Zeitschrift: Candollea : journal international de botanique systématique = international journal of systematic botany
Herausgeber: Conservatoire et Jardin botaniques de la Ville de Genève
Band: 40 (1985)
Heft: 1

Artikel: Taxonomie revision of the genus Tulipa L. in India and adjoining regions
Autor: Dasgupta, Syamali / Deb, D.B.
DOI: https://doi.org/10.5169/seals-879777

Taxonomic revision of the genus Tulipa L. in India and adjoining regions

SYAMALI DASGUPTA
&
D. B. DEB

RÉSUMÉ

DASGUPTA, S. & D. B. DEB (1985). Révision taxonomique du genre Tulipa L. en Inde et dans les régions voisines. *Candollea* 40: 157-173. En anglais, résumé français.

Ce travail est une révision taxonomique du genre *Tulipa* L. (Liliaceae) en Inde et dans les régions voisines. Six espèces et quatre formes extratypiques sont illustrées et décrites avec synonymies, citations, typifications, répartition, phénologie et écologie. Une clé des espèces et des formes est ajoutée. Quatre espèces sont signalées pour la première fois dans cette région. Trois espèces précédemment décrites sont mises en synonymie et quatre réduites à la forme. Les spécimens étudiés sont cités.

ABSTRACT

DASGUPTA, S. & D. B. DEB (1985). Taxonomic revision of the genus Tulipa L. in India and adjoining regions. *Candollea* 40: 157-173. In English, French abstract.

This paper presents a taxonomic revision of the genus *Tulipa* L. (Liliaceae) in India and adjoining regions. Six species and four extratypical forms are described and illustrated with synonymy, citations, typification, distribution, phenology and ecology. Key to the species and forms is worked out. Four species are reported for the first time from the region. Three hitherto known species are relegated to synonymy and four reduced to forms. Exsiccata studied are cited.

Introduction

LINNAEUS (1753, 1754) described the genus *Tulipa* with 3 species, *T. sylvestris, T. breyniana* and *T. gesneriana* basing on CLUSIUS (1583), BAUHIN (1623) and TOURNEFORT (1700) and placed the genus in-between *Erythronium* L. and *Ornithogalum* L. HITCHCOCK (1929) designated *T. gesneriana* as the lectotype. Other two species *T. sylvestris* and *T. breyniana* were transferred to *Liriopogon* Rafin. and *Beemetra* Salisb. respectively.

J. H. SCHULTES (1829) placed *Tulipa* between *Fritillaria* L. and *Erythronium* L. This was followed by BAKER (1874), BENTHAM (1883), ENGLER (1888) and KRAUSE (1930). In the meantime, some new genera allied to *Tulipa* were created on segregation of species already described under this or other genera. *Orithyia,* a monotypic genus was described by D. DON (1836) on the basis of *Ornithogalum uniflorum* L. Three genera, *Liriactis, Liriopogon* and *Podonix* were described by RAFINESQUE (1837) on the basis of *T. stellata* Hook., *T. sylvestris* L. and *T. biflora* L. respectively. Distinction of *Orithyia* was not recognised and it was merged with *Tulipa* by BAKER (l.c.), REGEL (1880), BOISSIER (1882), BENTHAM (l.c.), ENGLER (l.c.), KRAUSE (l.c.), VVEDENSKY (1935), HALL (1940), HUTCHINSON (1973) but ENDLICHER (1836), KUNTH (1843) and KOCH (1849) accepted it and placed the genus *Tulipa* L. in-between *Erythronium* L. and *Orithyia* D. Don. The distinctions of other 3 genera were not recognised by any subsequent authors who maintained them as *Tulipa.*

The present work is based on the study of herbarium specimens extant in BM, K, DD, LWG, CAL and BSD.

The study reveals the presence of 6 species and 4 extratypical forms in India and adjoining regions in place of 2 species described by HOOKER (1892).

CODEN: CNDLAR
ISSN: 0373-2967
40(1) 157 (1985)

Tulipa L., [Syst. Nat. 1735 & Gen. Pl. ed. 1. 91. 1737] Sp. Pl. 303. 1753 & Gen. Pl. ed. 6. 145. 1754; A. L. De Juss., Gen. Pl. 54. 1789; Endl., Gen. Pl. 140. 1836; Rafin., Fl. Tellur. 2: 34. 1837; Kunth, Enum. Pl. 4: 219. 1843; Baker in Journ. Linn. Soc. 14: 275. 1874; Boiss., Fl. Or. 5: 191. 1882; Benth. in Benth. & Hook. f., Gen. Pl. 3: 818. 1883; Engl. in Engl. & Prantl, Nat. Pflanzenfam. Teil 2. Abtl. 5: 62. 1888; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 333. 1930; Hutchinson, Fam. Fl. Pl. 754. 1973. *Orithyia* D. Don in Sweet, Brit. Fl. Gard. Ser. 2, 4: t. 336. 1836 (**Type:** *O. uniflora* D. Don); Endl., Gen. Pl. 140. 1836; Kunth, Enum. Pl. 4: 226. 1843. *Liriopogon* Rafin., Fl. Tellur. 2: 35. 1837 (**Type:** *L. sylvestris* (L.) Rafin.). *Liriactis* Rafin., Fl. Tellur. 4: 97. 1837 (**Type:** *L. albiflora* Rafin.). *Podonix* Rafin., Fl. Tellur. 9: 28. 1837 (**Type:** *P. albiflora* Rafin.).

Type: *T. gesneriana* L. (C. Asia Minor, *Linn. 425.2* LINN).

Herbs small, bulbous; bulb little below the soil, oblong or ovoid, imbricated; scales brown, thick, coriaceous, drying on maturity, often hairy inside; hairs long, silky, at the base or dense, woolly at the tip or few adpressed at the tip; daughter bulb solitary at the tip of the dropper which is formed by the tubular elongation of the base of the first vegetative leaf that becomes fibrous stolon. *Stem* long or short, about 30 cm subterranean. *Leaves* cauline, 1 or 2 or few, on the ground, gradually reducing in size upwards, linear or lanceolate, or broadly lanceolate, often thick, undulated at the margin, parallel-veined, without distinct midrib. *Flower* solitary, terminal or few in raceme, campanulate or cupular, 1.5-8 cm long, variable in colour, white or yellow with varying degree of purple shades on the dorsal side, or deep scarlet with or without basal blotch; peduncle 4-23 cm long; bract absent. *Perianth* segments 6 in 2 whorls, slightly dissimilar in shape; outer segments elliptic, acute or acuminate, often dorsally coloured; inner segments oblong, obtuse or acute or obovate with abruptly acuminate tip, glabrous or pubescent at the base, often blotched at the base; veins parallel, diverging or prominent midvein with parallel lateral ones. *Stamens* 6, much shorter than the perianth, often unequal; filaments subulate, glabrous or pubescent; attached at the base of the perianth; anthers linear-oblong, basifixed, as long as or longer or shorter than filaments, dehiscing laterally. *Pistil* syncarpous; ovary sessile, oblong or ellipsoid; ovules many in axile placentation; style absent or short; stigma truncate, trilobed. *Capsules* erect, oblong or subglobose, beaked at the tip, trilobed, trilocular. Seeds many, compressed; testa membranous.

Distribution. — About 100 species in temperate Eurasia especially in Steppe of C. Asia (AIRY SHAW, 1973). In Indian subcontinent it is represented by 6 species and 4 extra typical forms, of which *T. clusiana* with its 4 forms belonging to the sect. *Eriobulbi* and *T. lanata* of sect. *Tulipa* occur in India proper.

Range of variation in the genus Tulipa

Tulipa is a genus comprising many polymorphic species. Diploid species with their polyploid derivatives form taxonomic groups. Plants are small, bulbous, slow growing herbs. Bulbs lie slightly below the soil and vary in form from subglobose to ovoid or oblong. Scales are imbricate, broadly ovate, thick, coriaceous, brown. Hairs are present at the tip of scales inwards, protruding like wool in *T. clusiana* group or at the base as in *T. lehmanniana* and *T. lanata.* In sect. *Orithyia* bulbs are glabrous or provided with few, short, adpressed hairs at the tip of the scales only. Fleshy bulb scales gradually dry up with the elongation of the stem and production of leaves and flowers. In the meantime at axil of the scale a dropper is produced which bears at the apex a daughter bulb.

ARBER (1925) coined the term "dropper" and discovered its foliar origin. She showed that after germination of a seed the base of the cotyledon is prolonged into a dropper which carries the plumule downward. There is a bud inside the tip of the dropper. In the next year plumular bud enclosed at the tip, produces a leaf which elongates at the base into a tubular dropper carrying terminal bud downwards. She also demonstrated that the tip of the dropper enclosing a bud develops into a full-fledged bulb, scale of which is formed by the dropper wall. Inside the scale she observed tubular base of the foliage leaf, which again continues downwards into another dropper.

In the young plant the dropper is formed from annual vegetative leaf. In this way bulbs are placed deep into the soil. The stem arising from the bulb runs underground for about 30 cm before coming out of the ground. It may be long and stout with leaves gradually diminishing in size up-

wards as in *T. clusiana* or may be short with 2 subterranean leaves and a flower borne on a relatively long peduncle as in *T. heteropetala* and *T. heterophylla.* Leaves may be linear or lanceolate with undulated margin and parallel veins without distinct midrib. The peduncle varies from 4 cm to 23 cm in length. Bract is absent.

