A REVIEW OF GAMOSEPALY IN THE BRASSICACEAE AND A REVISION OF *DESIDERIA*, WITH A CRITICAL EVALUATION OF RELATED GENERA[1]

Ihsan A. Al-Shehbaz[2]

ABSTRACT

Gamosepaly is reported in 12 genera of the Brassicaceae and is considered to have evolved independently as many times. It is concluded that gamosepaly is not a useful character for the circumscription of genera in the family. The boundaries of *Desideria* and several other genera are critically evaluated, and a taxonomic revision of *Desideria* is presented. A new name (*D. haranensis*), eight new combinations (*D. baiogionensis, D. flabellata, D. himalayensis, D. incana, D. linearis, D. prolifera, D. pumila,* and *D. stewartii*), and eight new synonyms (*Christolea karakorumensis, C. pinnatifida, C. scaposa, Desideria pamirica, Ermania bifaria, E. kachoori, E. kashmiriana,* and *E. parkeri*) are proposed. As herein delimited, *Christolea* consists of only two species; *Ermania* is reduced to synonymy of *Melanidion*, and *Ermaniopsis* and *Oreoblastus* are reduced to synonymy of *Desideria*. The relationship and distinguishing characters of *Desideria, Christolea, Ermania, Eurycarpus, Leiospora, Melanidion,* and *Solmslaubachia* are discussed.

Key words: Brassicaceae, *Christolea, Desideria, Ermania, Eurycarpus,* gamosepaly, *Leiospora, Melanidion, Solmslaubachia.*

During work on the Brassicaceae (Cruciferae) for the *Flora of China, Flora of Nepal,* and *Flora of Kazakstan,* it became evident that the limits of several Himalayan and Central Asian genera needed critical evaluation, and the nomenclature of many species and infraspecific taxa needed adjustments. The genera addressed in the present paper are *Christolea* Cambess., *Desideria* Pamp., *Ermania* Cham. ex Botsch., *Ermaniopsis* H. Hara, *Eurycarpus* Botsch., *Leiospora* (C. A. Mey.) Dvořák, *Melanidion* Greene, *Oreoblastus* Suslova, and *Solmslaubachia* Muschl. They exhibit overlapping similarities in several characters, and their limits have often been confused.

Because *Desideria* was based on a species with a gamosepalous calyx, a review of gamosepaly in the Brassicaceae is presented to determine whether or not this character alone is sufficient to establish genera. The study led to the revision of *Desideria* and also critically evaluated the limits of several presumably related genera.

GAMOSEPALY IN THE BRASSICACEAE

Gamosepaly has been reported in at least 12 genera of the Brassicaceae from Asia and South America. It was first reported by Oliver (1893) in *Braya uniflora* Hook. f. & Thomson. Hooker and Thomson (1861) and Hooker and Anderson (1872) did not report gamosepaly in the species even though the type collection has all flowers and fruits with persistent, united sepals. Schulz (1924) transferred the species to the monotypic *Pycnoplinthus* O. E. Schulz, a genus restricted to China and Kashmir (Jafri, 1973; Kuan, 1987; Hajra et al., 1993).

Desideria mirabilis Pamp. (China, Kashmir, Tajikistan) is the second species reported to have a gamosepalous calyx, and it too was placed in a monotypic genus (Pampanini, 1926, 1930). Hedge (1968b) described *Sisymbrium gamosepalum* Hedge and *Arabidopsis gamosepala* Hedge, both of which are endemic to Afghanistan, but the latter species was transferred by Al-Shehbaz and O'Kane (1997) to *Neotorularia* Hedge & J. Léonard. *Sisymbrium* L. (ca. 50 species; Al-Shehbaz, unpublished) is represented by indigenous species on all continents except Australia and Antarctica (Al-Shehbaz, 1988), whereas *Neotorularia* includes about 15 species distributed primarily in Central Asia and the Middle East (Al-Shehbaz, unpub-

[1] I am most grateful to Zhu Guanghua and Song Hong for their help in the translation of Chinese text and herbarium labels, to Tatyana Shulkina for help with the Russian literature, and to Henk van der Werff, Gerrit Davidse, Nicholas Turland, and Michael Gilbert for their advice on some nomenclatural problems. I am profoundly thankful to A. R. Naqshi for sending duplicates of type material. Suzanne I. Warwick, Peter Heenan, and an anonymous reviewer are thanked for their critical review of the manuscript. I also thank the curators and directors of the herbaria cited in this paper. I am grateful to Oliver Appel and Juan Martínez-Laborde for bringing to my attention gamosepaly in *Catadysia rosulans* and *Eudema friesii*, respectively.

[2] Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.

ANN. MISSOURI BOT. GARD. 87: 549–563. 2000.

lished). *Sisymbrium* and *Neotorularia* each includes only a single species with a gamosepalous calyx.

Two additional species of *Desideria*, *D. pamirica* from Tajikistan (Suslova, 1973) and *D. nepalensis* from Nepal (Hara, 1975), were described with a gamosepalous calyx. The reports of gamosepaly in *Christolea scaposa* by Jafri (1973), *C. karakorumensis* by Wu and An (1994), and *D. pamirica* are shown in the present study to be erroneously based on plants of *D. mirabilis*.

Gamosepaly was first reported from South America by Al-Shehbaz (1990b) in *Brayopsis* Gilg & Muschl., a genus of six species of which only *B. gamosepala* Al-Shehbaz (Bolivia) has united sepals. An examination of other South American species revealed gamosepaly in *Catadysia rosulans* O. E. Schulz (Appel, pers. comm.) and *Eudema friesii* O. E. Schulz (Martínez-Laborde, pers. comm.). *Eudema* Humb. & Bonpl. includes six species distributed from Ecuador into Argentina and Chile (Al-Shehbaz, 1990a), of which only *E. friesii* has a gamosepalous calyx, whereas *Catadysia* O. E. Schulz is a monotypic genus endemic to Peru (Schulz, 1929, 1936).

Gamosepaly has recently been discovered in one of six species of the Himalayan *Pegaeophyton* Hayek & Hand.-Mazz., *P. watsonii* Al-Shehbaz of Sikkim (Al-Shehbaz, 2000a), and in one of six species of the Himalayan and Central Asian *Phaeonychium* O. E. Schulz, *P. jafrii* Al-Shehbaz (Al-Shehbaz, 2000b), although the type collection of the latter has plants with free and united sepals. *Solmslaubachia xerophyta* (W. W. Sm.) Comber (China) also has calyces with either free or completely united sepals, whereas *S. gamosepala* Al-Shehbaz & G. Yang (China), which is known only from the type collection, has united sepals (Al-Shehbaz & Yang, 2000b).

At least one of the approximately 150 species of *Erysimum* L., *E. siliculosum* (M. Bieb.) DC., has a gamosepalous calyx. The species was previously recognized in *Syrenia* Andrz., a genus that I place in the synonymy of *Erysimum*. It is likely that some of the species related to *E. siliculosum* also have gamosepalous calyces, but I have not examined adequate material of those.

In all four species of *Pugionium* Gaertn. (northern China, Mongolia, and adjacent Siberian Russia) the sepals are connate. As the fruit develops, the calyx ruptures basally along the lines of sepal connation.

Finally, the genus *Gamosepalum* Hausskn. was initially thought to have a gamosepalous calyx (Schulz, 1927b, 1936). However, careful examination of its component species revealed that the sepals are free, but they appear connate because of interlocking stellate trichomes (Dudley, 1964).

In conclusion, two generalizations can be made regarding gamosepaly. First, the union of sepals evolved independently several times in the Brassicaceae. It is not known whether it evolved one or more times within *Desideria*, but a phylogenetic study based on molecular data should reveal that. With the critical examination of more genera of Brassicaceae, it is likely that more species with gamosepalous calyces will be found. Second, gamosepaly alone cannot be used to define the boundaries of genera because it occurs in several genera in which the majority of species have free sepals. Therefore, in the present delimitation of *Desideria* gamosepaly is ignored as a generic character, and the overall similarities and relationships of species are emphasized.

Nothing is known about the inheritance of gamosepaly in the family, but the occurrence of plants with free and united sepals in the same population of *Phaeonychium jafrii* is a good lead for conducting a simple experiment to test the genetic basis of this character.

Generic Relationships and Circumscriptions

DESIDERIA

Pampanini (1926) established the monotypic *Desideria* solely on the basis of having a gamosepalous calyx. Although he indicated that *D. mirabilis* resembles what was then known as *Cheiranthus himalayensis* Cambess., Schulz (1927a, 1936), Botschantsev (1955, 1956), and Jafri (1955) regarded gamosepaly as an anomaly and reduced *D. mirabilis* to synonymy of *C. himalayensis*, a species that Schulz and Botschantsev assigned to *Ermania* and Jafri to *Christolea*. However, these authors overlooked the significant features (see below) that distinguish these two species. With the description of two additional species in *Desideria* (Suslova, 1973; Hara, 1975), the genus was recognized as distinct in subsequent floristic works (e.g., Czerepanov, 1995; Hara, 1979; Pachomova, 1974; Yunussov, 1978), and it remained to be delimited primarily on the basis of having a gamosepalous calyx.

