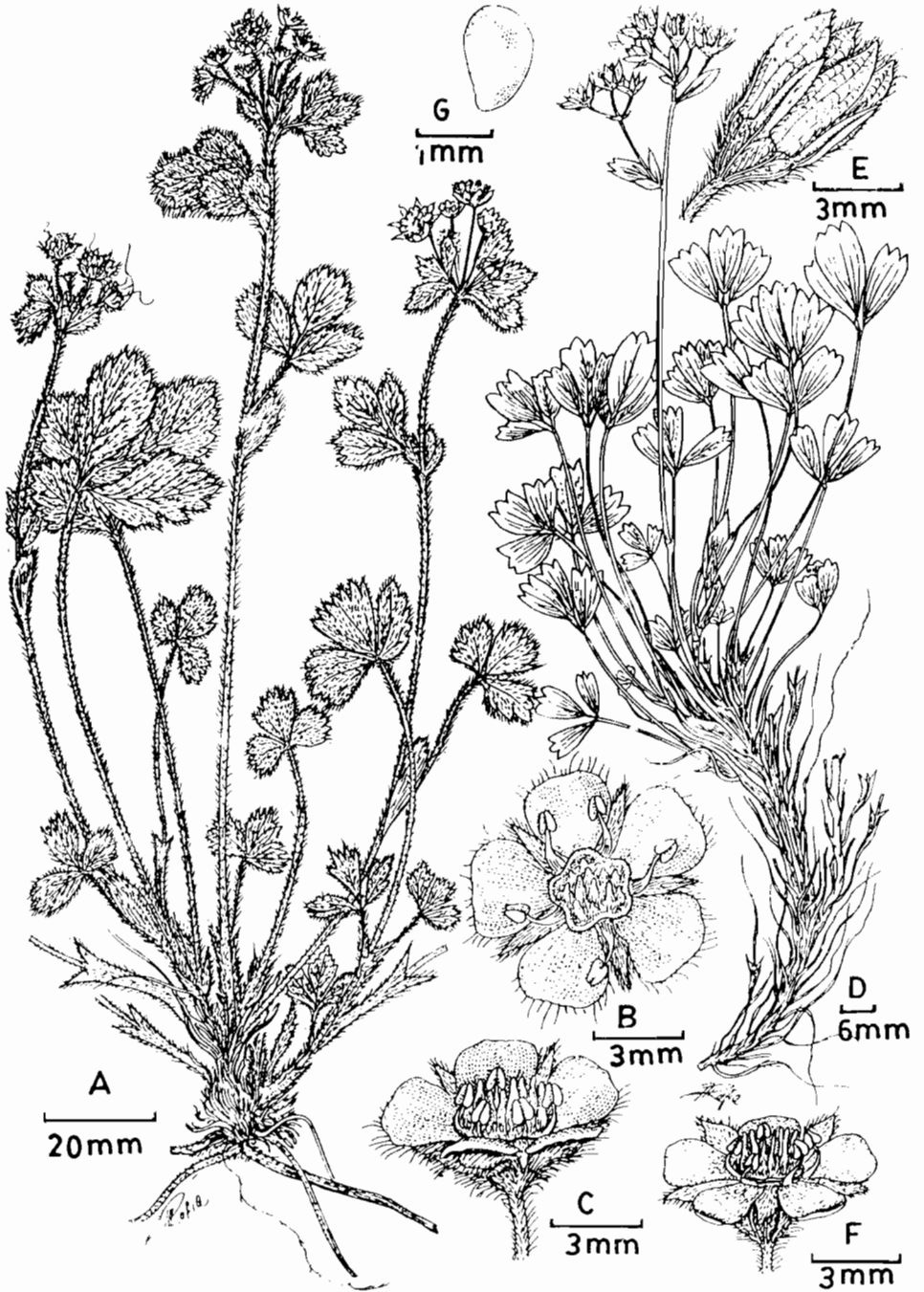


Fig 16. *S. askimensis*: A, habit, B, Flower (ventral view); C, Flower (side view); *S. procumbens*: D, habit; E, mature calyx with prominent veins and joints; F, flower (ventral view); G, seed.

Sibbaldia semiglabra C.A.M. in Beitr. Z. Pflanzenk. d. Russ. Reich 4: 44 (1849). Type not designated.

Sibbaldia taiwanensis H.L.Li., Lloydia 14:4: 236 (1952) Type: Formosa. Mt. Tugata-ka, 8 July, 1939, S. Suzuki 5379 (holotype, NTU).

Tomentose to almost glabrous prostrate herbs from woody rootstocks, stem bases covered with persistent brown leaf bases. Leaves trifoliolate and pinnate or palmate, petiolate; the petioles 0.7-8.5 cm long, tomentose with stiff, usually appressed grey hairs; stipule bodies 5-15 mm long, 2-5 mm wide, membranaceous, glabrescent or sparsely tomentose at the margin; stipule auricles 2-5 mm long, 1.5-2.5 mm wide, sharply acute, veined, glabrous adaxially, sparsely tomentose at the apices or on veins abaxially. Leaflets 3, 12-30 mm long, 6-17 mm wide, sessile or petiolulate, not articulated at base, the petiolules to 3.5 mm long; blades obovate or obovate-cuneate, apex truncate with 3-5(-8) glandular tipped teeth, the blades densely tomentose to glabrescent or glabrous on both surfaces, distinctly veined, the midvein sometimes elevated beneath. Inflorescence comprised of 5-11 flowers in dense, \pm umbell-like, bracteate cymes, the pedicles 1.2-2.5 mm long, glabrescent to densely tomentose with grey hairs; bract 4-10 mm long, 1-2.5 mm wide, lanceolate, acute, prominently veined, tomentose to glabrescent on both surfaces the bract stipule non-membranaceous, 1.5-6 mm long, 0.7-3 mm wide, mostly glabrous adaxially, glabrescent to tomentose abaxially, the bracts and stipules occasionally with 2-4 apical glandular teeth at the apex, otherwise with a solitary glandular teeth; bracteole 0.3-1.5 mm long 0.6-1 mm wide, oblong-lanceolate, cup-shaped, glabrescent or tomentose with appressed grey hairs abaxially, glabrous adaxially. Flowers perfect, 5-merous; epicalyx lobes 5, 1.5-2.2 mm long, 0.2-0.5 mm wide, linear, acute, distinctly veined, the veins elevated near base, the surfaces glabrescent to tomentose abaxially, glabrous to tomentose apically adaxially. Sepals 5, 1.7-2.5 mm long, 0.7-1.2 mm wide, oblong-lanceolate to ovate deltoid, glabrescent or tomentose with stiff, appressed grey hairs abaxially, \pm glabrous or tomentose toward apex adaxially, the apices mostly glandular. Petals 5, yellow, 0.6-2.2 mm long, 0.5-1 mm wide, elliptical to obovate or obovate-spathulate, obtuse, Stamens 5, antisepalous; filaments linear, 0.2-8 mm long, the anthers 0.4-0.5 mm long and broad, \pm elliptical; disc 1.5-2 mm across, sometimes lobed, surrounding the hairy receptacle. Carpels 5 or 6, the ovary \pm reniform, 0.2-0.5 mm long \pm 0.4 mm broad; styles lateral, glabrous, 0.5-0.9 mm long; stigma ca. 0.05 mm across. Achenes 1-1.5 mm long, ca. 1 mm broad, glabrous, mostly glossy, smooth dark to light brown (Fig.10 D-G).

