Astragalus (Fabaceae): Taxonomic Studies of the Plants from the Kunlun Mountains in Central Asia, 1

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This is the first treatise on Astragalus from the Kunlun Mountains, central Asia (between Tibetan Plateau and Takla Makan Desert). An account is given on twenty-three species found in the region. Key, description, synonymy, distribution, specimens examined, and, partly, note are given each species. Two of the twenty-three species are new to science: these are A. nematodioides and A. kunlunensis. A variety, var. konlonicus, is recognized in A. densiflorus Kar. et Kir. Astragalus hendersonii Baker is regarded as a variety of A. heydei Baker, and a new combination, A. heydei var. hendersonii is proposed.

Astragalus is the largest genus of the flowering plants consisting of 2,000 species, and also one of the most diversified genera in the mountains. Since Bunge’s revisions (1868, 1869) only parts of the genus have been revised mainly on a regional basis.

This is the first treatise of the species of Astragalus in the Kunlun Mountains, located at the northern end of Tibetan (Qinghai-Xizang) Plateau and the south margin of Takla Makan Desert in central Asia. During the three years since 1987 large collections of plants have been made in the region by the members of expeditions organized by Chinese Academy of Sciences.

For the Kunlun representatives of Astragalus no comprehensive treatise has been published. The treatises on Astragalus in the floras of the former Soviet Union (Borissova et al. 1946) and Pakistan (Ali 1977) are most useful for circumscription of the Kunlun species. Recently a group of some Chinese taxonomists have started preliminary works of the Chinese species (Fu 1982a, 1982b; Y. C. Ho 1980, 1981; S. B. Ho 1983a, 1983b, Li and Ni 1979, 1985). These works are also relevant to the species occurring the mountains.

This study was principally based on the pressed specimens collected during our field researches. The first author, Ohba visited in the central and eastern part in 1988 with S. K. Wu, Y. H. Wu and Y. Fei. The third author, S. K. Wu surveyed the western part in 1987 and 1989, and the central and eastern parts in 1988 and 1989. The principal set of the specimens is kept in Kunming Institute of Botany (KUN) and the duplicate set in University of Tokyo (TI).

This paper aims to publish two new species and one variety, and also provide revised or amended descriptions of floral features for 19 species. In regard to the central Asian and Himalayan Astragalus, previous descriptions of flowers are mostly insufficient. In
this study flowers were dissected and observed under a
binocular microscope after hydrating. Sketches were
made using cameralucida.

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**Systematic treatment**

1. Subgenus *Calycocystis*


*Astragalus nivalis* Kar. et Kir. var. *aureocalycatus*

*Astragalus thomsonianus* Benth. ex Baker in Hook. f., Fl. Brit. Ind. 2: 136 (1876), pro syn.

Flowers sessile. Calyx 12–14 mm long, inflated in fruit; teeth 1.5–2.5 mm long, subulate to triangular, 1/6–1/5 of tube. Vexillum narrowly obovate, apex notched, 21–22 × 6–9 mm; Wings 20–21 mm long, lamina narrow oblong, apex notched, 8–10 mm long, shorter than claw. Keel-petals 17–19 mm long, lamina semi-orbicular, apex obtuse, shorter than claw. Ovary densely hairy. Pods semicircular, beaked, base truncate, 7–9 mm long, c. 3 mm wide, 3–4 mm deep, white hairs dense, spreading to ascending, 1–1.2 mm long, simple, straight, black hairs sparse to dense, spreading, straight, c. 0.8 mm long.

Habitat: Common on exposed sandy or stony slopes, flood river-bed and grassland, elevations between 3,000 m and 4,400 m.

Distr.: W. Himalaya, western Tibet, Kunlun, and Tien Shan, Dzhungarian Ala Tau and Tarbagatay Mts.

Specimens2). XINJIANG (Sinkiang, Chinese Turkestan). Akto Xian: Qiakelake, 4,300 m. W 870636 (KUN); Acketashi, 3,200 m. W 870195 (KUN); Qiaernong, 2,980 m. WWF 4631 (KUN, TI); loc. cit., 2,800 m. WWF 5102 (KUN, TI). Hotan Xian: Kaxtax, 3,300 m. WOWF 2053 (KUN, TI); Taxkax, 3,000–3,200 m. WOWF 2575 (KUN, TI). Yutian Xian: Pulu Volcano, 4,760 m. WOWF 3700 (KUN, TI); Suitepiya, 3,000 m. W 871085 (KUN); loc. cit., 3,100 m. W 871126 (KUN). Qiemo Xian: Konqibulaker, 4,000 m. WOWF 2088 (fl. & fr.) (KUN, TI); Konqibulaker Grazing land, Lamqinam, 4,000 m. WOWF 2634 (fl. & fr.) (KUN, TI). Ruoqiang Xian: Tufangzi, 4,200 m. WOWF 2771 (fr.) (KUN, TI); S slope of Qimantag Mountain, 4,400 m. WOWF 4294 (fl. & fr.) (KUN, TI); Yaziquan, 3,950 m. WOWF 3921 (fl. & fr.) (KUN, TI); Bing he, 4,200 m. WOWF 4211 (fr.) (KUN). QINGHAI (Tsinghai). Golmud Xian: 920 km in highway from Qinghai to Tibet, 4,400 m. WOWF 2823 (fr.) (KUN, TI).
2. Subgenus Cercidothrix


Flowers with pedicels less than 0.5 mm long with dense blackish bifurcate hairs. Calyx 3–4 mm long, with dense white and blackish, bifurcate hairs, the teeth triangular, 1/6–1/5 of the tube. Corolla purple or purple-red, rarely white with purplish throat. Vexillum obovate, apex notched, 6–8 × (3–)4–6 mm; laminas and claws of wing and keel-petals same in length; apex of wing slightly notched. Ovary densely hairy with 0.4 mm bifurcate, white and blackish hairs. Pods semiobirecular, c. 1 cm long, with dense appressed hairs.