A critical evaluation of all genera related to *Desideria* in this paper leads to the conclusion that the genus should include 6 of the 10 species treated in *Ermania* by Schulz (1936), 8 of the 10 species recognized in *Ermania* by Botschantsev (1955), and 5 of the 13 species assigned to *Christolea* by Jafri (1955). The species recognized by these authors in *Christolea* or *Ermania* and excluded from *Desideria* in the present account are: *Par-*

rya villosa Maxim. and *Cheiranthus albiflorus* T. Anderson, which now belong to *Phaeonychium* (Al-Shehbaz, 2000b); *Draba parryoides* Cham. and *Melanidion boreale* E. L. Greene, which are assigned to *Melanidion* (see below); *Christolea crassifolia* Cambess., which is retained in *Christolea*; and *Parrya lanuginosa* Hook. f. & Thomson, which is placed in *Eurycarpus* Botsch. (Al-Shehbaz & Yang, 2000a).

As herein delimited, *Desideria* consists of 11 Himalayan, Chinese, and Central Asian species characterized by having well-defined basal rosettes, slender and rhizome-like caudices, orbicular or flabellate to broadly ovate or obovate, often dentate and palmately veined basal leaves, simple and/or forked trichomes, linear to linear-lanceolate latiseptate fruits rectangular in cross section, nontorulose and strongly veined valves with distinct marginal veins, valve apices united with the replum, often obsolete styles, 2-lobed stigmas, and accumbent cotyledons. A combination of fruits rectangular in cross section, valves with prominent marginal veins, valve apices united with the replum, often obsolete styles, and dentate leaves often palmately veined readily distinguish *Desideria* from the other genera discussed in this paper.

CHRISTOLEA, ERMANIA, AND *MELANIDION*

In his description of *Draba parryoides*, Chamisso (1831: 533) stated, "DRABA? *parryoides* n. sp. vel potius novum genus e solo fructu, deficiente flore, haud rite definiendum. *Drabis* dolichocarpis subjungimus pro tempore plantam aliquando fors jure meritoque nomine inventoris ERMANIAM *parryoidem* slutandam." Several workers (e.g., Schulz, 1936; Botschantsev, 1955; Hedge, 1968a; Suslova, 1972; Ovczinnikov & Yunussov, 1978; Greuter et al., 1993) considered the above statement as a valid publication of the genus *Ermania*, while others (e.g., Jafri, 1955, 1973; Jurtsev, 1975; Berkutenko, 1988; Czerepanov, 1995) did not. According to Article 34 of the *Code* (Greuter et al., 2000), Chamisso's statement does not constitute valid publication of the genus. Despite Schulz's (1936) detailed description of *Ermania*, it was in German, and the genus remained invalidly published until Botschantsev (1956) provided the Latin diagnosis. Therefore, all transfers to *Ermania* proposed by Schulz (1927a, 1933a, b, c) and Botschantsev (1955) remained invalid. As it is presently delimited, *Ermania* includes only *E. parryoides* (Cham.) Botsch., the generic type, and all other species assigned to it belong to other genera. *Ermania* does not occur in the Himalayas and Central Asia and, therefore, regardless of the interpretation of its effective date of valid publication, it does not affect the nomenclature of the unrelated taxa herein placed in *Desideria.*

Although superficially resembling some species of *Desideria* and *Christolea, Ermania parryoides* is most closely related to *Melanidion boreale* E. L. Greene. Both species have Arctic and subarctic distribution (the Russian Far East for the former and Alaska, Yukon, and Northwest Territories for the latter) and are similar in habit, foliage, pubescence, flowers, and fruit morphology. Hultén (1945) was the first to point out this close relationship, and he transferred *M. boreale* to *Ermania,* but his transfer was illegitimate because *Ermania* was invalidly published. The principal difference between these species is that *E. parryoides* has latiseptate fruits (flattened parallel to the septum) and *M. boreale* has angustiseptate fruits (flattened at a right angle to the septum), but this difference is not as significant as once thought because there are many genera of the Brassicaceae with both fruit types. Drury and Rollins (1952) and Rollins (1993) reduced *Melanidion* to synonymy of *Smelowskia* C. A. Mey., but their circumscription of the North American *Smelowskia* was so broad that some of the species recognized are doubtfully congeneric. If *M. boreale* and *E. parryoides* were kept in a genus distinct from *Smelowskia,* as I presently support, then *Ermania* would have to be abandoned and the earlier published *Melanidion* recognized. These two species will be dealt with in a subsequent publication.

In his original description of *Cheiranthus himalayensis* and *Christolea crassifolia,* Cambessèdes (1844) did not indicate anything about their relationship or similarities to each other. However, Jafri (1955) placed them and several other species in *Christolea* and adopted a broad generic concept that included species presently assigned to the genera *Christolea, Desideria, Eurycarpus, Melanidion, Parrya* R. Br., and *Phaeonychium.* With such a broad delimitation, several additional genera, especially *Pegaeophyton* and *Pycnoplinthus,* could have easily been included in *Christolea* without expanding the generic limits any further. Unfortunately, Jafri's delimitation of *Christolea* was closely followed in some of the more recent floras (e.g., An, 1987, 1995; Hajra et al., 1993; Huang, 1997b; Kuan, 1985).

Ovczinnikov and Yunussov (1978) also adopted a rather broad concept of *Ermania* by including *Christolea* and *Oreoblastus* as sections. These authors differed from Jafri (1955) primarily in their decision about the effective date of valid publication of *Ermania.* In my opinion, their vastly heterogeneous generic circumscriptions of *Christolea* or *Ermania* are unacceptable. *Christolea* consists of two species, the Himalayan *C. crassifolia* and the Chinese endemic *C. niyaensis* Z. X. An, and it differs from *Melanidion* (including *Ermania*) by having many-leaved stems, nonrosulate lower leaves, exclusively simple trichomes, incumbent cotyledons, apiculate anthers, and transversely oriented seeds. By contrast, *Melanidion* has leafless stems, well-developed basal rosettes, dendritic trichomes mixed with simple ones, accumbent or obliquely accumbent cotyledons, obtuse anthers, and longitudinally oriented seeds.

Desideria differs from both *Melanidion* and *Christolea* by having fruits rectangular in cross section, valves with prominent marginal veins, and valve apices united with the replum. From *Christolea, Desideria* differs by having a well-developed basal rosette, usually leafless stems, slender and rhizome-like caudices, often palmately veined leaves, nontorulose fruits, longitudinally oriented biseriate seeds, and accumbent cotyledons. By contrast, *Christolea* has nonrosulate lower leaves, leafy stems, compact and woody caudices, pinnately veined leaves, strongly torulose fruits, transversely oriented uniseriate seeds, and incumbent cotyledons. The Himalayan and Central Asian *Desideria* also differs from the Arctic and subarctic *Melanidion* by lacking the dendritic trichomes and having sessile 2-lobed stigmas, smooth fruits, biseriate seeds, and toothed nectaries lacking the median glands. *Melanidion* has dendritic trichomes, entire and capitate stigmas on distinct styles, torulose fruits, uniseriate or rarely subbiseriate seeds, and annular nectaries with well-developed median glands. A comparison of *Desideria* with the presumably related genera is summarized in Table 1.

EURYCARPUS

In establishing the genus *Eurycarpus*, Botschantsev (1955) separated it from *Ermania* by having biseriate instead of uniseriate seeds, broadly lanceolate instead of linear fruits, entire instead of dentate leaves, and leafless instead of leafy scapes. However, he probably compared only the type species of both genera because most of the differences above do not hold if one compares *Eurycarpus* with the ten species Botschantsev recognized in *Ermania*. As indicated above, eight of Botschantsev's ten species of *Ermania* are presently assigned to *Desideria*. A comparison of *Desideria* with *Eurycarpus* (two species) sensu Al-Shehbaz and Yang (2000a) shows that the latter differs by having entire and pinnately veined leaves, obscurely veined valves without marginal veins, broadly lanceolate to oblong fruits narrowly elliptic in cross section, well-defined subconical styles, and minute, entire stigmas much narrower than the style. By contrast, *Desideria* almost always has dentate, palmately veined leaves, prominently veined valves with well-developed marginal veins, linear to linear-lanceolate fruits rectangular in cross section, obscurely differentiated or cylindric styles, and distinct, often 2-lobed stigmas as broad as the style.

OREOBLASTUS

Although Jafri (1973) admitted the artificiality of his delimitation of *Christolea*, he (p. 155) correctly stated that, "Even if, *Christolea* Camb. (s. str.) and *Ermania* Cham. ex [Botschantsev] Schulz (s. str.) are considered as separate genera, there can be no doubt that *Oreoblastus* Suslova is congeneric with *Desideria* Pamp., where most of our species would go."

Suslova (1972) separated *Oreoblastus* from *Desideria* by having free instead of united sepals, a deciduous instead of persistent calyx, and septate instead of eseptate fruits. However, she must have overlooked the persistent calyx in several specimens that she annotated as *Oreoblastus*, and the holotype of her *D. pamirica* (Suslova, 1973) has septate instead of eseptate fruits, though the septa are perforated but never lacking. Except for having free instead of united sepals, *Oreoblastus* is indistinguishable from *Desideria*. As indicated above, sepal connation alone is insufficient for the establishment of genera and, therefore, *Oreoblastus* is reduced herein to synonymy of the earlier published *Desideria*.

ERMANIOPSIS

The presence vs. absence of a tooth on the median stamens was considered by some (e.g., Schulz, 1936; Hara, 1974; Golubkova, 1976) as an important generic character. In my opinion, this feature alone does not justify the segregation of genera. Toothed and toothless filaments are found in *Dontostemon* Andrz. ex C. A. Mey. (Al-Shehbaz & Ohba, 2000), whereas winged or wingless, toothed or toothless, and appendaged or unappendaged filaments are found in *Alyssum* L. (Al-Shehbaz, 1987; Dudley, 1964).

