STUDIES IN EAST MEDITERRANEAN SPECIES OF SALVIA: II

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This paper is a continuation of studies in the south-west Asiatic species of *Salvia* (Hedge in Notes R.B.G. Edin. xxii (3), 173–188: 1957). Two new species are described: *S. halophila* Hedge and *S. longipedicellata* Hedge; *S. libanotica* Boiss. & Gaill., *S. lobryana* Azn., *S. spiraeifolia* Boiss. & Hoh., *S. altilabrosa* Pau, *S. cuspidatissima* Pau, *S. bourgeana* Barbey, *S. sulcata* Parsa and *S. kourossia* Parsa are reduced to synonyms of other species; *S. ballsiana* (Rech. fil.) Hedge and *S. willeana* (Holmboe) Hedge are raised to specific rank. *S. hypargeia* Fisch. & Mey, previously treated as a synonym of *S. montbretii* Benth., is shown to be a distinct species; the valid name for *S. graveolens* Vahl is shown to be *S. dominica* Linn.; two instances of hybridity in Turkish sages are reported; some other interesting or critical species are discussed with regard to their taxonomy and distribution. As appendices there are translations of the keys in Komarov, Flora U.R.S.S., to *Salvia* and *Schraderia* Medik. The status of the latter genus is discussed.

SECTION EUSPHACE BENTH.

Salvia willeana (Holmboe) Hedge, **comb. nov.**

Syn.: *S. grandiflora* Etling. subsp. *willeana* Holmboe, Studies Veg. Cyprus, 157 (1914).

CYPRUS. Troodos; Pedhoulas, flowers white or mauve, common on Troodos massif, 1200 m., 7 July 1946, *Davis* 1824; *Heron* H. 1752 (K!); *Kennedy* 789 (K!).

This taxon differs in sufficient features to be specifically distinguished from the mainland *S. grandiflora* Etling. The more rounded leaf apices, the shorter green calyces, the smaller calyx teeth and the densely glandular indumentum on the inflorescence axis are morphologically characteristic for *S. willeana* (Holmboe) Hedge. *S. grandiflora* does not grow in Cyprus. *S. willeana* is endemic to the Troodos range.

Salvia triloba Linn. fil. Suppl. 88 (1781).

Syn.: *S. libanotica* Boiss. & Gaill. in Boiss., Diag. Plant. Orient. Sér. II, iv, 16 (1859).
S. lobryana Aznav. in Magyar Bot. Lap. i, 195 (1902).
S. triloba Linn. fil. subsp. *libanotica* (Boiss. & Gaill.) Holmboe, Stud. Veg. Cyprus, 158 (1914).

TURKEY. Prov. Muğla: dist. Fethiye; Xanthus valley near Kalkan, 10 m., altitude, rocky limestone slopes, 1 m. high shrub, flowers lilac pink, 29M arch 1956, *Davis & O. Polunin* (D. 25451); Kalkan, 30 m. altitude,

rocky limestone slopes, flowers lilac pink, used for making tea! 30 March 1956, *Davis & O. Polunin* (D. 25474); Marmaris, 30 m. altitude, limestone knoll, 1 m. high shrub, flowers pale pinkish lilac, 24 March 1956, *Davis & O. Polunin* (D. 25266). Prov. Izmir: Kuşadasi, alt. 20 m., *Poterietum spinosi*, on marl, 0·7 m. shrub, 22 March 1956, *Davis & O. Polunin* (D.25177).

CYPRUS. Rhizocarpasso, in phrygana on sand dunes, 23 Feb. 1941, *Davis* 2384 (forma dentibus calycis longis). *Sintenis & Rigo* 118 (as *S. libanotica* Boiss. & Gaill.). Koronia, *E. Chapman* 225 (K!). Kyrenia, *Syngrassides* 1437 (K!). Akamas, *E. Chapman* 290 (K!). Platres, *Davis* 3530 (K!). Staurovouni, *Syngrassides* 1488.

PALESTINE. Wadi Fallah (Carmel), garique, 0·7 m. high shrub, 25 March 1942, *Davis* 4162. Bab el Wad, rocky places, *Dinsmore* 4642.

LEBANON. Saida, *Gaillardot* (as *S. libanotica* Boiss. & Gaill.). Ex regione inferiori Syriae prope Beyrout, 1877, *J. Ball* s.n.

SYRA. *M.F.X. Lobry* 30 (type of *S. lobryana* Azn.—Aznavour herbarium, Istanbul!); in insula Syra, March 1849, *Orphanides* s.n

CHIOS. 13–25 April 1856, *Orphanides*. Amorgos between Langadha and Potamos, a form with white flowers growing with type, 11 April 1940, *Davis* 1426.

S. triloba Linn. fil. is a variable species widespread throughout the east Mediterranean countries. Phytogeographically a characteristic member of the Mediterranean element, it grows in S. Italy, Sicily, Albania, the mainland of Greece, the Aegaean Islands, Crete, Cyprus, Lycia and Lydia (Turkey), S. Syria, Lebanon and in Israel. It is apparently absent, or at least not discovered, in all the southern provinces of Turkey and most of Syria.

S. triloba is very polymorphic in leaf shape, calyx size and shape, flower size and indumentum of the inflorescence axis. Some of its several facets have been described as distinct species. *S. libanotica* Boiss. & Gaill. was distinguished by its authors on the smaller entire leaves, and the smaller, blue flowers with white markings. Examination of further material from the Lebanon showed that these characters were quite inconstant and merged completely into those of *S. triloba* Linn. fil. The lobing of the leaf is of no taxonomic worth in *S. triloba*, and probably largely dependent on environmental conditions—simple and trilobed leaves often occur on the same plant and occasionally, as in D.25266, a pinnate leaf is found with a larger terminal lobe and two pairs of lateral leaflets. *S. lobryana* Azn. was described from the island of Syra in the Cyclades and based on the dwarfer habit and the obtuse calyx teeth. However, study of other material from the Cyclades showed that there was no reason for giving specific recognition to *S. lobryana* Azn. and that it were merely a habitat form.

It is in Cyprus that *S. triloba* Linn. fil. is most variable and where at first glance it might appear that infra-specific taxa could be recognised. However, examination of a large number of specimens from the island on characters of indumentum, calyx size, length of calyx teeth, leaf size, locality and altitude showed that there were no basic reasons for creating new taxa, and that, for the present, it is preferable to take a wide specific concept of *S. triloba* Linn. fil.

An interesting example of variability in one character is provided by

the indumentum on the inflorescence axis. In Cyprus, three apparently distinct types can be recognised: (1) entirely glabrous with a purple coloured stem (2) pilose eglandular (3) glandular with capitate hairs and eglandular multicellular hairs. These, however, occur indiscriminately and are not linked with any other character. Throughout its range, the calyx varies from 7–11 mm. in length, the calyx teeth from 1·5–3 mm., ranging from the obtuse teeth of Lobry's Syra plant to the very acute teeth of *Davis* 2384 from Rhizocarpasso in Cyprus.

Population gatherings and field observations made by Dr. Davis in western Turkey vindicated the conclusion reached on herbarium material —that *S. triloba* Linn. fil. is one very polymorphic species. Within the same population, leaf shape, calyx size and indumentum, branching and indumentum of the inflorescence axis were rarely constant.

S. triloba Linn. fil., blooming in March and April is one of the earliest of the perennial south-west Asiatic Salvias to flower.

The type specimen of *S. triloba* Linn. fil. in the Linnaean herbarium, a a cultivated specimen from seed gathered on Mt. Sipylus (Manisa dağ) near Izmir, Turkey, is clearly trilobed and has a very glandular inflorescence axis.

Salvia cypria Ky., Die Insel Cypern, 266 (1865).

CYPRUS. Platres, in garique *Cistus salvifolius* and *C. villosus* var. *creticus*, igneous, flowers lavender blue, 1220 m., 21 May 1941, *Davis* 3530; nr. Limnatis district Limassol, macchie on chalk hills, flowers violet blue, 1 m. shrub, 10 April 1941, *Davis* 3088; Skazinou, distr. Larnaca, shingly river bed, flowers lavender blue, 17 March 1941, *Davis* 2788; Prodromos, edge of pinewoods, flowers violet-blue, 1500 m., 10 July 1940, *Davis* 1828.

This taxon is recognised on the compact woody habit, the very glandular stems, the small leaves, the densely compacted inflorescence, the small calyces with obtuse teeth and the small flowers. Although in the past it has been recorded from the mountains of the Kyrenia range, it is apparently restricted to the Troodos range where it grows up to high altitudes. Undoubtedly very closely allied to *S. triloba* Linn. fil., its right to specific rank is doubtful. However, as it is easily recognisable in the herbarium and in the field, it is preferable to regard it meantime as a separate species. Field observations to determine whether in the Troodos there is a gradual intergradation between *S. triloba* and *S. cypria* (i.e. whether or not the latter is a high altitude form of *S. triloba*) are needed before a conclusion can be reached.

Salvia ballsiana (Rech. fil.) Hedge **comb. nov.**

Syn.: *Salvia suffruticosa* Montb. & Auch. var. *ballsiana* Rech. fil. in Arkiv för Bot. i, (5), 318 (1949).