The flower may be solitary or few. It varies in shape, size and colour. It may be narrow or broad, 1.5-2 cm long in sects. *Orithyia* and *Sylvestris,* 2-4 cm long in sect. *Eriobulbi* and 5-8 cm long in sect. *Tulipa.* Colour may be white, yellow or red and purple, varying in degree on the dorsal side, particularly on the outer perianth of white and yellow flowers. White flowers with yellow basal blotch are seen in *T. clusiana* f. *stellata* and with pink basal blotch in *T. clusiana* f. *clusianoides.* Yellow flowers are seen in *T. clusiana* f. *porphyreochrysantha* and f. *fernandezii.* Flower colour is light dirty yellow with violet tinge in sects. *Orithyia* and *Sylvestris.* Deep red flower with deep brown basal blotch is present in sect. *Tulipa.* Perianth whorls are slightly dissimilar. Outer segments are elliptic, acute, while inner ones are oblong and obtuse in *T. clusiana.* Sometimes outer segments are acuminate and inner ones acute as in *T. heteropetala.* In *T. lehmanniana* and *T. lanata* the inner segments are obovate, abruptly acuminate, and outer ones are oblong, acute. Veins are parallel in sects. *Sylvestris* and *Orithyia,* whereas prominent midvein with parallel lateral veins are seen in sect. *Tulipa. Stamens* and pistil are much smaller than perianth. Filaments are subulate, bearing narrowly oblong, basifixed, laterally dehiscing (latrorse) anthers. They are shorter than anthers in *T. clusiana* f. *clusianoides* and f. *fernandezii,* as long as anthers in sect. *Tulipa,* and also in *T. clusiana* f. *stellata,* f. *porphyreochrysantha,* f. *clusiana* and longer than anthers in sects. *Sylvestris* and *Orithyia.* Filaments and perianth segments are hairy at the base in sect. *Sylvestris* and glabrous in others. Style varies in length. It is absent in sects. *Tulipa* and *Eriobulbi,* insignificant in sect. *Sylvestris,* being formed of attenuation of the ovary, and prominent in sect. *Orithyia.* Propagation chiefly takes place by means of bulbs. Capsules when formed, are oblong or subglobose with beaked tip and many compressed seeds.

According to HALL (1940) visible colour of the *Tulipa* flower is determined by the presence of anthocyanins in the sap and of yellow or white plastids in the mesophyll cells. The blotch, filament, anther and pollen are deeply coloured with a deep purple anthocyanin in combination with a yellow plastid background. Good species as a rule contains single anthocyanin without admixture of second pigment. Hybrids show blending of colours. "The colour of *Tulipa* species is a variable feature, to which too much weight must not be attached in taxonomic determinations".

Cytology

Cytological study by various workers reveals high percentage of polyploidy within the genus. GUIGNARD (1900), originally determined the chromosome numbers of 3 species including *T. clusiana* as $n = 12$. Triploid, tetraploid, and pentaploid have been observed by DE MOLE (1925), NEWTON (1927) and NEWTON & DARLINGTON (1929). Polyploid series occur in both the sections *Eriostemones* and *Leiostemones* (UPCOTT & LA COUR, 1936) and these groups are mutually sterile. Differences in genotype, phenotype, time of meiosis and intersterility in the subgroup *Clusianae* of the *Leistemones* point to the conclusion that it is as distinct from the other subgroup as it is from *Eriostemones.* Although the diploid species reproduce sexually in the wild, polyploid is purely clonal since no aneuploids have been found. They showed odd multiples of polyploids and probably tetraploids are in effect clones and produce offsets and droppers. HALL (1937, 1940) observed that in all the sections of *Tulipa* original diploid parents and their polyploid derivatives are rarely distinguishable and appear to form a group. According to him many of the 200 species of "Index Kewensis" are synonymous. They are polymorphic. These clonal population often established as geographical subspecies.

Triploid, tetraploid and pentaploid were observed in *Tulipa clusiana* DC. and allied taxa which on morphological characters have been divided here into 5 forms as: *T.* clusiana DC. f. *clusiana,* f. *fernandezii* (Blatt.) Dasgupta & Deb, f. *porphyreochrysantha* (Blatt.) Dasgupta & Deb, f. *stellata* (Hook.) Dasgupta & Deb and f. *clusianoides* (Wendelb.) Dasgupta & Deb. Basic chromosome number of this group is $2n = 24$.

Both 24 and 48 chromosome numbers were reported in *T. chrysantha* Boiss. (= *T. clusiana* DC. f. *porphyreochrysantha* (Blatt.) Dasgupta & Deb) and *T. clusiana* DC. (= *T. clusiana* DC. f. *clusiana*) by UPCOTT & LA COUR (l.c.) and *T. stellata* Hook. (= *T. clusiana* DC. f. *stellata*

(Hook.) Dasgupta & Deb) by DARLINGTON & JANAKI AMMAL (1932). HALL (l.c. and 1938), SOBTI & SINGH (1961) and PODLECH & BADER (1974) observed 24 chromosomes in *T. stellata* Hook. (*T. clusiana* DC. f. *stellata* (Hook.) Dasgupta & Deb) and *T. aitchisonii* Hall (= *T. clusiana* DC. f. *porphyreochrysantha* (Blatt.) Dasgupta & Deb). Thirty six chromosomes were observed in *T. stellata* Hook. by MALIK (1961) and MEHRA & PANDITA (1978). Sixty chromosomes were observed by NEWTON (l.c.) and NEWTON & DARLINGTON (1929).

HALL (1938) discovered the diploid species with yellow flowers from Kashmir and named it as *T. aitchisonii* in honour of the well known collector of the area J. E. T. Aitchison, which is reduced here as *T. clusiana* DC. f. *porphyreochrysantha* (Blatt.) Dasgupta & Deb. *T. clusiana* DC. f. *clusiana* pentaploid is sterile, stoloniferous in habit but often shows seed setting by parthenocarpy. Tetraploid species shows reduced fertility. As such it appears, that they are autopolyploid arising within the species without hybridization (HALL, 1940).

Infrageneric classification

KOCH (1849) grouped the species on hairy or glabrous bulbs into two divisions, *Lanigera* and *Leiobulbos,* without indicating the status. REGEL (1880) divided the genus into two divisions on hairy or glabrous perianth and filaments' base, without naming or assigning the status of the divisions. These divisions were named by BOISSIER (1882) as *Eriostemones* and *Leiostemones.* BAKER (1874) reduced the genus *Orithyia* D. DON (1836) to a subgeneric status under *Tulipa* for only difference in having ovary attenuated at the apex. Typical *Tulipa* without style was named as subgenus *Eutulipa (= Tulipa). Eutulipa* was further divided into 5 sections: *Eriobulbi, Gesnerianae, Scabriscapae, Saxatiles, Sylvestris* for the presence or absence of hairs on the bulb scales, peduncle or at the base of the filaments.

ENGLER (1888) and KRAUSE (1930) followed the classification by Baker. VVEDENSKY (1935) divided the genus into six sections for presence or absence of hairs in the bulb, base of the filaments, presence or absence of style, etc. as: *Tulipanum* Reb., *Leiostemones* Boiss., *Spiranthera* Vved., *Lophophyllum* Vved., *Eriostemones* Boiss. and *Orithyia* Baker.

HALL (l.c.) in consideration of cytological study divided the genus into two sections, following Boissier (l.c.). He further subdivided the sect. *Eriostemones* Boiss. into three subsections: *Australes, Saxatiles, Biflora* and sect. *Leiostemones* Boiss. into six subsections: *Clusianae, Gesnerianes, The oculus soles* Group, *Eichlers, Kolpakowskianae* and *Orithyia.*

In course of this study, *Tulipa* of Indian subcontinent are grouped into 4 sections — *Orithyia, Sylvestris, Eriobulbi,* and *Tulipa,* following VVEDENSKY (l.c.) and correcting the nomenclature according to ICBN.

Key to the sections and species of Tulipa

1. Flowers big (2-8 cm long). Perianth white or deep yellow or red. Style absent. Filament glabrous 2

1a. Flowers small (1.5-2 cm long). Perianth yellow with deeper-coloured streaks. Style distinct or not 4

2. Bulb scales with long hairs within. Perianth red with prominent deep-coloured basal blotch; segments obovate or elliptic abruptly acuminate; lateral veins at 45 angle with the midrib and running parallel (Sect. **Tulipa**) 3

2a. Bulb scales profusely woolly at the apex within. Perianth not red, basal blotch absent or light-coloured. Perianth segments elliptic or oblanceolate, acute or blunt; veins diverging (Sect. **Eriobulbi**) ..... **3. T. clusiana**

3. Peduncle pubescent. Leaves scattered, oblong ..... **1. T. lanata**

3a. Peduncle glabrous. Leaves crowded below, linear or linear-lanceolate **2. T. lehmanniana**

4. Bulb scales glabrous or with few short hairs at the apex within. Filaments and perianth base glabrous. Style distinct (Sect. **Orithyia**) 5

4a. Bulb scales hairy at the apex within. Filaments and perianth hairy at base. Style indistinct (Sect. **Sylvestris**) ..... **6. T. buhseana**

5. Bulb scales glabrous within. Perianth elliptic, acute ..... **4. T. heterophylla**

5a. Bulb scale glabrous or few short hairs at the apex within. Perianth elliptic or oblong, outer acuminate, inner acute ..... **5. T. heteropetala**

Tulipa L. sect. **Tulipa**

Tulipa sect. *Dulipanum* Reb., Giorn. Bot. Ital. Parl. 2: 60. 1847, pro parte. *Tulipa* L. sect. *Lanigera* C. Koch in Linnaea 22: 225. 1849, stat. incert. *Tulipa* L. sect. *Gesnerianae* Baker in Journ. Linn. Soc. 14: 276. 1874; Hall, Gen. Tulipa 93. 1940, pro subsect. *Tulipa* L. sect. *Leiostemones* Boiss., Fl. Or. 5: 191. 1882, pro parte; Engl. in Engl. & Prantl, Teil 2, Abt. 5: 62. 1888, pro parte; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 15a: 336. 1930, pro parte; Vved. in Komarov, Fl. U.S.S.R. 4: 331. 1935.

