

# A REVIEW OF THE HERBACEOUS SPECIES OF POLYGALA IN MALESIA (POLYGALACEAE) \*

F. ADEMA

## SUBDIVISION OF THE GENUS

The subdivision of the genus as proposed by Chodat in his Monograph of the family, seventy five years ago, needs emendation. First, one of his sections, *Semeiocardium* (Zoll.) Hassk. must be completely reconstructed. It is typified by a singular genus *Semeiocardium* occurring in Madura and Kangean Is. (off NE. Java) which was described by Zollinger as a *Balsaminaceae*, but included by Hasskarl in the *Polygalaceae*, in which he was followed by Chodat. Backer has indubitably shown that Zollinger's opinion was correct and that it represents a remarkable, endemic genus of the *Balsaminaceae* (Gard. Bull. Str. Settl. 9, 1935, 70). For the other species included in this section a new section must be accepted which I have named *Pseudosemiocardium*. Furthermore, through the type method, the sectional name *Orthopolygala* Chodat must be substituted by *Polygala* to which belongs the lectotype species of the genus, *P. vulgaris* L. (cf. Linné, Sp. Pl. repr. 1959, vol. 2, Stearn's index notes, p. [137]).

Finally, Chodat's first key character to the sectional subdivision, namely whether the keel is cristate or not, does not hold, because the species of sect. *Pseudosemiocardium* defined as ecristate in that key, and which certainly represent a natural taxon, almost all possess a cristate keel, viz. *P. malesiana*, *P. cardiocarpa*, *P. furcata*; only one has an ecristate keel viz. *P. tatarinowii*. Provisionally, it seems to me more practical to use as first key character whether the two paired (inner) sepals are caducous or persistent. This can always be observed as in the herbarium in almost all specimens the lower flowers of at least some racemes are beyond anthesis.

In reframing Chodat's key under the above observations, and leaving intact sections which I have not studied, the following tentative key emerges:

## SECTIONAL DIVISION OF POLYGALA

1. Sepals and alae caducous.
2. Shrubs or undershrubs, woody.
  - 2'. Carina without crest.
    3. Capsule broadly winged, subsamaroid . . . . . sect. **Phlebotaenia**
    3. Capsule not subsamaroid.
      4. Spiny shrub. Stigma simple. Capsule glabrous . . . . . sect. **Acanthocladus**
      4. Unarmed. Stigma divided. Capsule pilose . . . . . sect. **Hebecarpa**
  - 2'. Carina crested. Stigma divided. Capsule glabrous, not samaroid. Plants not spiny.
 

sect. **Chamaebuxus**

\*) This revision was made under supervision of Prof. Dr. C. G. G. J. van Steenis, as part of the practical work for my doctoral examination at the University, Leyden.

*Acknowledgements.* I express warm thanks to the directors of the following Herbaria which granted me the privilege of loans: Berlin-Dahlem, Bogor, Calcutta, Canberra (CSIRO), Cambridge (England), Copenhagen, Edinburgh, Florence, Geneva, Kew, Lae, New York, Singapore, Utrecht, and Washington, D.C.

The Latin descriptions were kindly drawn by Dr. R. C. Bakhuizen van den Brink Jr.

2. Herbs, unarmed, not woody. Capsule not subsamaroid, glabrous. Stigma divided. Carina almost always crested (not in *P. tatarinowii*) . . . . . sect. **Pseudosemeiocardium**
1. Sepals and alae persistent.
  5. Carina without crest.
    6. The anterior (ventral) sepals connate. Seed with carunculus . . . . . sect. **Hebeclada**
    6. Sepals free.
      7. Carunculus developed into a dorsal appendage . . . . . sect. **Ligustrina**
      7. Seeds without carunculus . . . . . sect. **Gymnospora**
      7. Carunculus 3-lobed . . . . . sect. **Brachytropis**
  5. Carina crested in some way or other . . . . . sect. **Polygala**

### POLYGALA

Linné, Gen. Pl. ed. 5 (1754) 315; Sp. Pl. 1 (1753) 701; DC., Prod. 1 (1824) 321; Benth. & Hook., Gen. Pl. 1 (1862) 136; Boerlage, Fl. Ned. Ind. 1, 1 (1890) 77; Chodat, Monogr. 1 (1891); *ibid.* 2 (1893); Engl. & Pr., Nat. Pfl. Fam. 3, 4 (1897) 330.

Annual or perennial herbs, shrubs, or treelets, sometimes spiny. Roots not seldom aromatic (by methylsalicylate) and containing saponins. *Leaves* (in Mal.) spirally arranged. Flowers in terminal or lateral racemes (in Mal.), sustained by a small, caducous or persistent bract. Bracteoles 2, caducous or persistent. *Sepals* 5, caducous or persistent, unequal, 2 inner ones largest (*alae* or *wings*), often petaloid. *Petals* 3, 2 upper ones (*lateral petals*) basally adnate to the staminal tube, lower one (*keel*) boat-shaped, clawed (the basal part of the blade above the claw sometimes auricled), entire or bearing a dorsal crest, crest consisting of 2 lobes, the latter entire or divided in a various number of appendages. *Stamens* 8, monadelphous; anthers sessile or on a free filamentous stalk, basally attached, opening with only 1 terminal pore common to both cells. *Disk* (in § *Pseudosemeiocardium* and § *Chamaebuxus*) present, annular or consisting of 1—2 short appendages which are not rarely persistent under the fruit. *Ovary* laterally compressed, 2-celled, each cell with 1 pendent, anatropous ovule attached apically on the dissepiment. *Capsule* compressed contrary to the dissepiment, mostly margined, sometimes with a double wing, dehiscing by a marginal split (if wings are present between these). *Seed* in the Malesian herbaceous spp. mostly dark and hairy, at the micropylar part (that is close to the attachment at the funicle) with a *carunculus*, this cap-like and ± entire or provided with 2—3 lobes of various length; the other end of the seed sometimes (sect. *Pseudosemeiocardium*) bearing a black glossy appendage (*strophiolus*) of various shape.

Type species: *P. vulgaris* L. (sect. *Polygala*).

*Distribution.* Ubiquist, both in the tropics and in colder climates.

*Ecology.* The herbaceous species are not constituents of the primary forest. They are heliophilous, and grow on open terrains, open woodland, with a preference for grasslands in seasonal areas (subject to a more or less pronounced dry season), in contrast to the shrubby species of sect. *Chamaebuxus* which are restricted to the undergrowth of rain-forest.

*Notes.* In several species, notably *P. chinensis*, *P. longifolia*, *P. glomerata*, and *P. tatarinowii* sometimes monstrous flowers occur in which the flowers become radial instead of symmetric; in these flowers there occur supernumerary flowerparts, especially in the calyx; these flowers are usually sterile and consequently racemes become longer.

In species where the stem is hairy in some way or other the rachis of the racemes and the pedicels bear the same kind of indumentum; this is not always repeated in the descriptions.

The length of the racemes is always given including the peduncle, because frequently an isolated flower is found in the basal part of the raceme which makes the definition of the peduncle proper very difficult.