TURKEY. Prov. Malatya; Karanik Dere, Erkenek to Geulbashe, 1200 m., flowers white hood and yellow lip, to 35 mm. long, in pairs opposite at wide intervals up stem, stiff upright stems to 90 cm., leaves grey with very fine decumbent hairs, flowers and stems very sticky, whole growth heavily aromatic, non-lime screes, 20 May 1935, *E. K. Balls* 2325 (holo S!, iso. E.).

This plant differs in many respects from *S. suffruticosa* Montb. & Auch.: the erect habit (not procumbent ascending), the narrow leaves with entire-margins (not with serrate margins), the much smaller calyx teeth and much less acute lobes of the upper lip, the dense glandular indumentum on the floral leaves and calyces (not eglandular), the white hood of the corolla (not yellow) and the fewer flowers to the verticil. Nevertheless, it is more closely allied to *S. suffruticosa* Montb. & Auch. than to any other species. Although the calyces are apparently deciduous shortly after flowering, suggesting that the plant does not set seed and is of hybrid origin, there were a few more or less ripe seeds in some of the shed calyces and the pollen appeared to be fertile. Also, I know of no other *Salvia* in the Malatya region which would hybridise with *S. suffruticosa* Montb. & Auch. to give the characters of *S. ballsiana* (Rech. fil.) Hedge.

Salvia bracteata Banks & Solander × **Salvia suffruticosa** Montb. & Auch.

Syn.: *S. spiraeifolia* Boiss. & Hohen. in Boiss. Diag. Sér. I, (5), 5 (1844).

TURKEY. Prov. Elaziğ: Elaziğ—Pertek, 1300 m., fallow ground, among the parents (*S. suffruticosa* Montb. & Auch. D.29190 and *S. bracteata* Banks & Solander D.29192), flowers very variable, combinations of pale yellow, lilac and pink, setting seed so presumably various back crosses present, 6 June 1957, *Davis & Hedge* (D.29191); about half-way between Elaziğ and Kale, 1300 m., marly slopes, perennial, procumbent, flowers pale yellow, lip fading lilac pink (1 plant), 4 June 1957, *Davis & Hedge* (D.28952) Prov. Diyarbakir: 5 km. N. of Ergani, 1000 m., calcareous vineyards, stems ascending, flowers pale yellow, with or without a bluish or lilac tinge on lateral lobes of lower lip, 2 June 1957, *Davis & Hedge* (D.29015); Diyarbakir, 28 June 1888, *Stapf* 729 (K!). Prov. Mardin: between Mardin and Savur, on N. side of watershed, 11–12 miles from Mardin, 1200 m., limestone banks (1 plant seen), perennial, procumbent ascending, flowers pale lavender-blue, 24 May 1957, *Davis & Hedge* (D.28516); between Mardin station and Kiziltepe, 600–650 m., edge of fields, rare, flowers pale lilac blue, 26 May 1957, *Davis & Hedge* (D.28634). Anatolia: *Wiedemann* s.n. (as *S. suffruticosa* Montb. & Auch.).
SYRIA. Aleppo, circa fodinas glareae prope Aleppum, medio Majo, 1841, *Kotschy* 256 (p.p.—type of *S. spiraeifolia* Boiss. & Hohen.)

Considering the large number of species in the genus (about 900) and the frequency of hybrids in many other Labiate genera, surprisingly few hybrids have been recorded in *Salvia*. A few have been reported in the huge New World Section *Calosphace* Benth., and others, not completely authenticated, in Sections *Aethiopis* Benth. and *Hemisphace* Benth. (cf. Hruby K. Some new *Salvia* species hybrids, Stud. Plant Phys. Lab. Univ. Prag. v, 1–73: 1935). The greatest number of validated examples occur in Sect. *Plethiosphace* Benth. among the *S. pratensis* Linn., *S. nemorosa* Linn. and *S. nutans* Linn. species aggregates. In Sect. *Eusphace* Benth., Hruby (l.c.) described an experimentally produced hybrid between *S. officinalis* Linn. and *S. grandiflora* Etl. which was the first known case of hybridity in the section.

It was, therefore, of special interest to observe in Anatolia two clear instances of inter-specific hybridisation—one in Sect. *Eusphace* and the

other in Sect. *Aethiopis* (see page 56). The former and quite spectacular case was a large population of the parents *S. bracteata* Banks & Solander and *S. suffruticosa* Montb. & Auch. and the massive hybridisation between them. The parents are quite distinct species which previously were not considered closely allied. *S. suffruticosa* Montb. & Auch. has yellow flowers, small floral leaves, long pedicels, a glabrous inflorescence axis and a thin indumentum on the calyx, narrow pinnate leaves with a thin indumentum and a tightish clump forming habit. *S. bracteata* Banks & Solander has purple-red flowers, many purple coloured floral leaves which envelop the calyces, shortly pedicellate flowers, a dimorphic indumentum on the inflorescence axis and calyx of glandular capitate hairs and eglandular hairs, broad pinnate leaves with a dense indumentum and a loose habit. The hybrids between them were so varied and apparently fertile (i.e. young nutlets were developing) that considerable back crossing with the parents seemed probable. There was a complete range of characters from one parent through many intermediates to the other parent.

The table overleaf gives some details of the parents and the hybrids in this particular instance.

In all the stamens examined in the hybrid flowers there was no clearly fertile pollen. The thecae were either well developed with small almost circular empty pollen grains or else they were stunted and without pollen. In the female organs, however, the stigmas, styles and ovaries were always fully developed and apparently fertile to pollination from the hermaphrodite flowers.

Although this was the only observed instance of a hybrid swarm with both parents present, at other localities in south Turkey plants of hybrid origin were seen (D.28952, D.28516, D.28634 and D.29015)—nearer to *S. suffruticosa* Montb. & Auch. than to *S. bracteata* Banks & Solander.

The species *S. spiraeifolia* Boiss. & Hohen. was described from Aleppo. It was said to be closely related to *S. suffruticosa* Boiss. but distinguished from it by the blue flowers, pruinose indumentum and a larger terminal leaflet. The holotype is a specimen of *Kotschy* 256 which does have these characters. However, under the same number are other specimens which have all the characters of *S. suffruticosa* Montb. & Auch. and have been named as such. Evidently, then, *Kotschy* 256 is a mixed gathering of *S. suffruticosa* Montb. & Auch. and plants which differ from it only in flower colour and indumentum. The differences are, in fact, those which would occur in a hybrid swarm between *S. suffruticosa* Montb. & Auch. and *S. bracteata* Banks & Solander. Further, as both these species grow near Aleppo (*S. bracteata* was described from there), it seems certain that *S. spiraeifolia* Boiss. & Hohen. was based on a hybrid between them, the specimen being considerably closer to *S. suffruticosa* Montb. & Auch. than *S. bracteata* Banks & Solander.

Rather than adopt the name *S.* × *spiraeifolia* Boiss. & Hohen., it is preferable, because of the range within the hybrid populations, to designate all the hybrids as *S. bracteata*×*S. suffruticosa*. Despite the considerable hybridity between the two species in the south of Turkey, the great majority of the hybrids seen were much closer to *S. suffruticosa* Montb. & Auch. than to *S. bracteata* Banks & Solander.

	S. suffruticosa (D.29190)	*S. bracteata* (D.29192)	Hybrids (D.29191)
Flower colour	yellow	purplish-pink	yellow, blue, lilac, pink, in various combinations.
Flora leaves size . . .	12×5 mm.	32×18 mm.	21×11 mm., 30×12 mm. 19×10 mm., 15×11 mm.
number . .	2 to the verticil	many	several.
Calyx size	10 mm.	9 mm.	8 mm., 9 mm., 10 mm.
Calyx indumentum . . .	long eglandular broad multicellular hairs, short crisp eglandular hairs, dark sessile glands.	long glandular and thin eglandular multicellular hairs.	very long thin eglandular hairs (ad 3 mm.)/, long glandular hairs/, short eglandular hairs/, yellow sessile glands in various combinations.
Inflorescence axis indumentum	none.	long glandular and eglandular multicellular hairs, very dense.	long glandular hairs/, short glandular hairs/, long eglandular hairs/, short eglandular hairs of varying density and in various combinations.
Pedicel	7·5 mm.	3 mm.	3 mm., 4 mm.
Corolla	25 mm.	23 mm.	22 mm., 25 mm. 26 mm., 28 mm.
Theca	4 mm.	3 mm.	2·5 mm., 3 mm.
Pollen grain	60×48μ	60×45μ	45×35μ

SECTION DRYMOSPHACE BENTH.

Salvia forskahlei Linn. (*S. Forskolei*) Mant. 26 (1767).

Syn.: *S. bifida* Forsk., Fl. Aegypt. Arab. 202 (1775).
S. longipetiolata Koch in Linnaea, xxi, 657 (1848).
S. hierosolymitana Boiss. var. *pontica* Fr. & Bornm. in Freyn, Pl. Novae Orient. in Oest. Bot. Zeit. xli, 58 (1891).
S. bulgarica David. in Mag. Bot. Lap. iv, 29 (1905).
S. pontica Fr. & Bornm. ex Hand.-Mazz. in Ann. Nat. Hofmus. Wien, xxii, 185 (1909).