Type: *Tulipa gesneriana* L.

Bulb scales with long hairs within. *Perianth* deep red, with deep brown basal blotch; inner perianth obtuse abruptly acuminate with midvein and parallel lateral veins.

Distribution. — From W. & C. Asia extend to India.

1. Tulipa lanata Regel in Act. Hort. Petrop. 8: 647. 1884 (**Type:** U.S.S.R. Bukhara-Beldschuan, *Regel* s.n. LE); Stapf in Curtis, Bot. Mag. 152: t. 9151. 1926; Hall, Gen. Tulipa 118. t. 29. f. 20. 1940; Wendelbo in Koie & Reching., Symb. Afghan. 4: 162. 1958 (Fig. 1).

Herb medium-sized; bulbs 4-5 cm across, ovoid, stoloniferous; scales brown, outer papery, enclosing a thick coat of long hairs arising from the base of the inner ones. *Stem* up to 50 × 0.6 cm. *Leaves* 4-5, sessile, scattered, smaller above, 12-30 × 2-6 cm, lanceolate or oblong, acute, sometimes long acute, entire, often undulated at margin, parallel-veined, often pubescent above. *Flower* solitary, terminal, widely cupular; peduncle 10-21 × 0.3-0.5 cm, pubescent. *Perianth* segments brilliant scarlet with black blotch at the base with yellow margin, light-coloured outside, 6-8 × 3-3.5 cm, obovate, abruptly acuminate, glabrous, few prominent median veins with parallel lateral veins, tip of outer segments pubescent. *Filaments* black, except the tip, 8-10 × 2-3 mm, subulate, long-pointed at the apex, glabrous; anthers deep purple, 10-15 × 3-4 mm, ovate-oblong. *Ovary* deep green, 15-25 × 4-5 mm, oblong; style absent; stigma 5 mm broad, papillose.

Flowering. — April-May.

Distribution. — Extends from N.W. Persia, Bukhara, Turkestan, Afghanistan to Pakistan and Kashmir in India at about 2000 m altitude.

Exsiccata examined

India. Kashmir, Srinagar, *Mrs. Wather 76* (K) & *P. N. Kohli 47* (K). **Pakistan.** *Mozae Khir* s.n. (DD).

2. Tulipa lehmanniana Merckl. ex Bunge, Beitr. Kenntn. Fl. Russl. 1851; reimp. ex Mem. Sav. Etr. Acad. Petersb. 7: 513. 1854 (**Type:** U.S.S.R., Buchara, 1892, *Lehmann 23* LE); Vved. in Komarov, Fl. U.S.S.R. 4: 341. 1935; Hall, Gen. Tulipa 140. 1940; Wendelbo in Koie & Reching., Symb. Afghan. 4: 162. 1958; Kitam., Fl. Afghan. 2: 75. 1960. *T. montana* Lindl. var. *chrysantha* Boiss., Diagn. Pl. 2(13): 19. 1854 (**Type:** Iran, *Kotschy 78* BM, CAL — duplicate!). *T. chrysantha* [Boiss. in Kotschy Pl. Pers. Bor. Exsicc. No. 78. 1846] Baker in Journ. Linn. Soc. 14: 279. 1874, pro parte; Boiss., Fl. Or. 5: 193. 1882; Hook. f., Fl. Brit. Ind. 6: 355. 1892, pro parte (Fig. 1).

Herbs small; bulbs 2-5 × 2.5-5 cm, globose or ovoid, stoloniferous; scales enclosing a thick layer of long hairs; dropper 16-30 × 1 cm, scaly outside, fibrous inside, developing from the mother bulb and bearing daughter bulb. *Stem* 9-25 cm long, glabrous. *Leaves* 3-4, crowded at the base of the aerial stem, upper smaller, 3-16 × 0.2-2 cm, sessile, linear to lanceolate, acute, plicate, undulated cartilaginous at margin. *Flowers* solitary, 3.5-5 × 1.5-2.3 cm, red with blackish blotch

Fig. 1. — *Tulipa lanata* Regel
a, flowering twig; **b,** stamen; **c,** pistil.
Tulipa lehmanniana Merckl.
d, whole plant; **e,** stamen; **f,** pistil; **g,** capsule.

at the base; blotch $^1/_{5th}$ of perianth; few midveins, and parallel, lateral veins at 45° angle with midveins, outer segments elliptic, acuminate; inner obovate, abruptly acuminate. *Filaments* 6-8 × 1.5 mm, subulate, glabrous; anthers 6-8 × 1.5 mm oblong. *Ovary* ± 8 × 2.5 mm, ovoid-oblong; style absent; stigma ± 2 mm, broad. *Capsule* ± 3.7 × 2 cm, oblong, dull, brown, dehiscing margin with short, erect hairs.

Flowering & fruiting. — April.

Distribution. — Extends from Iran, S. U.S.S.R., through Afghanistan to Pakistan, in mountain ranges up to 2000 m altitude.

Local name. — 'Govarikh' (Baluchistan); 'Lala', 'Lale', 'Gole-i-Lale', 'Wadak' and 'Gwaragh' (Afghanistan).

Uses. — Bulbs are eaten as a vegetable by local people and leaves are used as fodder for goats.

Note. — A note regarding the taxonomic position of *T. chrysantha* (Boiss.) Baker is given under *T. clusiana* f. *porphyreochrysantha.*

Exsiccata examined

Pakistan. Baluchistan, Khojak Pass, *Duthie 8723* (BM, CAL); Quetta, *Hamilton* s.n. (CAL); Peshin Eti, *J. H. Lace 3536* (CAL); Shelabagh, *J. H. Lace 3536* (CAL); Upper Baluchistan, *Dalzell 860* (CAL). **Afghanistan.** Harirud valley, *J. E. T. Aitchison 151 & 193* (CAL).

Tulipa sect. **Eriobulbi** Baker in Journ. Linn. Soc. 14: 276. 1874.

= *Liriactis* Rafin., Fl. Tellur. 4: 97. 1837. *Tulipa* L. sect. *Tulipanum* Reb., Giorn. Bot. Ital. Parl. Ann. 2: 60. 1847. *Tulipa* L. sect. *Leiostemones* Boiss., Fl. Or. 5: 191. 1882, pro parte; Engl. in Engl. & Prantl, Nat. Pflanzenfam. Teil 2, Abt. 5: 62. 1888, pro parte; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2, 15a: 336. 1930, pro parte; Vved. in Komarov, Fl. U.S.S.R. 4: 331. 1935; Hall, Gen. Tulip. 81. 1940, pro subsect. *Clusianae* Hall.

Type: *T. clusiana* DC.

Bulbscales profusely woolly at the apex within. *Flowers* big. *Perianth* white or deep yellow with light-coloured basal blotch and often outer perianth coloured outside, elliptic or oblanceolate, outer acute, inner obtuse; veins parallel, diverging. *Filaments* glabrous. *Style* absent.

Distribution. — W. Asia to Pakistan and India.

3. Tulipa clusiana DC. in Red., Liliac. 1. t. 37. 1803; Kitam. in Fl. Afghan. 2: 75. 1960 (Fig. 3).

Herbs small to medium-sized, bulbs lie little below the soil, 1.5-4 × 1-3.5 cm, globose or ovoid; often with daughter bulb at the end of a stolon coming out of the bulb; scales few-layered, deep brown, dull, coriaceous, broadly ovate, longitudinally fissuring, woolly inside at the apex. *Stem* 8-50 cm long, lower $^1/_3$-$^1/_2$ the portion underground, glabrous. *Leaves* crowded or sparse, 2-2.5 × 0.2-1.5 cm, linear or linear-lanceolate, acute or acuminate, coriaceous, without distinct midvein, often margin undulated cartilaginous. *Flowers* terminal, solitary, broadly campanulate, variable in colour from white with pink shade to complete yellow with red shade outside; peduncle 4-30 cm long, glabrous. *Perianth* segments dissimilar, 2-6 × 0.5-1.8 cm, elliptic or oblanceolate, outer acute, inner obtuse, glabrous; veins diverging. *Stamens* less than half the length of perianth; filaments subulate, glabrous; anthers as long as filaments or longer or shorter, oblong. *Pistil* as long as stamens; ovary oblong; style absent; stigma obscurely trifid. *Capsules* 2-3.5 × 1.5-2.5 cm, oblong or broadly oblong, trilobed, trilocular, beaked above. *Seeds* semi-rotund, compressed, brown, thickened at the margin.