Distribution and Ecology: Widely distributed in Asia, Europe and North America (Fig.12). On wet quartzite rocks, granitic rocks, and in moist places on calcareous rocks, generally on gravelly soil and rock slides. Flowering period July-August. Altitudes 300-3500 m.

Selected Specimens Examined: Afghanistan: Prov. Laghman, Alishang, upper part of Darrah, Rastylon, Wendelbo & Ekberg W9644 (E); Kumum Valley, Aitchison sn, 1879 (A,BM). Bhutan: Yale La, Ludlow, Sherriff, & Hicks 16404 (BM); Mela (South side), Ludlow Sherriff, & Hicks 200353 (BM). China: Szechuan, Kaushu shan, leilung (Leirong), Rock 24500 (A,BM). Tibet: Langong (28. 51-93.47). Ludlow, Sherriff, & Taylor 5501 (BM, E). Yunnan: Atuntze Mt. Miyetzimu, T.T. Yu 10540 (A,BM).



Fig. 11. Distribution of *Sibaldia sikkimensis*

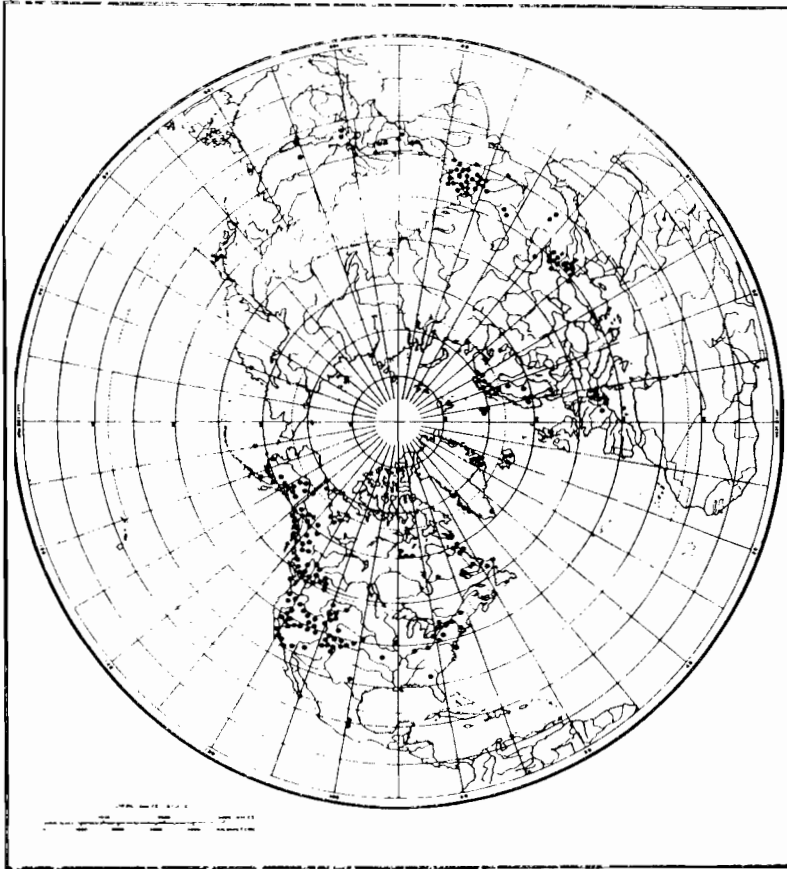


Fig 12. Distribution of *Sibbaldia procumbens*.

India: Punjab Manali, Lehal, N.L. Bor 12635 (E,K); Patar: Sikkim, Jongri, Hara, Kanai, Murata, Togashi & Tuyama 2033 (A,KYO). Japan: Prov. Shinano, between Sepuku Pass & Mt Shiomu, Murata 10315 (KYO); Mt Arakawa dake Igawa mura. Abe-Gun, Prov. Suruga, Miyoshi, Furuse sn. 23 August, 1959 (A). Kashmir: Gangabal, O. Polunin, 56/752 (B,BM,E); Rana Killanmarg, Duthie, 13051 (B). Nepal: Bhurchula lekh, near jurmia, Polunin, Sykes & Williams 4569 (A,BM,E); Dojam Khola near suli Gad, Polunin, Sykes & Williams 2258 (A,BM,E). Pakistan: Gangalwat Gol, Kafirstan, s.w. of Chitral, Stainton 2722 (A,BM); Karakorum, Gharesa Glacier Base Camp, 13 miles east of Nagar, Polunin 6154 (B, BM). Taiwan: Pref. Taichung, Mt. Hsueh-shan, main peak, Tamura 21164 (E); formosa edge of Mt Morrison, Price 989 (A). Turkey: Prov. Van. Satak, kavussahap Dag, Davis 23, 126 & Polunin (BM, E,K); Prov. Rize, Distr. Ikizdere cermanin Tape, Davis 21059, & Dodds (BM,E,K); France: Alpes due Dauphine et de provence, J. A Raynal sn., (BM). Great Britain: Scotland, Mountains Scotland, J.G. Baker sn, Feb. 1899 (US 545510); Breadalbane