TURKEY. Prov. Istanbul; Belgrader Wald, lichter Laubwald, 3 Nov. 1895, *J. Nemetz* (WU!). Prov. Bolu: Adapazari—Bolu, c. 25 km. from Bolu, c. 500 m., cleared woodland dominated by *Rhododendron ponticum*, blue flowers, 21 July 1956, *McNeill* 242. Prov. Giresun; Tamdere—Yavuzkemal, 1500 m., flowers violet-blue, 10 Aug. 1952, *Davis, Dodds & Çetik* (D.20681). Prov. Trabzon; in valle Kalanema Dere prope oppidum Aktsche Abad, locis siccis lapidosis, substrato eruptivo, 300 m., 10 Juli 1907, *Handel-Mazzetti* 350 (as *S. pontica* Fr. & Bornm. WU!). Prov. Çoruh; Borçka—Hopa, 450 m., forest above Borçka, on banks, scarce, flowers violet-blue, 19 June 1957, *Davis & Hedge* (D.29852).

Under different habitat conditions, *S. forskahlei* Linn. shows remarkable variation in stature. In the Belgrade woods near Istanbul, it is often a small unbranched plant about 25 cm. high with leaves 6–8 cm. long. The other extreme is represented by specimens from the wet forests of Trabzon and Çoruh. Here the leaves are up to 26 cm. long the plant over 1 metre tall and much branched. It was with these luxuriant plants that Freyn and Bornmüller were dealing when they described the new species *S. pontica*. In addition to the variation in leaf size, the leaf shape varies from simple and entire to lyrate (as in the holotype in the Linnaean herbarium).

S. forskahlei Linn. has several rather unique features among the south-west asiatic species of the genus: a markedly bifid upper lip on the corolla, a reflexed upper lip which gives the corolla a characteristic gape, and the long oblong-headed glandular hairs, which are abundant on the inflorescence axis.

S. forskahlei Linn. has a limited and distinct distribution. It grows in the coastal region of Bulgaria, in Thrace, on Bithynian Olympus and along the north coast of Turkey as far as the Turco-Russian fronter. It is, in fact, restricted to a fairly narrow belt along the south-coast of the Black Sea in woods and forests—a typical representative of the Hyrcano-Pontic floral element.

SECTION AETHIOPIS BENTH.

Salvia montbretii Benth. in Ann. Sc. Nat. Sér. II, vi, 42 (1836).

This epithet has been generally used to cover two distinct species. The plant which Bentham described is apparently a local species restricted to a few of the southern provinces of Turkey and adjacent parts of Syria. The other species is widespread and common throughout much of inner Anatolia. It was first described by Fischer and Meyer as *S. hypargeia* (Ann. Sc. Nat. iv, i, 34: 1854); Boissier reduced it to a synonym of *S. montbretii* (Fl. Or. iv, 612: 1879) where it has languished ever since.

Because Boissier cited neither the type of *S. montbretii* nor a good representative specimen of it (*Aucher* 1534 and *Balansa* s.n. cited in Fl. Or. are not ideal gatherings) it is quite understandable that he recognised only one species and merged the two names.

The two species are certainly quite closely allied but *S. montbretii* is most clearly distinguished from *S. hypargeia* by the larger floral leaves which are longer than the calyces, the larger, broader basal leaves and the longer calyces. Some of the dimensions of the two species are listed here:

	S. montbretii	*S. hypargeia*
Basal leaves	(4–)9(–14) cm. × (0·5–)1·3(–2) cm.	(4–)6(–8) cm. × (0·3–)0·8(–1) cm.
Floral leaves	15–25 mm. × 14–25 mm.	10–12 mm. × 10–12 mm.
Calyx length	15–21 mm.	10–12 mm.
Mucro on lower calyx lip	2–2·5 mm.	0·75–1 mm.

The varieties *pannosa* Freyn & Bornm. (Oest. Bot. Zeit. xlii, 376: 1892) and *virescens* Freyn (Bull. Herb. Boiss. Sér. II, i, 278: 1901) which were described under *S. montbretii* should, if they are to be recognised, be transferred to *S. hypargeia.*

It is of considerable phytogeographical interest that *S. montbretii* is also closely allied to *S. phlomoides* Asso—a species which grows in Spain, Algeria and Morocco. The West Mediterranean plant can be distinguished by the more spathulate leaves and the shorter mucros on the calyx.

Below are listed all the gatherings I have seen of *S. montbretii* and a representative selection of specimens of *S. hypargeia* to cover its distribution.

TURKEY. Prov. Mardin: between Mardin and Savur, on S. side of watershed about 10 miles from Mardin, 1150 m., fallow fields on limestone, tufted stems several, erect, very viscid above, flowers violet, 24 May 1957, *Davis & Hedge* (D.28517); Mardin, 1888, *Sintenis* 852 (K!); Arabkir, in collibus, 22 June 1889, *Sintenis* 858; Mardin—Diyarbakir, 24 km. from Mardin, 1000 m., *Quercus aegilops* scrub, perennial, flowers violet, 27 May 1957, *Davis & Hedge* (D.28710). Prov. Gaziantep: Aintab, 1836, *Montbret* 1909 (typus, K!); Aintab, *Aucher-Eloy* 1534 (K!); Aintab, 700 m., 20 May 1865, *Haussknecht* s.n. (K!). Prov. Diyarbakir: Mardin—Diyarbakir, 40 km. from Mardin, 1000 m., stony calcareous slopes with spiny *Astragalus*, flowers violet, 27 May 1957, *Davis & Hedge* (D.28707).
SYRIA borealis (?). Region inf. du Djebel Seman, 1200 m., 15–20 May 1908, *Haradjian* 2095 (K!).

S. hypargeia Fisch. & Meyer, Icon. Tchih. As. Min. Atlas, tab. 22 (1860).
TURKEY. Prov. Konya: subalp. Region über Bulghar Maaden, 2000 m., Juli 1912, *Siehe* 270. Prov. Kayseri: Bakir Dağ above Kisge, 1400 m., June 1952, *Davis & Dodds* (D.19277). Prov. Mersin: Cilician Gates, June 1855, *Balansa* 518. Prov. Kirşehir: Mucur, calcareous hillsides, fl. lavender blue, June 1954, *Davis* 21824. Prov. Niğde: in Ortakayaardi valley, fallow steppe

fields, 1200 m., *Davis & Dodds* (D.19074). Prov. Sivas: Sivas—Sarkişla calcareous hillsides, 1500 m. August 1958, *Davis & Hedge* (D.32723). Prov. Kastamonu: circa 30 km. westlich von Samsun 1891–92, *Manissadjian* 667 (K!); Prov. Zonguldak: Sofranbol, *Wiedemann* 332 (K!).

Salvia dominica Linn., Sp. Pl. 25 (1753).

Syn.: *S. graveolens* Vahl, Enum. i, 273 (1805).
S. commutata Benth., Labiat. 222 (1833).

Although Linnaeus' trivial name shows that he thought he was describing a West Indian plant, some mistake with labels must have occurrred since it is, in fact, an east Mediterranean species and the first description of the species which was subsequently described by Vahl as *S. graveolens*. The citation *S. graveolens* Vahl has been generally used since then. Although the specimen in the Linnaean herbarium is but a small scrap of inflorescence about an inch long there is no doubt whatsoever that it is the Mediterranean species and the type of *S. dominica* Linn. Therefore, despite the unfortunate and misleading epithet it must, in accordance with the International Code of Nomenclature, be adopted as the valid name in preference to *S. graveolens* Vahl.

Salvia sclarea Linn., Sp. Pl. 27 (1753).

Syn.: *S. altilabrosa* Pau in Trab. Mus. Nac. Cienc. Nat. Madrid, Bot. xiv, 33 (1918).

S. altilabrosa Pau was described from a gathering made by F. M. de la Escalera near Gotvend in Persia. The type specimen, which is in the Madrid herbarium (MA!) is in no way different from *S. sclarea* Linn.

Salvia aristata Auch. ex Benth. in DC., Prod. xii, 270 (1848).

Syn.: *S. sulcata* Parsa in Kew Bull. 1948, 225.

PERSIA. Mesh Kambar, 1400 m., 14 June 1941, *A. Parsa* (K! as *S. sulcata* Parsa); Sanandadj/Marivan, 16 June 1956, *H. Sabeti* 14 (W!); Kurdistan, inter Sanandaj et Saqez, prope Husseinabad et usque 20 km. N. Husseinabad, 30 Aug. 1957, *K. H. Rechinger* 14709 (W!). Durud, Luristan, 1670 m., 2 ft. high, flowers pale lemon, 21 May 1940, *W. Koelz* 15622 (W!).

Parsa's gathering is identical with all the other collections I have seen of this most distinct species.

Salvia macrosiphon Boiss. in Boiss., Diag. Sér. I, (5), 11 (1844).

Syn.: *S. cuspidatissima* Pau in Trab. Mus. Nac. Cienc. Nat. Madrid, Bot. xiv, 33 (1918).

The considerable variation within *S. macrosiphon* Boiss. of floral leaf, calyx and corolla size certainly covers the species which Pau described from a plant collected by F. M. de la Escalera near Gotvend in Persia (Typus in MA!).

Salvia cyanescens Boiss. & Bal. in Boiss., Diag. Sér. II, (4), 19, (1859).