## KEY TO THE MALESIAN SPECIES

1. Calyx caducous after anthesis. Keel whether or not provided with 2 broad appendages. Sect. PSEUDO-SEMEIOCARDIUM.
  2. Keel devoid of appendages. Mature fruit almost orbicular to subquadrangular with rounded edges, the tip with a minute point at the stunted or faintly emarginate apex . . . . . 1. *P. tatarinowii*
  2. Keel with 2 broad appendages. Fruit elliptic to obcordate, without such point.
    3. Fruit obcordate symmetric, lined by a narrow wing broadening apically. Seed oblong, with a large black appendage at the chalaza (the apex on the other end of the seed bearing the micro-pylar carunculus). . . . . 2. *P. malesiana*
    3. Fruit elliptic, roundish, or oblong to subobovate-oblong, distinctly asymmetric through unequal, wide wings one of which is mostly patent. Seed obtriangular-oblong, with a small, knob-shaped appendage at the chalaza . . . . . 3. *P. cardiocarpa*
1. Calyx persistent after anthesis. Keel mostly provided with more than 2 appendages. Sect. POLYGALA (sect. *Orthopolygala* Chodat).
  4. Alae (inner calyx lobes) symmetric, triangular, obovate or elliptic, blunt, petaloid (coloured).
    5. Alae mucronate, triangular or elliptic.
      6. Alae triangular, haired. Anthers on filaments. Fruit oblong,  $\pm$  quadrangular, notched at both ends, narrowly winged all around, puberulous (also along margin of wings) . . . . . 4. *P. javana*
      6. Alae elliptic, glabrous. Anthers sessile. Fruit about orbicular, obcordate, broadly winged at apex, glabrous. . . . . 5. *P. japonica*
    5. Alae blunt, not mucronate, elliptic to almost orbicular.
      7. Alae obovate to nearly orbicular, in fruit 6—7 mm long, 5-nerved. Bracts and bracteoles persistent . . . . . 6. *P. persicariaefolia*
      7. Alae elliptic, in fruit less than 5 mm long, 3-nerved. Bracts caducous after anthesis.
        8. Fruit with a distinct wing all around broadening upwards, elliptic to obovate. Alae distinctly exceeding the fruit. Style much curved with a terminal punctiform stigma and no appendages. Plant 'stalky', little branched; stem glabrous and ribbed; racemes few. . . . . 7. *P. longifolia*
        8. Fruit practically wingless, oblong, apex stunted, notched. Alae shorter or at most equalling the fruit. Style almost straight, ending in a unilaterally attached cuplet which bears at the apical side a hair-tuft and at the basal end (towards the fruit) the punctiform stigma. Plant generally profusely branched, with many racemes; stem mostly a little hairy, terete, not ribbed; racemes mostly many . . . . . 8. *P. paniculata*
  4. Alae asymmetric, subfalcate, oblong to elliptic, apex very acute, not petaloid (green).
    9. Racemes short, dense, more or less conical, c. 1 cm long. Keel with 2 clavicular lobes. Style top more or less straight, flat and widened with rounded apex, the stigma sessile below this widening. Flowers c. 4 mm long. Lateral petals somewhat shorter than the keel. . . . . 9. *P. exsquamata*
    9. Racemes short or long, but not conical. Keel with a tuft of 4 or more fringe-like appendages. Style top either acute or horseshoe-shaped curved (hooked).
      10. Flowers c. 3 mm. Lateral petals much smaller than the keel, obtriangular, emarginate. Keel with a tuft of c. 16 short fringe-like appendages. Stigma ending in a sterile tooth below which is a short, lateral, stalk-like widening bearing the stigma. . . . . 10. *P. chinensis*
      10. Flowers larger than 4 mm. Lateral petals shorter than or as long as the keel, obovate to oblong. Keel with a tuft of 4—many, short filiform or forked appendages. Style at apex horseshoe-shaped curved or hooked, the stigma at the inner side inserted about halfway the apical part or terminal.
        11. Style hook-like curved, with 2 wings, one in the lower part in the curve, the other below the apex at the outer side of the curve; stigma terminal. Staminal tube split halfway, the upper half with 2 single filaments and 2 bundles of each 3 connate filaments and sessile anthers. Keel with 2 bundles of each 5 forked appendages; auricles ciliate. Fruit oblong, rather longer than wide . . . . . 12. *P. wightiana*
        11. Style to apex horseshoe-shaped curved, not winged; stigma at the inner side inserted  $\pm$  halfway the hook. Staminal tube with 8 apically free filaments. Keel with 16 filiform or 2—8 forked appendages; auricle or base not ciliate.
          12. Appendages on keel 16, filiform. Racemes short, shorter than the leaves. Bracts caducous before or after anthesis. Pedicels in flower c. 1—1½ mm, in fruit c. 1½—2 mm. Fruit as long as wide, almost orbicular. Carunculus with 2 short, broad appendages. . . . . 11. *P. glomerata*
          12. Appendages on keel (2—)4—8, each shortly forked or emarginate at tip. Racemes usually longer than the leaves. Bracts persistent. Pedicels in flower c. 2 mm, in fruit c. 3 mm. Fruit usually longer than wide, obovate oblong or rhomboid.

13. Fruit asymmetric, more or less rhomboid. Racemes usually longer than 10 cm, slender, rather straight. Carunculus almost always with 2 appendages.

13. *P. elongata*

13. Fruit symmetric, obovate-oblong. Racemes up to 9 cm, usually fairly thin and straight. Carunculus with 3 appendages . . . . . 14. *P. linarifolia*

### Section *Pseudosemeiocardium*, sect. nov.

*Semeiocardium* (non Zoll.) Hassk., *pro parte, excl. spec. typ.*, in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 150. — *Polygala* sect. *Semeiocardium* [non (Zoll.) Hassk.] Chodat, *pro parte, excl. spec. typ.*, Monogr. 2 (1893) 41.

Herbacea, annua, erecta, plerumque brachiata, rami-ficationibus superioribus saepe di- vel trichotomis, in axillis foliorum positis. Racemi plerumque longi et multiflori. Calyx, corolla et staminum tubus post anthesin caduci. Discus annularis, vel appendicibus 1 vel 2 brevibus, haud raro sub fructu persistentibus formatus. Stylus apicem versus curvatus, plusminusve tubiformis, apice denticulo unico ante stigma sessile posito munitus. Carina appendicibus duabus latis vel raro exappendiculata.

Species typica: *Polygala furcata* Royle (*P. glaucescens* Wall., Cat. 4182).

1. *Polygala tatarinowii* Regel, Bull. Soc. Nat. Moscou 34, 2 (1861) 523; Forb. & Hemsl., J. Linn. Soc. 23 (1888) 62; Craib, Not. R. Bot. Gard. Edinb. 11 (1919) 187; Gagn., Fl. Gén. I.-C. 1 (1938) 226; Ohwi, Fl. Jap. (1965) 587. — *P. triphylla* (non Buch. Ham. ex D. Don, 1825) Royle, Ill. (1839) t. 19D, non Burm. f. 1768, et auct. var. *pro parte*; Merr., En. Philip. 2 (1923) 384 (type specimen: NW. India, Royle, K!). — *Semeiocardium hamiltonii* Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 151, *excl. specim. novog. Zippel, excl. syn. P. triphylla* D. Don. — Fig. 1.