mountains, J. Ball sn., 1850 (US 297818). Greenland: S.W. James on land, Hall breeding, near sea shore north of Fegins elv. etuary (71 08 40N 24 00W). R. Morris 1825 (BM): Headwall Tuckermans Ravine Mt. Washington ecos. country NH. F.G.F. & F.F. Farbes 2458 (A). Iceland: S.W. north of Thingvellir, H.G. Vevers 39 (BM): Mt. Esja, near Reykjavik, edith Scamman 1419 (A). Italy: Italien Aosta-Tal, Gressoney St-Jeans, Gruchen-Alm, Feinschutthalde Urgestein, Ketelhlt & Schiers 214-60-81-10 (B). Norway: Lacradal, s.w. Fretheuvy sn, 1925 (BM): Arolla foot of glacier near Evolene, Herb. A.H. Maude, 1933 (K). Sweden: Torne Lappmark N. of Tourist Station at Rikshgrahsen, on south west facing slope at Njutums and Clausen 1350 (A): Kamtchatka Australis avatcha Volcano, Eric an 740 (BM, K). Switzerland: Gornergrat coulon valais, G.S. Miller, 25th July 1904 (US 545212); Vogenen, Granitfelsen am Hohnneck, N. an Retourner 322 (BM). USSR: Caucasus Dist. Ashtarak, in declivis austro-orientalis, Montis Aragac, V. Vasak, sn. 13-7-1975 (B,BM, K): Georgia in Vicin op. Bukuriani. In summo monte Tskhra-Tskharo, ad pedem rupium in declivibus meridionalis bus, Juzepczuk et vysokoostrovskaja 4060 (A,B,E,K). Canada: Alaska, Kodiak, Piper 4314 (US 420771): Head of Sourdough creek n. of Steese highway, mile 66 central Alaska (circle quadrangle) G. Haliday No. A. 32676 (BM, E). Quebec-Labrador height of land, (58 08 n 64 25 w) Gillett 9009 (BM, US 2260846). British Columbia: 9.5 miles north of Topley along road to Babine lake, Calder, Savile & Ferguson 12802, (A, US 2330842): Selkirk, and Rocky mountains in British Columbia near 51 30 N. 1 at.,, Shaw 44 (A,BM, US 52584!). Mexico: State of Mexico, Nevado de Toluca, on south walls of Crater, Beaman 3434 (A, US 2575876). U.S.A: Arizona: San-Francisco mountain, knowlton 129 (US 85438); California: Jonesville, Butte Country, Copeland 418 (A,B,BM); Colorado: Just over the uncomphgre National Forest boundary, about 3 miles north west of capital city on the north branch of Henson Creek, Hinsdale County, Stephen Sponberg 64-57 (A): Idaho: Silver City Owyhee Country, Francis Macbride 1011 (A, US 543688): Nevado: Elko Country, Jarbidge, Quadrangle, R.R. Coats (US 2234863): Oregon Moist slopes of Strawberry Mt. Henderson 56660 (A): New York Ithaca, Bailey Hortorium Garden, Ithaca, Dress 1070 (BM): Utah: Dyer mine wintah mts. Leslie N. Goodding, 1253 (A, US 485666): Washington: Cascade Mountains Washington, Grant 8383 (US 1469909): Wyoming: Wyoming range, 15 miles west of Merna, Sublette county, Edwin B. Payso & Lois B. Payson 2785 (A).

Discussion: *Sibbaldia procumbens* has a wide geographical distribution and spans the greatest latitude of any species in the genus *Sibbaldia* but populations are discontinuous between Europe, America and Southeast Asia. Correspondingly, the species consists of a series of relatively pronounced forms, many of which have been described as distinct taxa. However, the detailed examination of a large number of specimens from throughout the range shows that plants similar to a form characteristic of one area frequently occur in a population from another part of the range. In the past Juzepczuk (1941) described *S. macrophylla* and was characterised by the apical tooth of the leaflets of the basal leaves, which is said to be shorter and smaller than the lateral teeth. However, in the same publication it was admitted that this is a variable character. After the examination of large numbers of specimens it seems impossible to separate that species from *S. procumbens* as a distinct species and it hardly even deserves to be regarded as a

variety. Originally, *Sibbaldia procumbens* was described from Europe, the form upon which the name was based occurring predominately in North America and Eurasia, and has elliptical to ovate leaflets borne on medium to fairly long petioles, flowering scapes fairly long, hairs moderately distributed on the vegetative parts. Similar plants occur in Russia. In Russia, however, there are also plants with almost entirely or semi-glabrous leaves. In fact, the size of the leaflets, density of hairs, the number of apical teeth on the leaflets, leaflet venation, and size of sepal, epicalyx lobes, petals, varies greatly throughout the range. In Asia (China, India, and Pakistan) the plants are more compact, and the flowering scope does not usually exceed the leaves. Another variation has also been found in the specimens collected from Turkey. They have very thick rootstocks, but this same feature is also found less frequently in other areas of its range. The degree of elevation of veins also varies greatly in this species.

7. *Sibbaldia sikkimensis* (Prain) Chatterjee, Notes Roy. Bot. Gard. Edinburgh, 19: 327. (1938). Basionym: *Potentilla sikkimensis* Prain, Jour. Asiatic Soc. Bengal, 73: 201 (1904). Type: India. Sikkim, Jongri, 1887, Dr. King's Collector s.n. (lectotype: CAL).

Sibbaldia melinotricha Handel-Mazzetti, Symb. sin., 7: 521 (1933). Type: China Yunnan, alt. ca. 4200 m, 18 June, 1916, *Handel-Mazzetti* 8964 (holotype, W; isotype, E!). Yellowish tomentose perennial herbs from thick root stocks, the basal portions of the stems densely clothed with the persistent, light brown remains of leaf bases. Leaves trifoliolate and palmate; petioles 1.2-7.2 cm long, ridged, tomentose with long, stiff, spreading hairs; stipule bodies membranaceous, 10-25 mm long, 10-12 mm long, 4-7 mm wide, oblong-elliptical, the stipules 4-6 mm long, ca. 1 mm wide, distinctly veined; bracteoles 1.5-4.5 mm long, 0.2-1 mm wide, linear to linear-lanceolate, tomentose abaxially, glabrous adaxially. Flowers perfect, 5-merous; epicalyx lobes 5, or rarely 6, 1.7-2.2 mm long, 0.8-1.2 mm wide, lanceolate-elliptical, acute-obtuse, with glandular apices, densely tomentose abaxially, sparsely tomentose or glabrescent adaxially, distinctly 3-veined. Sepals 5, 1.3-2.4 mm long, 1-1.3 mm wide, deltoid, with acute, glandular apices, densely tomentose abaxially sparsely tomentose or glabrescent adaxially. Petals 5, purple-red, 2.3-3.5 mm long, 2.2-0.32 mm wide, obovate to elliptical, emarginate, longer than the sepals, Stamens 5, antisepalous, inserted at the edge of the lobed disc, the filaments 0.4-0.5 mm long, linear, tapering toward apex; the anthers ca. 0.2 mm long, 0.3-0.5 mm broad, broadly elliptical; disc 2-2.6 mm across, 5-6 lobed. Carpels 10-21, inserted on the tomentose receptacle; ovary 0.5-0.7 mm long, ca. 0.5 mm broad, + reniform, hairy at the base, otherwise glabrous; style glabrous. 0.7-1.0 mm long; stigma capitate ca. 1 mm across. Achene purplish-brown to black, 1.2-1.6 mm long, ca. 1 mm wide, smooth, usually depressed on one side and mostly surmounted by the persistent stigma and style (Fig. 10 A-C).

Specimens examined: China: Yunnan Province: Yangbi Xian, West side of Diancang Shan mountain range, vicinity of Balyundfeng peak above Malutang (25°46'N) long. 1000.01' w), 1984 Sino-American Botanical Expedition 544 (A,E); Hsi mountain, McLaren D Collector 69 (E); Mekong Salwin divide (28°12'N), Forrest 14223 (E); Mount Fu-chuan, SW of i-Hsi, Mekong-Salwin divide, Rock 16987 (A); Wei-Hsi (27°19'N, 99°15'E) McLaren 69 (E). Tibet: Tasanang La, near Paka (29°13'N, 94°24'E) Ludlow, Sherriff & Taylor 5871 (BM, E); Ata Zayal, Kingdon-ward 10503

(BM). Burma: Western Flaukgtne chemi-lin maikla-salwin divide (26°24'N, 98°24'E), Forrest 26874 (BM). Nepal: Rambrong, Lamjung Himal, Stainton, Sykes & Williams 6083 (A,E); Jata, Lall dhvaj 0458(BM); Arun Valley Kasowa Khola N of Norn, Stainton 496, (A, BM, E); Pambrang Langung Ylinal, stainton, Sykes & Williams 6083 (BM).