TURKEY. Prov. Sivas: Zara-Suşeheri, upper lip pale lilac, lower lip white, 4 Aug. 1952, *Davis, Dodds & Çetik* (D.20451); Sarkişla—Kayadibi, 1400 m., dry gravel hills, upper lip lavender-blue (pale), lower lip cream, 28 Aug. 1957, *Davis & Hedge* (D.32728); Suşehri—Zara, above Suşehri, 1300 m., dry slopes, abundant here, ascending to c. 2000 m., flowers pale lavender-blue, 26 Aug. 1957, *Davis & Hedge* (D.32700). Prov. Gümüşane: Erzincan—Kelkit, 1750 m., dry shaley slopes and fallow fields, perennial, stems many, slender, flowers white with upper lip tinged with lavender-blue, growing with *S. candidissima* Vahl which is now in ripe seed and must flower 3–4 weeks earlier—a much stouter, coarser plant, 1 Aug. 1957, *Davis & Hedge* (D.31923). Prov. Ankara: Idris dağ, ad Angoram Galatiae, 1892, *Bornmüller* 3184; Kizilcahamam-Gerede, 1300 m., steep bare bank, flowers pale lavender-blue, 6 Sept. 1957, *Davis & Hedge* (D.32857). Prov. Čankiri: ad oppidum Čankiri, in vinetis derelictis vallis Čakmaklidere, c. 800 m., 6 June 1929, *Bornmüller* 13507. Prov. Konya: in campis ad Koniah, June 1848, *Heldriech* 887. No date or locality, *Lady Liston.*

Although there has previously been some doubt as to the validity of *S. cyanescens* Boiss. & Bal., field observations and study of more dried material show that it is a distinct and not uncommon species. Allied to *S. candidissima* Vahl, *S. cyanescens* Boiss. & Bal. is easily recognised in the field by its slenderer, finer habit, the lavender-blue of the corolla hood (or the whole flower), the smaller calyces often tinged blue, and normally, the later date of flowering. There is little doubt that in central Anatolia considerable introgression takes place between the two species (cf. *S. candidissima* Vahl × *S. cyanescens* Boiss. & Bal. below) which, in the past, has not been recognised from dried material and has obscured the characters and recognition of *S. cyanescens* Boiss. & Bal. *Wiedemann* 324 from near Tokat, and the Czeczott and Bornmüller specimens which I had previously queried as being *S. cyanescens* Boiss. & Bal. (Hedge in Notes Roy. Bot. Gard. Edinb. xxii, 187: 1957) are referable to that species. The considerable variation in leaf size and shape and indumentum of all parts more or less parallels that within *S. candidissima* Vahl. Other than the characters mentioned above there is a seed difference between the two species. In the mature seeds of *S. candidissima* Vahl the testa has fine slightly raised reticulate markings on the surface; in *S. cyanescens* Boiss. & Bal., the seeds are smaller, darker and with thick, not raised, reticulate markings on the testa.

Salvia candidissima Vahl × **Salvia cyanescens** Boiss. & Bal.

TURKEY. Prov. Gümüşane: Kelkit—Köse, 1550 m., dry gravelly banks, perennial, flowers varying from small with pale lilac blue hood to larger and whiter. A hybrid swarm between *S. cyanescens* and *S. candidissima*, 2 Aug. 1957, *Davis & Hedge* (D.31970).

The complete range in characters from one species to the other, and the apparent fertility of them all suggests considerable back crossing. As *S. candidissima* Vahl grows in all the areas where *S. cyanescens* Boiss. &

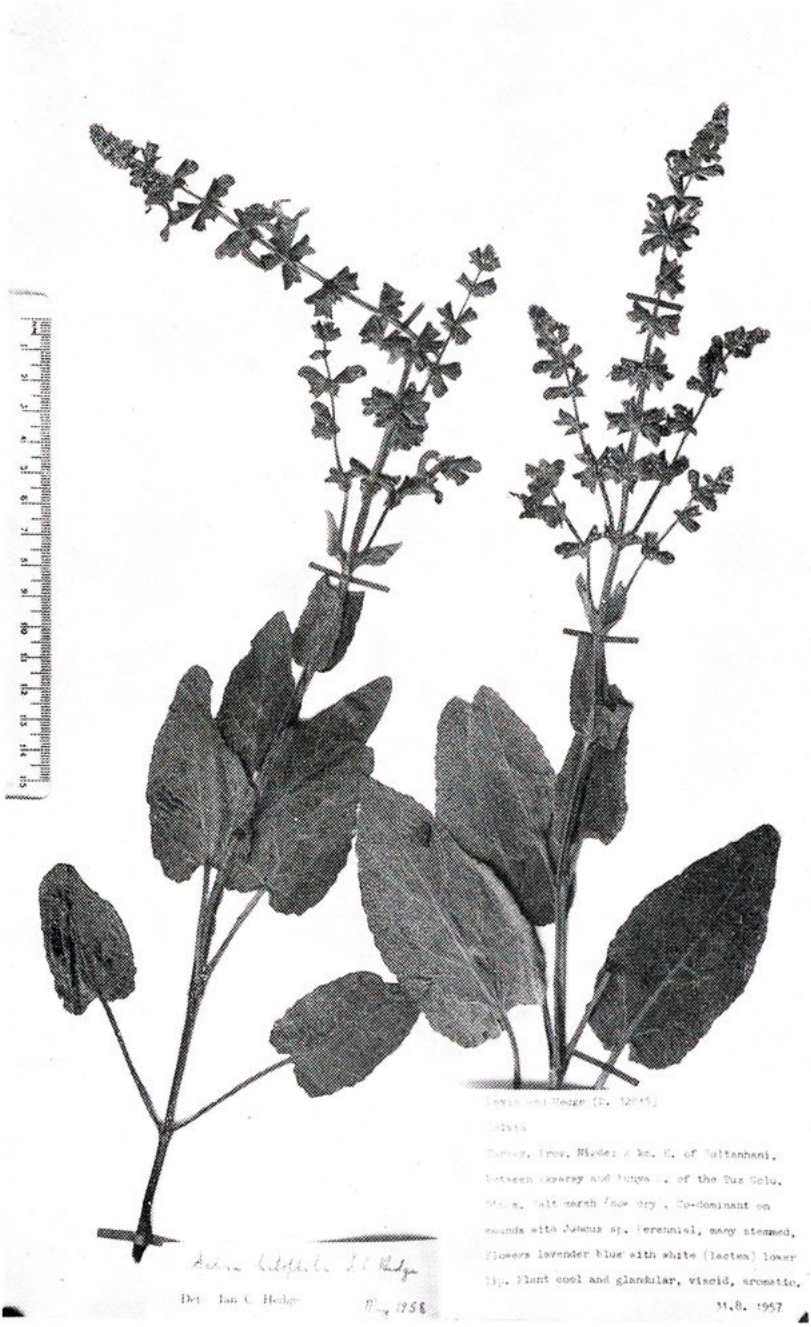

PLATE 4. Type specimen of *Salvia halophila* I. C. Hedge (D. 32815).

Bal. occurs, hybridity between them is probably frequent although with inadequate dried material it would be difficult to recognise in the Herbarium.

Salvia longipedicellata I. C. Hedge, **sp. nov.**

Affinis *S. chionanthae* Boiss. et *S. candidissimae* Vahl; a priore foliis multo latioribus corollis calycibus sesquilongioribus (non 2½-plis longioribus), labio superiore calycis vix tridentato (dente intermedio obsolete) differt; ab altera pedicellis longioribus (c. 10 mm. longis), foliis majoribus, habitu majore divergit.

Herba perennis, basi indurata. *Caules* floriferi circa 100 cm. alti, erecti, ± acuti quadrangulares, in dimidio superiore late paniculato-racemosi, inferne dense albo-arachnoideo-tomentosi, in regione inflorescentiae pilis multicellulis glandulis capitatis et pilis paucis eglandulis praediti, dense viscosi. *Internodia* inferiora c. 9 cm. distantia, superiora c. 6 cm. distantia. *Folia basalia* longe petiolata (c. 10 cm.); lamina lanceolata vel ovato-lanceolata ad 21 cm. longa et 7 cm. lata, margine irregulariter sublobato-crenata vel serrata, apice acuta, basin versus attenuata vel truncata, subtus pilis eglandulosis numerosis et glandulis sessilibus aureis dense floccoso-tomentosa, supra rugosa indumento tenuiore, in juventute densissime albo-canescentia. *Folia superiora* similia sed minora in folia floralia transeuntia. *Verticillastra* 5–6-flora, circa 4 cm. distantia. *Folia floralia* rotundato-ovata, c. 10×8 mm. viscoso-hirsuta, abrupte mucronata (mucrone c. 3·5 mm. longa). *Pedicelli* 9–10·5 mm. longi, erecti. *Calyx* 11–13 mm. longus, 13-nervosus, viridis vel purpureo-suffusus, conicus, ± ad trientem bilabiatus, labiis paulo divergentibus, rigidule herbaceo-membranaceus, nervis viridiscentibus prominentibus provisus, pilis glandulosis et glandulis sessilis aureis et pilis paucis eglandulosis praeditus, dense glanduloso-hirsutus; labium superius vix tridentatum, dente intermedio non vel obsolete prominente lateralibus multo breviore; labium inferius in dentes duos triangulares spinuloso-acuminatos (mucrone c. 2 mm. longo) fissum. *Corolla* calyce sesquilongior, alba, parce pubescens et glanduloso-punctata, ad medium circa bilabiata, tubus in calyce inclusus, in fauce abrupte inflatus, intus squamula provisus; galea falcato-compressa, circa 10 mm. longa; labium inferius galea paulo brevius, trilobatum, lobo mediano rotundato-dilatato 9×6 mm., lobis lateralibus oblongis 4×2 mm. *Connectivum* antherarum c. 14 mm. longum; stamina inferne cohaerentia; theca fertilis c. 3 cm. longa. *Stylus* c. 26 mm. longus exsertus. *Nuculae* ± ovatae 3×2 mm., fuscae. Floret Jul.-Aug.