Erect, branched annual herb, branchings not or hardly dichotomous, 4–18 cm. Stem glabrous and faintly ribbed. Leaves ovate to obovate, 2–35 by 1–20 mm, petioled ( $\frac{1}{2}$ –1 mm), penninerved, acute, base acutely decurrent, laxly short-hairy, ciliate. Racemes

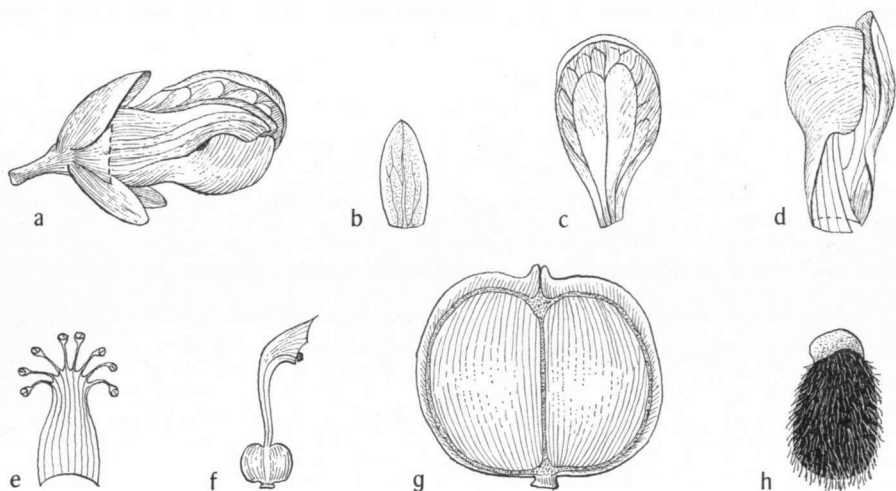


Fig. 1. *Polygala tatarinowii* Regel. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 15$ . (Ramos & Edaño BS 40317).



terminal, including the peduncle 1—10½ cm; bracts lanceolate, 1½—2 mm, bracteoles lanceolate, ½—1 mm, early caducous. Flowers rose red to purple. Outer *sepals* ± ovate, blunt, alae ± obovate, blunt, 5-nerved. Lateral *petals* oblong, ± longer than the keel; keel without appendages, the apical part orbicular, papillose. Staminal tube not hairy inside, filaments for c. ½ free. *Ovary* roundish; style curved, towards the apex trumpet-shaped and obliquely cut, the apical part a sterile tooth, the stigma opposite this at the shortest end of the trumpet. *Fruit* symmetric, ± quadrangular with rounded edges to ± orbicular, very narrowly winged all around (wings not visibly cross-veined), the truncate apical margin with a very short acumen. *Seed* black, suboblong, with short white hairs; carunculus small, hood-shaped, often with 2 small, thin appendages; strophiola 0.

*Type specimen*: North China prope Peking, leg. Tatarinow in herb. Fischer = herb. Turczaninow, not seen.

*Distribution*. Japan, China, and tropical SE. Asia, in Malesia only in the Philippines (Luzon and Mindanao), but apparently very rare. Fig. 2.

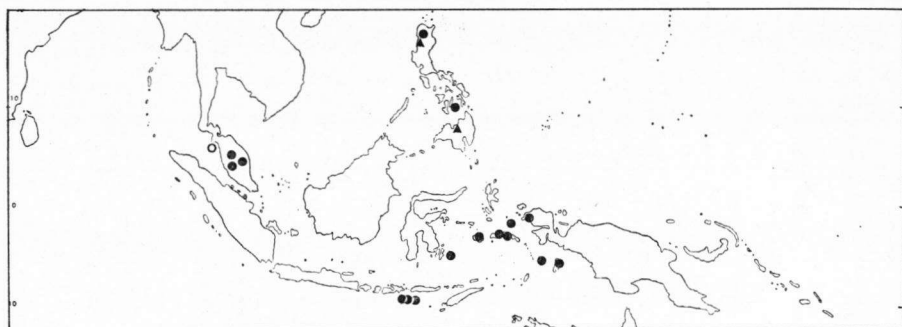


Fig. 2. Distribution in Malesia of *Polygala cardiocarpa* Kurz (O), *P. malesiana* Adema (●), and *P. tatarinowii* Regel (▲).

*Ecology*. Open grasslands ascending to 1300 m (Merrill).

*Notes*. This species was often cited under the name *P. triphylla* Buch. Ham. ex D. Don. This epithet cannot be used because of the older homonym *P. triphylla* Burm. f. 1768. For that reason Hasskarl renamed it in 1863, two years after Regel described another species which is anyway the species in question. Though Craib examined the type specimen in herb. British Museum he did not mention precisely the crucial character distinguishing it from the closely allied, continental SE. Asiatic *P. furcata*, which has a keel bearing 2 flab-like appendages, an orbicular fruit without apical acumen, and an almost globular seed with 2 broad appendages to the carunculus. I could re-examine the type of *P. triphylla* (in BM) and find it conspecific with *P. furcata* Royle.

**2. *Polygala malesiana* Adema, sp. nov.** — *P. cardiocarpa* (non Kurz) Ridl., Fl. Mal. Pen. 1 (1922) 139, *pro parte*; Merr., En. Philip. 2 (1923) 383. — *P. triphylla* Buch. Ham. ex D. Don var. *glaucescens* (non Wall., Cat. 4182 ex Benn. in Hook. f., Fl. Br. Ind.) King, J. As. Soc. Beng. 59, ii (1890) 130. — Fig. 3, 4.

Differt a *Polygala umbonata* Craib characteribus sequentibus: petala lateralia oblonga obtusa; styli apex tubae modo dilatatus; stigma breviter stipitatum; fructus plerumque longior quam latus; strophiola quam semen paullum angustior, parte apicali subcurvata, in lamellam orbicularem concavam exeunte.

Spec. typ. Moluccas, Kei Is., Jensen 169 (L. holotypus, BO, C).

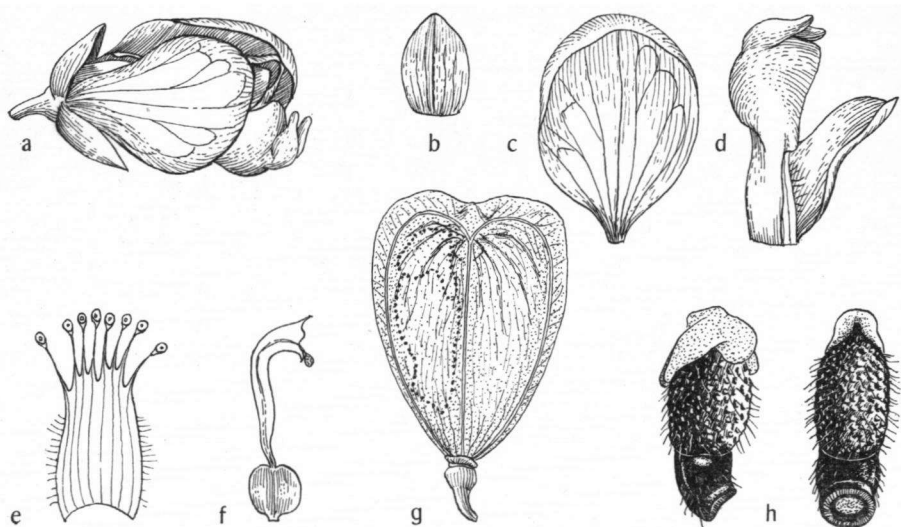


Fig. 3. *Polygala malesiana* Adema. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed, lateral and ventral view. All  $\times 15$ . (Jensen 169, type).