Although Hara (1974) provided a detailed discussion to distinguish *Ermaniopsis* from *Ermania* and related genera, the single character that sets *Ermaniopsis* apart is the presence of a lateral tooth on the filaments of median stamens. On the basis of all other characters, *Ermaniopsis pumila* H. Hara

Table 1. Comparison of *Desideria, Christolea, Eurycarpus, Leiospora, Melanidion,* and *Solmslaubachia.*

	Desideria	*Christolea*	*Eurycarpus*	*Leiospora*	*Melanidion*	*Solmslaubachia*
No. of species	11	2	2	6	2	9
Trichomes	simple and/or forked	simple	simple and/or forked	simple and/or forked or absent	dendritic with some simple and forked	absent or simple
Basal leaves	rosulate	not rosulate	rosulate	rosulate	rosulate	rosulate
Leaf margin	dentate	dentate	entire	entire or dentate	dentate	entire
Leaf venation	palmate	pinnate	pinnate	pinnate	palmate	pinnate
Cauline leaves	present or sometimes absent	present	absent	absent	present	mostly absent
Flowers	solitary or in racemes	in racemes	in racemes	solitary or in racemes	in raceme	solitary or rarely in racemes
Sepals	equal, nonsaccate	equal, nonsaccate	equal, nonsaccate	unequal, inner pair saccate	equal, nonsaccate	equal, nonsaccate
Anther apex	obtuse	apiculate	obtuse	obtuse	apiculate	obtuse
Anther shape	ovate to oblong	oblong	oblong	linear	oblong	linear-oblong
Median nectar glands	present or absent	present	present	absent	present	absent
Fruit attachment to pedicel	readily detached from pedicel	persistent on pedicel	persistent on pedicel	readily detached from pedicel	persistent on pedicel	readily detached from pedicel
Fruit valve	smooth	torulose	smooth	torulose	smooth	smooth
Fruit in cross section	rectangular	transversely narrowly oblong or elliptic	transversely narrowly elliptic	rectangular	transversely narrowly oblong or elliptic	rectangular
Fruit marginal veins	prominent	obscure	obscure	prominent	obscure or prominent	prominent
Valve apex and replum	adnate	readily detached	readily detached	adnate	readily detached	adnate
Style	obsolete	obsolete or distinct	distinct	absent	distinct	obsolete or distinct
Stigma	slightly 2-lobed	entire or slightly 2-lobed	entire	strongly 2-lobed	entire	entire or slightly 2-lobed
Stigma lobes	not decurrent	not decurrent	NA	strongly decurrent	NA	not decurrent
Seed arrangement	uniseriate or biseriate	uniseriate	biseriate	uniseriate or biseriate	uniseriate	uniseriate or biseriate
Seed margin	wingless, not margined	wingless, not margined	wingless, not margined	winged or margined	wingless, not margined	wingless, not margined
Cotyledons	accumbent	incumbent	accumbent or incumbent	accumbent	obliquely accumbent or obliquely incumbent	accumbent

is perfectly at home in *Desideria*. In fact, Hara indicated that *E. pumila* resembles *Desideria* (as *Parrya*) *pumila* in vegetative characters. A close examination of flower and fruit characters clearly shows that the two species are congeneric, and *Ermaniopsis* is reduced herein to synonymy of *Desideria*. Unfortunately, both species have the same epithet, and *E. pumila* is named hereafter as *D. haranensis*. The median filaments of both *D. pumila* and *D. haranensis* are dilated, and only the latter species shows a minute to prominent tooth on the median staminal filaments.

SOLMSLAUBACHIA AND *LEIOSPORA*

On the basis of fruit morphology, *Desideria* is most closely related to *Solmslaubachia* (9 spp.: 8 endemic to China and 1 extending also into Bhutan and Sikkim) and the Central Asian and Himalayan *Leiospora* (6 spp.). All three genera have fruits readily detached from the pedicel, and their valves are adnate apically to the replum. Upon maturity, the fruit falls off the plant and its apex remains tardily dehiscent. The three genera also have obsolete or no styles, and their fruit valves are strongly angled at the margins and completely conceal the replum. These combinations of characters are not found in any Himalayan or Central Asian genera of the Brassicaceae.

Desideria is easily separated from *Solmslaubachia* by having palmately veined leaves apically 3- to 9(to 11)-toothed, ovate to oblong anthers often less than 1 mm long, and forked trichomes sometimes mixed with simple ones. By contrast, *Solmslaubachia* has entire, pinnately veined leaves, linear-oblong anthers more than 1 mm long, and exclusively simple trichomes.

Desideria is readily distinguished from *Leiospora* by having wingless seeds, equal sepals with the lateral pair nonsaccate, palmately veined leaves apically 3- to 9(to 11)-toothed, oblong-linear anthers 0.4–1(–1.6) mm long, and capitate, slightly 2-lobed stigmas with neither decurrent nor connivent lobes. *Leiospora* often has winged or margined seeds, unequal sepals with the lateral pair strongly saccate, entire or marginally dentate leaves, linear anthers 2.5–3 mm long, and conical, prominently 2-lobed stigmas with connivent, decurrent lobes.

Taxonomic Treatment

Desideria Pamp., Bull. Soc. Bot. Ital. 1926: 111. 1926. TYPE: *Desideria mirabilis* Pamp.

Ermaniopsis H. Hara, J. Jap. Bot. 49: 198. 1974. TYPE: *Ermaniopsis pumila* H. Hara.
Oreoblastus Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 648. 1972. TYPE: *Oreoblastus flabellatus* (Regel) Suslova.

Herbs perennial, with a slender, often many-branched, rhizome-like caudex often covered with remains of basal rosettes. Trichomes simple and/or mixed with short-stalked forked ones. Stems simple, leafy or leafless, sometimes absent. Basal leaves petiolate, rosulate, simple, 3- to 9(to 11)-toothed, often palmately veined, persisting whole or only petioles persistent. Cauline leaves similar to basal ones, entire or toothed, subsessile or petiolate, or absent. Racemes 3- to 30-flowered, dense or lax, bracteate throughout or ebracteate, corymbose, elongated or not elongated in fruit, sometimes flowers solitary on pedicels originating from basal rosette. Sepals ovate to oblong, free or united, deciduous or persistent, erect, equal, base of inner pair not saccate, margins membranous. Petals purple, purple-green, or rarely white, sometimes yellowish at base of blade; blade obovate to spatulate, apex obtuse to subemarginate; claw strongly differentiated from blade, subequaling or longer than sepals. Stamens 6, erect, tetradynamous; filaments wingless or rarely winged, toothless or rarely toothed, free, dilated at base; anthers ovate to oblong, not apiculate at apex. Nectar glands 2 and lateral, or 1 and confluent outside bases of all stamens; median nectaries present or absent. Ovules 10 to 70 per ovary. Fruit dehiscent siliques, linear to lanceolate, latiseptate, rectangular in cross section, not inflated, sessile; valves papery, with a prominent midvein and distinct marginal veins, glabrous or pilose, smooth, adnate with replum at fruit apex; replum rounded, often concealed by valve margin; septum complete, perforated, or reduced to a rim, membranous, translucent, veinless, rarely absent; style obsolete; stigma capitate, slightly 2-lobed. Seeds uniseriate or biseriate, wingless, oblong to ovate, often flattened; seed coat obscurely reticulate, not mucilaginous when wetted; cotyledons accumbent.

Eleven species: Himalayas, western China, and adjacent central Asia.

Key to the Species of *Desideria*

1a. Sepals united, persistent till or after fruit dehiscence; septum absent or reduced to a rim.
 2a. Petals 11–13 × 5–6 mm; calyx 5–6 mm long; flowers 2–4, appearing solitary; Nepal .... 11. *D. nepalensis*
 2b. Petals and calyx smaller; flowers more than 4, in distinct racemes; China, Kashmir, Tajikistan .... 10. *D. mirabilis*

1b. Sepals free, caducous or rarely persisting till about fruit maturity; septum complete or rarely perforated apically.
  3a. Flowers solitary from a basal rosette.
    4a. Fruit ovate to broadly lanceolate, 6–9 mm wide, prominently reticulate veined ... 9. *D. baiogionensis*
    4b. Fruit linear to linear-lanceolate, 2–5 mm wide, obscurely veined.
      5a. Leaf trichomes forked and simple; replum retrorsely pilose; valves glabrous; sepals 3–4 mm long; petals 6–8 mm long ... 8. *D. pumila*
      5b. Leaf trichomes exclusively simple; replum and valves pilose to villous; sepals 6–7 mm long; petals 11–14 mm long ... 7. *D. prolifera*
  3b. Flowers (3 to)6 to 30 in a raceme.
    6a. Racemes bracteate throughout.
      7a. Stem and pedicel trichomes forked ... 2. *D. stewartii*
      7b. Stem and pedicel trichomes exclusively simple or absent.
        8a. Fruit lanceolate to linear-lanceolate, (3–)4–6 mm wide; petals (6–)6.5–8 × 3–4 mm; seeds biseriate, (1.5–)1.8–2(–2.3) × 1–1.4 mm ... 1. *D. himalayensis*
        8b. Fruit linear, (0.8–)1–1.7(–2) mm wide; petals 4–5(–5.5) × 1.5–2.5 mm; seeds uniseriate, 0.8–1.1 × 0.5–0.8 mm ... 3. *D. linearis*
    6b. Racemes ebracteate.
      9a. Filaments flattened, subapically toothed; petals 6.5–8 mm long; leaf trichomes minutely forked, mixed with short simple ones ... 6. *D. haranensis*
      9b. Filaments terete, toothless; petals 11–18 mm long; leaf trichomes either exclusively simple or distinctly forked.
        10a. Plants canescent; leaf trichomes almost exclusively branched; leaves 3(to 5)-toothed ... 5. *D. incana*
        10b. Plants greenish; leaf trichomes exclusively simple, to 1.5 mm long; leaves (3 to)5- to 9(to 11)-toothed ... 4. *D. flabellata*

1. Desideria himalayensis (Cambess.) Al-Shehbaz, comb. nov. Basionym: *Cheiranthus himalayensis* Cambess., in Jacquemont, Voy. Inde 4: 14. 1844. *Ermania himalayensis* (Cambess.) O. E. Schulz, Notizbl. Bot. Gart. Berlin-Dahlem 9: 1080. 1927. *Oreoblastus himalayensis* (Cambess.) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 652. 1972. TYPE: [W Tibet.] "In declivitate orientali jugi vulgò Kioubrung-ghauti in Tartariâ sinensi," *Victor Jacquemont 1782* (holotype, P!; isotypes, K!, P!).