Distribution and Ecology: Southeastern Tibet and Yunnan Province of China, upper Burma and Nepal (Fig.11). Stony ground often at the edge of streams, also in open forests, at an altitude 3500-4150 m. Flowering period May-June.

Discussion: *Sibbaldia sikkimensis* is closely allied to *S. micropetala* (D. Don) Handel-Mazzetti. However, these two species can be separated from one another as follows: *S. sikkimensis* has leaves which consist of three leaflets, which are tomentose abaxially with stiff brownish hairs, and petals 2.2-3.0 mm wide with emerginate apices. In *S. micropetala* the leaves consist of 3-9 leaflets, which are tomentose abaxially with soft, woolly, snow-white hairs, and the petals are \pm 1 mm wide with obtuse apices.

8. *Sibbaldia purpurea* Royle III. Bot. Himal, 208: t: 40: fig.3 (1835). *Potentilla purpurea* J.D. Hooker, Fl. Brit. India, 2: 347 (1879). Type: None designated; lectotype, here designated, tab. 40, fig.3 in Royle, 1835 (A!).

Sibbaldia pentaphylla J. Krause, Feddes Repert. Beih., 12: 410 (1922). *Dryandanthepentaphylla* (Krause) Murav., Acta Inst. Bot. Ac. Sci. USSR, 1:2:240 (1936).

Sibbaldia purpurea var. *Pentaphylla* (Krause) B.K. Dixit in Bull. Bot. Soc Bengal, 38: 1:2 (1984) Published in 1987. Syntypes: Ost Tibet. Ta tsien lu steinige Matten, sudsudwestlich de Passes Gila, 4500-4600 m. Collector Unknown. 1661. (not seen); Ta Tsien lu-dawo Dschungku, Gibiet des Dshara auf dem Grat der westlichen Parallelkelte 4730 m. Collector unknown 1776. (not seen). *S. macropetala* Muravj, in Acta Inst. Bot. Acad. Sc. URSS. Ser. 1. Fasc., 2: 235 (1936).

Holotype: China, Prov. Kansu orientalis, Montes Tschogola, II-VI-1885, G.N. Potanin (probably in LE). Syntype: Prov. Yunnan distr. Likiang, 1922. J.F. Rock, 4996, (A!)

Sibbaldia purpurea var. *macropetala* (Muraj). T.T. Yu & C.L.Li, in FL. Reipubl. popul. Sin., 37: 340 (1985). Type: Chinna prov. Kansa orientalis montes Tschogola, 11-VI-1885, G.N. Potanin (LE).

Silvery tomentose perennial herbs, caespitose from procumbent, woody rootstocks, the branches clothed with the persistent remains of leaf bases. Leaves palmately 5-foliate; petioles 3-29 mm long, tomentose with spreading soft silky hairs; stipule bodies membranaceous, 5-12 mm long, 3-5 mm wide, 3-veined, sparsely tomentose abaxially; stipule auricles membranaceous, 2.5-5 mm long, sharply acute at the apices, and distinctly veined, essentially glabrous except on the abaxial surface at the apices, and distinctly veined, essentially glabrous except on the abaxial surface at the apices. Leaflets sessile, articulated at base, 2.5-12 mm long, 1-7 mm wide, elliptical to obovate or oblong-obovate, the upper 3 \pm equal in size and shape and larger than the lower most pair, the apices of each with 3 glandular-tipped teeth, the lower 2 leaflets with 2-glandular-tipped teeth; leaflet blades often folded longitudinally when dry, tomentose, with purplish venation distinct on both surfaces. Flowers in small, cymose inflorescence, 4- or 5-merous, perfect or occasionally staminate, borne on bracteate pedicels; the pedicels 4-11 mm long, tomentose; the bracts 1.5 - 6 mm long, 0.3 - 1.4 mm wide, lan-

recipitate. The bract-stipule leaf 2-5 mm long, 0.3-2.0 mm wide, tomentose abaxially; bractiole 1.5-2.5 mm long, 0.3-1.4 mm wide, cupshaped to elliptical, sharply acute, with distinct veins adaxially, tomentose abaxially. Epicalyx lobes 4 or 5, sometimes 6, 0.8-1.2 mm long, 0.3-0.7 mm wide, oblong to oblong-elliptical, acute or acute-obtuse, with 3 distinct veins, the surface glabrous adaxially, tomentose abaxially. Sepals 4 or 5, 1-2.2 mm long, 0.3-1.2 mm wide, deltoid or \pm triangular, acute, with distinct venation, glabrous or lower half glabrous, and upper half tomentose adaxially, tomentose abaxially. Petals 4 or 5, 1.2-4.0 mm long, 0.6-3.0 mm wide, obovate-elliptical or spatulate-oblong, with emerginate to rounded apices, the surfaces with 3-5 distinct veins. Stamens 4 or 5, antisepalous, inserted at the edge of the disc; the filaments 0.2-1.0 mm long, (or longer in staminate flowers); the anthers broadly elliptical; disc circular to lobed, 1-3 mm across. Carpels 4-24, inserted on the tomentose receptacles, the central carpels usually larger; ovary 0.2-1.2 mm long; \pm ovoid, hairy at the base, otherwise glabrous, the style 0.6-1.2 mm long, lateral, usually purple, terminated by a capitate stigma ca. 0.1-0.2 mm across. Achene 1-2 mm long, \pm 1 mm wide, ovoid, purple-brown, glabrous, smooth-dull, surmounted by the persistent style and stigma (Fig 8 E-H).

Ecology and distribution: Bhutan, India, Kashmir, Nepal and Southwestern China in (Sikang), Sichuan and Yunnan provinces (Fig.5). On streams banks, among rocks, common on alpine slopes and can also grow on compact soil, at altitudes between 4300 - 4600 m. Flowering period May - October.

Selected specimens examined: Bhutan. Me La Ludlow, Sherriff & Hicks 20749 (BM,E): Mangde Chu, Bowes Lyon 3418 (BM). China: Szechuan: West slopes of Mt. Mitzuga, Muli Territory, Rock 24038 (A,BM, US 1513318). Sikang Tapaoshan, Harry Smith 11205 (A, BM). Tibet: Mountains West of the Kaakerpo, Dokerla, and Yundshi, S.E. of Tibet, Rock 23157 (A, BM, E, US 1512871). Yunnan Eastern flank of the lichiang Range (Lat 27° 30'N) George Forrest 6011 (BM, E, K). India: Punjab. Tehri-Garhwal, Duthei 1073 (BM, K): Sikkim J.D.H. sn, (A,BM, K). Kashmir: Bangar, Kishtar Dist. Ludlow & Sherriff 9279 (BM): Nepal: Lumjung, Himal., Stainton, Sykes & Williams 6306 (A, BM, & E). Jumla, Polunin, Sykes & Williams 4576 (A, BM, E).