Erect, 2—3-chotomously branched annual, 6—20 cm. Stem glabrous, ribbed. *Leaves* mostly in pseudowhorls of 3, broad-elliptic to ovate, 10—55 by 9—25 mm, thin, penninerved, acute, base acutely decurrent, laxly very short-hairy and ciliate, petioled ( $\frac{1}{2}$ —1 cm). Racemes terminal or in a fork, including the peduncle 3—7 $\frac{1}{2}$  cm; bracts  $\pm$  lanceolate, acute, twice as long as the bracteoles, early caducous. Flowers variously coloured. Outer *sepals* broad obovate to  $\pm$  orbicular, rounded; alae obovate-oblong, blunt, 5-nerved. Lateral *petals* somewhat oblong bluntish, about as long as the keel; keel with 2 broad 2-tipped appendages. Staminal tube inside somewhat hairy at the adnation with the lateral petals; filaments free for *c.*  $\frac{1}{2}$  of their length. *Ovary*  $\pm$  obcordate; style curved, flattened, trumpet-shaped, obliquely cut, at the higher end (apex) with a sterile tooth, the lower end with the punctiform stigma on a minute stalk. Fruit pedicel less than 1 mm; *fruit* obcordate, symmetric, notched at apex, without acumen, with a narrow cross-veined wing all around, wing distinctly widening apically, pericarp parallel-veined. *Seed* black, oblong, somewhat tubercled, with sparse white hairs, with both stropholus and carunculus; carunculus small with 2—4 minute or 2 broad appendages; stropholus black and shining, *c.*  $\frac{1}{3}$  as long as the seed, a little narrower than the seed, to apex slightly curved, ending in an orbicular, sunken, membranous lamella, hollow.

*Distribution.* Malesia: Malay Peninsula (Perak, Pahang, Selangor), SE. Celebes (Tukang-besi Is.), Philippines (Bohol), Moluccas (Buru, Ceram, Key and Aru Is.), Lesser Sunda Islands (Sumba), and West New Guinea (Sorong and South Vogelkop Peninsula). Fig. 2.

*Ecology.* In Malaya and Celebes noted from limestone (Sumba should also be so), in open terrain, below 300 m.

*Notes.* This is closely allied with the continental SE. Asian *P. umbonata* Craib (fig. 5), more than with any other species. There are no vegetative differences, but this is valid for all species of sect. *Pseudosemeiocardium*.

There is very constant difference with *P. umbonata* in three different organs: *P. umbonata*

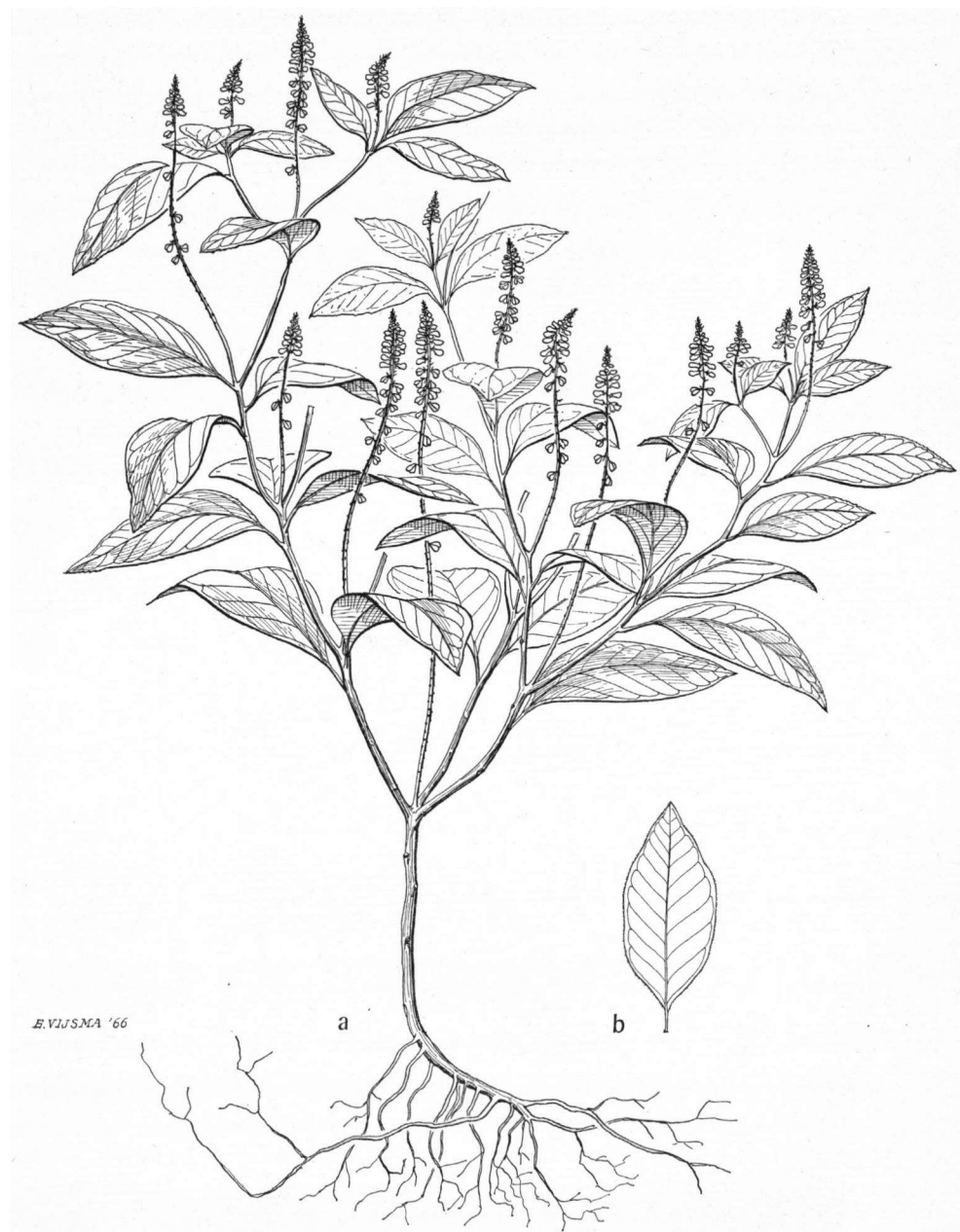


Fig. 4. *Polygala malesiana* Adema. a. Habit, b. leaf. Both  $\times \frac{1}{4}$ . (Jensen 169, type).

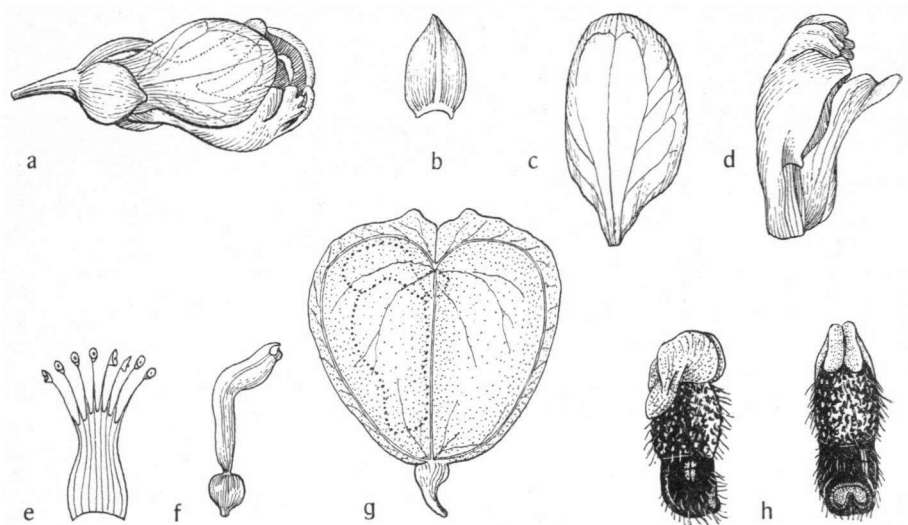


Fig. 5. *Polygala umbonata* Craib. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, e. right one petal, f. opened staminal tube, g. pistil, h. fruit, i. seed, lateral and ventral view. All  $\times 10$ . (Vanpruk 328).

possesses petals which are more or less spatulate with a wide, subtruncate, shallowly notched apex, an inflated, suburceolate style apex which is narrowed at the end with a sessile stigma, and a seed with a strophliola about as wide as the seed proper and bearing the scar-like apical, kidney-shaped (not circular) hollowed membrane distinctly laterally.