TURKEY. Prov. Erzurum: Aşkale—Tercan, 1800 m., disturbed steppe on hillside, perennial, stems 1–4 erect, now in ripe seed 25 Aug. 1957, *Davis & Hedge* (D.32665); Aşkale—Tercan, 1800 m., fallow fields, flowering out of season, flowers white, 25 Aug. 1957, *Davis & Hedge* (D.32671); between Ilica and Tercan, near the turning to Aşkale, 1850 m., moist meadow with *Alopecurus myosuroides* (D.30855), perennial, flowers white throughout, leaves erect, also seen on the east side of the mountains towards Tercan with 2–3 stems (instead of 1 as here), 10 July 1957, *Davis & Hedge* (D.30875 holo. E, iso. K, BM).

In general facies *S. longipedicellata* is similar to *S. chionantha* Boiss., with which it shares the rather unusual feature of long pedicels. However,

the characters of smaller flowers, much broader leaves (c. 7 cm. broad as against 2·5 cm.), and the almost obsolete middle tooth of the upper calyx clearly separate *S. longipedicellata* from *S. chionantha*. The two species are geographically widely separated; *S. chionantha* is only known from the south west coast of Turkey (Caria and Lycia); *S. longipedicellata* from the far east of the country.

The polymorphic *S. candidissima* Vahl which is frequent in the Erzurum region is a smaller plant (about 0·7 m. high as opposed to the 1 m.+of *S. longipedicellata*), has shortly pedicellate flowers and a calyx indumentum without the long capitate glands of the new species. The flower colour in *S. candidissima* has generally a trace of pale yellow on the lower lip in contrast with the uniformly white flowers of *S. longipedicellata*.

Salvia microstegia Boiss. & Bal. in Boiss., Diag. Sér. II, (4), 17 (1859).

Syn.: *S. kourossia* Parsa in Kew Bull. 1948, 224.

PERSIA. Shahzad-i-Kuh, 3000 m., 1 Jul. 1940, *Parsa* 501 (K! as *S. kourossia* Parsa); Prov. Mazanderan, Zentral Elburs, im Einzugs-gebiet des oberen Tedschen-Flusses an Felsen an der Ostseite des Ghadam-gah, 60 km. östlich von Firuzkuh, c. 2600 m., 23 July 1948, *E. Behboudi & P. Aellen* 750 (W!).

Salvia chrysophylla Stapf in Denk. Akad. Wien, i, 96 (1885).

Syn.: *S. bourgeana* Barbey in Bull. Soc. Vaud. Sc. Nat. xxi, No. 93, 222 (Feb. 1886).

Examination of Stapf's type specimen of *S. chrysophylla* (at WU) and Pichler material of *S. bourgeana* from the type locality showed that they are the same species. The respective dates of publication of the two species reveal that Stapf's name appeared first and is, therefore, the valid name of the species. Barbey's paper was published in a part of the Bull. Soc. Vaud. Sc. Nat. dated February 1886, and although there is no mention of the exact date of publication of Stapf's paper other than the year 1885, there is no reason for believing it to be later than February 1886.

SECTION PLETHIOSPHACE BENTH.

Salvia halophila I. C. Hedge, **sp. nov.**

Affinis *S. virgatae* Jacq. sed habitu minore et minus ramoso, foliis crassis margine crenulatis vel subintegris (non serratis). Planta halophila.

Herba perennis, multicaulis. *Caules* floriferi 15–50 cm. alti, erecti, ± quadrangulares, in dimidio superiore racemosi, internodiis inferioribus 6 cm. longis, internodiis superioribus 3 cm. longis, in parte inferiore pilis eglandulosis provisi, in regione inflorescentiae pilis longis glandulosis et pilis brevius eglandulosis praediti. *Folia inferiora* petiolata; lamina ovato-lanceolata (5–)7(–9) cm. longa et 3–5 cm. lata, basi cordato-truncata, margine crenulata vel ± integra, apice acuta, utrinque pilis albis longis eglandulosis, tomentoso-pubescentia, sine glandulis punctatis, viridia, nervatura subtus plana. *Petiolus* 4–7 cm. longus, pilis eglandulosis albis longis vestitus. *Folia superiora* minora et suprema sessilia. *Panicula* obconica c. 20 cm.× 10 cm.; rami 2–4-nati. *Verticillastra* 5–14-nata,

4–6-flora, inferiora c. 1·5 cm. distantia, superiora c. 1 cm. distantia, ad summam florentia. *Folia floralia* rotundato-cordata, viscosa, vix mucronata, c. 6×5 mm. *Bracteae* lineares 1·5–3 mm. longae. *Calyx* tubuloso-infundibularis interdum purpureo-suffusus, 13-nervosus, 6–8 mm. longus, pilis eglandulosis ad 1·5 mm. longis et pilis glandulosis brevioribus obsitus, ± ad medium bidentatus, labiis divergentibus; labium superius tridentatum, dentibus spinulosis (mucrone 1–1·5 mm. longo), intermedio vix breviore; labium inferius bidentatum dentibus triangularibus spinulosis. *Corolla* albo-violacea c. 17 mm. longa, ± ad trientem bilabiata, intus fasciculo pilorum provisus, galea c. 11 mm. longa emarginata pilis paucis glandulosis et eglandulosis provisa; labium inferius 7 mm. longum, lacteum, lobo mediano ± reniformi 4×3 mm., lobis lateralibus oblongis 3 mm. longis. *Connectivum* antherarum c. 15 mm. longum, loculis fertilibus 3 mm. longis, grano pollinis 59×40μ; staminodia evoluta. *Nuculae* fuscae, laeves, ± ovatae, 1·5×1 mm. Floret Aug.-Sept. 2n=18.

TURKEY. Prov. Niğde: 2 km. E. of Sultanhani, between Aksaray and Konya, south of the Tuz Gölü, 950 m., salt marsh (now dry), codominant on mounds with Juncus sp., perennial, many stemmed, flowers lavender blue with white (lactea) lower lip, plant cool and glandular, viscid, aromatic, 31 Aug. 1957, *Davis & Hedge* (D.32815 holo. E, iso. K, BM); An der Südwestseite des Tuz Gölü, Salzweise, 6 Oct. 1957, *Beug & Wagenitz* nr. 316 (B!). Prov. Konya: Konya—Kasanan, railway side, flowers violet 7 Sept. 1947, *Davis* 14771 (cited as *S. virgata* Jacq. in Kew Bull. 1949, 415).

CULTIVATED SPECIMEN: grown from seed of D.32815; 70 cm. high, leaves slightly fleshy; flowers pale lilac with paler almost white middle lobe of labellum, 23 Sept. 1958, *Edinburgh* C.2826.

As far as I can trace, no species of *Salvia* has been described previously from a saline habitat in either the New World or the Old. In the south-west Asiatic area some species, such as *S. dracocephaloides* Boiss., have been recorded as growing in salt steppe although not restricted to such habitats. The discovery of a distinct new *Salvia* in central Anatolia growing among halophytes and apparently restricted to salt steppe was, therefore, of great interest. When it was collected in August, a few kilometres south of the Great Salt Lake, the ground was quite dry, but during the winter and spring months the whole area must be flooded and constantly marshy and fairly saline. *S. halophila* was growing on small low mounds over a large area of flat ground in company with a species of *Juncus* and, at the base of the mounds, a species of *Salicornia*.

It is noteworthy that two even more remarkable salt steppe relic species have recently been discovered in the same region of Anatolia: *Linum seljukorum* P. H. Davis (Notes Roy. Bot. Gard. Edin. xxii (3), 147: 1957) which was described from the same locality as the D.14771 gathering of *S. halophila*; and *Verbascum helianthemoides* Huber-Morath (Bauhinia, i (1), 27: 1955), a new gathering of which (D.32817) was made near the type locality of the new *Salvia*.