Habitat: On gravelly sandy slopes in alpine desert, elevations between 4,000 m and 4,900 m.

Distr. W. Himalaya, Tibet and Kunlun.

Specimens examined. XINJIANG. Akto Xian: Aketashi, alt. 3,200 m. W870197 (KUN). Yutian Xian: Pulu Volcano, Luker Lake, 4,700 m. WOWF 3704 (KUN, TI); Ulugkula Lake, 4,900 m. WOWF 3730 (KUN, TI). Qiemo Xian: Kongqibulaker, 4,000 m. WOWF 2597 (fl. & fr.) (KUN, TI); loc. cit. 4,050 m. WOWF 2072 (KUN, TI) & 2071 (KUN). Pishan Xian: Shanxuanwan, Hangyangtang, 4,900 m.


Flowers with c. 2 mm long pedicel. Calyx 13–14 mm long, cylindriclal, densely hairy; tube 8–9 mm long; teeth 4–5 mm long, linear-subulate. Corolla cream yellow. Pods ellipsoid, 2.4–2.8 cm long, 0.8–1.0 cm deep, apex beaked, base cuneate, hairs dense, bifurcate, spreading, white, slightly curled, 1–2 mm long.

Habitat: On sandy banks or gravels in desert, elevation between 3,650 m and 4,730 m.

Distr.: Kunlun and Mongolia (Altai and Alashan).

Specimens. XINJIANG. Ruoqiang Xian: Yaziquan, 3,650 m. WOWF 2640 (fr.) (KUN); loc. cit., 4,730 m. WOWF 4240 (fr.) (KUN, TI).

The vegetative and fruit characters of the Kunlun plants well agree with those of the type collected in Inner Mongolia (E. MONGOLIA. Ad tractum mervatorium, prope Zaghan-tururik. *Kirilow* 642 in 1842, LE). This species represents an extraordinary pattern of geographic distribution of the Kunlun plants.


Flowers solitary at axils of radical leaves, sessile, c. 26 mm long; bracts triangular ovate, densely hairy, 3–8 mm × 2 mm; bracteoles 1, linear, c. 5 mm × 0.5 mm. Calyx c. 11 mm long, with dense white bifurcate hairs up to 2 mm long; tube c. 7 mm long; teeth linear to subulate, c. 3 mm long. Corolla powder red? Vexillum c. 25 mm × c. 6 mm, narrow obovate, apex truncate to slightly retuse, base auriculate. Wings 20–21 mm long; lamina narrowly oblong-ovobate, 11–12 mm long. Keel-petals 16–17 mm long, lamina semi-orbicular, c. 7 mm long, shorter than claw c. 10 mm long. Pistils c. 1.7 cm long; ovaries 4–5 mm long, sessile, densely pubescent, hairs appressed, 1–1.5 mm long.

Habitat: On stone slopes, elevation between 2,200 m and 3,400 m.

Distr.: Pamir, Kunlun, Tien Shan, Dzungarian Ala Tau, and Borborogussun Range.

Specimens. XINJIANG. Akto Xian: Qiakelake to Muji, 3,400 m. W870584 (KUN). Wuqia Xian: Konysu, 2,200 m. W870002 (KUN); Jigan, 2,800 m. W870056 (KUN).


Habitat: On stony slope, elevation around 3,700 m.

Distr.: Pamir (Alai Valley), western Kunlun and Tien shan.

Specimen. XINJIANG. Taxkorgan Xian: Maza, 3,700–3,800 m. W 870389 (KUN).

*Astragalus wensuensis* S. B. Ho is probably falls in the variation range of this species.


Flowers c. 1.6 cm long, pale yellow, sessile. Calyx c. 9 mm long, appressed- to ascending-hairy with brown straight hairs 0.6–0.8 mm long and white curved hairs 0.6–1 mm long; tube 6–7 mm long; lobes c. 2 mm long, subulate. Vexillum obovate, c. 16
mm × c. 7 mm, apex truncate, base slightly auriculate. Wings c. 14 mm long, lamina narrow obovate, c. 7 mm long, apex slightly retuse. Keel-petals slightly shorter than wings; lamina semi-orbicular, c. 6 mm long, shorter than claw c. 8 mm long. Pistils c. 13 mm long; ovaries c. 2.5 mm long, hairy, stipe c. 0.5 mm long.

Habitat: On stony mountain slope, elevation 2,800–3,200 m.

Distr.: Pamir (eastern Alai Valley), western Kunlun, Tien Shan, and Dzungarian Ala Tau.

Specimen. XINJIANG. Wuqia Xian: Jigen, 2,800–3,200 m. W 870057 (KUN).

7) Astragalus nematodioides H. Ohba, S. Akiyama et S. K. Wu, sp. nov.

[Figs. 1C; 4 (above)]

Astragali nematodis Bunge, ex Boiss. primo adspectu maxime similis, sed foliis brevioribus quam 4 cm longis et foliolis anguste oblongo-lateralibus 6–12 mm longis 1.5–1.8 mm latis differt.