Distribution. — Iran to India to the east, through Afghanistan and Pakistan along the mountain ranges above 1670 m (Fig. 2).

Note. — This is a polymorphic group having members slightly differing from one another. According to HALL (1937, 1940) members are evolved by natural polyploidy, and probably autopolyploids arising within the species without hybridization. He postulated that polyploids

have been evolved from *T. aitchisonii* Hall with diploid chromosome number. From this diploid pentaploid *T. clusiana* DC. and tetràploid *T. stellata* Hook. and *T. chrysantha* (Boiss.) Baker were evolved.

REGEL (1880) reduced *T. stellata* Hook to *T. clusiana* DC. var. *stellata* (Hook.) Regel. SEALY (1948) considered them as one variable species with different chromosome numbers, and reduced *T. chrysantha* (Boiss.) Baker to *T. clusiana* var. *chrysantha* (Baker) Sealy. WENDELBO (1958) found another diploid which he named *T. aitchisonii* Hall var. *clusianoides* Wendelbo. KITAMURA (1960) reduced *T. aitchisonii* Hall and *T. aitchisonii* Hall var. *clusianoides* Wendelbo to *T. clusiana* DC. var. *chrysantha* (Baker) Sealy.

Scatter diagrams (Fig. 2) throw light on distribution of the characters, and delimitation of taxa. Tall plants (more than 20 cm long), scattered leaves, bigger flowers (more than 3.5 cm long), perianth white with pink markings outside and pink basal blotch, anthers not longer than filaments have been taken as standard characters as evident in *T. clusiana* DC. f. *clusiana.* Opposite characters are represented by different signs. It is observed that plants with yellow flowers, longer anthers and other characters in different combinations occur in Chitral at 2134-3350 m in altitude. It extends southwards along the mountain ranges bordering Afghanistan and Pakistan at lower altitudes. It is rarely found in the west. These specimens tally with the description of *T. fernandezii* Blatt. from Waziristan, which has not been studies cytologically.

Another group with yellow flowers and anthers as long as or shorter than filaments associated with other characters, in different combinations is wide spread in Karakorum, Kashmir and Himachal Pradesh between 2134 m and 3350 m in altitude. It occurs in Pakistan at lower altitudes along the same distributional line. The type specimen of *T. aitchisonii* Hall from Kashmir (*Konway* s.n. K; *Toppin 33,* K) possesses these characteristics. Photograph of the type of *T. aitchisonii* Hall subsp. *cashmiriana* Hall, collected by *T. Hay* from Zaskar, Ladak, also shows the same characters. The type of *T. chrysantha* Baker. (= *T. clusiana* DC. var. *chrysantha* Sealy) *Griffith 5788* (CAL) also belongs to this group. *T. aitchisonii* Hall has already been merged with *T. clusiana* DC. var. *chrysantha* Sealy by KITAMURA (1960). Though the type of *T. porphyreochrysantha* Blatt. collected from Waziristan has not been seen yet the description agrees with these above-mentioned specimens. Since diploid *T. aitchisonii* Hall and tetraploid *T. chrysantha* Baker are morphologically similar they are treated here as synonymous.

Another taxon with longer white flowers, pink outside, with longer anthers occurs at Chitral (Pakistan), Kashmir and U.P. Though the type has not yet been seen it is visualised that this is also a diploid of Hall, collected by W. R. Dykes and later on validated by Wendelbo as *T. aitchisonii* Hall var. *clusianoides* Wendelbo based on Afghanistan specimens *Volk 1466* (W).

A group of white-flowered plants with smaller anthers and scattered leaves are available. Flowers with pink basal blotch in typical *T. clusiana* DC. which according to Hall is pentaploid and occurs in Kashmir, U.P. and Pakistan in Rawalpindi, Saltrange below 1828 m in altitude. White flowers with yellow basal blotch, *T. clusiana* DC. var. *stellata* (Hook.) Regel has more eastern extension in the Himalayas in Kashmir, H.P., U.P. It is rare in Chitral and Saltrange. Hall observed tetraploidy in this species.

Dwarf plants with tendency of whorled leaves are found more towards the drier west in Pakistan and Afghanistan. This appears to be an ecological variation. Yellow diploid has no difference with yellow tetraploid. Even though it might have been originally described from Kashmir it extends more towards Pakistan and other western countries and is found at higher altitudes than white forms. White forms might have originated in Hindukush mountain and migrated to the east to India and west in Pakistan. Polyploid white forms differ from diploid in smaller anthers. Tetraploid of white distinguished by its yellow blotch of perianth is more frequent in India and pink blotched pentaploid is more common in Pakistan and westwards.

This shows polyploidy is not associated with morphological variation. For this reason such plants cannot be assigned to any infraspecific rank other than form. Accordingly this group is treated as five forms of the same species.

Key to the forms of Tulipa clusiana

1. Anthers as long as or shorter than filaments 2

1a. Anthers longer than filaments 4

2. Flowers white with pink outside 3

2a. Flowers yellow suffused with red ..... **3c. T. clusiana** f. **porphyreochrysantha**

3. Basal blotch of perianth pink ..... **3a. T. clusiana** f. **clusiana**

3a. Basal blotch of perianth yellow ..... **3b. T. clusiana** f. **stellata**

4. Flowers yellow with violet or red outside ..... **3d. T. clusiana** f. **fernandezii**

4a. Flowers white with pink outside ..... **3e. T. clusiana** f. **clusianoides**

3a. T. clusiana DC. f. **clusiana**

= *T. clusiana* DC. in Red. Liliac. 1: t. 37. 1803; Sims., in Curtis Bot. Mag. 34: t. 1890. 1811; Kunth, Enum. Pl. 4: 223. 1843; Baker in Journ. Linn. Soc. 14: 281. 1874; Boiss., Fl. Or. 5: 194. 1882; Hall, Gen. Tulipa 86. 1940; Wendelbo in Symb. Afghan. 4: 162. 1958. *T. chitralensis* Hall, Gen. Tulipa 85. 1940, nom. nud. (**Type:** Chitral, *Lt. Col. Hamilton* s.n. K, DD — duplicate!).

Herbs 30-50 cm long; bulbs lie at a depth of 20-23 cm below soil, 2.5-3.5 × 1.5-3 cm, globose or ovoid; scales broadly ovate, outer deep brown, dull, coriaceous, longitudinally fissuring, woolly inside at the apex; stem 18-45 cm long, stouter when fruiting, glabrous. *Leaves* 5-6, sparse or more or less crowded, 7-25 × 0.2-1.5 mm, linear or linear-lanceolate, often undulated at the margin, acute or acuminate at the apex. *Flower* solitary, terminal, broadly campanulate; peduncle 10-30 cm, very long. *Perianth* both the whorls pink or inner white striped with pink outside; segments dissimilar, outer 5-6 × 1.5-1.8 cm, elliptic, acute, obtuse; inner 3.5-4 × 0.8-1 cm, oblanceolate, obtuse. *Filaments* 8-11 × 1.5 mm, subulate, glabrous; anthers 8-10 × 1.5 mm, narrowly oblong, as long as the filaments. *Ovary* 11 × 3 mm, oblong; stigma trifid.

Flowering. — March-May.

Ecology. — Open rocky ground or sandy soil on mountain ranges at 2700-3000 m altitude and on sandy soil in cultivated areas. Bulbs 20-23 cm below soil.

Distribution. — W. Himalayas in U.P., Kashmir and Pakistan (Fig. 2).

Exsiccata examined

India. Kashmir, Lidar valley, *F. Ludlow 10* (BM); Verynag, *Srivastava* s.n. (LWG). U.P., Dehradun, *Hiralal* s.n. (LWG). H.P., Kunwar, *Drummond 26 543* (K): **Pakistan.** Peshwar, *Stewart 19* (CAL); Rawalpindi, *Aitchison 1119* (K); Landikotal, *D. G. Lowndes 1715* (CAL); Kilbu, *Schlich* s.n. (CAL); N.W. Himalaya, Jaunsar, *Duthie 14 451* (BM, CAL).

3b. T. clusiana DC. f. **stellata** (Hook.) Dasgupta & Deb **comb. & stat. nov.**

= Basionym: *T. stellata* Hook. Bot. Mag. 64: t. 2762. 1827 (**Type:** Kumaon, *Wallich 5081A* (K-W), flowering in Liverpool Botanic Garden); Kunth, Enum. Pl. 4: 223. 1843; Baker in Journ. Linn. Soc. 14: 281. 1874 (excluding *Kotschy 99*); Hook. f., Fl. Brit. Ind. 6: 355. 1892; Collett., Fl. Simlens. 528. 1902; Bamber, Pl. Punj. 443. 1916; Coventry, Wild Fl. Kashmir 99. 1923; Blatt., Beaut. Fl. Kashmir 2: 178. t. 5. 1928; Hall, Gen. Tulipa 84. 1940; Wendelbo in Koie & Reching., Symb. Afghan. 4: 163. 1958. *Liriactis albiflora* Rafin., Fl. Tellur. 97. 1836. *Tulipa clusiana* DC. var. *stellata* (Hook.) Regel in Act. Hort. Petrop. 1. 54. 1873 (Fig. 3).