Discussion: We are unable to find any difference on the basis of which *Sibbaldia macropetala* Muravjova can be separated from *S. purpurea*. In describing *S. macropetala*, Muravjova (1936) provided a key indicating that *S. purpurea* consists of "Flores dioici, petala pallido purpurea, oblonga foliorum petioli usque ad 2 cm longi", while *S. macropetala* consists of "Flores hermaphroditi, petals atro purpurea, cordata, foliarum petioli 2-5 cm long." *Sibbaldia purpurea* was described by Royle in 1835, and in his original description he mentioned that *S. purpurea* is a polygamous species, bearing unisexual and bisexual flowers on the same plant. According to Muravjova (1936), the flowers of *S. purpurea* are dioecious, which is not correct. Moreover, *S. purpurea* are dioecious, which is not correct. Moreover, in *S. purpurea* the petals are obovate with round to slightly emerginate apices, which is quite clear from Royle's original description and the accompanying illustration. According to Muravjova (1936), petals are oblong in *S. purpurea*, which is again not true. The other characters viz, dark purple vs pale purple, petiole up to 2 cm vs 2-5 cm cannot be maintained, because of continuous variation. Moreover, we have examined J.F. Rock 4996 (A) cited by Muravjova in his

original description of *S. macropetala* and are unable to find any difference in it and other specimens of *S. purpurea*. After the examination of large number of collections from different herbaria, over a wide range of distribution, it is impossible to maintain *Sibbaldia pentaphylla* Krause. *Sibbaldia pentaphylla* was separated from *S. purpurea* on the basis of 4-merous flowers with yellow petals in the latter and 5-merous flowers with purple petals in the former. In *S. pentaphylla* flowers are not always 4-merous, but sometimes 5-merous flowers are also found even on a single shoot, and the same is noticed with the colour of the petals. Moreover, Yu et Li (1981) have discovered, that the number of the floral parts of *S. pentaphylla* from China are both 4 and 5-merous, and accordingly they had emended the description of *S. pentaphylla*. In *S. purpurea* there is a great variation in the size of plant and density of hairs. Variation has also been noticed in the size and apex of the petals, the apex ranging from obtuse - rounded to emarginate. There is a great variation in habit of *S. purpurea* from densely compact moss-like to normal plant. Mostly plants collected from Sikkim are more moss-like or compact. It may be that the high altitude is the governing factor. Specimens collected from 15,000-16,000 ft altitude are very densely tomentose, with shiny hairs both staminate and perfect flowers are found in this species. In the original description Royle has not cited any type collection, therefore plate 40, Figure 3 (Royle L.C.) is selected as the iconotype (A!). However, we have received one specimen from Kew, which is in the type folder of *S. purpurea*. It will be erroneous to consider Kew specimen, as type, because Royle has not mentioned the type.

9. *Sibbaldia adpressa* Bunge in Ledebour, Fl. Altaica, 1: 428 (1829). *Sibbaldianthe adpressa* (Bunge) Juzepczuk, Fl. USSR, 10: 17 (1941/1971). Type: Hab. in apricis montium et in campis siccis editis ad fl. ken. et Tschuja (B), *Potentilla lindenbergii* Lehmann - Hamburger Garten-Blumenzeitung, 7: 339 (1851). Type: India orientali acceptit, *Lindenberg* s.n. (Not located).

Sibbaldia manassima Kitamura, Acta Phytotax. Geobot., 15:5: 132 (1954). Type: Nepal Sangda 3800 meters alt., Sasuke Nakao, 12 May 1953, *Himalayan Expedition III* (holotype, KYO!). *Sibbaldia sericea* (Grubov) Sojak in Folia Geobot. & Phytotax, Praha 4: 79 (1967). Type: Altai. Gobicus. Jugum Gurban-Saichan, in Promoloriis borealibus apud viam in Dalan-Dzadagad in Steppa deserta stipacea, 6-v-1941 FL. (fr) n 4963A. Index Bot. Hort. Bot. G. Ac. Sc. USSR (LE).

A number of requests for loans or photos of specimens to LE were made, but no acknowledgment was received.

Tomentose perennial herbs from woody rootstocks, the stems branched, prostrate or semi-erect, clothed by the persistent remains of leaf bases. Leaves odd-pinnate or rarely trifoliate and pinnate; petioles 4-9 mm long, sulcate, tomentose with stiff hairs; stipule bodies membranaceous, 3.5-5 mm long, 1.5-1.7 mm wide, tomentose abaxially with short appressed hairs, the veins distinct; stipule auricles 1.5-2 mm long, sharply acute and distinctly veined, tomentose abaxially along the margins and near veins. Leaflets 3 or rarely 5, the terminate the petiolulate and larger, 9-16 mm long, 3.5-5 mm wide, oblong-spathulate, with 3 apical, glandular teeth; lower leaflets not petiolulate, opposite when 3, sub-opposite when 5, 6-13 mm long, 1.2-3 mm wide, laccolate, acute with a glandular apices, (otherwise without apical teeth), the blades

sparsely tomentose or glabrescent on the adaxial surfaces, densely tomentose abaxially with coarse, stiff, appressed, brownish hairs. Flowers usually solitary or sometimes 2 together, perfect, 5-merous; peduncles 4-19 mm long, tomentose; bracts 4-6 mm long, 0.8-1.2 mm wide, glabrous adaxially, tomentose abaxially; bract stipule 1.4-1.6 mm long, ca. 0.2 mm wide, linear or oblong, acute, tomentose abaxially, glabrous adaxially. Epicalyx lobes 5, 1.7-4.5 mm long, 0.8-1.4 mm wide, linear lanceolate, the apices glandular, sparsely tomentose abaxially, the venation indistinct. Sepals 5, 3.2-4.5 mm long, 1-1.7 mm wide, ovate or deltoid, acuminate, the apices glandular, the surfaces tomentose abaxially with appressed hairs, glabrous adaxially with a distinct midvein. Petals 5, yellow or pale white, 1.4-1.6 mm long, 0.8-1 mm wide, spatulate or oblong-ovate, obtuse, distinctly veined. Stamens 10, antisealous, inserted at the edge of the lobed disc; filaments linear, 1.6-1.9 mm long, tapering toward the apex; anthers 1.6-1.8 mm long, 1-1.2 mm broad, disc 1.2-2 mm in diameter. Carpels 10-12, inserted on a hairy receptacle; ovary 1.5-2 mm long, obliquely ovoid, pubescent at base, otherwise glabrous; style 2.7-3 mm long, yellowish-brown, lateral, arising below the middle of the ovary; stigma ca. 0.2 mm long, ca. 0.4 mm broad, obliquely capitate. Achenes ca. 1.5 mm long, ca. 1 mm broad, \pm triangular, glabrous, greenish-brown, the style usually persistent (Fig. 7 D-F).