Perennial herb with a buried caudex with many short divisions. Stems 0.5–2 cm long, densely hairy, usually 3–5 nodes. Leaves 2–4 cm long, ascending, hairs white, bifurcate, c. 1 mm long; petioles 1.5–2 cm long, densely hairy; leaflets 4–6 pairs, greyish green, narrow oblanceolate, apex acute, base attenuate, ses-
sile, 6–12 mm × 1.5–1.8 mm, densely hairy on both surfaces. Stipules connate throughout to lower two third, amplexicaule, triangular-ovate to triangular, hairy, brownish, 2–4 mm long.

Inflorescences axillary, raceme with 6–13 flowers, 2–6 cm long; peduncles erect, up to 13 cm long, conspicuously longer than stems (protruding?), hairy; bracts lanceolate, 1.5–2 mm long, hairy.

Flowers with c. 1 mm long, hairy pedicels. Calyx 3–6 mm long, hairy; teeth 2–4 mm long, subulate, longer than tube. Vexillum widely obovate, apex emarginate, 7–10 × 5–9 mm. Wings 7–9 mm long, lamina narrow oblong, apex emarginate, 2 times longer than claw. Keel-petals 7–9 mm long; lamina semi-orbicular, apex obtuse, longer than claw. Ovary densely hairy. Pods flat, linear, arched, apex with beaked like persistent style, base tapering, 10–15 mm long, hairs dense white, appressed to spreading, up to 1 mm long, bifurcate and often simple.

Type: China. Xinjiang: Qira Xian, Yamei, alt. 3,000 m. Wu, Ohba, Wu & Fei 2522 (KUN-Holo; TI-Iso).

Habitat: In various exposed grounds such as desert, riverbeds, grazings, hill side slopes, and rarely in the sparse forest floors, elevations between 2,420 m and 3,700 m.

Distr.: Endemic to the Kunlung Mts.

Specimens. XINJIANG. Akto Xian: Aketashi, 2,420 m. W 870260 (KUN). Pishan Xian: Buqun, 2,750 m. WOWF 1831 (KUN, TI); Kaxtax, 2,800 m. WOWF 3611 (KUN, TI); Naoarbat, 3,000 m. WOWF 2405 (KUN, TI); Naoarbatibuqiong, 2,600 m. WOWF 2443 (KUN, TI); Habake Daban, 3,700 m. WWF 4771 (KUN). Yutian Xian: Kekeya to Momoke, 2,700 m. W 870970 (KUN); Pulu to Pulu Volcano, 3,100–3,500 m. WOWF 3671 (KUN, TI). Qira Xian: Nuer, 3,200 m. WOWF 1993 (KUN, TI); Yamei, 3,000 m. WOWF2522 (KUN, TI). Qiemo Xian: Kongqibulaker, 3,000 m. WOWF 2584 & 2585 (fl. & fr.) (KUN, TI); loc. cit., 3,150 m. WOWF 2063 (fl. & fr.) (KUN, TI); Aqiaaxiang, Kongqibulaker Grazing land, 3,250 m. WOWF 3843 (fr.) (KUN, TI).

This species is somewhat similar to Astragalus nematodes Bunge ex Boiss. distributed in Kazakhstan, but differs in having shorter leaves less than 4 cm long, shorter narrow oblanceolate (6–12 mm long) leaflets and flowers less than 1 cm long.

3. Subgenus Pogonophace

Sect. Trichostylus


Calyx 5–6 mm long, densely hairy with less than 0.6 mm long, white and brownish hairs; teeth 1.5–2.5 mm long, triangular. Vexillum very widely obovate, apex retuse, 9–12 × 9–12 mm. Wings 8–11 mm long, lamina oblique, narrow oblong, apex round, longer than claw. Keel-petals 7–10 mm long, lamina semi-orbicular, apex around, claw as long as lamina. Style in apical portion (at least the upper side) and stigma hairy. Ovary densely hairy.

Habitat: On sandy or gravelly slopes or desert, elevations between 3,200 m and 5,300 m.

Distr.: W. Himalaya (Kashmir), Tibet, Kunlun, and S. Qinghai.

Specimens. XINJIANG. Yutian Xian: Tianwenggian, 5,100 m. W 871246 (fr.) (KUN). Ruoqiang Xian: Piaqiretakorgan, 3,900 m. WOWF 2155 (fl. & fr.) (KUN, TI); Aqqikkol, 3,250 m. WOWF 2191 (fl. & fr.) (KUN, TI); loc. cit., 4,280 m. WOWF 4035 (fl. & fr.) (KUN, TI); Yaziquan to Aqqikkol, 4,000 m.
Astragalus dshimensis falls in the variation range of A. coluteocarpus Boiss. in the vegetative and floral (including) features. The Himalayan representatives are smaller than those of Kunlun and Tien Shan. The epithet dshimensis might be an printing error, dshihensis, which is derived from Dshihe River now known as Jinghe.

**Sect. Pogonophace**


Flowers with c. 1 mm long pedicels. Calyx 4–4.5 mm long, densely spreading-hairy with blackish, c. 0.2 mm long and white c. 0.5 mm long hairs; tube 2.0–2.5 mm long; teeth 2.0–2.3 mm long, triangular. Corolla red purple. Pods ellipsoid, apex acute, base widely cuneate, 10–13 mm long, 4–5 mm deep, hairs sparse, blackish, spreading, c. 0.3 mm long; unilocular, many seeded.