Plants 4–20 cm tall, densely pilose throughout to subglabrous. Trichomes simple, to 1.5 mm long. Stems simple, pilose or glabrous. Basal leaves not fleshy, pilose or glabrous, persistent; petiole 0.4–1.6(–3) cm long, not ciliate; leaf blade broadly obovate to spatulate, 4–14 × 3–9 mm, base cuneate to attenuate, margins (3 to)5-toothed, apex acute. Stem leaves similar to basal or linear to lanceolate, 5–17 × 1–4 mm, often entire, short petiolate to subsessile. Racemes 6- to 25-flowered, bracteate throughout; bracts similar to stem leaves but smaller, sometimes adnate to pedicel. Fruiting pedicels ascending, straight or curved, 3–10 mm long, pilose or glabrous. Sepals free, oblong, 3–4 × 1.2–1.5 mm, caducous, pilose or with a terminal tuft of hairs, base not saccate, margins membranous. Petals purple or lilac with yellowish center, broadly spatulate, (6–)6.5–8 × 3–4 mm, apex subemarginate; claw 3–4 mm long. Filaments white, slightly dilated at base, median pairs 3–4 mm long, lateral pair 2–4 mm long; anthers ovate, ca. 0.6 mm long. Ovules 7 to 12 per locule. Fruit lanceolate to linear-lanceolate, (1.7–)2–3.5(–4) cm × (3–)4–6 mm, strongly flattened; valves pilose or glabrous, distinctly veined; septum complete, membranous; style obsolete; stigma 2-lobed. Seeds brown, ovate, (1.5–)1.8–2(–2.3) × 1–1.4 mm, biseriate, minutely reticulate.

Phenology. Flowering June through August. Fruiting July to mid October.

Habitat and distribution. Alpine tundra, open hills, sandstone scree; 4300–5300 m. China (Qinghai, Xizang), India, Kashmir, Nepal.

Selected specimens examined. CHINA. **Qinghai:** Leixie-wu-den, *Wu, Huang & Yang K-890* (HNWP). **Xizang:** Baingoin Xian, Whale Lake, *Wu, Ohba, Wu & Fei 4075* (KUN, MO, TI); E of Moincer, 31°14′N, 80°56′E, *G. & S. Miehe 9643/17* (GOET, MO); NW Tibet, 34°55′N, 82°24′E, *Pike 842* (K); Aksu, *Deasy 92* (BM); Shuang Ho Xian, *Qinghai-Xizang Team 12009* (PE); Ritu Xian, *Qinghai-Xizang Team 76-9061* (KUN, PE), *Li Bosheng & Zhang Du 10980* (PE). INDIA. **Punjab:** Lahul, Kangra, Bara Lach La, *Koelz 6738* (GH). KASHMIR. Harnag, Upper Lidder valley, *Stewart 9349* (B, G, K, MO). NEPAL. Dhaulagiri Himal, hidden valley, between Dhampus pass and French pass, *Wald 65* (BM); Thorong La, Marsyandi Valley, *McBeath 1486* (E); Naurgaon, Marsyandi, *McBeath 1406* (E); Annapurna Himal, between N Annapurna Glacier base camp and top of N Annapurna Glacier icefall, 170–175 km N of Pokhara, *Komarkova 18* (GH).

Desideria himalayensis is most frequently confused with *D. linearis*, and some authors (e.g., Jafri, 1955) considered them to be conspecific. Three collections of *Desideria linearis* (*Lyon 44, Stainton 3055, Stainton 3241*) were cited by Jafri (1973) as *Christolea himalayensis*, and the first two were listed by Hedge (1968a) as *Ermania himalayensis*. The two species can be readily separated by petal size, fruit width, and seed arrangement and size (see key). Mixed collections of the two species (e.g., *Koelz 6738*) are not uncommon, but no intermediates have been found. Both species can be distinguished from the related *D. stewartii* by having leaf and stem trichomes exclusively simple instead of forked.

Desideria himalayensis was reported (as *Christolea*) from Xinjiang by An (1995), but I have not seen any material from that part of China. One collection (*Polunin, Sykes & Williams 37*) was cited by Hara (1979) as this species, but this collection clearly belongs to *Desideria linearis*.

Desideria himalayensis was erroneously illustrated in Jafri (1973) with ebracteate inflorescences. It is likely that the plant illustrated belongs to *D. flabellata*, a species that occurs in bordering Afghanistan, China, Kyrgyzstan, and Tajikistan but is not yet reported from Kashmir. *Desideria himalayensis*, *D. stewartii*, and *D. linearis* are the only three species of *Desideria* that consistently have racemes bracteate throughout.

2. **Desideria stewartii** (T. Anderson) Al-Shehbaz, comb. nov. Basionym: *Cheiranthus stewartii* T. Anderson, in J. D. Hooker, Fl. Brit. India 1: 132. 1872. *Ermania stewartii* (T. Anderson) O. E. Schulz, Bot. Jahrb. Syst. 66: 98. 1933. *Christolea stewartii* (T. Anderson) Jafri, Notes Roy. Bot. Gard. Edinburgh 22: 53. 1955. *Oreoblastus stewartii* (T. Anderson) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 653. 1972. TYPE: Kashmir. Ladak, 15,000–16,500 ft., *J. L. Stewart s.n.* (holotype, K!; isotype, E!).

Plants 8–20 cm tall, densely pilose. Trichomes stalked forked, rarely some simple near the stem base. Stems simple, pilose or glabrous. Basal leaves subfleshy, pilose, persistent; petiole 2–10 mm long, not ciliate; leaf blade broadly obovate to spatulate, 2–15 × 2–10 mm, base cuneate to attenuate, margins 3- to 5-toothed or subentire, apex acute. Stem leaves similar to basal or linear to lanceolate, often entire. Racemes 8- to 15-flowered, bracteate throughout; bracts similar to stem leaves but smaller, often adnate to pedicel. Fruiting pedicels ascending, straight or slightly curved, 4–12 mm long, pilose. Flowers not seen. Ovules 7 to 12 per locule. Fruit lanceolate to lanceolate-linear, 1.7–3.5 cm × 3–5 mm, strongly flattened; valves pilose or glabrous, distinctly veined; septum complete, membranous; style obsolete; stigma 2-lobed. Seeds brown, ovate, 1.4–2.2 × 0.8–1.1 mm, biseriate, minutely reticulate.

Phenology. Flowering unknown. Fruiting in August.

Habitat and distribution. Scree slopes; 4100–5000 m. China (Xizang), India, Kashmir.

Selected specimens examined. CHINA. **Xizang:** Ali, Geji, *Qinghai-Tibet Team 76-8652* (PE). INDIA. **Punjab:** Bara Lacha Pass, Lahul, *Cooper 5490* (E). **Himachal Pradesh:** Zingzingbar, *McBeath 2105* (E).

Desideria stewartii is a very rare species known thus far from the few collections cited above. Reports of the species from China (Kuan, 1985; An, 1987) are most likely based on misidentified plants of *D. himalayensis*.

Jafri (1973) doubted the distinction of *Desideria stewartii* from *D. himalayensis* (both as *Christolea*), and he confused the limits of the two species by citing one collection, *Stewart 9349*, under the former instead of the latter species. I have not seen any flowering material of the species, and the description of the flowers by Jafri (1973), which was followed by Hajra et al. (1993) and An (1987), was almost certainly based on a small flowering branch of *D. linearis* mounted on the holotype sheet of *D. stewartii*.

In overall aspects of foliage and fruit, *Desideria stewartii* most closely resembles *D. himalayensis*. However, *D. stewartii* is readily separated by the presence of forked, stalked, intermingled trichomes instead of exclusively simple straight ones.

3. **Desideria linearis** (N. Busch) Al-Shehbaz, comb. nov. Basionym: *Christolea linearis* N. Busch, in Komarov, Fl. URSS. 8: 636. 1939. *Ermania linearis* (N. Busch) Botsch., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 17: 166. 1955. *Oreoblastus linearis* (N. Busch) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 652. 1972. TYPE: Tajikistan. Pamir: Schugnan, Abchary, 2 Aug. 1904, *B. Fedtschenko s.n.* (holotype, LE!).