S. halophila is readily distinguished from all other members of Section *Plethiosphace* Benth. but is nearest to *S. virgata* and *S. nemorosa* Linn. It differs from both in habit, leaf and indumentum characters. The leaves in *S. halophila* are somewhat thick, oblong to ovate-lanceolate, flat edged

with entire or crenulate margins and with a densish indumentum on both lower and upper surfaces. In *S. virgata* the leaves are thin, irregularly shaped, toothed with a sinuate margin and with a sparse indumentum on the lower surface only. *S. nemorosa* has a similar habit to *S. halophila* but is easily recognised by the conspicuous violet coloured floral leaves and by the leaf indumentum which is almost entirely restricted to the lower surface. The indumentum on the inflorescence axis and calyx of the new species is composed of flat multicellular glandular hairs and shorter eglandular hairs; in *S. virgata* the indumentum, though variable, normally consists of capitate glandular hairs, eglandular hairs and numerous punctate glands; in *S. nemorosa* the inflorescence axis is eglandular. Other diagnostic or differentiating characters for *S. halophila* which, however, are not so constant, are the true bracts which are often longer than the pedicels, the yellow coloured pollen and the smaller brown (not black) seeds.

Both in the wild and in cultivation *S. halophila* is a later flowering species than the other members of Sect. *Plethiosphace* which are generally well past flowering in late August or September.

A further interesting feature of *S. halophila* is its chromosome number of n=9. The base number in Sect. *Plethiosphace* is apparently n=7 or 8. The other species in the section with n=9 are *S. nutans* Linn. and *S. pratensis* Linn. neither of which grow in Anatolia. (Cf. Scheel in Bot. Archiv. xxxiv, 148–208: 1931).

Appendix I

Translation of the key by E. G. Pobedimova to the species of *Salvia* growing in the U.S.S.R.* (In Fl. U.R.S.S., xxi, 245–256: 1954).

As many of the species dealt with in Pobedimova's work are allied to, or the same as, species which grow in Europe, South-West Asia and the Sino-Himalayan region, this translation should prove useful both for further taxonomic research in the Salvias of these regions and for naming Soviet species.

Although, for the most part, Pobedimova's treatment of the genus is fairly conservative and her key to the species works well, I cannot agree with the recognition of *Schraderia* Medik. (Appendix II) as a genus separate from *Salvia*. Identical with Sect. *Hymenosphace* Benth., which is given as a synonym, there are several non-Soviet species in it such as *S. cadmica* Boiss., *S. smyrnaea* Boiss., *S. blepharochlaena* Hedge & Huber-Morath, *S. calycina* Sb. & Sm. and *S. haussknechtii* Boiss. which form a very natural link with Section *Eusphace* Benth. and make the elevation of it (Sect. *Hymenosphace* Benth.) to generic level both unnatural and undesirable. The other fairly distinct sections of the genus might equally well be raised to generic level and a dozen artificial genera created out of one natural one!

1. Connective short, equal to the staminal filament or shorter than it, arcuate, with almost equal joints 2

\+ Connective long, elongated several times longer than the staminal filament, seldom less, not arcuate 25

* The translations of the keys to *Salvia* and *Schraderia* were prepared in collaboration with the Botanical Institute, Leningrad. I am very grateful for the assistance received.

2. Inflorescence consisting of 2-flowered verticils, flowers solitary in axils of floral leaves on very long pedicels; two small bracts occur at middle, or just above or below the middle, of pedicel . . 3

\+ Plant with other characters 7

3. Calyx indumentum of simple hairs 20. *S. schmalhausenii* Regel

\+ Calyx indumentum of glandular hairs 4

4. Tube of corolla short, completely or almost completely hidden within the calyx; calyx 16–20 mm. long with short triangular cuspidate teeth . . . . . 23. *S. aequidens* Botsch.

\+ Tube of corolla longer, fully exserted from calyx or half exserted 5

5. Inflorescence axis with a glandular indumentum, peduncles short, 6–8 mm. long . . . . . 22. *S. drobovii* Botsch.

\+ Inflorescence axis glabrous, peduncles long, 7–12 mm. long . 6

6. Both lips of calyx almost equal, teeth of upper calyx lip almost equal, lateral ones curved inwards; stem many times branched 24. *S. campylodonta* Botsch.

\+ Lower lip of calyx exceeding the upper; middle tooth of upper lip of calyx shorter than lateral which project; stem usually simply branched, but sometimes compoundly branched 21. *S. margaritae* Botsch.

7(2) Leaves entire or deeply lobed 8

\+ Leaves pinnate-laciniate 15

8. Leaves elliptical, oblong or oblong lanceolate (3·5–)4·5(–5·5) cm. long, (1·5–)2(–2·5) cm. broad; panicle longly pyramidal with 2–3 pairs of branches; flowers very small 7–8 mm. long, calyx 2–3 mm. long; glandular indumentum; annual . . 25. *S. plebeja* R. Br.

\+ Leaves and flowers several times larger 9

9. Leaves nearly all arranged in basal rosettes 10

\+ Leaves uniformly spread over the stem 12

10. Leaves broadly elliptical or almost round, doubly serrate on the margin, or crenate, (8–)14(–15) cm. long (6–)9(–12) cm. broad; upper calyx lip tridentate, longer than lower, upper lip of corolla turned backwards . . . . . 19. *S. forskahlei* Linn.

\+ Leaves elliptical, oblong or almost oblong-ovate, 3·5–7 cm. long, (1–)2(–3) cm. broad, deeply laciniate, upper calyx lip bidentate, almost equalling lower, upper lip of corolla broad with upturned edges 11

11. Outside of corolla and anthers with an indumentum of fine tangled hairs, stem internodes almost glabrous, with isolated short appressed hairs, swollen at the base . . . 16. *S. glabricaulis* Pobed.

\+ Outside of corolla and anthers glabrous or rarely with isolated hairs, stem internodes with a dense indumentum of long fine multicellular spreading hairs mixed with long and short stalked glands 17. *S. lilacinocoerulea* Nevski

12. Leaves very large, (7–)12(–20) cm. long, (4–)6·5(–11) cm. broad, smooth not wrinkled; flowers yellow, falcate with sides of upper corolla lip compressed . . . 18. *S. glutinosa* Linn.

\+ Leaves smaller (3·5–)9(–12) cm. long, (0·8–)3·5(–5·5) cm. broad, oblong lanceolate or ovate, wrinkled, flowers violet or blue, upper lip of corolla straight 13

13. Verticils 2–4-flowered, peduncles 2–3·5 cm. long
3. *S. trigonocalyx* Woron.

\+ Verticils 6–10-flowered, flowers on short peduncles 3–7 mm. long 14

14. Calyx 9–10 mm. long, short curly indumentum, corolla violet, 2–2·5 cm. long; leaves constricted at base . . 1. *S. officinalis* Linn.

\+ Calyx 12–17 cm. long, indumentum of scattered, long multicellular hairs and short-stalked, large-headed, glands mixed with small-headed glands, flowers blue 3–4 cm. long; leaves at base wide, rounded or cordate . . . . . 2. *S. grandiflora* Etling.

15(7) Stem leafless or with a few stem leaves 16

\+ Stem uniformly leafy 19

16. Leaves with two-three pairs of small elliptical leaflets, and one large terminal one (5·5–)9(–12) cm. long, (2·5–)5(–7·5) cm. broad, stem leaves and branches of inflorescence paired; flowers blue
8. *S. ringens* Sb. et Sm.

\+ Leaves with unpaired leaflets, not different from terminal one, stem leaves and branches of inflorescence in threes; flowers white 17

17. Calyx indumentum of long- and short-stalked glands, upper lip of calyx bidentate, all calyx teeth almost equal 13. *S. lipskyi* Pobed.

\+ Calyx indumentum of fine multicellular hairs mixed with long- and short-stalked glands, upper lip of calyx tridentate, with a very small middle tooth, all calyx teeth prominently cuspidate . . 18

\++ All teeth of calyx not prominently cuspidate
15. *S. submutica* Botsch. & Vved.

18. Calyx 16–18 mm. long, narrowed towards the base, leaves oblong or elliptical, divided into linear twisted incised segments
12. *S. trautvetteri* Regel

\+ Calyx 19–20 mm. long, not narrowed towards base, leaves oval, pinnately cut with elliptical or oblong acute segments, toothed or almost lobed . . . . . 14. *S. komarovii* Pobed.

19. Leaves pinnate with 5–6 pairs of narrow linear leaflets, terminal not different from others; corolla yellowish blue 20

\+ Leaves pinnate with 2–4 pairs of elliptical oblong or lanceolate leaflets, terminal leaflet a little wider and larger than others; corolla purple, yellow, or creamy white 22

20. Entire plant or only inflorescence with an indumentum of simple hairs, inside of upper half of calyx with very short glandular hairs
9. *S. scabiosifolia* Lam.

\+ Entire plant or only inflorescence and calyx, except for long simple hairs, with an indumentum of long-stalked glands with blackish heads 21

21. The inflorescence, outside of calyx and inside of upper half of calyx with an indumentum of glandular black-headed hairs; upper lip of calyx with almost equal teeth; nutlets 4 mm. in diameter, dark brown
10. *S. adenostachya* Juz.

\+ Entire plant, except for long simple hairs, with an indumentum of long-stalked glands with lightish and darkish heads; inside of upper half of calyx almost glabrous with some scattered, light, short-stalked glands; upper lip of calyx with broad teeth, grooved at margins, exceeding lower lip; nutlets 3 mm. in diameter, black
11. *S. demetrii* Juz.

22. Upper part of stem, inflorescence, floral leaves and calyx with an indumentum of long- and short-stalked black-headed glands, some simple hairs . . . . . 4. *S. pachystachya* Trautv.