Distr.: Himalaya (Kashmir and? Sikkim), Kunlun, Tibet, and N. and SW. China (Gansu & Sichuan).

Specimen. TIBET. Ritu Xian: Maduo, 4,500 m. W 871336 (fr.) (KUN).

4. Subgenus *Phaca*

Sect. *Hypoglossis*

Fig. 3. *Astragalus coluteocarpus* Boiss. (above). Holotype of *A. dshimensis* Gontsch. (Regel 15 Mai 1879, LE). *A. monophyllum* Maxim. (below). Holotype (Kirillow 642 in 1842, LE).
Fig. 4. Types of Astragalus nematoidoides H. Ohba et al. (WOWF 2522, TI) (above) and A. densiflorus var. konlonicus H. Ohba et al. (WOWF 3719, TI) (below).
Fig. 5.  A: *Astragalus coluteocarpus* Boiss. (WOWF 2132). B & C: *A. tibetanus* Benth. ex Bunge, B: Xinjiang (WOWF 3858), C: Pakistan (Ohba et al. 77, TI). All × 2.5.


*Fig. 5B & C*


Calyx 6–8 mm long, hairs dense, 0.2–0.5 mm long; teeth 1.4–2 mm long, shorter than 1/5–1/4 of tube length, narrow triangular. Vexillum narrow obovate, apex obtuse, (17–)18–20 × 7–9 mm. Wings 15–16.5 mm long; lamina narrow oblong or semi-orbicular, apex slightly notched, slightly longer than claw. Keel-petals 12–14 mm long, lamina semi-orbicular, apex obtuse, slightly shorter than claw. Ovary densely hairy, stipitate.

Habitat: On exposed grassland slopes, stream side banks, and sometimes on the floor of *Picea* forests, elevations between 2,000 m and 4,600 m.


Specimens. XINJIANG. Taxkorgan Xian: Mazato Kalaqigu, 3,600 m. WWF 4961 (KUN, TI); Kelaqigo, 3,600 m. W 870539 (KUN). Wuqia Xian: Wulagen, 2,300 m. W 870026 (KUN). Akto Xian: Wuyitage, 2,800 m. WWF 4800 (KUN, TI); loc. cit. WWF 4823 (KUN, TI). Yutian Xian: Kekeya, 3,000 m. W 870846 (KUN); Sukepiya, 3,000 m. W 870991


Flowers with c. 1 mm long pedicel. Calyx 4.5–6 mm long, hairs blackish only, ascending, straight, on tube (including pedicels) c. 0.3 mm long, on teeth c. 0.7 mm long; teeth linear-subulate, 2.7–3.5 mm long, nearly as long as tube (2.2–2.7 mm long). Vexillum narrow obovate, apex retuse, base attenuate, 12–13.5 mm×5.5–6 mm. Wings 10–11 mm long, shorter than keel-petals, lamina 6–6.8 mm long, narrow oblong, apex round, claw c. 4 mm long. Keel-petals 11.5–12.5 mm long, lamina arched-shape, apex round, 6.5–7 mm long, claw 4.5–5 mm long. Stamens 13–14 mm long. Pistils 13–14 mm long; ovary 4.5–5 mm long, dense minute hairs c. 0.2 mm long, tapering on both ends, stipes 2.5–3 mm long, style 6–6.4 mm long; ovules 6.

Habitat: On grassland in mountain slopes, elevation 3,200 m.

Distr.: W. Himalaya (Kashmir & Ladak) and western Kunlun.

Specimen. XINJIANG. Akto Xian: Aketashi 3,200 m. W 870215 (KUN).


Flowers with c. 1 mm long pedicels. Calyx 3.5–4.5 mm long, teeth 1–2 mm long, linear to subulate; hairs (including pedicels) blackish, ascending, straight, 0.15–0.5 mm long with c. 0.6 mm long, white, straight hairs. Vexillum obovate to widely obovate, apex retuse, 7–10×5–7 mm. Wings 7–9 mm long, lamina oblique, linear, apex round, 5–6 mm long. Keel-petals 6–8 mm long, lamina semi-orbicular, apex round, 4–5 mm long.

Habitat: On desert and grassland, elevations between 3,100 m and 4,800 m.