I have seen the following specimens of *P. umbonata*: Burma (Lace 5477) and N. Siam (Garrett 451, 1339; Rabil 298; Put 318; Vanpruk 328, type; Franck 143, 754).

Though admittedly *P. umbonata* and *P. malesiana* are geographically exclusive, which would suggest a subspecific status, the differences found concern organs which are important in *Polygala* taxonomy; this has induced me to accept them as different species. It is of course not impossible that *P. malesiana* will be found in future also in continental Asia when more collecting will have been done.

It is not clear whether *P. cardiocarpa* reported by Gagnepain (Fl. Gén. I.-C. 1, 1909, 253) belongs to *P. umbonata* or to *P. malesiana*; I have not seen the specimens on which this record is based.

**3. *Polygala cardiocarpa* Kurz, J. As. Soc. Beng. 41, ii (1872) 293; Chodat, Monogr. 2 (1893) 42, *sine descr.*; Craib, Not. R. Bot. Gard. Edinb. 11 (1919) 187, 188; Ridl., Fl. Mal. Pen. 1 (1922) 139, *pro parte, pro specim. langkaw.*; Craib, Fl. Siam. En. 1 (1931) 100. — *Heterosamara birmanica* O. Kuntze, Rev. Gen. Pl. 1 (1891) 47 (type specimen: Moulmein, O. Kuntze 6268, NY!, K!). — *P. birmanica* (O. K.) Chodat, Bull. Herb. Boiss. 3 (1895) 128. — Fig. 6.**

Erect annual, 4—25 cm, towards apex 3-chotomously branched. Stem glabrous and mostly somewhat ribbed. Leaves ovate-elliptic, 6—55 by 4—30 mm, thin, penninerved, acute, with acutely decurrent base, fairly long-petioled ( $\frac{1}{2}$ —1 $\frac{1}{2}$  cm). Racemes terminal or in a fork, including the peduncle 1 $\frac{3}{4}$ —14 cm. Bracts very small,  $\pm$  lanceolate, early caducous. Flowers orange-yellow to bright yellow. Outer sepals ovate to nearly orbicular,

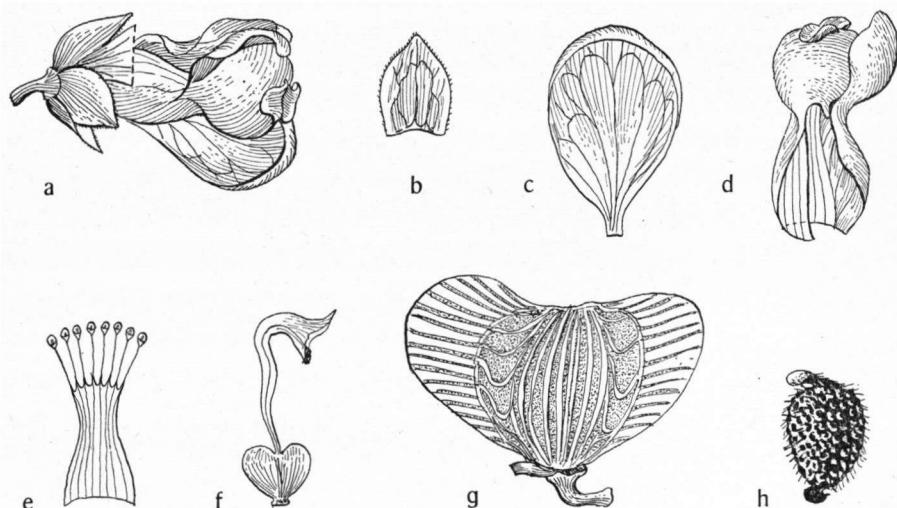


Fig. 6. *Polygala cardiocarpa* Kurz. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 15$ . (Curtis 3686).

short-mucronate; alae broad-obovate to  $\pm$  orbicular, blunt, 3-nerved. Lateral petals  $\pm$  oblong,  $\pm$  as long as the keel; keel short, with 2 rounded appendages. Staminal tube somewhat hairy inside at the adnation with the petals; filaments free for  $\pm \frac{1}{2}$  of their length. Ovary  $\pm$  obcordate, the cells unequal, the upper one being smaller; style curved, trumpet-shaped, only faintly obliquely cut, one apex a sterile point, opposite the sessile stigma. Fruit obcordate, distinctly asymmetric (the upper cell smallest), provided with 2 very unequal cross-veined wings, pericarp parallel-veined. Seed black, narrowly obtriangular-oblong or rarely stunted at both ends,  $\pm$  minutely tubercled and very laxly puberulous; carunculus minute; stropholus also minute, knob-shaped, shining black.

*Type specimen:* Tenasserim, Parish 307 (CAL!).

*Distribution.* Burma, Lower Siam, and the Malay Peninsula (Langkawi Is.). Fig. 2.

*Ecology.* At low altitude, apparently restricted to limestone rocks.

*Note.* Bennett believed this to be a monstrous form of '*P. triphylla* Buch. Ham. ex D. Don', but I accept it as a distinct species. Special thanks are due to Prof. Santapau for the loan of the holotype.

### Section *Polygala*

*Polygala* sect. *Orthopolygala* Chodat, Monogr. 2 (1893) 120, *nom. illeg., incl. sect. Psychanthes* DC., *Polygalon* DC., *Blepharidium* DC., *Clinclinia* DC., *Timutua* DC., Prod. 1 (1824) 321—330.

Herbs sometimes woody at the base or small shrubs. Alae persistent. Carina cristate. Type species: *P. vulgaris* L.