\+ Plant without black-headed glandular hairs 23

23. Calyx 8–10 mm. long, upper lip of calyx with equal teeth, calyx with a dense glandular indumentum . . . . 5. *S. alexandri* Pobed.

\+ Calyx 12–20 mm. long, middle tooth of upper lip exceeding lateral, calyx with an indumentum of simple hairs 24

24. Calyx campanulate, 15–20 mm. long, indumentum of long multicellular spreading hairs, antrorse hairs and a small quantity of short-stalked glands; upper lip of calyx broad, flat rounded, with a fine pointed middle tooth, exceeding the small lateral ones
S. garedji Troitzki

\+ Calyx broadly campanulate, 12–15 mm. long, indumentum on veins of short retrorse hairs, sometimes mixed with a few long multicellular hairs and with a few short-stalked glands between; upper lip of calyx with three small teeth, middle a little longer than lateral
7. *S. rosifolia* Sm.

25(1) Staminal filaments a little longer than the connectives, the latter appearing as if a continuation of filament, with a non-articulating socket, anterior joint short awl-shaped, directed downwards along the staminal filament; upper lip of corolla equal to or shorter than lower; tube of corolla with a ring of hairs 72

\+ Staminal filaments shorter than connectives, filaments making an angle with connective ; tube of corolla without a ring of hairs . 26

26. Anterior joint of connective longer than posterior, somewhat enlarged, not attached to its neighbour, not having a differentiated sterile theca; tube of corolla very long up to 3–3½ times length of calyx; floral leaves, calyx and corolla scarlet-red
72. *S. splendens* Ker-Gawl.

\+ Posterior joint of connective very long, anterior very short ending in a differentiated sterile theca, membranaceous, flat rectangular or sometimes uneven, attached to its neighbour; corolla tube short; floral leaves, calyx and corolla some other colour . . 27

27. Calyx broadly campanulate; upper lip at fruiting time strongly bent outside with two deep grooves, somewhat enlarged at fruiting (Section *Plethiosphace*) 58

\+ Calyx tubular, conical-tubular, tubular campanulate or campanulate; upper lip straight and little enlarged at fruiting, rarely much enlarged 28

28. Upper lip of calyx with unequal sided lateral teeth, corolla small with a straight upper lip, floral leaves with long stipules; annual herbs (Section *Horminum*) 29

\+ Upper lip of calyx with isolateral teeth, straight or hardly converging; middle part very small, floral leaves not stipulate; perennials 31

29. Uppermost sterile leaves above inflorescence large, bright violet or rose coloured, tube of corolla exposed from calyx 26. *S. horminum* Linn.

\+ Uppermost sterile leaves above inflorescence often not developed, inflorescence bearing flowers up to the top or if sterile leaves then small and green; tube of corolla concealed in the calyx . 30

30. Ribs of calyx with an indumentum of long multicellular hairs with swollen basal cells, with some short appressed retrorse hairs; similar indumentum on floral leaves, verticils and inflorescence axis . . . . . 27. *S. viridis* Linn.

\+ Calyx, floral leaves, verticils, inflorescence axis and sometimes the stem to the base with an indumentum of simple multicellular hairs and ± numerous long-stalked large-headed glands 28. *S. intercedens* Pobed.

31. Calyx a little expanded at fruiting, or almost not, lip split to less than half its length; upper lip of corolla falcate, compressed at edges usually longer than lower; perennial herbs, very seldom semi-shrubs (Section *Stenarrhena*) 32

\+ Calyx strongly expanding at fruiting, up to one and a half times, divided to half its length; upper lip of corolla weakly curved, equal to or shorter than lower; floral leaves very large, exceeding the flowers, rose coloured, perennial . 56. *S. insignis* Kudr.

32. Tube of corolla gradually expanding towards the throat; without a nectary; posterior stamens always reduced to staminodes (Subsection *Homalosphace*) 33

\+ Tube of corolla suddenly expanded before the throat; nectary in the shape of a scale with glandular hairs on upper edge; staminodes not, or seldom, present (Subsection *Gongrosphace*) . . 41

33. Teeth of upper lip of calyx equal or almost equal . . . 34

\+ Middle tooth of upper lip of calyx considerably shorter than the laterals 37

34. Calyx campanulate; indumentum of plant fleecy and, on the inflorescence, with stalked glands; corolla 8–12 mm. long; middle lobe of lower lip of corolla broad obovate, cup-shaped concave 29. *S. syriaca* Linn.

\+ Calyx tubular or conical tubular; indumentum of the plant composed of multicellular simple hairs and broad flat articulate hairs and stalked glands; corolla 2–3 cm. long; middle lobe of lower lip of corolla obovate, feebly concave 35

35. Calyx tubular, teeth of it, and floral leaves with long fine soft, not prickly, points; axis of inflorescence with an indumentum of short-stalked glands, edge of floral leaves and nerves of calyx covered with scattered, short, 2–3 membered hairs with swollen basal cell, also with short-stalked glands 32. *S. macrosiphon* Boiss.

\+ Calyx conical tubular, teeth of it and floral leaves with shorter firm prickly points; axis of inflorescence, floral leaves and calyx nerves with fine multicellular hairs with broad flat members mixed with long-stalked glands, also with a few short-stalked glands 36

36. Underside of floral leaves with stalked glands, stem leaves almost rounded off, white floccose indumentum, calyx with large quantity of glandular hairs . . 31. *S. nachiczevanica* Pobed.

\+ Underside of floral leaves without stalked glands, stem leaves ovate or elliptical, indumentum much less, calyx with few glandular hairs . . . . . 30. *S. spinosa* Linn.

37. Flowers with linear ciliate bracts, 5–6 mm. long; indumentum of the plant consisting of short simple hairs with swollen joints 33. *S. compar* Trautv.

\+ Flowers without bracts; whole plant (including calyx) with a soft indumentum of slender matted hairs, or of bristly hairs or pannose 38

38. Calyx tubular, or tubular campanulate, 16–20 mm. long . . 39
Calyx campanulate, 6–10 mm. long 40

39. Leaves ovate or broad elliptical, 12–15 cm. long, 5–10 cm. broad, slight indumentum; plant 25–50 cm. high 35. *S. gontscharovii* Kudr.

\+ Leaves elliptical or oblong elliptical (5–)7(–8) cm. long, (1·5–)2·2(–3) cm. broad, dense white indumentum, plant 15–30 cm. high . . . . . 34. *S. zeravschanica* Rgl.

40. Plant 10–35 cm. high; leaves white pannose beneath for most part, greenish above, large (2·5–)3(–18) cm. long, (0·4–)2(–6) cm. broad, edges strongly toothed, sometimes laciniate; flowers 15–23 mm. long, violet, nutlets triangular, ellipsoidal 2·5 cm. long . . . . . 36. *S. canescens* C.A.M.

\+ Plant (7–)10(–22) cm. high; leaves snowy white on both sides, narrow, small, (2–)3·5(–10) cm. long (0·4–)0·5(–1.5) cm. broad, edges rarely regularly toothed or almost entire; flowers smaller 14–17 cm. long, blue; nutlets 2 mm. long, trihedral-spherical 37. *S. daghestanica* Sosn.

41(32) Leaves pinnate 42
Leaves simple 43

42. Verticils 1–3-flowered, floral leaves gradually acuminate, calyx green at fruiting, calyx teeth with long mucronate points; flowers white (Turcomania) . . . 53. *S. semilanata* Czerniak.

\+ Verticils more often 5–6-flowered, rarely 2–3-flowered and then on all the inflorescence, floral leaves abruptly acuminate, calyx tube filmy, clearly ribbed at flowering and particularly so at fruiting, calyx teeth shorter, mucronate: flowers yellow (Caucasus) . . . . . 52. *S. ceratophylla* Linn.

43. Corolla small 8–9 mm. long, leaves mostly basal, floral leaves nearly all equal to, or half as long as, the calyx, no staminodes *S. brachyantha* (Bordz.) Pobed.

\+ Corolla large, 1·2–3·5 cm. long 44

44. Whole plant, including calyx, with dense whitish canescent indumentum; inflorescence pyramidal, multi-flowered panicle; flowers white . . . . . 44. *S. aethiopis* Linn.

\+ Whole plant without whitish canescent indumentum or if on the stem and leaves the calyx is without it 45

45. Floral leaves membranaceous, large, exceeding the calyx and sometimes the flowers, rose coloured or white with greenish edges . . . . . 38. *S. sclarea* Linn.

\+ Floral leaves green or violet coloured, shorter than the calyx . 46

46. Floral leaves soon falling off . . 55. *S. beckeri* Trautv.
Floral leaves persisting 47

47. Indumentum of plant consisting of multicellular hairs with broad flat articulae or fine curly or long-stalked glands . . 48

\+ Indumentum of plant consisting of short hairs, swollen at the base 50

48. Stem from base with glandular hairs, only inflorescence axis with glandular hairs; upper lip of corolla narrow, weakly falcate . . . . . 47. *S. xanthocheila* Boiss.

\+ Stem from base without glandular hairs; upper lip of corolla broad, strongly falcate 49

49. Corolla whitish yellow, 2–2·5 cm. long, verticils 1–2·5 cm. apart, inflorescence axis with long-stalked glands 45. *S. verbascifolia* M.B.