Specimen examined: China: North China, *Licent* 3926 (BM), Nepal: Namdo, (29^o23'N, 83^o05'E) *Dobremex* DBR NEP N (?) 291 / (BM); mustang (29^o10'N, 83^o57'E), *Dobremex* DBR NEP N 2990 (BM); Sangda, S. Nakao s.n. 12 May 1953 (KYO). USSR: Siberia, Guv. Irkutsk, ad flumen Lena Markov-skoji, Nilsson-Ehle s.n. 4-6-1898 (A); Irkutsk, *Ficherdedit* s.n. 1836 (A); Irkutsk Herb. John A. Lowell (A); Dahuricae weiden Grasplatze Gri E. Kurv 12 9B,E); Irkutsk, Herb H. F. Hance 18099 (B); Dahuricae, Nertschinsk J. Freyn 12 (B); Altai Herb. N.B. Ward s.n. (BM); Altai Ex-Herb. Greville (E); Altai, C.A. Meyer s.n. (B).

Distribution and Ecology: China, Nepal and USSR (Fig.6). On stony gravelly mountains, coastal slopes, and on sandy soils, at altitudes between 3600-3800 m. Flowering Period May-June.

Discussion: Juzepczuk (1941) transferred *Sibbaldia adpressa* Bunge to his new monotypic genus *Sibbaldianthe*. The original description of genus as well as the detailed description in English provided for its solitary species do not include a single unique character or character combination that separate the genus for *Sibbaldia*. We have examined specimens of *S. adpressa* and have concluded that the transfer of *S. adpressa* to the genus *Sibbaldianthe* is not justified. Moreover, in the key to genera of subfamily Rosoideae presented by Juzepczuk in the Flora of the USSR (Juzepczuk, 1941), there are some confusing discrepancies, Juzepczuk (1941) described stamens in *Sibbaldia* as opposite the petals, but in all material we have studied they are antisealous. In addition, there is a contradiction between the key and description; in the key style attachment is given as basal whereas in the description it is described as lateral.

Specimens of *S. adpressa* from Nepal generally have narrower leaves than collections from other areas. *S. sericea* (Grubov) Sojak is separated from *S. adpressa* on the basis of petals pure white and longer than the sepals vs petals yellowish-green equal to or shorter than sepals. The petal characters used by Sojak are variable and are not good enough to separate the *S. sericeae* from *S. adpressa*, thus it is placed in the synonymy.

10. *Sibbaldia micropetala* (D. Don) H. S. Gentry & G. K. Sreen & G. Schodde, Vegetationsbinder, 22:8: 6 (1932). Basionym: *Potentilla micropetala* D. Don, Prodr. Fl. Nepal, 321 (1825). Type: Gossain than, Wallick Num. List 1018 (holotype, K!).

Sibbaldia potentilloides Camb. in Jacquem. Voy. Indes, 4: 54 (2: 67) (1844). Type: Indian Himachal Pradesh, Bashahs dt. Mountain tops of Hation Sta. Lect. 18510. (MPU).

Potentilla albifolia Wallick ex Hooker f., F. Brit. India, 2: 347 (1878). Type: Gossain than, Wallick Num. List No. 1018 (holotype, K!). This sheet has three collections mounted on it. The top collection is the type.

Potentilla (Sibbaldia) micropetala var. *gibbosa* Cardot, Extraits de Not. Syst., III: 7/8. 242 (1916). Type: Yunnan: paturages pres du col de Yun-tze-hay alt. 3000 m, Delavay 2360 (holotype, P, isotype, K!).

Sibbaldia axilliflora (Hooker f.) Chatterjee, Notes Roy. Bot. Gard. Edinburgh, 45: 325 (1938). Basionym: *Potentilla axilliflora* J.D. Hooker, Fl. Brit. Ind. 2: 346. 1878. Type: Western Himalayas, Kumaon, Herb. Wallich (*Fragaria indica* Wall. Cat. 1236, in part K!).

Sibbaldia byssitecta Sojak, Preslia 42: 184 (1970). Type: Bhuttan: Ra La, alt. ca. 12,000 ft (ca. 3650 m) 26 June 1938 Gould 589. (Holotype K!, isotypes, A.). *Sibbaldia phanerophlebia* T.T. Yü & C.L. Li, in Acta-Phytotax. Sin., 19: 4:517 (1981). Type: Yunnan, Laquan, alt 3500 m, VI-5-1952, P.Y. MaO 01136 (Holotype: PE 0570210).

White tomentose, *Potentilla* - like herbs to 30 cm tall from woody tap roots, the branches clothed at the base with persistent leaf bases. Leaves odd-pinnate with 5-9 leaflets, 3-4.5 cm long, the basal leaves larger and with membranaceous stipules, the upper cauline leaves smaller with leafy stipules; petioles 6-20 mm long, ridged, tomentose; stipule bodies of basal leaves membranaceous, 5-7 mm long, 4-6 mm wide, brown, glabrous or sometimes tomentose abaxially at the edges with silky soft hairs, with 3 distinct dark brown to red veins adaxially, stipule auricles membranaceous, 3-4.5 mm long, 2-3.6 mm wide, obtuse round, distinctly veined, stipules of cauline leaves 5-8 mm long, 4.5-6.5 mm wide, tomentose abaxially, glabrescent abaxially. Leaflets sessile, their size decreasing downward from the terminal one, obovate-orbicular, with 3-16 glandular tipped teeth or lobes along the margins, abaxially white tomentose densely intermixed short and long hairs, adaxially tomentose with short dark brown hairs. Flowers perfect, 5-merous borne on ebracteate pedicels, the pedicels 5-17 mm long, densely tomentose with very soft densely interlaced woolly hairs; bracts leaflike, bracteoles absent. Epicalyx lobes 5, or sometimes 6 or 10, 1.2-2.0 mm long, 0.3-0.8 mm wide, lanceolate, acute, tips glandular, tomentose abaxially with soft woolly hairs, deltoid, glabrous adaxially with faint venation. Sepals 5 or rarely 6, 1.5 - 2.8 mm long, 0.8-1.2 mm wide, tomentose abaxially with soft woolly hairs, glabrous adaxially except at the pubescent and glandular apices, 3 - veined. Petals 5 or rarely 6, creamy white, 1.5-2.5 mm long, 0.8-1.5 mm wide, ovate-lanceolate, obtuse-emarginate, veined. Stamens 5, antisepalous, inserted at the edge of the disc; filaments 0.3-0.5 mm long, terete; anthers 0.2-0.3 mm long, ca. 0.2 mm broad, circular-elliptical; disc circular, 0.7-1.0 mm across. Carpels 8-18, inserted on a tomentose receptacle; ovary ca. 0.5 mm long, ca. 0.3 mm broad, obovate, hairy at the base otherwise glabrous and smooth; styles 0.5-0.7 mm long, lateral, glabrous; stigma ca. 0.5 mm across, capitate, light

brown. Achene brown, 0.8-2.0 mm long, 0.4-0.7 mm broad, + reniform, a keel-like structure present on the stylar side, usually with wrinkles or folds, dull, the style usually persistent (Fig.13).