4. *Polygala javana* DC., Prod. 1 (1824) 327; Miq., Fl. Ind. Bat. 1, 2 (1859) 124; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 180; Chodat, Monogr. 2 (1893) 324; Backer, Schoolfl. Java (1911); 79; Onkruidfl. Suiker. (1934) 394, Atlas t. 375; Bekn. Fl. Java (em. ed.) 4A (1942) fam. 50, p. 3; Backer & Bakh. f., Fl. Java 1 (1963) 198. — *P.*

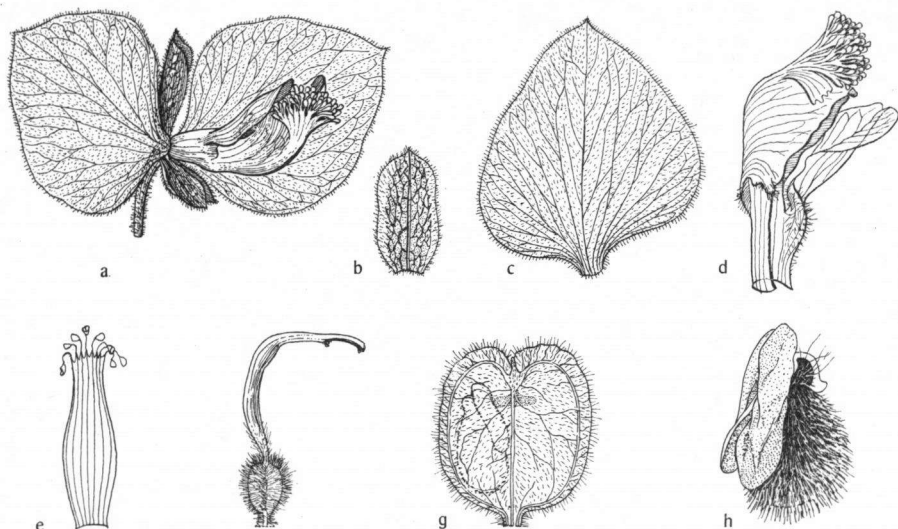


Fig. 7. *Polygala javana* DC. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. a—c and g  $\times 4$ , d—f and h  $\times 6$ . (a—f from Teijsmann s.n., Java; g and h from Backer 36532).

*ceylanica* Heyne in Wall., Cat. (1831) 4183 (L!, G!, FI!, CGE!), *nom. nud.* — *P. tinctoria* (non Vahl) Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 181 (*Thwaites* CP 184, *Zollinger* 2713). — Fig. 7.

Perennial, erect, branched herb, 10—80 cm. Stem terete, becoming woody at the base, short crispy haired. *Leaves* obovate-oblong, 5—35 by 1—12 mm, subsessile, short-mucronate at the rounded apex, puberulous at both sides, in transmitted light with minute areoles and besides fine punctate-dotted. Racemes lateral but not axillary, often  $\pm$  leaf-opposed, 2—8 cm; bracts persistent,  $\pm$  rhomboid, hairy, 1—2 mm, twice as long as the bracteoles. Outer *sepals* elliptic to lanceolate, hairy; *alae* triangular, short-unguiculate, base asymmetric, flabellate-veined, hairy on both sides, very short-mucronate, yellowish. Lateral *petals* elliptic-spathulate, hairy inside from the adnation with the staminal tube to halfway; keel with 2 bundles of numerous thread-like purple appendages, auricles of keel sometimes ciliate. Staminal tube ciliate at the adnation with the corolla inside, filaments free for  $\pm \frac{1}{3}$  of their length. *Ovary* more or less quadrangular, notched at both ends, hairy; style long, curved along the keel, filiform, slightly widened to the apex, with 2 minute, spaced, lateral stigmas, one just below the apex, the other at the base of the widening. *Fruit* smaller than the alae (the latter 8—10 mm long), very narrowly membranous-winged all around, puberulous. *Seed* black,  $\pm$  barrel-shaped, puberulous; carunculus  $\pm$  hood-shaped, with 2 long and 1 short membranous appendages.

*Type specimen*: from Java, no number cited by DC., not seen.

*Distribution*. Ceylon and SE. continental Asia, in Malesia: Java (from Semarang eastwards), Madura I., Kangean, Lesser Sunda Islands (Bali, Sumba, Lombok, Sumbawa, and Timor). Fig. 14.

*Ecology*. Characteristic for areas subject to a strong dry season, in teak forests, between grass, several times noted on limestone, below 250 m, once in Sumba at 700 m.

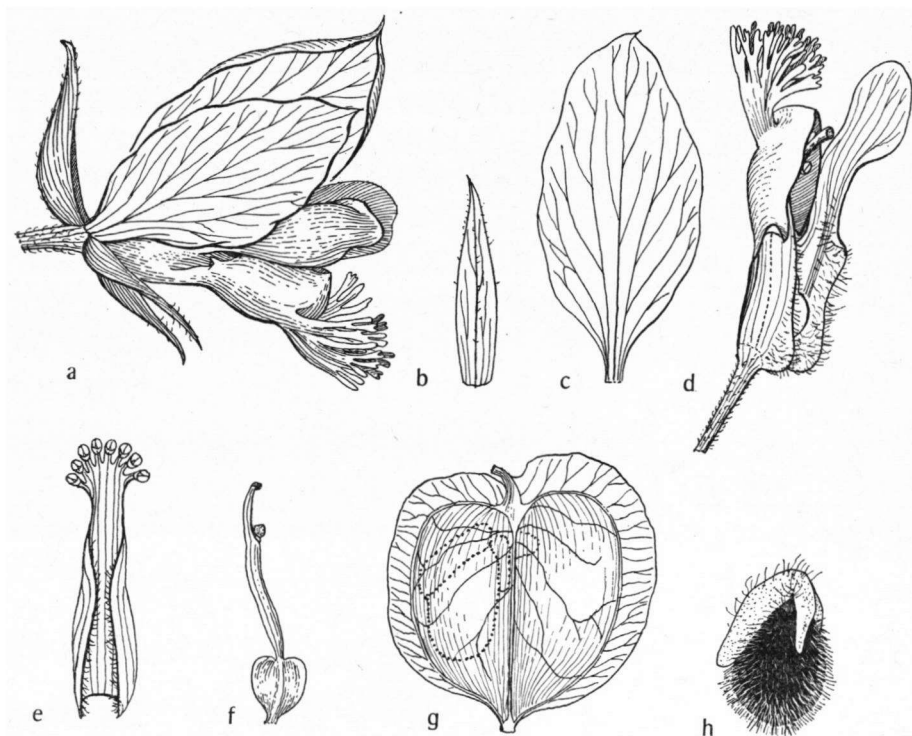


Fig. 8. *Polygala japonica* Houtt. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 7$ . (a–f from F. Shaw Mayer s.n., New Guinea; g and h from Borgmann 326).

**5. *Polygala japonica* Houtt.**, Handl. 10 (1779) t. 62 fig. 1; DC., Prod. 1 (1824) 324; Chodat, Monogr. 2 (1893) 353; Merr. & Rolfe, Philip. J. Sc. 3 (1908) Bot. 106; Gagn., Fl. Gén. I.-C. 1 (1909) 255; Merr., En. Philip. 2 (1923) 384. — *P. vulgaris* (non L.) Thunb., Fl. Jap. (1784) 277. — *P. khasyana* Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 176 (type specimen: Khasya, Hook. f. & Thomson 17, CGE!, L! fragment). — *P. luzoniensis* Merr., Philip. J. Sc. 1 (1906) Suppl. 202 (type specimen: Luzon, Philippines, Merrill 4368, US!). — Fig. 8.