Distr.: W. Himalaya (Kashmir to Nepal), Tibet and Kunlun.
Specimens. XINJIANG. Taxkorgan Xian: Hongqilapu, 4,600 m. WWF 4901 (KUN, TI). Maza to Kalagiqu, 3,600 m. WWF 4973 (KUN); Subashidaban, 4,000 m. W 870311 (KUN). Akto Xian: Qiakelake to Muji, 3,400 m. W 870577 (KUN). Yutian Xian: Pulu, 3,750 m. WOWF 3690 (KUN, TI); Pulu, Kanyan, 3,800 m. WOWF 3767 (KUN, TI). Pishan Xian: Naza, 4,750 m. WWF 4775 (KUN, TI). Hotan Xian: Kaxtax, 3,650 m. WOWF 2038* (KUN, TI); loc. cit., 3,100 m. WOWF 2572* (KUN, TI). Qira Xian: Nuer, Yamei, 3,400 m. WOWF 2512* (KUN, TI); Nuer, 3,200 m. WOWF 1992* (KUN, TI). Qiemo Xian: Kongqibulaler, 3,150 m. WOWF 2061 (KUN, TI); loc. cit., 3,100 m. WOWF 2590 (fl. & fr.) (KUN, TI); Aqjiangxiang, 3,200 m. WOWF 3842 (KUN, TI). Ruoqiang Xian: Yaziquan, 3,950 m. WOWF 3957 (KUN, TI); loc. cit., 3,900 m. WOWF 3948 (KUN, TI); Yaziquan to Aqqikkol, 4,000 m. WOWF 2654 (fl. & fr.) (KUN, TI); A pass between Yaziquan and Aqqikkol Hu, 4,450 m. WOWF 2289 (KUN, TI); Yixiakepati, 4,200 m. WOWF 4265 (fl. & fr.) (KUN, TI); Mingyalakdong, 4,120 m. WOWF 4187 (fl. & fr.) (KUN, TI); SE of Kumkol Hu, 4,150 m. WOWF 2312 (fl. & fr.) (KUN, TI); Piaqiriketagor, 3,950 m. WOWF 2159 (fl. & fr.) (KUN, TI); Aqqikkol, 4,280 m. WOWF 4019 (fl. & fr.) (KUN, TI); Hashkelel River, 4,720 m. WOWF 4152 (KUN, TI). TIBET. Ritu Xian, 4,230 m. W 871619 (fr.) (KUN). QINGHAI. Golmud Xian: 920 km in highway from Qinghai to Tibet, 4,500 m. WOWF 2865 (fl. & fr.) (KUN, TI); loc. cit., 4,400 m. WOWF 2839 (fl. & fr.) (KUN, TI).

This species varies greatly in the length of stem, the shape and size of leaflets as well as flowers. The specimens with an asterisk have relatively large flowers and leaflets. Though A. confertus has usually densely hairy ovaries and pods, the hairiness seems to vary dense hairy to glabrous. Astragalus golumunensis Y. C. Ho (in Bull. Bot. Lab. NE. Forest Inst. no. 8: 61, t. 5, 1980) seems to be only an extreme with glabrous ovary. W 871619 has glabrous to sparsely hairy pods, but belongs to the variation of A. confertus.

Sect. Myobroma


Calyx 14–16 mm long, densely hairy, teeth 3–5 mm long, subulate. Corolla yellow. Vexillum 24–26×9–10 mm, narrowly oblanceolate, apex retuse, base auriculate, clawed. Wings 23–24 mm long, lamina c. 11 mm long, linear, apex round, shorter than claw. Keel-petals c. 20 mm long, lamina c. 7 mm long, semi-orbicular, apex round, shorter than 1/2 of claw. Pods ellipsoid with beaked apex, base attenuate, 2–2.3 cm long, 6–8 mm deep, purplish red, dense hairs appressed and ascending, white, c. 0.6 mm long.

Habitat: Variable, on grassland, exposed flood ground or edge or floor of sparse Juniperus forests, elevations between 2,800 m and 3,600 m.

Distr.: Pamir (Alai Valley), Kunlun, Tien Shan, and Dzungarian Ala Tau.

Specimens. XINJIANG. Akto Xian: Aketashi, 3,120 m. W 870102 (KUN); loc. cit., 3,200 m. W 870225 (KUN); Qiaernong, 3,600 m. WWF 5029 (KUN). Taxkorgan Xian: Maza. W 870378 & 870333 (KUN); Maza to Kalaquigu, 3,600 m. WWF 4930 (KUN). Yutian Xian: Sukipeya, 3,200 m. W 871120 (KUN). Shache Xian: Kalatuzi, 2,800 m. W 870707 (KUN). Pishan Xian: Kaxtax, 2,800 m. WOWF 3609 (KUN, TI); Naoarbati, 3,100 m. WOWF 2417 (fl. & fr.) (KUN, TI); Buqun, 2,800 m. WOWF 1902 (fl. & fr.) (KUN, TI); Buqiang, 3,000–3,400 m. WOWF 3013 (KUN, TI).


Fig. 7. A: Astragalus alatavicus Kar. et Kir. (WOWF 1902). B: A. talassicus M. Pop. (WWF 4993). All × 2.5.


Habitat: On sandy slopes, elevation 3,400 m.

Distr.: Pamir (eastward from Alai Valley) and western Kunlun.

Specimen. XINJIANG. Akto Xian: Qiakelale to Muji, 3,400 m. W 870588 (KUN).

This is similar to Astragalus alatavicus, but different in having ovate large stipules, much more dense and long, conspicuous greyish white hairs on leaves, peduncles and calyx, and narrow oblong or narrow oblong ovate leaflets.


Flowers yellow, 2.4–2.7 cm long. Calyx c. 1 cm long, hairs 0.8–1 mm long, pale brown, slightly curved, tube c. 7 mm long; lobes subulate, apex not pointed, c. 2 mm long. Vexillum obovate, 2.3–2.5 cm × c. 1.7 cm, apex truncate. Wings c. 2.2 cm long, lamina narrow oblanceolate, c. 1 cm long, apex round, shorter than claw c. 1.2 cm long. Keel-petals c. 2 cm long, lamina semiorbicular, c. 0.8 cm long, shorter than claw 1.2
cm long. Pistils c. 2 cm long; ovaries c. 1 cm long, glabrous; stipes 6–7 mm long.

Habitat: On flood river-bed, elevation between 4,200 m and 4,500 m.

Distr.: W. Himalaya (Chitral and Kashmir), Pamir, Kunlun and Tien Shan.