\+ Corolla violet, 15–17 mm. long, verticils 1–1·5 cm. apart; inflorescence axis with only simple hairs, together with a considerably denser indumentum on calyx than in the previous species . . . . . 46. *S. andreji* Pobed.

50. Leaves wrinkled 51

\+ Leaves not wrinkled or slightly wrinkled sometimes only at margins 53

51. Leaves small, 2·2 cm. long, 1·2–1·8 cm. broad, nutlets 2·5 cm. long . . . . . 50. *S. prilipkoana* Grossh.

\+ Leaves large, 5–11 cm. long, 2·5–7·5 cm. broad 52

52. Stem leafy to the top; corolla 14–19 mm. long, with strongly falcate upper lip; seeds 2 mm. long . 51. *S. fominii* Grossh.

\+ Leaves concentrated at base of stem, corolla 24–27 cm. long with upper lip weakly falcate or almost straight; seeds 3 mm. long . . . . . 48. *S. limbata* C.A.M.

53. Indumentum on all the stem or only at base without glandular hairs or only occurring on inflorscence 54

\+ Indumentum at the edges of the stem of short-stalked glands . 56

54. Leaves not large 5·5–10 cm. long, 1·5–3 cm. broad, wrinkled, fine arachnoid indumentum 55

\+ Leaves noticeably larger, 9–16 cm. long, 5–7 cm. broad, smooth, slightly wrinkled at the margin, above almost glabrous, or with dispersed tufts of hairs, beneath on the veins with an indumentum of long fine hairs . . . . 43. *S. karabachensis* Pobed.

55. Upper lip of calyx with three ± regularly arranged teeth; calyx indumentum of long multicellular hairs with broad flat joints, mixed with similar but glandular hairs; corolla 1·5–2 cm. long; upper lip of corolla narrow, middle lobe of lower lip deeply concave, inflorescence axis with stalked glands 41. *S. grossheimii* Sosn.

\+ Upper lip of calyx rounded with three connivent teeth; calyx with a dense indumentum of short fine curly hairs; corolla 2·5–3 cm. long, upper lip of corolla broad, middle lobe of lower lip slightly concave more elongated than in previous species; inflorescence axis without glandular hairs 42. *S. hajastana* Pobed.

56. Leaves above almost glabrous, beneath with a dense indumentum of spreading hairs . . 49. *S. chloroleuca* Rech. fil.

\+ Leaves floccose or with an indumentum of long fine intertwined hairs 57

57. Basal leaves oblong lanceolate or elliptical, (7–)10(–15) cm. long (2·5–)5(–6) cm. broad; verticils about 3–6 cm. apart; corolla 2–2·5 cm. long . . . 40. *S. linczewskii* Kudr.

\+ Basal leaves broad, ovate or rhombic oblong, broader (8–)11(–13) cm. long, (3–)5·5(–8) cm. broad; verticils looser 2·5–3 cm. apart; corolla 2·5–3 cm. long . . 39. *S. kopetdaghensis* Kudr.

58(27) Top of inflorescence drooping, verticils on inflorescence axis and branches crowded; leaves all basal, broadly ovate, on stem a pair of small sessile ones . . . . 68. *S. nutans* Linn.

\+ Top of inflorescence erect, verticils on inflorescence axis and branches ± spaced out 59

59. Stamens and connective twice or thrice as long as the corolla, upper lip of corolla narrow, almost straight or feebly falcate; corolla yellow 60

\+ Stamens and connective $\frac{1}{3}$–$\frac{1}{2}$ the length of the upper lip of corolla, exposed or stamens hidden under lip; corolla violet and blue coloured 61

60. Calyx indumentum of long, fine, multicellular spreading hairs, back of upper lip of corolla with long-stalked glands 69. *S. austriaca* Jacq.

\+ Calyx indumentum of fine multicellular hairs with broad flat articulate glands and long-stalked glands; back of upper lip of corolla with very short pilose hairs 70. *S. armeniaca* (Bordz.) Grossh.

61. Flowers small, 8–9 mm. long; leaves broad elliptical, deeply indented at margin . . . . 71. *S. verbenaca* Linn.

\+ Flowers large 9–30 mm. long; leaves ovate, ovate-oblong or oblong, crenate at margin 62

62. Floral leaves longer than calyx, violet, imbricate in bud at top of inflorescence 63

\+ Floral leaves equal to, or shorter than, calyx, green, not imbricate in bud at top of inflorescence 65

63. Calyx indumentum on veins of very short appressed hairs, corolla 8–10 mm. long, middle lobe of lower lip of corolla pressed against calyx . . . . . 64. *S. nemorosa* Linn.

\+ Calyx with a ± thick indumentum of longer hairs, corolla 8–16 mm. long; middle lobe of lower lip of corolla not pressed against calyx 64

64. Floral leaves broad, shortly pointed, usually longer than the calyx, violet, persisting after fruiting, projecting upwards; lower internodes with shorter spreading hairs 65. *S. tesquicola* Klok. et Pobed.

\+ Floral leaves lanceolate-ovate, longly pointed, usually shorter than calyx, green or green beneath, upper faintly violet coloured, after fruiting turning back and appressed on axis of inflorescence, sometimes deciduous; lower internodes with a denser indumentum of longer hairs . . . . . 66. *S. deserta* Schang.

65. Calyx deciduous on maturity of seeds . . 67. *S. fugax* Pobed.
Calyx persisting on maturity of seeds 66

66. Inflorescence with very long spreading, thick branches, projecting from inflorescence axis, or, if simple, all leaves basal, 8–40 verticils; leaves oblong, seldom ovate-oblong, blunt . 67

\+ Inflorescence simple or with branches not projecting from axis, 5–20 verticils; leaves acute seldom ovate-oblong, truncate . 69

67. Leaves almost all basal, stem with one-two pairs of small, sessile, broad lanceolate leaves, inflorescence with 8–20 verticils 63. *S. sibthorpii* Sm.

\+ Leaves distributed equally over stem, inflorescence with 12–40 verticils 68

68. Floral leaves broad, short pointed, verticils 20–40, considerably spread out, indumentum of stem and calyx consisting of long-stalked, large-headed glands . . 61. *S. virgata* Jacq.

\+ Floral leaves lanceolate-ovate, longly pointed, verticils 12–20, approximating at summit, towards base distant, without a glandular indumentum on stem and calyx 62. *S. turcomanica* Pobed.

69. Base of stem glabrous or with very short scattered hairs 59. *S. stepposa* Schost.

\+ Base of stem with long, multicellular, felted hairs with flat broad members mixed with a few longly stalked glands . . . 70

70. Upper lip of corolla scarcely bent, narrow 60. *S. kuznetzovii* Sosn.

\+ Upper lip of corolla falcate, broad 71

71. Bisexual flowers, 2·5–3 cm. long, violet: leaves ovate-oblong or ovate . . . . . 57. *S. pratensis* Linn.

\+ Bisexual flowers, 1–2 cm. long, dark violet; leaves oblong or ovate-oblong . . . . . 58. *S. dumetorum* Andrz.

72(25) Corolla with the upper lip deeply tri-laciniate almost equalling the lobes of the lower; flowers solitary in the leaf axils, calyx deciduous on maturation of nuts; semi-shrub with a dense white indumentum on leaves . . 75. *S. baldschuanica* Lipsky

\+ Corolla with entire upper lip arched backwards, suddenly contracted at the base, lateral lobes of lower lip considerably smaller than centre which is 2-lobed; perennial herbs with green leaves 73

73. At the base of leaves a single or double pair of small thin opposite lobes; verticils 20–40-flowered, calyx with a slanting throat, upper lip exceeding lower, dense indumentum of long multicellular hairs; no staminodes . . 73. *S. verticillata* Linn.

\+ Leaves without lobes at the base or with weakly developed lobes, verticils 15–20-flowered, calyx with a straight throat and almost equal lips, indumentum of short hairs on ribs and between with short-stalked glands; with staminodes 74. *S. amasiaca* Fr. et Bornm.

Appendix II

Translation of the key to *Schraderia* Medik. in Komarov, Flora U.R.S.S. xxii, 364 (1954)

1. Calyx and corolla pink, light or dark purple; non-articulating staminal socket; floral leaves persistent 2

\+ Calyx and corolla yellow; articulating staminal socket; floral leaves soon falling off . 4. *S. korolkovii* (Rgl. et Schmalh.) Pobed.

2. Stem simple but with many stems; leaves entire, almost all basal, with a white indumentum beneath; verticils distant 3. "*S. acetabulosa* (Vahl) Pobed."*

\+ Stem branched along entire length, leaves pinnate, spread over the stem, less dense indumentum; verticils ± approximating . 3

3. Tube of corolla long, noticeably exserted from calyx; leaves large, terminal segment 3–6 cm. long, 1·5–2·5 cm. broad (Central Asia) . . . . 1. *S. bucharica* (M. Pop.) Nevski

\+ Tube of corolla short, scarcely exserted from calyx; leaves small, terminal segment 1–3 cm. long, 0·5–1·2 cm. broad 2. *S. dracocephaloides* (Boiss.) Pobed.

* *cf.* Hedge, Notes R.B.G. Edin. xxii, (4), 427 (1958).