Ermania parkeri O. E. Schulz, Repert. Sp. Nov. Regni Veg. 31: 333. 1933. *Christolea parkeri* (O. E. Schulz) Jafri, Notes Roy. Bot. Gard. Edinburgh 22: 52. 1955. *Oreoblastus parkeri* (O. E. Schulz) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 653. 1972. Syn. nov. TYPE: Kashmir. Sonamarg, Luderwas, 13,000 ft., 11 Aug. 1928, *R. R. Stewart 9874A* (holotype, B!).

Ermania kashmiriana Dar & Naqshi, J. Bombay Nat. Hist. Soc. 87: 274. 1990. Syn. nov. TYPE: Kashmir. Shalimar, Sonamarg (Sind Valley), 3900 m, 20 Aug. 1983, *G. H. Dar 7786* (holotype, KASH).

Ermania kachrooi Dar & Naqshi, J. Bombay Nat. Hist. Soc. 87: 277. 1990. Syn. nov. TYPE: Kashmir. Baltal, Sonamarg (Sind Valley), 3200 m, 2 Sep. 1982, *G. H. Dar 3934* (holotype, KASH; isotypes, KASH, MO!).

Plants 4–15 cm tall, densely pilose throughout to subglabrous. Trichomes simple, to 1.5 mm long. Stems simple, pilose or glabrous. Basal leaves not fleshy, pilose or glabrous, persistent; petiole 2–7 (–12) mm long, not ciliate; leaf blade broadly obovate to spatulate, 4–15 × 2–12 mm, base cuneate to attenuate, margins 3- to 5-toothed or rarely subentire, apex acute. Stem leaves similar to basal or linear to lanceolate, 5–10 × 1–3 mm, often entire, short petiolate to subsessile. Racemes 8- to 20-flowered, bracteate throughout; bracts similar to stem leaves but smaller, often adnate to pedicel. Fruiting pedicels ascending, straight, 2–8(–12) mm long, pilose or glabrous. Sepals free, oblong to ovate, 2–3 × 1–1.5 mm, caducous, pilose or with a terminal tuft of hairs, base not saccate, margins membranous. Petals purple or lavender with paler base, narrowly spatulate, 4–5(–5.5) × 1.5–2.5 mm, apex rounded; claw 2–2.5 mm long. Filaments white, slightly dilated at base, median pairs 2.5–3.5 mm long, lateral pair 1.8–2.5 mm long; anthers ovate, 0.4–0.5 mm long. Ovules 8 to 13 per locule. Fruit linear, (1.5–)2–3.5(–4.2) cm × (0.8–)1–1.7 (–2) mm, flattened; valves pilose or glabrous, distinctly veined; septum complete, membranous; style obsolete; stigma 2-lobed. Seeds brown, ovate, 0.8–1.1 × 0.5–0.8 mm, uniseriate, minutely reticulate.

Phenology. Flowering June through August. Fruiting July through September.

Habitat and distribution. Gravelly or sandy slopes, scree, gravelly moraine below glacier; 3200–5200 m. China (Xinjiang, Xizang), Kashmir, Nepal, Tajikistan.

Selected specimens examined. CHINA. **Xinjiang:** Yecheng Xian, *Li Bosheng et al. 11278* (PE); Tagdumbasch-Pamir, Pistan near Saryokol, *Alexeenko 2729* (LE). **Xizang:** without locality, *Thomson s.n.* (BM, G, GH, K, P); Ali, *Qinghai-Xizang Team 76-7948* (HNWP). INDIA. **Punjab:** Lahul, Kangra, Bara Lach La, *Koelz 6738* (GH). KASHMIR. Ishkuman Aghost, *Schmid 2449* (G). **Chitral:** Laspur (Hachin), 36°2′N, 72°27′E, *Lyon 44* (A, E); Sirogol, S of Shah Jinali Pass, *Stainton 3055* (E); Dorah Pass, Lutko valley, *Stainton 3241* (E); Amarnath, *Stainton 8709* (E); Sonamarg, Luderwas, *Stewart 9874* (B, G, MO). **Karakorum:** Gharesa Glacier base camp, 13 mi. E of Nagar, *Polunin 6133* (BM); Karakorum, Oct. 1877, *Clarke s.n.* (K). **Ladak:** above Stok, *Maxwell 92* (E); Zanskar, glacier Sentik, 34°N, 76°E, *Delouche 27* (P). **Thui region:** ca. 200 km NW of Gilgit, near watershed separating Gilgit from Chitral, *Broadhead 39* (E); Taklung La, *Koelz 6500* (GH). NEPAL. Naur Pass, *Lowndes 1159* (BM); 5 mi. S of Saldanggaon, *Polunin, Sykes & Williams 37* (BM). TAJIKISTAN. **Pamir:** N slope, river Zor-Chechekty, 12 Aug. 1948, *Stanjukovich & Kishkovsky s.n.* (LE); Chechekty, river Zor-Chechekty, *Raikova 228* (LE).

Although I have not seen the holotype of *Ermania kashmiriana*, the original description and illustration, as well as the examination of a paratype (*Dar 8301*), clearly support the placement of the species in synonymy of *Desideria linearis*. Dar and Naqshi (1990) compared *E. kashmiriana* and *E. kachrooi* with *D. stewartii* and *D. himalayensis* (all as *Ermania*), but they failed to relate their novelties to *D. linearis*. In my opinion, *E. kachrooi* is only a glabrous form of *D. linearis*, a species within a given population of which one can find glabrous and pubescent plants. In general, plants of *Desideria*, including *D. linearis*, that grow in partly shaded areas, especially under large boulders, often have the apex of the caudex elongated so that the leaf rosette appears much less congested.

Several authors (e.g., An, 1987, 1995; Kuan, 1985) followed Jafri (1955) in listing *Desideria linearis* as a synonym of *Christolea himalayensis*, but these authors erroneously recognized *C. parkeri* as a distinct species. In my opinion, the last species is only a glabrescent form of *D. linearis*. In fact, *C. parkeri* is based on *Ermania parkeri*, an invalidly published species assigned to the invalid *Ermania* (see Greuter et al. (2000) under Article 43.1).

Although Jafri (1973) maintained *Christolea parkeri*, he correctly indicated that it is not different from the earlier-published *Desideria* (as *Christolea*) *linearis*, a species that he did not recognize for Pakistan and Kashmir. However, Suslova (1972) maintained both species (as *Oreoblastus*) and separated them mainly by the presence in the former of a subapical tuft of hairs on the sepals instead of its absence in *D. linearis* and *D. himalayensis*. Obviously, this distinction is artificial, and all taxa have pubescent sepals that often are more densely hairy below the apex. The restriction of trichomes to the sepals and leaf apices is quite frequent in glabrescent forms of *D. linearis* and *D. himalayensis*.

Schulz (1931) considered *Desideria linearis* (as *Ermania parkeri*) to be closely related to *E. albiflora* (T. Anderson) O. E. Schulz, but the nearest relative of the first is *D. himalayensis*. As shown by Al-Shehbaz (2000b), *E. albiflora* belongs to the genus *Phaeonychium* O. E. Schulz.

Desideria linearis is extremely variable in the occurrence and density of the indumentum, fruit width, length, and indumentum, and number of leaf teeth. However, an examination of material from the various parts of the species range clearly negates the need to subdivide the species into infraspecific taxa.

4. Desideria flabellata (Regel) Al-Shehbaz, comb. nov. Basionym: *Parrya flabellata* Regel, Bull. Soc. Imp. Naturalistes Moscou 43: 261. 1870. *Christolea flabellata* (Regel) N. Busch, in Komarov, Fl. URSS 8: 330. 1939. *Ermania flabellata* (Regel) O. E. Schulz, Bot. Jahrb. Syst. 66: 98. 1933. *Oreoblastus flabellatus* (Regel) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 651. 1972. TYPE: Southern Tian Shan, Dschaman-Daban, *Sewerzow s.n.* (holotype, LE!).

Christolea pinnatifida R. F. Huang, Acta Phytotax. Sin. 35: 556. 1997. Syn. nov. TYPE: China. Qinghai: Maqen, Anyemaqen Mt., 4800 m, 25 June 1981, *R. F. Huang CG-81-154* (holotype, HNWP!).

Plants greenish, 4–15 cm tall. Trichomes simple, straight, to 1.5 mm long. Stems distinct, simple, densely pilose. Basal leaves subfleshy; petiole 2–7 mm long, pilose; leaf blade flabellate to broadly obovate, rarely spatulate, 0.6–2.5 × 0.3–2.5 cm, pilose, base cuneate to attenuate, margins (3 to)5- to 9(to 11)-toothed, rarely lowermost entire, apex acute; teeth to 10 × 3 mm. Stem leaves similar to basal. Racemes 7- to 12-flowered, ebracteate. Fruiting pedicels ascending, straight to curved, (0.5–)0.7–1.5(–2.5) cm long, spreading pilose. Sepals free, narrowly oblong, 5–8 × 1.5–2.5 mm, often persistent, pilose, base not saccate, margins membranous. Petals purple, broadly spatulate, 1.1–1.5 cm × 3.5–6 mm, apex subemarginate; claw 7–9 mm long. Filaments white to mauve, slightly dilated at base, median pairs 4.5–6 mm long, lateral pair 3–4 mm long; anthers oblong, 0.9–1.3 mm long. Ovules 7 to 12 per locule. Fruit lanceolate to lanceolate-linear, (1.7–)2.5–3.5(–4.5) cm × 2.5–5 mm, strongly flattened; valves pilose, distinctly veined; septum complete, membranous; style obsolete; stigma 2-lobed. Seeds brown, ovate, 1.3–2 × 0.9–1.2 mm, uniseriate, minutely reticulate.