Specimens. XINJIANG. Taxkorgan Xian: Mintiegai, 4,300 m. WWF 4979 (KUN, TI); Keketuluke, 4,600 m. W 870490 (KUN); loc. cit., 4,200–4,500 m. W 870504 (KUN).

*Astragalus pamiroalaicus* Lipsky (Acta Hort. Petrop. 26: 147, 1907) seems to fall the synonymy of this species, though we could not examine any authentic specimen.

17) **Astragalus talassicus** M. Pop. in Sched. Herb. Asiae Med., Fasc. 15: 21 (1928). Boriss. et al. in Fl. URSS 12: 189 (1946). [Fig. 7B]

Calyx 14–15 mm long, teeth linear-subulate, 3–4 mm long. Corolla yellow. Vexillum ob lanceolate, apex retuse, 20–22 × 9–10 mm. Wings c. 20 mm long, lamina narrow oblong, apex round, 10–11 mm long. Keel-petals c. 16 mm long, lamina semi-orbicular, apex obtuse, c. 7 mm long. Ovary densely hairy.

Habitat: On gravelly slopes, elevation 4,300 m.

Distr.: Kunlun and Tien Shan (Kuraminskii, Talass, Chatkal’ and Uzun-Akhmatskii regions).

Specimen. XINJIANG. Taxkorgan Xian: Mintiegai, 4,300 m. WWF 4993 (KUN, TI).

Sect. **Brachycarpus**


Var. **konlonicus** H. Ohba, S. Akiyama et S. K. Wu, var. nov. [Figs. 4 (below); 8A]

A typo caule minore quam 15 cm longi, saepe stolonifero et racemi cylindrici differt.

Perennial; caudex often stolons with scales ending aerial stems. Stems with long subterranean part; aerial part (including peduncles) 5–12 cm long, basally branched, 3 or 4 nodes, with simple hairs ascending, white or brownish, straight or curved, c. 0.6 mm long.

Leaves 2.5–5.5 cm long, uppermost two opposite, others alternate, imparipinnate; petioles less than 1 cm long, shorter than laminas, moderately to densely hairy; leaflets usually 13, narrow oblong or lanceolate, apex round, base round or cuneate with less than 1 mm petiolules, 5–14 × 2–5 mm, dense simple white hairs c. 0.7 mm long, appressed, curved on lower surfaces, margin and rachis, glabrous on upper surface. Stipules basally connate, triangular, 3–6 mm long, green, marginal portion hairy.

Inflorescences terminal, compact, cylindrical racemes with 20 or more flowers, 1.5–3 cm long; peduncles 2–4 cm long, densely hairy; bracts linear-subulate, longer than calyx, 4–6 mm long, hairs simple, ascending, blackish, c. 1 mm long.

Flowers with c. 1 mm long pedicels with dense blackish hairs. Calyx 4–6 mm long, hairs dense, c. 0.5 mm long, straight; teeth linear to linear-subulate, (1.5–)2–3 mm long. Corolla purple. Vexillum obvate to widely obovate, apex retuse, 8–9.5 × 5–6 mm. Wings (6–)7–8 mm long, lamina narrow oblong, apex round or rarely slightly retuse, 5–6 mm long. Keel-petals 5–7 mm long, lamina semi- orbicular, apex obtuse, 3.7–4.3 mm long. Ovary densely hairy.

Pods flat, nearly circular, beakless with persistent style, bilocular, smooth, cross-wrinkled, with dense simple hairs appressed or ascending, white or blackish, straight or curled, c. 1.2 mm long.

Type: China. Xinjiang: Yutian Xian: Ulugkula Lake, 4,800 m. Wu, Ohba, Wu & Fei 3719 (KUN-Holo; TI-Iso).

Habitat: Dominant species in sandy flood glacier valley, sandy desert, and gravelly or stony slopes, elevations between 3,950 m and 5,200 m.

Distr.: Endemic to central and east Kunlun Mts.

Specimens. XINJIANG. Yutian Xian: Ulugkula Lake, 4,800 m. WOWF 3718 & 3719 (KUN, TI). Hotan Xian: Chalukou, 5,160 m. W 871194 (fl. & fr.) (KUN). Qiemo Xian: Kongqibilaker, 4,000 m. WOWF 2092 & 2094 (KUN, TI). Ruoqiang Xian:
Yaziquan, 3,950 m. WOWF 3950 (fl. & fr.) (KUN, TI); loc. cit., 4,500 m. WOWF 2752 (fl. & fr.) (KUN, TI); A pass between Yaziquan and Aqqikkol lake, 4,450 m. WOWF 2294 (fr.) (KUN, TI); Aqqikkol, 5,100 m. WOWF 2724 (KUN, TI); Mt. Qimantag, 4,600 m. WOWF 3974 (KUN, TI); Bing he, 4,300 m. WOWF 4217 (fl. & fr.) (KUN, TI); Mt. Mutzag, 4,800 m. WOWF 3087 (fr.) (KUN, TI); Mutzag, SE of Xuezhaobi, 5,200 m. WOWF 2255 (fl. & fr.) (KUN); Mutzag, Yueya River, SE of Xuezhaobi, 4,900 m. WOWF 2250 (fl. & fr.) (KUN, TI). TIBET. Baingoin Xian: Whale Lake, 4,730 m. WOWF 4057 (KUN, TI); loc. cit., 4,850 m. WOWF 4088 (KUN, TI); Kunlun Mountains, NEN of Whale Lake, 5000 m. WOWF 2231 (KUN, TI). Qianghai. Golmud Xian: 920 km in Highway from Qianghai to Tibet, 4,500–4,600 m. WOWF 2851 (fl. & fr.) (KUN, TI).