Prostrate or ascending, branched perennial, 10–20 cm, mostly developing a thickened, woody, rhizomatous, erect root-crown or stem-base. Stem terete, short-hairy. Leaves ovate to elliptic, the lower ones proportionally broadest, 2–15 by 3–8 mm, subsessile, acute, faintly fine-pellucid dotted, prominently reticulate-veined, margin slightly recurved, mostly (minutely) puberulous on at least midrib and margin. Racemes lateral, not axillary, 1–3 cm, rather few-flowered. Bracts very small, puberulous, caducous. Flowers purple to deep lavender. Outer sepals lanceolate, acute, puberulous; alae ovate-elliptic, 3–5-nerved, mucronate. Lateral petals  $\pm$  oblong, ciliate and somewhat hairy at the adnation with the staminal tube to halfway their length; keel with 2 bundles of fringe-like appendages; staminal tube short ciliate at the adnation with the lateral petals; anthers sessile. Ovary  $\pm$  oblong; style long, somewhat curved, the apical part not widened, stigmas 2, spaced, 1 apical, the other lateral on a slightly knob-like base. Fruit broader and



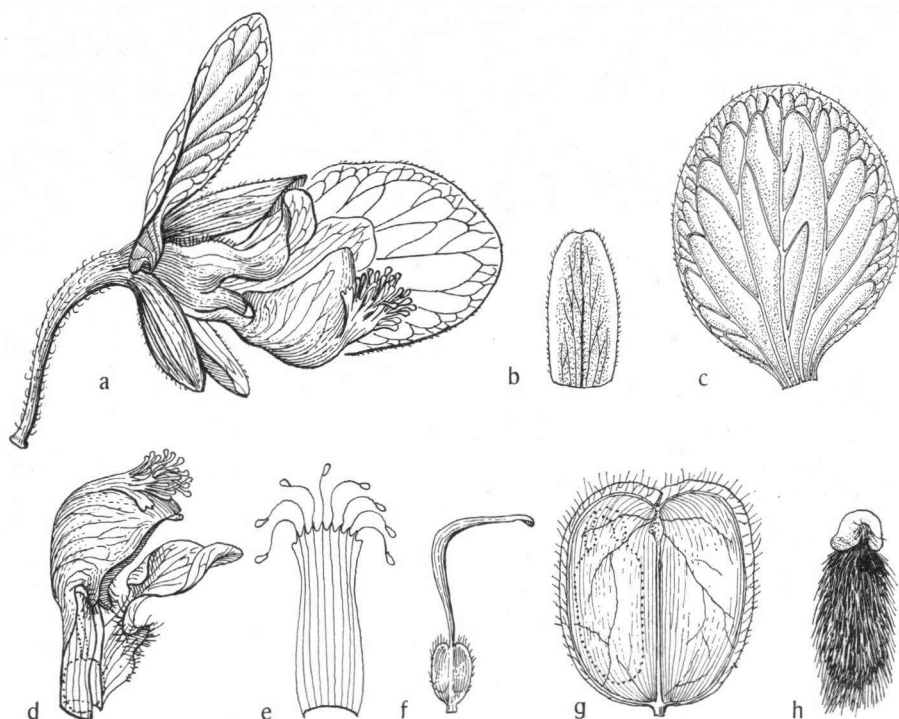


Fig. 9. *Polygala persicariaefolia* DC. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 7$ . (a—f from Pringo Atmodjo 123; g and h from Iboet 32).

somewhat shorter than the alae (which are 5—6 mm long), orbicular, emarginate at apex, fairly widely winged all around, sometimes wings broadest at apex, apex of wing notched. Seed black, slightly flattened-ovoid, puberulous; carunculus small with 3 membranous appendages over half as long as the seed.

*Type specimen*: not mentioned; from Japan.

*Distribution*. Japan, China, Tonkin, Formosa, Khasya, in Malesia: Philippines (Luzon: Benguet Prov.; Mindoro) and New Guinea. Fig. 14.

*Ecology*. Road-sides, grasslands, trodden ground in the mountains, 1200—2600 m, once found in Mindoro at 850 m (Concklin).

*Notes*. This species is allied to *P. sibirica* L. which occurs from Central Europe to Central China and India (Assam: Khasya). This differs from *P. japonica* by the following characters: mostly longer and narrower leaves, alae asymmetric subfalcate, acute but not mucronate, ovary orbicular and ciliate, stigmas closer together, fruit oblong with narrower wing, anthers not sessile, but shortly filamented.

Bennett in Fl. Br. India (and Kew Index) reduced *P. japonica* to *P. sibirica*, but I agree with Chodat that they should be kept apart. Bennett sank many synonyms into *P. sibirica* (*P. monopetala* Camb. and *P. elegans* Wall. rightly so), but *P. heyneana* Wall. (of which I have not seen Wall. 4184) — and *P. macrolophos* Hassk. which is possibly conspecific with *P. heyneana* — is a different species.

Bentham, in Fl. Austr., followed by Bailey in his Queensland Flora and Comprehensive Catalogue, recorded *P. japonica* from Queensland, the oldest record of which would



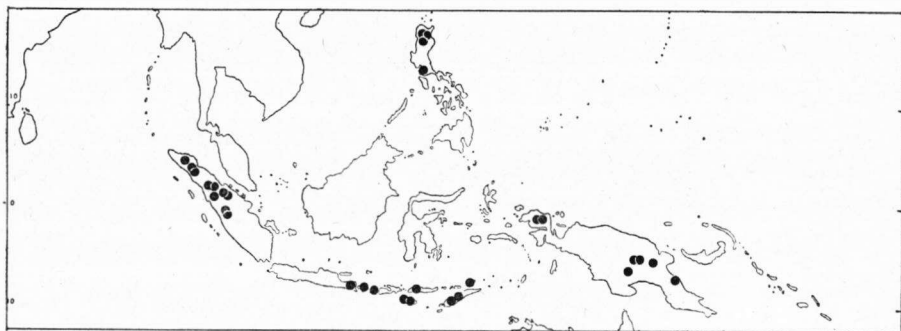


Fig. 10. Distribution of *Polygala persicariaefolia* DC. in Malesia.

be *P. veronica* F. v. M. (etymologically changed into *P. veronicaefolia* Chodat) which Chodat keeps apart as distinct from *P. japonica*.

**6. *Polygala persicariaefolia* DC.**, Prod. 1 (1824) 326; Wall., Pl. As. Rar. II (1831) 79, t. 184; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 178; F. v. M., Descr. Not. Pap. Pl. 7 (1887) 26; Chodat, Monogr. 2 (1893) 331; K. Sch. & Laut., Nachtr. Fl. Schutzgeb. (1905) 326; Merr., En. Philip. 2 (1923) 384; Pap. Mich. Ac. Sc. 20 (1935) 100; Backer, Bekn. Fl. Java (em. ed.) 4A (1942) fam. 50, p. 5; Backer & Bakh. f., Fl. Java 1 (1963) 199. — *P. buchanani* Buch. Ham. ex D. Don, Prod. Fl. Nep. (1825) 199, *nom. superfl.*, *illeg.* — *P. wallichiana* Wight, Ill. 1 (1840) 49 t. 22 A (type specimen: no number cited). — *P. rufa* Span., Linnaea 15 (1841) 167, Ic. 40 (ined.) (type specimen: *Spanoghe*, L!). — *P. septemnervia* Merr., Philip. J. Sc. 1 (1906) Suppl. 202 (type specimen: Luzon, Philippines, Merrill 4401, US!). — Fig. 9.

Erect annual, mostly branched, 10–70 cm. Stem terete, short crispy-haired. Leaves shortly petioled, lanceolate to linear-lanceolate, 15–50 by 3–10 mm, in the herbarium very thin, with flat margin; margin and midrib beneath puberulous or subglabrous, venation not prominent, finely pellucid-dotted, cuneate towards the base, apex blunt to rounded, short-mucronate. Racemes in the forks and terminal on the lateral branches. Pedicels  $2\frac{1}{2}$ – $3\frac{1}{2}$  mm. Bracts persistent, lanceolate, c. 1 mm. twice as long as the bracteoles. Flowers tinged purple. Outer *sepals*  $\pm$  elliptic, ciliate; alae broad-obovate to orbicular, 5-veined, blunt, sometimes ciliate. Lateral *petals*  $\pm$  oblique triangular, hairy inside from the adnation with the staminal tube to  $\pm$  halfway; keel with 2 bundles of linear appendages, at the rounded base to somewhat upwards ciliate. Staminal tube with a few hairs at the adnation with the lateral petals, filaments free for half their length. Ovary obovate, ciliate; style curved, the apical part not widened; stigmas 2, slightly spaced, one apical, the other lateral, sessile. Fruit smaller than the alae (which are 6 mm long), broad-elliptic, notched at apex, sparsely ciliate, wing narrow, widening in the apical part. Seed black, barrel-shaped, long white-hairy; carunculus hood-shaped, with 3 very short, narrow appendages.