Phenology. Flowering early July and August. Fruiting late July through early September.

Habitat and distribution. Alpine gravelly slopes, moraine slopes; 3300–5100 m. Afghanistan, China (Xinjiang), Kyrgyzstan, Tajikistan.

Selected specimens examined. AFGHANISTAN. Mountain above Salang tunnel, *Gibbons 823* (MO); Hindu Kush, *Gilbert 88* (E). **Parvan:** Panjshir, *Hedge & Wendelbo 5451* (E). **Kapisa:** Mir Samir area, *Gibson 211* (E). **Takhar:** Khost-o-Fereng, valley Echani-Tai, E of Chunduk, *Podlech 11832* (G). CHINA. **Xinjiang:** Kashgaria, Tian Shan, 1889, *Roborowski s.n.* (LE), *Merzbacher 354* (LE); Kashgaria, Billuli Pass, 13 June 1909, *Divnogorskaya s.n.* (LE, MO); Akto Xian, Qiaornong, *S. G. Wu, Y. H. Wu & Y. Fei 4641* (HNWP, KUN). KYRGYZSTAN. **Semirechie:** Przewalsk, river Kayche, 30 July 1913, *Shishkin s.n.* (LE), 2 Aug. 1913, *Capoznnikov s.n.* (MO). **Tianshan:** Glacier Kaïndï, *Brocherel 338* (G). TAJIKISTAN. **Shugnan:** E Bukhara, near Pass Garm-Chashmy, *Tuturin 150* (A, LE). **Pamir:** Kurushdy Glacier, *Gorbanov 191* (LE).

In every aspect of trichome morphology, flower size and color, and habit, *Christolea pinnatifida* is indistinguishable from plants of *Desideria flabellata*. The type of the former has no fruits and is rather immature. It differs only slightly from typical plants of *D. flabellata* by having slightly elongated, spatulate leaves instead of typically flabellate ones. Huang (1997a) considered *C. pinnatifida* to be related to *C. karakorumensis*, but the latter is a synonym of *D. mirabilis* and has sepals typically united instead of free. He indicated that the ovaries are glandular mamillate, but this observation was based on developing trichomes, and neither *Desideria* nor *Christolea* has any glandular trichomes or papillae.

5. Desideria incana (Ovcz.) Al-Shehbaz, comb. nov. Basionym: *Christolea incana* Ovcz., Sovetsk. Bot. 1941(1 & 2): 151. 1941. *Ermania incana* (Ovcz.) Botsch., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 17: 164. 1955. *Oreoblastus incanus* (Ovcz.) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 652. 1972. TYPE: Tajikistan. Darvaz: Mt. Masar, glacier Abdul Gassan, 11,000–12,000 ft., 23 July 1899, *V. I. Lipsky 1936* (holotype, LE!).

Plants 4–15 cm tall, densely tomentose throughout. Trichomes short-stalked forked and simple, to 1 mm long. Stems simple, tomentose. Basal leaves subfleshy, canescent, densely tomentose, persistent; petiole 0.5–2 mm long, not ciliate, unexpanded and not papery at base; leaf blade broadly obovate to spatulate, 4–13 × 2–8 mm, base cuneate to attenuate, margins 3(to 5)-toothed, sometimes subentire on sterile branches, apex acute. Stem leaves similar to basal. Racemes 6- to 20-flowered, only basally bracteate. Fruiting pedicels ascending, straight, 2–7 mm long, tomentose. Sepals free, narrowly oblong, 5–7 × 1.5–2 mm, caducous, densely tomentose, base not saccate, margins membranous. Petals purple with paler or yellowish base, spatulate, 12–18 × 4–6 mm, apex rounded; claw 7–10 mm long. Filaments white, slightly dilated at base, median pairs 5–6 mm long, lateral pair 3–4 mm long; anthers narrowly oblong, 1.2–1.5 mm long. Ovules 25 to 35 per locule. Fruit linear, 3–6.5 cm × 2.5–3.5 mm, strongly flattened; valves tomentose, distinctly veined; septum complete, membranous; style obsolete; stigma 2-lobed. Seeds brown, oblong, 1.2–1.5 × 0.7–1 mm, minutely reticulate.

Phenology. Flowering July. Fruiting July and August.

Habitat and distribution. Alpine gravelly areas, 3300–4600 m. Endemic to Tajikistan.

Selected specimens examined. TAJIKISTAN. **Pamir-Alay:** Sauk-Dara valley, *Ikonnikov 17878* (LE). **Bukhara:** Darvaz, range of Peter-the-Great, glacier Vereshkay, 29 July 1899, *Lipsky s.n.* (G, LE).

6. Desideria haranensis Al-Shehbaz, nom. nov. Replaced name: *Ermaniopsis pumila* H. Hara, J. Jap. Bot. 49: 200. 1974, not *Desideria pumila* (Kurz) Al-Shehbaz. TYPE: Nepal. Ca. 5 mi. SW of Saldanggaon, 26 June 1952, very loose scree, 19,500 ft., *N. Polunin, W. R. Sykes & L. H. J. Williams 24* (holotype, BM!; isotypes, A!, BM!, E!).

Plants 2–6 cm tall. Trichomes simple, straight, to 0.5 mm long, mixed on leaves with short-stalked, unequally branched forked ones. Stems erect, simple, pilose to hirsute. Basal leaves fleshy, persistent; petiole 2–12 mm long, sparsely to densely pilose with simple trichomes, ciliate at base, not expanded or papery at base; leaf blade broadly ovate, suborbicular, to obovate, 3–13 × 3–11 mm, sparsely to densely pubescent, base cuneate or obtuse, margins 1- to 5-toothed, apex obtuse. Stem leaves absent. Racemes 3- to 8-flowered, ebracteate. Pedicel divaricate, straight, 4–12 mm long, pilose. Sepals free, oblong, 3.5–4.5 × 1.7–2 mm, caducous, pilose, base not saccate, margins membranous. Petals white tinged with greenish blue, obovate, 6.5–8 × 3–4 mm, apex obtuse; claw 3–4 mm long. Filaments white, flattened, subapically toothed, median pairs 3–4 mm long, lateral pair 2–3 mm long; anthers oblong, 0.9–1.1 mm long. Ovules 5 to 7 per locule. Immature fruit linear, flattened, sessile, straight, retrorsely pilose; septum complete; style-like apex glabrous, to 1.5 mm long; stigma capitate, subentire. Seeds not seen.

Phenology. Flowering in June.

Habitat and distribution. Scree slopes; 5000–5900 m. Endemic to Nepal.

Additional specimen examined. NEPAL. Dolpo, Sya Gompa, 29°10′N, 82°59′E, *Stainton 4332* (BM, E).

Desideria haranensis is named in honor of Hiroshi Hara (5 January 1911–24 September 1986), an eminent Japanese botanist and the discoverer of this species and *D. nepalensis.* The new name is proposed because the transfer of *Ermaniopsis pumila* to *Desideria* would create a homonym of *D. pumila* (Kurz) Al-Shehbaz, which is based on the earlier published *Parrya pumila* (Kurz, 1872).

Desideria haranensis is a very rare species known thus far only from the two collections cited above. It is most closely related to *D. pumila,* from which it is distinguished by having papery instead of thickish petiolar bases, toothed instead of toothless filaments, subentire instead of 2-lobed stigmas, and several-flowered racemes instead of solitary flowers.

7. Desideria prolifera (Maxim.) Al-Shehbaz, comb. nov. Basionym: *Parrya prolifera* Maxim., Fl. Tangutica 56. 1889. *Ermania prolifera* (Maxim.) O. E. Schulz, Bot. Jahrb. Syst. 66: 98. 1933. *Christolea prolifera* (Maxim.) Ovcz., Sovetsk. Bot. 1941(1 & 2): 151. 1941. *Oreoblastus proliferus* (Maxim.) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 652. 1972. *Christolea prolifera* (Maxim.) Jafri, Notes Roy. Bot. Gard. Edinburgh 22: 53. 1955. TYPE: China. Tibet: Kon-chun-ua, 14,500 ft., 3 July 1984, *N. M. Przewalski s.n.* (holotype, LE!; isotypes, K!, P!, PE!).

Plants scapose, villous to pilose. Trichomes simple, straight, to 1.5 mm long. Stems absent. Basal leaves subfleshy; petiole (0.2–)0.8–2(–3) cm long, persistent, sparsely to densely pilose or villous, ciliate, somewhat papery at base; leaf blade broadly ovate, suborbicular, obovate, to spatulate, 2–10 (–15) × 2–9(–12) mm, villous or pilose, base obtuse to cuneate, margins (3 to)5- to 9-toothed, rarely subentire, apex subacute. Stem leaves absent. Flowers solitary from basal rosette. Pedicel ascending-divaricate, straight, (0.2–)0.5–1.5(–2.5) cm long, villous. Sepals free, oblong, 6–7 × 2–2.5 mm, usually persistent, pilose, base not saccate, margins membranous. Petals purplish green, broadly obovate, 1.1–1.4 cm × 4–5 mm, apex subemarginate; claw 6–7 mm long. Filaments white, dilated at base, toothless, median pairs 4–6 mm long, lateral pair 3–4 mm long; anthers 1.2–1.6 mm long. Fruit linear to linear-lanceolate, (2.5–)4–6.5(–7.2) cm × (3–)4–5 mm, flattened, sessile, straight; valves obscurely veined; replum and valves pilose to villous; septum complete; style obsolete; stigma capitate, 2-lobed. Seeds oblong, 2.5–3.5 × 1.4–1.7 mm.