Var. densiflorus


Stems up to 15 cm long, internodes usually longer than leaves. Leaflets 5 or 6 pairs, upper surface glabrous, lower surface appressed, c. 0.5 mm long, white hairs. Racemes conical, usually 3, these from lowest axils surpassing others; bracts linear-subulate, c. 5 mm long.

Calyx 5–6 mm long, teeth linear, c. 2 mm. Vexillum narrow obovate, apex retuse, 7–10 × 4–5.5 mm. Wings 6–7 mm long, lamina narrow oblong, apex retuse or round, 4–5 mm long. Keel-petals c. 5 mm, lamina 3–4 mm long.

Habitat: On grassland and meadow, elevations between 3,200 m and 3,730 m.

Distr.: Endemic to central region of the Kunlun Mountains.
Specimens. XINJIANG. Karakash, watershed. Calev in 1870 (K). Pishan Xian: Naoarbatibujiong, alt. 3,300 m. WOWF 2434 (KUN, TI); Buqun, 3,200 m. WOWF 1858 (KUN, TI). Yutian Xian: Kekeya, 3,700 m. W 870805 (KUN); Pulu, 3,730 m. WOWF 3688 (KUN, TI).

This differs from var. konlonicus in having taller stems and usually three racemes, of which the lowest surpassing others. Var. konlonicus grows mainly on less vegetated places elevations above nearly 4,000 m while var. densiflorus occurs in grassland and meadows with other herbs and grasses in elevation between 3,200 m and 3,700 m. No morphological transitional form between them was found.

Astragalus heterodontus Boriss. primo adspectu maxime similis, sed a quo pedunculo 10–15 (nec usque 8) cm et longitudine vulgo intermodiis superantl, foliis 4–9 (nec 2–4) cm longis cum petiolo 1–3.5 (nec 0.5–1.5) cm longo statim dignoscendus. Ex affinitate Astragalus clareani Ali, a quo stipulis basi connatis 3–4(–6) (non 6–7) mm longis, pilis cauliferis inerces et floribus minoribus cum calycce 3 (nec 7.0–7.5) mm longo cum vexillo c. 7 (nec 13–14) mm longo bene distinctus.

Perennial herb with buried caudex with many short divisions. Stems 2–4, 20–45 cm long, simple, 6–8 nodes, with sparse appressed, c. 0.5 mm long hairs. Leaves 4–9 cm long; petioles 1–3.5 cm long, shorter than laminas, sparsely appressed-hairy; leaflets 12–18, oblong or oblong obovate, apex round or slightly retuse, base round with 1–2 mm petiolules, 7–19 mm × 4–6 mm, hairs c. 0.5 mm long on lower surfaces and rachis, glabrous on upper surface. Stipules basally connate, triangular ovate to tri-angular, 3–4(–6) mm long, greenish, glabrous.

Inflorescences terminal and axillary, raceme capitate in flowering but elongate in fruiting, with 10 or more flowers; peduncles 10–15 cm long, usually longer than nodes, except for blackish hairy upper portion hairs sparsely or nearly glabrous; bracts linear, usually shorter than calyx-tube, 1–2.5 mm long, with sparse blackish hairs.

Flowers with c. 1 mm long pedicels with dense blackish hairs. Calyx 3 mm long, hairs dense, c. 0.2 mm long; teeth subulate, c. 1 mm long. Corolla purplish or often white. Vexillum widely obovate to orbicular, apex retuse, c. 7 × 5–6.4 mm, base more or less clawed. Wings 5–6 mm long, lamina narrow oblong, apex round, 4–5 mm long. Keel-petals 4–5 mm long, lamina semi-orbicular, apex obtuse, c. 3 mm long. Ovary usually glabrous.

Pods flat, widely obovate, beakless with remaining style, bilocular, grooved, cross-wrinkled, with dense appressed or ascending, white or blackish, straight or curled, c. 0.6 mm long, hairs.


Habitat: On rocky grassland along stream banks or slopes.

Distr.: Endemic to the Kunlun Mts.

Specimens. XINJIANG. Yutian Xian: Chalukou, 4,960 m. W 871244 (KUN); Pulu to Pulu Volcano, 3,300 m. WOWF 3676 (KUN, TI); Pulu, Kanyan, 3,800 m. WOWF 3778 (KUN, TI); Arxkula Lake, 4,300 m. WOWF 3759 (KUN, TI). Pishan Xian: Kaxtax, 3,300 m. WOWF 3645 (KUN, TI); Naoarbatibujiong, 3,300 m. WOWF 2435 (KUN, TI). Qiemo Xian: Aqianxiang, Kongqibulaker Grazing land, 3,260 m. WOWF 3844 (fl. & fr.) (KUN, TI). Qinhai. Golmud Xian: Zidatan, 4,000 m. WOWF 2909 (KUN).

Fig. 9. *Astragalus kunlunensis* H. Ohba et al. (WOWF 3844, type) (above) and *A. clarkeanus* Ali (WWF 4871) (below).
peduncles up to 10–15 cm long and longer than internodes, longer leaves 4–9 cm long with 1–3.5 cm long petioles. *Astragalus clarkeanus* differs from this by the almost free stipules not adnate to petioles, the blackish hairs on stems and larger flowers with 7.0–7.5 mm long calyx and 1.3–1.4 cm vexillum.