Ecology and distribution: Sikkim, Nepal, India, Bhutan, Eastern Himalayas and Yunnan Province of China (Fig.5). On open soil among small rocks, around summer grazing encampments, at an altitude between 3325-4200 m: Flowering period May-July.

Selected specimens examined: Bhutan: Shingbe, Me La, N.E. of Bhutan, Ludlow, Sherriff & Hicks 20707 (BM, E). China: Szechuan: Szechuan bor occid, Karlong, in prato herbosa puticosa, Harry Smith 3036 (BM): Tibet: Source of the Irrawaddy, adung vally (28° 20' N 97° 40' E) Kingdon-ward 9759 (BM): Yunnan Yangtze Watershed prefectural district of likiang, Eastern slopes of likiang Snow Range, Rock 4777 (E, US 121497): India: Punjab, Drummond 22904 (K): Assam orka la Bhuttan frontier, Kingdon-ward 13733 (BM): Sikkim Jongri, Gamothan, Hara, Kanai, Murata, Togashi, Tayama 566 (A, BM, KYO): Kashmir: Srinager, above Gulmarg, Khillan-marg, Plateau, Lancaster 2 (BM). Nepal: Chipli north of Pokhara, Stainton sykes & Williams 4895 (BM, US 2318032): Near Balangra Pas, Polunin, Sykes & Williams 2567 (A, BM, E).

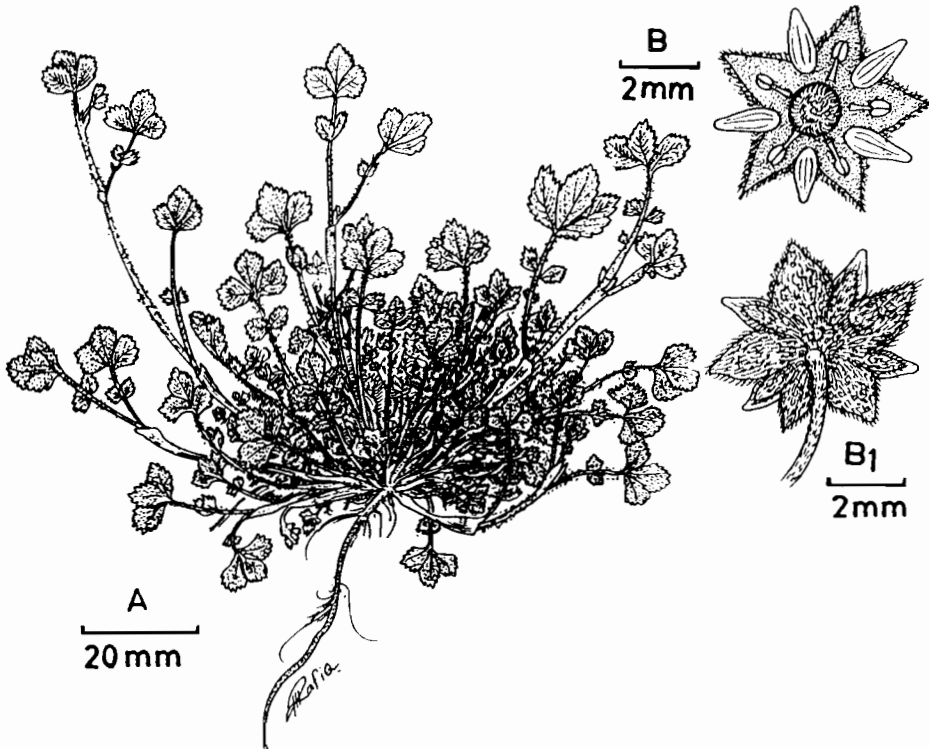


Fig.13. *S. micropetala*: A, habit; B, Flower (ventral view); D, Flower (dorsal view).

Discussion: *Sibbaldia micropetala* can be distinguished from all other species of *Sibbaldia* by its leaves which are densely covered by snow white hairs on their lower surfaces. A variation has been noticed in the colour of the hairs on the upper surface of leaflets. Mostly leaves are brownish or greenish brown tomentose on upper surface, but in young condition the leaflets are snow white on both surfaces. The field notes on AGSES 37 at (E) indicates that in apparently richer soil the plants develop a greener foliage.

Morphologically *Sibbaldia micropetala* resembles *S. sikkimensis*, but *S. micropetala* can be separated as follows: *S. sikkimensis* has petals which are purple-red, and leaf petioles 1.2-7.2 cm long, whereas *S. micropetala* has yellow petals and leaf petioles 0.6-2.0 cm long. For further details see the discussion of *S. sikkimensis*.

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Index to the names of *Sibbaldia* species, recognized species are shown in bold letters

- S. adpressa* Bunge
- S. aphanopetala* Hand-Mazzetti
- S. axilliflora* (Hook. f.) Chatterjee
- S. byssitecta* Sojak
- S. cuneata* Edgeworth
- S. cuneata* Kunze
- S. cuneata* Kunze var. *micrantha* (J. D. Hooker) R. R. Stewart
- S. glabriuscula* T. F. Yü & C. L. Li
- S. macropetala* Murray
- S. macrophylla* Turcz.
- S. melnotricha* Hand-Mazzetti
- S. micropetala* (D. Don) Hand-Mazzetti
- S. micropetala* var. *gibbosa* Cardot
- S. minutissima* Kitamura
- S. olgae* Juzepczuk & Ovezinn
- S. parviflora* Willd.
- S. parviflora* Willd. var. *micrantha* (Hook. f.) Dixit & Panigrahi

- S. parajflora* var. *semiglabra* Trautv.
S. pentaphylla Krause
S. perpusilla (Hook.f) Chatterjee
S. perpusilloides (W.W. Smith) Hand-Mazzetti
S. phanerophlevia T.T. Yü & C.L. Li
S. potentilloides Cambess.
S. procumbens L.
S. procumbens L. var. *aphanopetala* (Hand-Mazzetti) T.T. Yü & C.L. Li
S. procumbens L. var. *Orientalis* Somm. et Lev.
S. procumbens L. var. *thebetica* J.D. Hooker
S. purpurea Royle
S. purpurea Royle var. *pentaphylla* (Krause) Dixit
S. purpurea Royle var. *macropetala* (Muraj) T.T. Yü & C.L. Li
S. semiglabra C.A.M.
S. sericea (Grubov) Sojak.
S. sikkimensis (Prata) Chatterjee
S. taiwanensis Li
S. tenuis Hand Mazzetti
S. tetrandra Bunge
S. trullifolia (Hook.f) Chatterjee
S. unguiculata Rajput *et al.*,