Phenology. Flowering July and August. Fruiting July through September.

Habitat and distribution. Scree slopes, siliceous shist; 4700–5900 m. Endemic to China (Qinghai, Xizang).

Selected specimens examined. CHINA. **Qinghai:** Bayan Har Pass, between Madoi Xian and Chindu Xian, on road between Madoi and Yushu, 34°7′N, 97°39′E, *Ho, Bartholomew, Watson & Gilbert 1684* (BM, CAS, E, HNWP, MO); Tangula Shan, Tangula Pass, 32°53′N, 91°54′E, *G. & S. Miehe 9436/08* (GOET, MO); Xue Shan Community, *Anonymous 470* (HNWP). **Xizang:** Nyainqentangula Shan, N of Damxung, 30°39′N, 91°5′E, *G. & S. Miehe, 9495/14* (GOET, MO); Mekong-Salween divide, pass E of Zongang/Wangda, 29°42′N, 98°0′E, *Dickoré 8866* (GOET, MO); Demula Shan, Basu Xian, *Qinghai-Tibet Team 73-1253* (KUN, PE); Biru Xian, Gu Teng Shan, *Qinghai-Xizang Team 11172* (KUN); Zhongba, *Qinghai-Tibet Team 6537* (KUN); peak of Sengge, near Shingkyer Yubrong, 24 July 1951, *Aufschnaiter s.n.* (BM)

Maximowicz (1889) compared *Desideria prolifera* (as *Parrya*) with *D. himalayensis* and *D. flabellata* and discussed their distinguishing characters. Both *D. prolifera* and *D. flabellata* have similar flower size and their calyces tend to persist. The principal feature separating them is that the flowers in *D. flabellata* are arranged in distinct racemes, whereas in *D. prolifera* they are solitary from the basal rosette.

8. Desideria pumila (Kurz) Al-Shehbaz, comb. nov. Basionym: *Parrya pumila* Kurz, Flora 55: 285. 1872. *Christolea pumila* (Kurz) Jafri, Fl. West Pakistan 55: 157. 1973. *Vvedenskeyella pumila* (Kurz) Botsch., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 17: 176. 1955. *Solmslaubachia pumila* (Kurz) Dvořák, Folia Prirodovcd. Fak. Univ. Purkyne Brne, Biol. 13(4): 24. 1972. TYPE: Kashmir (as Tibet). Rupschu, 15,000–18,000 ft., *F. Stoliczka s.n.* (holotype, CAL?; isotype, K!).

Ermania koelzii O. E. Schulz, Repert. Sp. Nov. Regni Veg. 31: 332. 1933. TYPE: Kashmir. Rupshu, Kyensa La, 19,000 ft., 9 July 1931, *Walter Koelz 2231* (holotype, B!).

Ermania bifaria Botsch., Bot. Zhurn. (Moscow & Leningrad) 41: 730. 1956. Based on the invalidly published (see below) *E. bifaria* Botsch., Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 17: 164. 1955. *Oreoblastus bifarius* (Botsch.) Suslova, Bot. Zhurn. (Moscow & Leningrad) 57: 652. 1972. Syn. nov. TYPE: China. Xinjiang: Kuen-Lun, Humboldt Range, Ulan-Bulak, 4200 m, 30 June 1894, *W. Roborowski s.n.* (holotype, LE!).

Plants scapose, pilose to tomentose. Trichomes simple, straight, to 0.5 mm long, mixed on leaves with short-stalked forked ones. Stems absent. Basal leaves fleshy; petiole 2–10 mm long, persistent, densely pilose with simple trichomes, ciliate, expanded and papery at base; leaf blade broadly ovate, suborbicular, obovate, to spatulate, 2–14 × 1–11 mm, densely tomentose or pilose, base obtuse, margins 3- to 7-toothed to repand, apex obtuse. Stem leaves absent. Flowers solitary from basal rosette. Pedicel ascending-divaricate, straight, 3–10 mm long, pilose. Sepals free, oblong, 3–4 × 1.5–2 mm, caducous, pilose, base not saccate, margins membranous. Petals creamy white to purplish green, broadly obovate, 6–8 × 3–4.5 mm, apex subemarginate; claw 3–4 mm long. Filaments white, dilated at base, toothless, median pairs 3–4 mm long, lateral pair 2–2.5 mm long; anthers narrowly oblong, 0.9–1.2 mm long. Ovules ca. 7 per locule. Immature fruit oblong-linear to linear-lanceolate, 1–2 cm × 2–3 mm, flattened, sessile, straight, retrorsely pilose along replum; valves glabrous; septum complete; style obsolete; stigma capitate, 2-lobed. Seeds not seen.

Phenology. Flowering June and July.

Habitat and distribution. Limestone, mica shist; 4200–5800 m. China (Xinjiang,? Xizang), Kashmir.

Botschantsev's (1955) description of *Ermania bifaria* was invalid because he placed the species in what was then an invalidly published genus. When he (Botschantsev, 1956) validated *Ermania,* he listed *E. bifaria* with full reference to his earlier work. Therefore, the correct date of the valid publication of *E. bifaria* should be Botschantsev's 1956 instead of 1955 work.

Botschantsev (1955) recognized two species in *Vvedenskeyella* Botsch., of which the generic type, *V. kashgarica* Botsch., has been transferred to *Phaeonychium* (Al-Shehbaz, 2000b). The second species, which is based on *Parrya pumila,* is assigned here to *Desideria.* Apparently, Botschantsev did not examine the type material of *P. pumila,* as evidenced from his description of the same species as *Ermania bifaria. Phaeonychium* differs from *Desideria* by having a thick and compact instead of slender and rhizome-like caudex, pinnately veined instead of often palmately veined leaves, incumbent instead of accumbent cotyledons, and fruit valves without instead of with prominent marginal veins.

Desideria pumila was said to occur in Xizang (Kuan, 1985; An, 1987), but I have not seen any material other than the types cited above, which were collected from Rupshu, Kashmir. Jafri (1973) considered the species (as *Christolea*) to be very closely related if indeed different from what he called *C. lanuginosa* (Hook. f. & Thomson) Ovcz. However, the last species is clearly unrelated to *D. pumila* and has been treated in *Eurycarpus* by Al-Shehbaz and Yang (2000a).

9. Desideria baiogoinensis (K. C. Kuan & Z. X. An) Al-Shehbaz, comb. nov. Basionym: *Christolea baiogoinensis* K. C. Kuan & Z. X. An, in C. Y. Wu, Fl. Xizang. 2: 388. 1985. TYPE: China. Xizang: Baiogoin, 5100 m, 18 June 1976, *K. Y. Lang 9460* (holotype, PE!; isotype, PE!).

Plants scapose, villous. Trichomes simple and short-stalked forked, straight, to 1 mm long. Stems absent. Basal leaves subfleshy; petiole 0.4–1.6 cm long, persistent, villous, ciliate, somewhat papery at base; leaf blade broadly ovate, suborbicular, or obovate, 4–8 × 3–6 mm, villous, base obtuse to cuneate, margins 3- to 7-toothed, apex acute. Stem leaves absent. Flowers solitary from basal rosette. Pedicel ascending-divaricate, straight, 0.5–2 cm long, villous. Sepals free, oblong, 4–6 × 1.5–2.5 mm, usually persistent, pilose, base not saccate, margins membranous. Petals purplish, broadly obovate, 7–1.2 cm × 3.5–4.5 mm, apex subemarginate; claw 4–6 mm long. Filaments white, dilated at base, toothless, median pairs 3.5–5 mm long, lateral pair 2–2.5 mm long; anthers 1–1.2 mm long. Ovules 15 to 20 per locule. Fruit ovate to lanceolate, 1–2.5 cm × 6–9 mm, flattened, sessile, straight; valves prominently reticulate veined; replum and valves villous; septum complete; style 0.5–1 mm long; stigma capitate, 2-lobed. Seeds oblong, 1.5–2 × 0.8–1.1 mm.

Phenology. Flowering June and July. Fruiting July and August.

Habitat and distribution. Open sand and gravel; 4700–5600 m. Endemic to China (Qinghai, Xizang).

Selected specimens examined. CHINA. **Xizang:** Amdo Xian, *Tao Deding 10819* (HNWP, KUN); Baingoin Xian, *Lang Kaiyong 9469* (PE), *9487* (KUN); Tumain, *Yang Jinxiang 1884* (KUN), *Qinghai-Xizang Team 177* (HNWP); NE plateau along Golmud–Lhasa hwy, Wudaoliang-Tanggulashanqu, 34°35′N, 92°44′E, *G. & S. Miehe 9416/00* (GOET, MO).

The species was included in the *Flora of Qinghai* (Huang, 1997b), but I have not seen any material from that province.

10. Desideria mirabilis Pamp., Bull. Soc. Bot. Ital. 1926: 111. 1926. *Christolea mirabilis* (Pamp.) Jafri, Fl. West Pakistan 55: 160. 1973. TYPE: [Kashmir.] Karakorum; above Caracash Valley, Chisil Gilgha Pass, 5360 m, 28 June 1914, *G. Dainelli & O. Marinelli 2* (lectotype, here designated, FI, photo!).

Christolea scaposa Jafri, Notes Roy. Bot. Gard. Edinburgh 22: 58. 1955. Syn. nov. TYPE: Kashmir. Shaksgam Valley, 4950 m, 3 July 1926, *R. C. Clifford 7* (holotype, K!).