Herbs 30-40 cm long, bulbs lie little below the soil, 2-3 × 1.5-2 cm, globose or ellipsoid; scales deep brown, dull, coriaceous, hairy inside at the tip; stem 30-35 cm long, glabrous. *Leaves* 4-6, more or less crowded, 6-30 × 0.3-1.5 cm, linear or linear-lanceolate, entire, acute or acuminate. *Flower* solitary, terminal, campanulate; peduncle 10-22 cm. *Perianth* white, yellow at base, outer whorl crimson outside, 3.5-6 × 1-1.3 cm, elliptic, acute; inner 3-5 × 0.8-1 cm, elliptic, oblanceolate, obtuse. *Filaments* 9-11 × 1.5 mm, subulate; anthers 5-7 × 1.5 mm, oblong, apiculate. *Ovary* 1.3-1.5 × 0.25-0.3 cm, oblong, 6-striated; stigma trifid. *Capsules* ± 3 × 2 cm, oblong, trilobed, trilocular, prominently beaked.

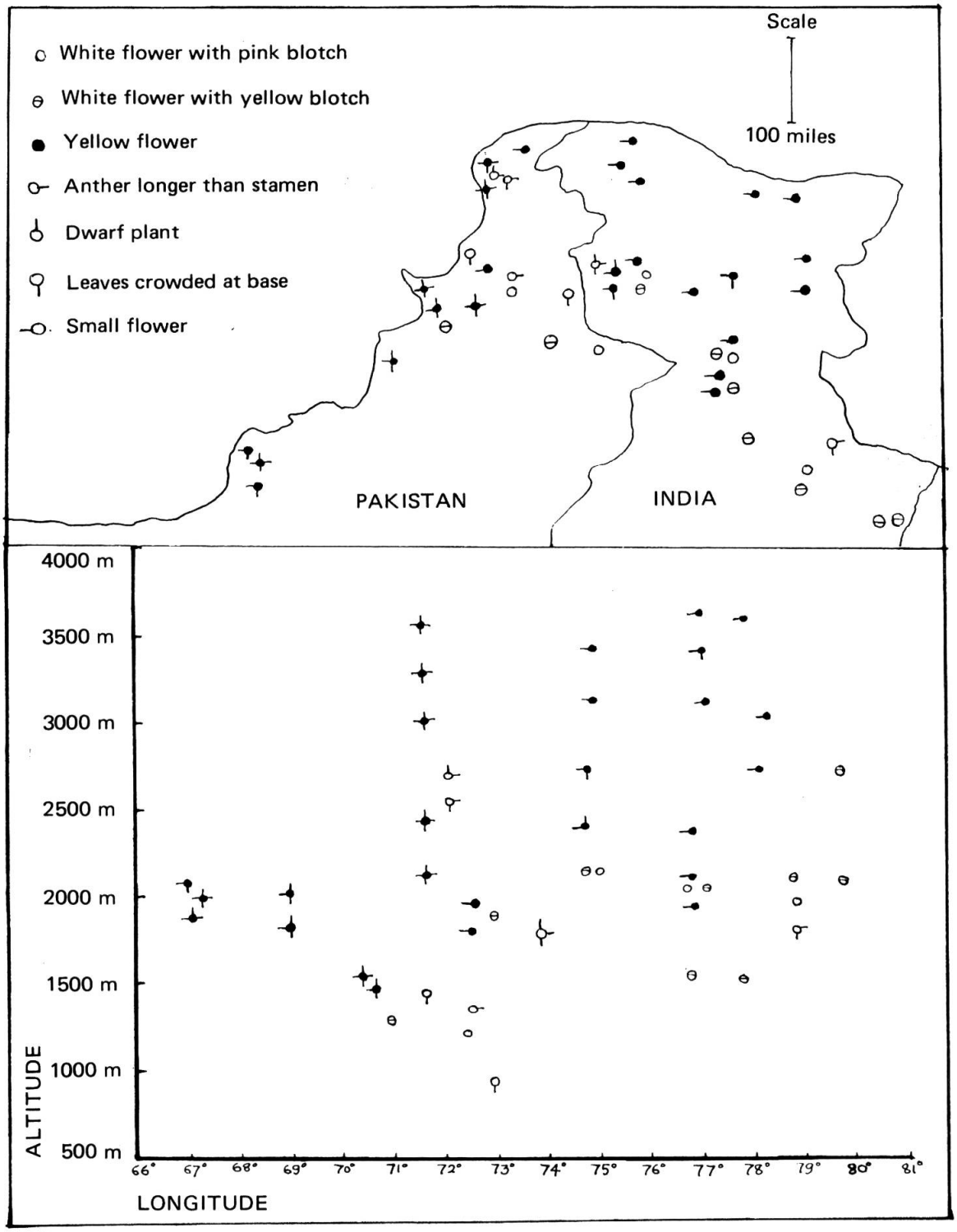

Fig. 2. — *Tulipa clusiana* DC.
Scatter diagram showing distribution in India and Pakistan.

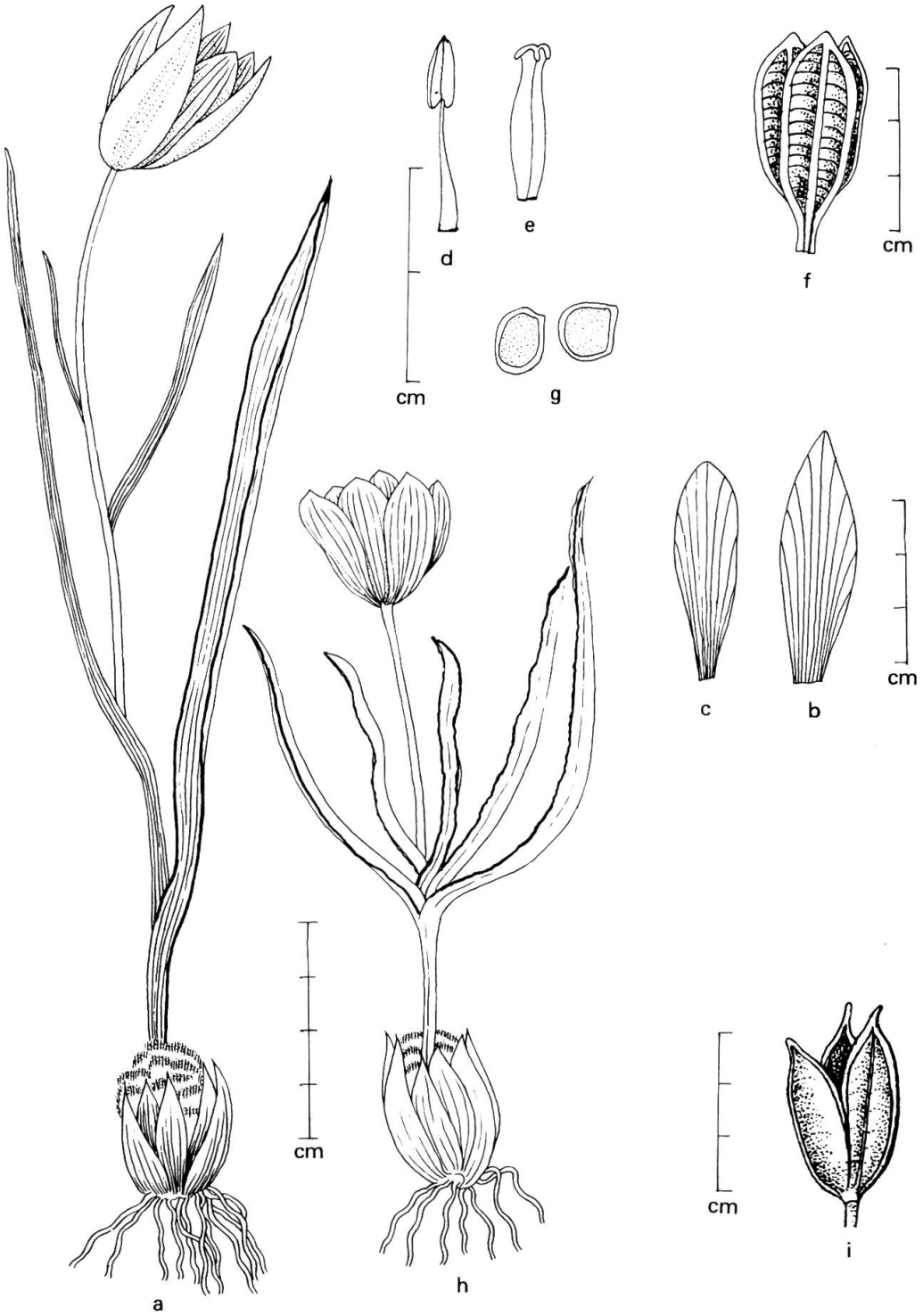

Fig. 3. — *Tulipa clusiana* DC. f. *stellata* (Hook.) Dasgupta & Deb
a, whole plant; **b,** outer perianth segment; **c,** inner perianth segment; **d,** stamen; **e,** pistil; **f,** capsule; **g,** seed.
Tulipa clusiana DC. f. *fernandezii* (Blatt.) Dasgupta & Deb
h, whole plant; **i,** capsule.

Flowering. — February-May.

Fruiting. — May.

Ecology. — On rocks or sandy soil at 2000-2200 m altitude.