WOWF 2435 and 3645 differs from the other specimens by the shape of vexilla, widely obovate against obovate or widely oblate.


[Fig. 8D; 9 (below)]

Flowers with c. 1 mm long pedicels. Calyx 7.5–8.5 mm long, hairs (incl. pedicel) dense, blackish, ascending and appressed, c. 0.5 mm long; teeth subulate, 2–3 mm long. Corolla purple. Vexillum oblong, apex emarginate, base clawed, 12–14 × 7–8 mm. Wings 11–12 mm long, lamina narrow oblong, apex retuse or retuse-truncate, c. 8 mm long. Keel-petals c. 8 mm long, lamina semi-orbicular, apex obtuse, 4–5 mm long. Ovary densely hairy.

Habitat: On grassland and meadow in mountain slopes, elevations between 3,400 m and 4,600 m.

Distr.: W. Himalaya (Karakorum range) and Kunlun.

Specimens: XINJIANG. Taxkorgan Xian: Maze, 4,400–4,600 m. W 870728 (KUN); Hongqilapu, 4,040 m. W 870450 (KUN); loc. cit., 4,600 m. WWF 4871 (KUN, TI). Akto Xian: Akekashi, 3,400 m. W 870147 (KUN); Qiaernong, 3,700 m. WWF 4648 (KUN, TI). Yutian Xian: Kekeya, 3,500 m. W 870833 (KUN).

This species is characterized by the blackish hairs on stems. Our specimens have stipules which are basally connate and highly adnate to petioles, but the type and other authentic specimens have almost free stipules not adnate to petioles.


Calyx c. 5 mm long, hairs dense, blackish, 0.3–0.5 mm long; teeth subulate, 2–2.2 mm long. Corolla yellow. Vexillum oblong, apex round-retuse, base attenuate or claw-like, 9.5–10 × c. 5 mm. Wings 7.5–8 mm long, lamina narrow oblong, apex round, c. 5 mm long. Keel-petals 6.5–7 mm long, lamina semi-orbicular, apex obtuse, 3.7–4.2 mm long. Pistil c. 5.5 mm long, ovary glabrous, c. 2.5 mm long, stipitate, ovule 2.

Habitat: On mountain slope, elevation 3,000 m.

Distr.: Kunlun and Tien Shan (Naryn range).

Specimen. XINJIANG. Yutian Xian: Supeyi, 3,000 m. W 871067 (KUN).

This has been known only from the type locality in Naryn range in the Tien Shan Mountains. Our specimens differs from the type in having leaflets with round or round-apiculate apex, calyx-teeth slightly shorter than the tube, oblong, 9.5–10 mm long standard, 2.7–3 mm long wing- and keel-claws and particularly glabrous ovaries. In the species of Brachycarpus group the hairiness of ovaries is variable even in a single species like *A. densiflorus*.

Sect. *Cenanthurum*


[Fig. 10A]

*Phaca frigida* L., Syst. Nat. ed. 10: 1173 (1759)


Calyx tubular, 10–12 mm long, with sparse brownish hairs; teeth widely triangular, 1.5–2 mm long, as long as c. 1/8 of tube-length. Corolla yellow. Vexillum
narrow obovate, apex retuse, tapering from middle, 20–23 × 10–13 mm. Wings 20–22 mm long, lamina oblong, apex round, 8–9 mm long. Keel-petals 17–19 mm long, lamina semi-orbicular, apex round, 6–7 mm long. Ovary hairy, stipitate; style glabrous.

Habitat: On wet slopes, elevation 4,500 m.

Distr.: Northern Hemisphere including W. Himalaya, Pamir, Kunlun, and Tien Shan.

Specimen. XINJIANG. Taxkorgan Xian: Mintiegai, 4,500 m. WWF 4999 (KUN, TI).

We accept here a broader sense of the species delimitation. The Kunlun plants well agree with those of *A. lepsensis* described from Tien Shan (Ala Tau).

23) *Astragalus dictamnoides* Gontsch. in Notul. Syst. Herb. Inst. Bot. Acad. URSS 9: 116 (1946); in Fl. URSS 12: 31 (1946). [Fig. 10B]

Flowers yellow, with hairless, c. 2 mm long pedicels. Calyx 14–16 mm long, hairs soft, brown, curled, c. 0.8 mm long; teeth subulate, 2.5–3.5 mm long. Vexillum widely obovate, apex retuse, base clawed, 27–31 ×
17–19 mm. Wings 22–24 mm long, lamina oblong, apex round, c. 10 mm long. Keel-petals c. 20 mm long, lamina oblong, apex round, 8–9 mm long. Ovary sparsely hairy.

Distr.: Kunlun and Tien Shan (Ferganskii Khrebet).

Specimens. XINJIANG. Akto Xian: Wuyitage, 2,800 m. WWF 4845 (KUN, TI); loc. cit. 3,250 m. WWF 4846 (KUN).

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Endnote
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2) Collectors abbreviations are as follows:

The important alternative names of the counties and towns are as follows: Kaxgar (Kashgar); Pishan (Guma); Hotan (Kotan); Qiemo (Charkan, Ch’ieh-jo); Qihaqi (Ch’er-jo); Ruoqiang (Charkhlik[h], Jo-ch’i-ang); Shachte (Yarkand); Taxkorgan (Tash Kurgan); Yecheng (Karghalik); Yengisar (Yangi Shahr, Yangi Hissar); Yutian (Keriya).

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