Christolea karakorumensis Y. H. Wu & Z. X. An, Acta Phytotax. Sin. 32: 577. 1994. Syn. nov. TYPE: China. Xinjiang: Pishan (Guma), Shenxianwan, 5250 m, 25 July 1989, *Karakorum-Kunlun Expedition 5100* (holotype, HNWP!, listed as NWBI).

Desideria pamirica Suslova, Novosti Sist. Vyssh. Rast. 10: 163. 1973. Syn. nov. TYPE: Tajikistan. Pamir: above Czeczekty, near Zor, 4900 m, 10 Aug. 1970, *T. Suslova s.n.* (holotype, LE!).

Christolea suslovaeana Jafri, Fl. West Pakistan 55: 158. 1973, not *Christolea pamirica* Korshinsky, Mém. Acad. Imp. Sci. Saint Pétersbourg, ser. 8, 4: 89. 1896. TYPE: same as that of *Desideria pamirica.*

Plants 2–10 cm tall. Trichomes simple and to 1.5 mm long, rarely mixed with forked ones. Stems distinct, simple, densely pilose. Basal leaves subfleshy; petiole 3–15 mm long, densely pilose, not expanded or papery at base; leaf blade flabellate to spatulate-orbicular, (2–)5–15 × 3–9(–15) mm, pilose, base cuneate, margins 8- to 10-toothed, apex acute; teeth to 8 mm long. Stem leaves similar to basal. Racemes 8- to 20-flowered, ebracteate. Fruiting pedicels ascending, straight to curved, 5–10 mm long, spreading pilose. Sepals united, (2.5–)3.5–5.5 × 1.5–2.5(–3) mm, persistent, densely pilose, base not saccate; calyx lobes ovate, unequal, 0.5–2 mm long, margins membranous. Petals purple to purplish green with yellowish base, obovate, 5–8 × (1.5–)2.5–3 mm, apex obtuse; claw 2.5–4 mm long. Filaments white, slightly dilated at base, median pairs (3–)4–5 mm long, lateral pair (2–)2.5–3.5 mm long; anthers oblong, 0.5–0.8 mm long. Ovules 12 to 18 per ovary. Fruit linear, 1–2(–3) cm × ca. 2 mm, slightly flattened to subterete; valves pilose, distinctly veined; septum perforate or reduced to a narrow rim, membranous; style obsolete to 0.7 mm long; stigma 2-lobed. Seeds oblong, 1.5–1.8 × 0.8–1 mm, papillate.

Phenology. Flowering July and August. Fruiting August and early September.

Habitat and distribution. Gravelly slopes; 4000–5000 m. China (Xinjiang), Kashmir, Tajikistan.

Selected specimens examined. KASHMIR. **Karakorum:** above Caracash Valley, Chisil Gilgha Pass, 5300 m, 21 June 1914, *Dainelli & Marinelli 2* (photo, FI). TAJIKISTAN. **Pamir:** Badakhshan Mt., close to river Maldzhuran, *Tzvelev 700* (LE); Badakhshan Mt., 7 km N of Pass Takhta-Korum, *Tzvelev 1060a* (LE); Badakhshan Mt., basin of river Pshart, *Tzvelev 535* (LE); valley of river Chunjabay, *Kuzmina 6060* (LE); Checkekty slope, 19 Aug. 1965, *Ikonnikov s.n.* (LE).

Although Pampanini (1926) did not cite any collections within the original description of *Desideria mirabilis*, he listed in the preceding discussion three localities from which the species was collected, and he (Pampanini, 1930) gave the details of these three syntypes.

By their reduction of *Desideria mirabilis* to synonymy of *Cheiranthus himalayensis* (as *Ermania* or *Christolea*), Schulz (1927a, 1936), Botschantsev (1955, 1956), and Jafri (1955) overlooked the fact that the latter species has bracteate instead of ebracteate racemes, septate instead of eseptate fruits, free instead of united sepals, and fruits 3–4.5 mm instead of ca. 2 mm wide. The differences between the two species are so significant that it is hard to imagine they are conspecific.

Although they correctly noticed that the sepals in *Christolea karakorumensis* are united, Wu and An (1994) were probably unaware of *Desideria mirabilis*, a species endemic to the Karakorum Mountains and indistinguishable in every aspect from their novelty.

Jafri (1955) did not mention the connation of sepals in his original description of *Christolea scaposa*, though the illustration clearly shows gamosepalous calyces. By contrast, his (Jafri, 1973) illustration did not show gamosepaly accurately, though both illustrations were based on the same specimen. However, he mentioned that the sepals are "rarely connate below." Jafri (1955) suggested that *C. scaposa* is related to *C. prolifera*, while he (Jafri, 1973: 158) indicated that the species is closely related to *Desideria suslovaeana* except for "the absence of septum and slight difference in leaves." In my opinion, *C. scaposa* is indistinguishable from *Desideria mirabilis* and is unrelated to *D. prolifera*. The latter has solitary flowers and deciduous polysepalous calyces, whereas *D. mirabilis* has the flowers in racemes and persistent gamosepalous calyces.

11. Desideria nepalensis H. Hara, J. Jap. Bot. 50: 264. 1975. TYPE: Nepal. Barum Valley, 17,700 ft., 26 May 1954, *L. W. Swan 71-72* (holotype, BM!).

Plants 2–3 cm tall. Trichomes simple, straight, to 1 mm long. Stems minute, simple, glabrous. Basal leaves subfleshy; petiole 2–5 mm long, sparsely pilose with simple trichomes, ciliate at base, not expanded or papery at base; leaf blade broadly obovate to subflabellate, 2–3 × 1–3 mm, densely pubescent, base cuneate, margins 3- to 5-toothed, apex acute. Stem leaves absent. Flowers 2–4, ebracteate. Pedicel ascending, straight, 3–5 mm long, solitary from basal rosette, spreading pilose. Sepals united, 5–6 × 3–4 mm, densely pilose, base not saccate; calyx lobes ovate, 1.5–2 mm long, margins membranous. Petals ?purplish, obovate, 11–13 × 5–6 mm, apex obtuse; claw 6–7 mm long. Filaments slightly dilated at base, median pairs 4.5–5.5 mm long, lateral pair 3–4 mm long; anthers oblong, 0.9–1.1 mm long. Ovule number, fruits, and seeds unknown.

Desideria nepalensis is known only from the type collection made at an altitude of about 5400 m. It is readily distinguished from *D. mirabilis* by its much larger flowers (see key).

Literature Cited

Al-Shehbaz, I. A. 1987. The genera of Alysseae (Cruciferae; Brassicaceae) in the southeastern United States. J. Arnold Arbor. 68: 185–240.

———. 1988. The genera of Sisymbrieae (Cruciferae; Brassicaceae) in the southeastern United States. J. Arnold Arbor. 69: 213–237.

———. 1990a. Generic limits and taxonomy of *Brayopsis* and *Eudema* (Brassicaceae). J. Arnold Arbor. 71: 93–109.

———. 1990b. *Brayopsis gamosepala* (Brassicaceae), a remarkable new species with gamosepalous calyx. Ann. Missouri Bot. Gard. 77: 843–844.

———. 2000a. A revision of *Pegaeophyton* (Brassicaceae). Edinburgh J. Bot. 57: 157–170.

———. 2000b. A revision of the genus *Phaeonychium* (Brassicaceae). Nordic J. Bot. 20: 157–163.

——— & S. L. O'Kane, Jr. 1997. *Arabidopsis gamosepala* and *A. tuemurnica* belong to *Neotorularia* (Brassicaceae). Novon 7: 93–94.

——— & H. Ohba. 2000. The status of *Dimorphostemon* and two new combinations in *Dontostemon* (Brassicaceae). Novon 10: 95–98.

——— & G. Yang. 2000a. A reconsideration of the genus *Eurycarpus* (Brassicaceae). Novon 10: 346–348.

——— & ———. 2000b. A revision of *Solmslaubachia* (Brassicaceae). Harvard Pap. Bot. (in press).

An, Z. X. 1987. *Christolea*. *In:* T. Y. Cheo (editor), Fl. Reipubl. Popularis Sin. 33: 289–299. Science Press, Beijing.

———. 1995. Cruciferae. *In:* Z. M. Mao (editor), Fl. Xinjiangensis 2(2): 38–229. Xinjiang Science & Technology & Hygiene Publishing House, Urumqi. Science Press, Beijing.

Berkutenko, A. N. 1988. Brassicaceae. *In:* S. S. Charkevicz [Kharevich] (editor), Plantae vasculares orientis extremi Sovietici. 3: 38–115. Leningrad.

Botschantsev, V. 1955. De Cruciferis notae criticae. Bot. Mater. Gerb. Inst. Komarova Akad. Nauk S.S.S.R. 17: 160–178.

———. 1956. [A review of] S.M.H. Jafri. *Christolea*: With special reference to the species in N.W. Himalayas, W. Pakistan and Afghanistan. Bot. Zhurn. (Moscow & Leningrad) 41: 728–732.

Cambessèdes, J. 1844. Plantae rariores, quas in India orientali collegit Victor Jacquemont. Pp. 1–56 *in* V. Jacquemond (editor), Voyage dans l'Inde etc. 1828–1832. Paris.

Chamisso, L. K. A. 1831. De plantis in expeditione speculatoria Romanzoffiana observatis disserer pergunt: Arcticae, quae supersunt. Linnaea 6: 528–544.

Czerepanov, S. K. 1995. Vascular Plants of Russia and