Distribution. — W. Himalaya in Kashmir, Himachal Pradesh and Uttar Pradesh extending to Pakistan (Fig. 2).

Local name. — 'Unjvar' (Kangra).

Exsiccata examined

India. Himachal Pradesh, Simla, *J. S. Gamble 5882C* (CAL), *Johnson* s.n. (CAL) and *Collett* s.n. (CAL); Chamb, *J. H. Lace 1883* (CAL); Jawala Mukhi, *Watt 15 525* (CAL); Sarahan, *N. C. Nair 21 919* (BSD). U.P., Kumaon, *Strachey & Winterbottom* s.n. (CAL) and *N. Gill 563* (CAL, LWG); Almora, *Kaul & party 19 182* (K); Mussoorie, *P. N. Mackinnon* s.n. (CAL); Bashar-Kotgarh, *J. H. Lace 805* (CAL). Kashmir, Pahalgaon, *Ludlow & Sherriff 7600* (BM). **Pakistan.** Saltrange, *Aitchison 22* (CAL) and *Edgeworth* s.n. (CAL); Kohat, *J. H. Barbour* (BM); Hazara, *Inayat 20 209* (CAL).

3c. T. clusiana DC. f. **porphyreochrysantha** (Blatt.) Dasgupta & Deb **comb. et stat. nov.**

= Basionym: *T. porphyreochrysantha* Blatt. in Journ. Bomb. Nat. Hist. Soc. 37: 421. 1934 (**Type:** Pakistan, Wazirstan, *Meynell 999,* BLAT). *T. chrysantha* Baker in Journ. Linn. Soc. 14: 229. 1874, pro parte, excluding type, Hook. f., Fl. Brit. Ind. 6: 355. 1892, non Boiss., pro Afghanistan specimens; Bamber, Pl. Punj. 443. 1916. *T. aitchisonii* Hall in Journ. Bot. 76: 315. 1938 (**Type:** Chitral, *Schomberg* s.n. Holotype BM! *Toppin 33* paratype K — Photo! CAL! *Konway* s.n. paratype K!); Hall, Gen. Tulipa 83. 1940; Wendelbo in Koie & Reching., Symb. Afghan. 4: 161. 1958. *T. aitchisonii* Hall subsp. *cashmiriana* Hall in Journ. Bot. 76: 315. 1938 (**Type:** Kashmir, Ladak, *T. Hay* s.n.holotype K — Photo! Kashmir, Dras, *Osmaston 108* paratype K — Photo!), *syn. nov. T. stellata* Hook. var. *chrysantha* Hall, Gen. Tulipa 85. 1940. *T. clusiana* DC. var. *chrysantha* (Boiss.) Sealy in Curtis Bot. Mag. 165. t. 13. 1948; Kitamura in Fl. Afghan. 2: 75. 1960, *syn. nov.*

Herbs 20-40 cm long; bulbs lie little below the soil, 3.5-4 × 1.5-3 cm, ovoid or ellipsoid, scales few-layered, broadly ovate, coriaceous, hairy at the apex within, longitudinally fissuring, outer deep brown, dull; stem 20-40 cm long, glabrous. *Leaves* 4-6, more or less crowded, 4-22 × 0.3-1.5 cm, linear or linear-lanceolate, upper smaller, lower longer, acute or acuminate, entire or undulated at the margin. *Flower* solitary, terminal, campanulate; peduncle 12-30 cm long. *Perianth* bright yellow suffused with red, dissimilar, outer segments 2-3.5 × 1-1.5 cm, elliptic, acute; inner segments 2-3 × 0.8-1.2 cm, elliptic or obovate, obtuse. *Filaments* yellow, 6-10 × 1-1.5 mm, subulate, as long as or longer than anthers; anthers yellow, 4-8 × 1.5-2 mm, oblong. *Ovary* 5-9 × 2-3 mm, brown, broadly ellipsoid; stigma sessile, obscurely trifid. *Capsules* 2 × 2 cm, globose or broadly oblong, prominently beaked. *Seeds* brown, 6 × 4 mm, semi-rotund, narrowly winged.

Flowering & fruiting. — March-July.

Ecology. — On damp rock or grassy slopes of hills at 1219-3350 m in altitude.

Distribution. — Karakoram and Western Himalayas in Kashmir, Himachal Pradesh and Hindukush and other mountains of Pakistan and Afghanistan (Fig. 2).

Uses. — Local people in Kashmir eat the bulb as a vegetable.

Local name. — 'Shandi Gul' (Waziristan).

Note. — Holotype of *T. montana* Lindl. var. *chrysantha* Boiss. is Iran, *Kotschy 78* (BM, CAL — duplicate). *Tulipa chrysantha* (Boiss.) Baker l.c. (1874) is based on *T. montana* Lindl. var. *chrysantha* Boiss., Diagn. Pl. 2(13): 19. 1854, described on the basis of two gatherings from Iran and Afghanistan. Duplicate of the Type Iran, *Kotschy 78* (CAL) is completely different from Afghanistan, *Griffith 5788* (CAL) referred by BAKER (1874). HOOKER f. (1892) followed BAKER (l.c.) and overlooked the grouping of unrelated specimens. In this treatment *T. chrysantha*

(Boiss.) Baker pro Iran *Kotschy 78* has been reduced to a synonym of *T. lehmanniana* Merckl. HALL (1940) reduced *T. chrysantha* (Boiss.) Baker as a variety under *T. stellata* Hook. and SEALY (1948) reduced it as a variety under *T. clusiana* DC. KITAMURA (1960) reduced *T. aitchisonii* Hall to a synonym of *T. clusiana* DC. var. *chrysantha* (Boiss.) Sealy. Type of *T. aitchisonii* Hall *Konway* s.n. (K), photo of *Toppin 33* (K) and description tally with *T. chrysantha* (Boiss.) Baker. Photo of the type of *T. aitchisonii* Hall subsp. *cashmiriana* Hall *T. Hay* s.n. (K), *Osmaston 108* (K) and its description also tally with *T. chrysantha* (Boiss.) Baker. Though type has not been seen, the description of *T. porphyreochrysantha* Blatt. also refers to the same species. Due to priority of publication *T. porphyreochrysantha* Blatt. is the valid name and *T. chrysantha* will be invalid excluding its type. Other names become synonyms.

Exsiccata examined

India. Kashmir, Astor to Doyan, Karakoram, *W. M. Konway 340* (K); Kajnagrange, *J. F. Duthie 10 938* (CAL); Daksum, *J. D. A. Stainton 7529* (BM); Ladak, *Schomburg 40* (BM); *Ludlow & Sherriff 8320* (BM); *Meebold 4132* (CAL); Huripuri, *J. E. Winterbottom 140* (CAL); Kilur, *E. Ellis 1063* (CAL); Sind valley, Baltal s.n. (BM); Gurikot, *F. Schmid 1764* (BM); Bhadrawali, *T. A. Rao 9029* (CAL); Pirpanjal, *Srivastava 10 247* (LWG); Verinag, *Srivastava & party 82 897* (LWG), *K. N. Kaul & party 73 715* (LWG). H.P. — Kangra valley, *Watt 15 272* (CAL); Jwalamukhi, *Drummond 1746* (K); Chenab, *R. Ellis* s.n. (CAL); N.W. Himalaya, *T. T. Tomson 34* (CAL). **Pakistan.** Waziristan, *Fernandez 2935* (K); Kuram valley, *Harsukh 14 891* (K); Quetta, *J. H. Lace* 3414 (CAL); Palampur, *Watt 15 012* (CAL); Landikotal, *D. G. Lowndes 714* (CAL).

3d. T. clusiana DC. f. **fernandezii** (Blatt.) Dasgupta & Deb **comb. et stat. nov.**

= Basionym: *T. fernandezii* Blatt. in Journ. Bomb. Nat. Hist. Soc. 37: 420. 1934 (**Syntypes:** Pakistan, Waziristan, *Meynell 991, 991a & Fernandez 1526, 1526a*) (Fig. 3).

Herbs 17-26 cm long; bulbs lie little below the soil, 1.5-3.5 × 1-3.5 cm, brown, ovoid or subglobose, often with stolon terminating with a daughter bulb at the apex; scales few-layered, broadly ovate, coriaceous, woolly within at the apex, longitudinally fissuring, outer deep brown, dull; stem 12-25 cm long, glabrous. *Leaves* 4-6, crowded or sparse on the ground, 2-14 × 0.2-1 cm, linear-lanceolate, acute, sheathing at base, thick, often with undulated margin and cirrhose tips when young. *Flower* solitary, terminal, campanulate; peduncle 2-12 cm long, stout in fruit. *Perianth* yellow, violet or bright red outside of the outer segments, or oblanceolate, parallel-veined; outer segments 2-3.5 × 0.5-0.7 cm, acuminate; inner 1.5-3 × 0.7-1 cm, acute, often blunt. *Filaments* yellow, 3-8 × 1-2 mm, subulate, shorter than anthers; anthers yellow, 5-9 × 1.5 mm, linear-oblong, basifixed, laterally dehiscing. *Ovary* 6-14 × 2-4 mm, oblong, striated; stigma trifid, papillose, constricted below. *Capsules* 2.5 × 1.5-2 cm, narrowly oblong, with bluntly rounded end. *Seeds* brown, 5 × 2 mm, obovate, compressed, thickened at the margin.