Unplaced and excluded names

- S. altaica* Laxm. in Nov. Comm. Ac. Petro., 18: 527 (1774) *Chamaerhodes altaica*.
 Type: De Schle tendal in litt. ed. div. Romer. ad. Selengam, sibira (?) not traced.
S. ambigua Tuz., Fl. USSR. X: 169 (1971). Name is used in the discussion of *S. semiglabra* but validity not published.
S. argentea Owerin ex Juzepczuk in Bull. Jard. Bot. Princ. URSS., 25: 239 (1926).
 Cited in the synonym of *Potentilla ghalghana* the name is superfluous.
S. californica Spreng. Syst. IV. Cur. Post. 341 (1827). *Horkelia californica* Schlechtend.
S. caucasica C.A.M. in Beitr. Z. Pflanzenk. d. Russ. Reich. VI: 44 (1849). The type is not cited, and the description is poor.
S. compacta (Smith & Cave) Dixit & Panigrahi in Indian J. Forest., 3(1): 35 (1980).
 Type: India, Sikkim, Ghosaphu Chu Slouok, 4575 m, 6th August, 1909. Smith & Cave 2210. (Lectotype CAL., isolectotype K!) lectotype was selected by Dixit & Panigrahi (1980). We have examined the type at K, there are no flowers on the specimens nor any other specimen that agrees with the description we found. The name cannot be applied as yet due to insufficient material for an accurate identification.
S. congesta D. Dietr. Syn. Pl., 2: 1020 (1840) *Potentilla multijuga*
S. cuneata Bert., Bertoloni in Mem. Accad. Sc. Ist. Bologna Ser., II. V.III. t. 3 (1866)
 Type not cited, description is poor, for an accurate identification.
S. cuneata Harmen. ex. O. Kuntze var. *micrantha* (Hook.f) Grierson & Long, in Notes Roy. Bot. Garden Edinburgh 32 (2): 353 (1979). *Potentilla Sibbaldia* var. *mi-*

- *crantha* Type: Western Tibetan Region of Sikkim, Falconer? (not traced).
- S. cuneata* Harmen. Ind. Sem. Hort. Halm; 1: 4: 67 (1842) et (1845) The type is not cited, description is poor.
- S. erecta* Linn. sp. pl., 284 (1754). *Chamaerhodos erecta* (L.) Bunge in Ledeb. FL. Alt. 1: 430 (1841) Type: Dauria Gmelin collector? (not traced).
- S. erecta* Linn. Lamarck, III. i.t. 221 fig.2 (1797). The description is very poor, and no specimen of the type collection has been found.
- S. fragariastium*, Turcz ex Ledeb; Fl. Ross. II: 33 (1844-46) olim in litt.
- S. grandiflora* Pall. ex Schult. Syst., VI: 770 (1820). *Chamaerhodos grandiflora* pall Type: De Sche tendale in litt. ad. div. Romer. ad. *selengam sibira*, pall (BM!). The type sheet has three twigs mounted on the same sheet, the upper twig which is marked as No. 1 is the type of *S. grandiflora*, the lower twigs which are marked No. 2 is the type of *Salix* Linn.
- S. maxima* Kessels. ex Muravj in Acta. Inst. Bot. Acad. Sc. URSS., ser. I. Fax. 2: 231 (1936). Cited in the synonym of *S. cuneata*, not validity published.
- S. octopetala* Mill. Gard. Dict. ed. III. No.2 (1768) Just the name is used, but not validity published.
- S. parvifolia* var. *minor* Boiss., FL. orient., II: 726 (1872). The description is poor, and the type is not cited.
- S. polygna* Willd. ex Schult., Syst. VI: 770 (1820). *Chamaerhodos erecta* Bunga. Type: De Schlegel-tendall., L.C. In *Sibira* Pallas (?W).
- S. procumbens* var. *pilosior*, Trautv. in Acta. Horti. Petropolitane, 5: 1: 430 (1877). Type: In ossetiae monte kasbek, Dre. G Radde (not traced). The description is poor, and no specimen of type collection has been found.
- S. pulvinata* T.T. Yü & C.L. Li in Acta Phytotaxa. Sin., 19(4): 515 (1981). Type: Yunnan: Upper Dulong He (Kiukiang) valley (clulung) Tsugum, alt. 4300 m, alpine grassland, VIII-8-1938, T.T.Yü 19789 (HP?) according to Yü & Li (1981) Type is in HP but in fact it was not traced. We have examined the syntype (T.T. Yü 19881, PE 342326) the material has no flowers, thus material is insufficient to identify as *Sibbaldia*.
- S. sabulosa* Steud. Nom. ed. II, 2: 575 (1841). *Chamaerhodos sabulosa* Bunge in Ledeb. Fl. alt. 1: 431 (1841). Type: Chuya river next to estuary of Chegan-Uzun River and collector? (LE) Leningrad.
- S. omeinsis* T.T Yü & C.L. Li in Acta Phytolax. Sin., 19:4: 516 (1981). Holotype: Sichuan, Emie Shan, C.H. Hsiung *et al.*, 31802 (HP not traced) Type was not traced, and we are unable to find any specimen that fits well to the description.

Appendix-I

List of Vouchers used in Fig.1.

- S. sikkimensis*, 1 (Ludlow *et al* 58719, BM 013114); 2 (Stainton *et al* 6083 A); 3 (Kingdon-Ward 10503 A); *S. unguiculata*; 4-6 (Erica Clark Sn, BM 013168); *S. tenuis*, 7-8 (Harry Smith 3806, A); *S. perpusilloides*, 9-10 (Ludlow *et al* 20757, BM 013121), 11-12 (L.H.J. Williams 894, BM 013159); *S. trullifolia*, 13-14 (J.D.H., BM 013198).

Appendix-II**List of Vouchers used in Fig.2**

S. micropetala, 1 (Ludlow *et al* 16237, BM 013117); 2 (Stainton *et al* 6033, BM 013153); 3 (J.F. Duthie 5505); 4-5 (D. McCosh 346 BM 013124); *S. purpurea*, 6 (George Forrest 28492, A); 7 (George Forrest 19310,A); 8 (George Forrest Sn, BM 013189); 9-10 (Ludlow *et al.*, 5984, E); 11, (D. McCash 337, BM 013126); *S. adpressa* 12-14 (H.F. Hance 18099, BM 013194); 15-16 (Collector ?, BM 013129); 17 (J.F. Dobremex 2990, BM 013187); *S. tetrandra*, 18-20 (W. Lipsky 15, BM 013109), 21-2- (Korshinsky sn, BM 013210), 23-24 Muqarrab shah & Jamshed 195, BM 013144).

Appendix-III**List of Vouchers used in Fig.3**

S. procumbens, 1 (S A. Bowes Lyon 775,E); 2 (Davis 45491, E); 3 (C.H. Shaw 44, E); 4 (J.M. Macoun sn E); 5 (Polunin *et al* 2258, E); 6 (C.F. Baker 401, A) 7 (A.A. Heller 7181, E); 8 (B. Freds Kild 2733, BM 01393); 9 (George Forrest 16703, E) 10, (A. Neslon & E. Nelson 6386, E); 11 (J.F. Macbride 10111, E); 12 (G. Halliday 259/71, E); 13 (J.H. Lace 959 E); 14 (Allioni 1775, A); 15 (M. Julio 1877, E); 16 (L.N. Goodding 1585, E); 17 (C.B. Copeland 418, E).

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