Flowering. — April-June.

Ecology. — Open grassy slopes of rocky mountain ranges, often under shade, at 1524-3350 m altitude.

Distribution. — Hindukush Mt. to Kashmir in India, and to Baluchistan and Waziristan in Pakistan (Fig. 2).

Exsiccata examined

India. Kashmir; Bandapore, *Barnes* s.n. (K). **Pakistan.** Chitral, *Toppin 159* (K); *Harriss 16 719* (K) & *Harriss 16 718* (CAL); *J. D. A. Stainton 2233* (BM); Shelabagh Khojok Pass, *J. F. Duthie 8722* (CAL); Kohat, *HBK 545* (K); Birmogh height, *S. A. Bowes Lyon 731* (BM); Baluchistan, 1891, *Elliot* s.n. (DD).

3e. T. clusiana DC. f. **clusianoides** (Wendelbo) Dasgupta & Deb **comb. et stat. nov.**

= Basionym: *T. aitchisonii* Hall var. *clusianoides* Wendelbo in Koie & Reching., Symb. Afghan. 4: 162. 1968 (**Type:** Afghanistan, *Volk 1466* — holotype W).

Herbs small, 8-16 cm long; bulbs lie little below the soil, 3-3.5 × 1.5-2.5 cm, ovoid, scales coriaceous, longitudinally fissuring, many layers, woolly inside at the tip, deep brown, dull out-

side. *Stem* 8-15 cm long, glabrous. *Leaves* 4-5, crowded or more or less scattered, 5-20 × 0.2-1.5 cm, linear or linear-lanceolate, acute, coriaceous, entire or undulated at the margin. *Flowers* solitary, terminal, campanulate or narrowly campanulate; peduncle 2-6 cm long, glabrous. *Perianth* segments narrowly elliptic or oblanceolate, acute, with diverging veins; outer white inside and red or pink outside with white margin, 3-5 × 1.3-1.5 cm; inner smaller, white with pink basal blotch. *Filaments* pink, 4-9 × 1 mm, linear or subulate; anthers pink, 7-12 × 1.5-2 mm, linear-oblong, as long as or longer than filaments. *Ovary* 10-12 × 2 mm, ellipsoid; stigma sessile, trifid. *Capsules* 2-3.5 × 1.8-2.5 cm, oblong or broadly oblong, trilobed, trilocular, bluntly beaked, at the tip. *Seeds* ± 6 × 4 mm, semi-rotund, compressed, brown, thickened at the margin, apiculate at one end.

Flowering. — April-May.

Ecology. — Open grassy slopes on mountain ranges mentioned above at 1700-3340 m altitude.

Distribution. — Hindukush Mt. to India (Kashmir, U.P.) and Pakistan (Fig. 2).

Exsiccata examined

India. Kashmir, *P. N. Kohli 5* (K); Pirpanjal, *Kaul & party 41 612* (LWG). U. P. Chakrata, *R. Meinertzhagen* s.n. (BM). **Pakistan.** Peshwar, *Stewart* s.n. (CAL); Chitral, *Capt. Cobb* s.n. (K) & *Harriss 16 717* (BM); Ziarat, *J. D. A. Stainton 2342* (BM).

Tulipa L. sect. **Orithyia** (D. Don) Vved. in Komarov, Fl. U.S.S.R. 4: 362. 1935; Hall, Gen. Tulipa 143. 1940. *Orithyia* D. Don in Sweet, Flower Garden ser. B. 4: t. 336. 1836 (**Type:** *O. uniflora* D. Don); Endl., Gen. Pl. 140. 1836; Kunth, Enum. Pl. 4: 226. 1843; C. Koch in Linnaea 22: 226. 1849. *Tulipa* L. subgen. *Orithyia* (D. Don) Baker in Journ. Linn. Soc. 14: 277. 1874; Engl. in Engl. & Prantl, Nat. Pflanzenfam. Teil 2, Abt. 5: 62. 1888; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 335. 1930. *Tulipa* L. sect. *Leiostemones* Boiss., Fl. Or. 5: 191. 1882, pro parte. **Type:** *T. uniflora* (L.) Baker.

Bulbs small; scales glabrous or with few short hairs at the apex within. *Flowers* small. *Perianth* light yellow with violet streaks outside, not maculate, glabrous at the base. *Filaments* glabrous at the base. *Style* present.

Distribution. — C. Asia to Pakistan.

4. Tulipa heterophylla (Regel) Baker in Journ. Linn. Soc. 14: 295. 1874; Vved. in Komarov, Fl. U.S.S.R. 4: 364. 1935; Hall, Gen. Tulipa 153. 1940. *Orithyia heterophylla* Regel [Enum. Pl. *Semenow 117.* 1857] in Bull. Soc. Nat. Mosc. 41(1): 440. 1868 (**Type:** China-Tienshan-Trens Ui Ala Tau, *Semenow* s.n. LE); Regel & Bunge, Fl. Turkest. 143. t. 21. f. 11 & 12. 1876.

Herbs small; bulbs little below the soil, 2.5-3 × 1.5-2 cm, oblong-ovoid; scales brown, glabrous inside. *Stem* 2-11 cm above the soil and 4-6 cm below, glabrous. *Leaves* 2, subopposite, on the ground, 6-12 × 0.4-0.9 cm, linear-lanceolate, falcate, acute, coriaceous, entire. *Flowers* solitary, terminal, campanulate; peduncle 2-9 cm long, glabrous. *Perianth* segments yellow with reddish green streaks outside, 1.7-2 × 0.5-0.6 cm, elliptic, acute, scarious at the margin, parallel-veined. *Filaments* 8-11 × 1-1.5 mm, subulate, glabrous; anthers 4-5 × 1 mm, oblong, narrowed above. *Ovary* sessile, 5-6 × 2-3 mm, ellipsoid; style 4-7 mm long, as long as ovary, stout; stigma truncate, papillose.

Flowering. — April-June.

Ecology. — Grows on the snowline at 3350-3695 m altitude.

Distribution. — Pakistan-Chitral extending from C. Asia on mountain ranges.

Exsiccata examined

Pakistan. Chitral, *Stainton 2667* (BM) & *Bowes Lyon 748* (BM).

5. Tulipa heteropetala Ledeb., Icon. Pl. Fl. Ross. 1: 21. t. 85. 1829 (**Type:** Bukhtarminsk et Mont Kurtschum, *Ledebour* s.n. LE — Plate!); Vved. in Komarov, Fl. U.S.S.R. 4: 363. 1935; Hall, Gen. Tulipa. 153. 1940. *Ornithogalum oxypetalum* Ledeb., Fl. Alt. 2: 27. 1830 (**Type:** Bukhtarminsk et Mont Kurtschum, *Ledebour* s.n. LE, M). *Orithyia oxypetala* Kunth, Enum. Pl. 4: 227. 1843; Ledeb., Fl. Ross. 4: 137. 1852.

Herbs small, about 11 cm long; bulbs 1-1.5 cm long, ovoid; scales ovate, with few adpressed hairs inside at the top. *Stem* glabrous. *Leaves* 2-4, subopposite or alternate, 3-9 × 0.3-1.9 cm, linear above, lanceolate below, coriaceous, undulated at the margin, parallel-veined. *Flower* solitary, terminal, broadly campanulate; peduncle 2-6 cm long, glabrous. *Perianth* segments pale yellow inside, dirty violet outside, 1.5-1.7 × 0.7-0.8 cm, outer narrowly oblong, acuminate; inner oblong, acute. *Filaments* 5-7 × 1-1.3 mm, broader at base, abruptly pointed at apex, glabrous; anthers 5-6 mm long, linear-oblong. *Ovary* sessile, 6-8 × 2-2.5 mm, ellipsoid; style 2.5-3 mm long, smaller than ovary, stout; stigma trilobed, truncate. Fruit not seen.

Flowering. — May.

Distribution. — Pakistan, Chitral, extending from C. Asia at 3350 m altitude.

Exsiccata examined

Pakistan. Chitral, *J. E. Younghusband* s.n. (BM); Birmogh Lasht, *S. A. Bowes Lyon 732* (BM).

Tulipa sect. **sylvestris** Baker in Journ. Linn. Soc. 14: 277. 1874. *Liriopogon* Rafin., Fl. Tellur. 2: 35. 1837. *Podonix* Rafin., Fl. Tellur. 9: 28. 1837. *Tulipa* L. sect. *Dulipanum* Reb. in Giorn. Bot. Ital. Parl. Ann. 2: 60. 1847, pro parte. *Tulipa* L. *Leiobulbos* C. Koch, in Linnaea 22: 225. 1849, stat. incert. *Tulipa* L. sect. *Eriostemones* Boiss., Fl. Or. 5: 191. 1882, pro parte; Engl. in Engl. & Prantl, Nat. Pflanzenfam. Teil. 2. Abt. 5: 62. 1888, pro parte; Krause in Engl. & Prantl, Nat. Pflanzenfam. ed. 2. 15a: 336. 1930, pro parte; Vved. in Komarov, Fl. U.S.S.R. 4: 352. 1935; Hall, Gen. Tulipa 51. 1940, pro parte, subsect. *Australis.*

Type: *T. sylvestris* L., Sp. Pl. 438. 1753.

Bulb scales hairy at the apex within. *Flowers* small. *Perianth* segments light yellow with violet streaks outside, not blotched, hairy at the base. *Filaments* hairy at the base. *Ovary* attenuated at the apex.

Distribution. — Iran through Afghanistan to Pakistan.

6. Tulipa buhseana Boiss., Diagn. Ser. 2, 3(4): 98. 1859 (**Type:** Persia-Yezd, *Boissier* s.n., G); Vved. in Komarov, Fl. U.S.S.R. 4: 356. 1935; Hall, Gen. Tulipa 149. 1940. *T. polychroma* Stapf in Denkschr. Akad. Math. Nat. Wien 50: 18. 1885 (**Type:** Persia Mt. Karaghan, 1882, *Polak* s.n. Isolectotype — WU!); Vved. in Komarov, Fl. U.S.S.R. 4: 359. 1935; Hall, Gen. Tulipa 76. t. 12. 1940; Wendelbo in Koie & Reching., Symb. Afghan. 4: 163. 1938; Kitam., Fl. Afghan. 2: 76. 1960, *syn. nov.*

Herbs small; bulbs little below the soil, 2.3-2.5 × 1.5-2 cm, ovoid; scales many, 1-1.5 × 1.2-1.5 cm, ovate, brown, glabrous outside, woolly inside. *Stem* 8-11 cm below the soil, 6-13 cm above ground, glabrous, bifoliate, on the ground. *Leaves* 2, subopposite, sessile, 5-18 × 1-1.5 cm, lanceolate, falcate, entire, acute, parallel-veined. *Flowers* terminal, solitary, broadly campanulate; peduncle 4-11 cm long. *Perianth* outer 3 segments violet or pink, 2.3 × 0.7 cm, elliptic, acute; inner 5 segments white, greenish at base, 2 × 1 cm, obovate, obtuse, barbate at base. *Stamens* 6, unequal; filaments 4-9 mm long, subulate, barbate at base; anthers 4-5 × 1.5 mm, linear-oblong. *Ovary* sessile, 8-9 × 2-2.5 mm, oblong, narrowed at the tip, style indistinct; stigma trilobed, truncate. *Capsules* small, cylindrical, with rounded end.

Flowering. — April-June.

Distribution. — Iran to Pakistan through Afghanistan at an altitude 2743-3695 m.

Note. — Capsules character and colour have been taken from A. D. Hall (l.c.). After examination of the type of *T. polychroma* Stapf, P. Wendelbo merged it to *T. buhseana* Boiss. while work-

ing on the Flora of Iran, in 1981. The work has not yet been published. Type of *T. buhseana* Boiss. was not available for study. The description tallys with *T. polychroma* Stapf. Therefore *T. polychroma* Stapf has been reduced to a synonym of *T. buhseana* Boiss. following P. Wendelbo.

Exsiccata examined

Pakistan. Baluchistan-Nareikotal, *J. H. Lace 3313* (BM, CAL).

ACKNOWLEDGEMENTS

Authors are grateful to the Director, Royal Botanic Garden, Kew, Keeper, British Museum (Natural History) London, Officer-in-charge, Systematic Botany Branch, Forest Research Institute, Dehradun and Director, National Botanical Research Institute, Lucknow for kindly sending the specimens of their respective herbaria on loan. Grateful thanks are also due to the Director, Botanical Survey of India for the facilities to conduct this study and Deputy Director, Botanical Survey of India, Central National Herbarium, Howrah and Northern Circle, Dehradun for the access of the specimens at their disposal. Authors are also thankful to Dr. R. S. Raghavan, Regional Botanist, Botanical Survey of India, Western Circle, Poona for his help in sending literature from Kew.

REFERENCES

AIRY-SHAW, H. K. (1973). *Dictionary of Flowering Plants and Ferns,* by J. C. Willis. Cambridge.

ARBER, Agnes (1925). *Monocotyledons.* Cambridge.

BAKER, J. G. (1874). Revision of the Genera and Species of Tulipeae. *J. Linn. Soc.* 14: 211-310.

BAUHIN, G. (1623). *Pinax theatri botanici sive index in Theophrasti, Dioscoridis, Plinii et botanicorum, qui a saeculo scripserunt, opera.* Basel.

BENTHAM, G. (1883). Liliaceae. *In:* G. BENTHAM & J. D. HOOKER, *Genera Plantarum* 3: 748-836. London.

BOISSIER, P. E. (1882). *Flora Orientalis,...* 5: 122-211. Basel.

CLUSIUS, G. (1583). *Rariorum aliquot stirpium per Pannoniam, Austriam et vicinas guasdam provincias observatarum historia, quatuor libris expressa.* Antwerpen.

DARLINGTON, C. D. & E. K. JANAKI AMMAL (1932). The origin and behaviour of chiasmata in diploid and tetraploid Tulipa. *Bot. Gaz.* 93: 296-312.

DON, D. (1836). *In:* R. SWEET, *The British Flower Garden,* ser. 2, vol. 4, t. 336. London.

ENDLICHER, S. (1836). *Genera Plantarum, Secundum Ordines naturales disposita.* Wien.

ENGLER, A. (1888). Liliaceae. *In:* A. ENGLER & K. PRANTL, *Die Naturlichen Pflanzenfamilien.* Teil 2, Abt. 5: 10-91.

GUIGNARD, L. (1900). *Ann. Sci. Nat. Bot.* Ser. 3, 11: 365-387.

HALL, A. D. (1937). Polyploidy in Tulipa. *J. Linn. Soc. London* 50: 481-489.

HALL, A. D. (1938). Three new species of Tulipa. *J. Bot. London* 76: 313-319.

HALL, A. D. (1940). *The genus Tulipa.* London.

HITCHCOCK, A. S. & M. L. GREEN (1929). Standard species of Linnean genera of Phanerogamae. Internat. Bot. Congr. Cambridge, 1930. *Nomencl. Prop. Brit. Bot.:* 110-199.

HOOKER, J. D. (1892). Liliaceae. *In: Flora of British India,* 6: 299-362. London.

HUTCHINSON, J. (1973). Liliaceae. *In: Families of Flowering Plants:* 732-753. London.

KITAMURA, S. (1960). Liliaceae. *In: Flora of Afghanistan:* 64-76. Kyoto.

KOCH, C. (1849). Beitrage zu Ciner Flora des Orientes. *Linnaea* 22: 177-336.

KRAUSE, K. (1930). Liliaceae. *In:* A. ENGLER & K. PRANTL, *Die Naturlichen Pflanzenfamilien,* ed. 2. 15A: 227-386.

KUNTH, C. S. (1843). *Enumeratio Plantarum Omnium hucusque cognitarum, secundum familias naturales disposita, adjectis characteribus, differentiis et synonymis* 4: 216-258 & 280-379. Stuttgart, Tubingen.

LINNAEUS, C. (1753). *Species Plantarum,* vol. 1. Stockholm.

LINNAEUS, C. (1754). *Genera Plantarum,* ed. 5. Stockholm.

MALIK, C. P. (1961). *Chromosome number in some Indian Angiosperm: Monocotyledon.*

MEHRA, P. N. & T. K. PANDITA (1978). IOPB chromosome number reports. *Taxon* 27: 375-392.

MOLE, W. E. DE (1925). *Genetica* 7: 111-118.

NEWTON, W. C. F. (1927). Chromosome studies in Tulipa and some related genera. *J. Linn. Soc.* 47: 339-354.

NEWTON, W. C. F. & C. D. DARLINGTON (1929). Meiosis in polyploids pt. I. Triploid and pentaploid tulip. *J. Genet.* 21: 1-15.

PODLECH, O. & O. BADER (1974). Chromosome Studien an Afghanischen Pflanzen II. *Mitt. Bot. München* 11: 457-488.

RAFINESQUE, S. C. S. (1836-1837). *Flora Telluriana.* Philadelphia.

REGEL, E. (1880). Descriptiones plantarum novarum et minus cognitarum. A plantarum diversarum, in horto botanico Imperili Petropolitano Cultarum, descriptions. *Act. Hort. Petrop.* 6: 500-514.

SCHULTES, J. H. (1829). *In:* J. A. SCHULTES & J. H. SCHULTES, *Systema vegetabilium,* vol. 7, Part 1. Stuttgart.

SEALY, J. R. (1948). Tulipa clusiana var. chrysantha. *Curtis's Bot. Mag.* 165: 13.

SOBTI, S. N. & S. D. SINGH (1961). Chromosome Survey of Indian Medicinal Plants. I. *Proceed. Indian Acad. Sci.* 54: Sect. B. 138-144.

TOURNEFORT, J. P. (1700). *Institutiones Rei Herbariae* 1: 367-373, 2: t. 195-201. Paris.

UPCOTT, M. & L. F. LA COUR (1936). The genetic structure of Tulipa. *J. Genet.* 33: 237-254.

VVEDENSKY, A. I. (1935). Liliaceae — gen. Tulipa. *In:* V. L. KOMAROV, *Flora of the U.S.S.R.* 4: 320-364. Leningrad (English ed. Jerusalem 1968).

WENDELBO, P. (1958). Liliflorae. *In:* M. KOIE & K. H. RECHINGER, *Symbolae Afghanicae* 4: 151-164. Kobenhavn.

Address of the authors: Botanical Survey of India, Howrah, India.