Type specimen: Nepal, Wallich 4185 (L!, G!, CGE!)

Distribution. Africa (Angola via S. Africa to Abyssinia), SE. tropical Asia (India, Upper Burma, Siam), S. China (Yunnan), in Malesia: northern half of Sumatra, East Java (only Mt Idjen), Lesser Sunda Islands (Bali, Lombok, Flores, Timor, Alor), Philippines (N. Luzon, Benguet Prov.: Bontoc), and New Guinea (all over), also recorded from Queensland (Bailey, Domin, but no material seen). Fig. 10.

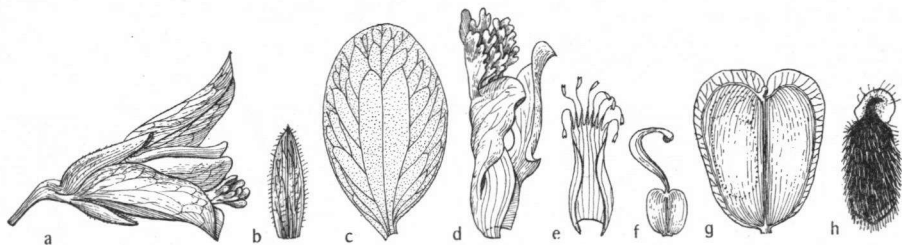


Fig. 11. *Polygala longifolia* Poir. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. a—g  $\times 7$ , h  $\times 9$ . (Brass 32360).

**Ecology.** In waste and often arid or stony places, mainly in grasslands, road-sides, old lava-streams, etc., (300—) 500—1500 (—1800) m.

**Notes.** Merrill (1923) referred the Malesian specimens to var. *wallichiana* (Wight) Chodat to which also the Indian material belongs. Having not studied African sheets I refrain from an opinion whether the varieties distinguished by Chodat are worthwhile to maintain.

**7. *Polygala longifolia* Poir.** in Lamk, Encycl. 5 (1804) 501; DC., Prod. 1 (1824) 325; F. v. M., Descr. Not. Pap. Pl. 6 (1885) 4; Chodat, Monogr. 2 (1893) 358; Backer, Schoolfl. Java (1911) 79; Merr., En. Philip. 2 (1923) 384; Craib, Fl. Siam. En. 1 (1931) 103; Backer, Bekn. Fl. Java (em. ed.) 4A (1942) fam. 50, p. 5; Backer & Bakh. f., Fl. Java 1 (1963) 199; Lauener, Not. R. Bot. Gard. Edinb. 26 (1965) 344. — *P. leptalea* DC., Prod. 1 (1824) 325; ? Benth., Fl. Austr. 1 (1863) 139; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 173; F. M. Bailey, Queensl. Fl. 1 (1899) 78; Domin, Beitr. Fl. & Pfl. geogr. Austr. 1 (1927) 855 (type specimen: *Wallich 4189*). — *P. oligophylla* DC., Prod. 1 (1824) 325; Chodat, Monogr. 2 (1893) 353 (type specimen: *Wallich 4188a*). — *P. discolor* Buch. Ham. ex D. Don, Prod. Fl., Nep. (1825) 199 (type specimen: ? *Hamilton* in BM, not seen). — **Fig. 11.**

Erect, slender, little-branched annual, 20—150 cm. Stem glabrous, ribbed. *Leaves* proportionally few, linear to linear-lanceolate, the lowest ones slightly broader, 10—55 by 1—6 mm, subsessile, 1-nerved, the margins recurved, acute, almost glabrous. Racemes mostly terminal, 2—20 cm. in the young stage the tip of the raceme  $\pm$  conical with exceeding bracts. Bracts caducous, 1—1½ mm, subtriangular, acute. Pedicel ½—1 mm. Outer *sepals* elliptic, acute,  $\pm$  ciliate; *alae* broad-elliptic, 3-nerved, blunt. Corolla whitish, somewhat purple tinged. Lateral *petals* oblique-quadrangular to  $\pm$  obovate, somewhat longer than the keel, hairy inside from the adnation with the staminal tube to halfway; keel with 8 broad appendages. Staminal tube not hairy inside, filaments free for  $\pm$  half their length. *Ovary*  $\pm$  obovate; style strongly curved with a terminal, knob-shaped stigma. *Fruit* shorter than the *alae* (the latter 3—4 mm long), very broad elliptic to almost orbicular, notched at apex, glabrous, wing all around, not very wide, and broader towards the apex. *Seed* black,  $\pm$  elongate-barrel-shaped, with short, appressed hairs; carunculus small, with 3 short, membranous appendages.

*Type specimen:* Java, Commerson (P. isotype FI!).

**Distribution.** Tropical SE. continental Asia, Ceylon, Nepal, Khasya, Cambodia, Laos, in Malesia: N. Sumatra (Gajo Lands), SW. Celebes, Philippines (Luzon: Benguet), Lesser Sunda Islands (Sumba), Moluccas (Key Is.), and New Guinea; also in Queensland and N. Australia, and Thursday I.



Fig. 12. *Polygala paniculata* L. a. Inflorescence, b. flower, c. upper sepal, d. ala, e. keel enveloping staminal tube, at right one petal, f. opened staminal tube, g. pistil, h. fruit, i. seed. a  $\times 11$ , b–h  $\times 13$ , i  $\times 17$ . (Elbert 218).

**Ecology.** Mainly grasslands (often burned) below 500 m, in Sumba at 800 m, in East New Guinea once reported at 1100 and 1370 m resp., in Sumatra at 1250 m (Toba); obviously with a preference for areas subject to a dry season.

**Note** The type specimen, collected by Commerson, is said to hail from Java; this is certainly an error, cf. Fl. Mal. I, 1 (1950) xxix.

**8. *Polygala paniculata* Linné**, Syst. ed. 10 (1759) 1154; Amoen. V (1759) 402; Chodat, Monogr. 2 (1893) 229; K. Sch. & Laut., Nachtr. Fl. Schutzgeb. (1905) 285; Backer, Schoolfl. Java (1911) 79; Backer & Sloot., Handb. Thee. (1924) 159; Backer, Onkruidfl. Suiker (1930) 393, Atlas t. 374; Bkn. Java (em. ed.) 4A (1942) fam. 50, p. 4; Sinclair, Gard. Bull. Sing. 14 (1953) 31; Backer & Bakh. f., Fl. Java 1 (1963) 78. — *P. variabilis* (non H.B.K.) Hassk., Retzia (1855) 149. — **Fig. 12.**

Erect, mostly much-branched annual, 10–50 cm. Stem terete, puberulous. *Leaves* lanceolate to linear-lanceolate, 5–20 by 1–4 mm, 1-nerved, acute, shortly petioled, the lowest often in one or more pseudowhorls of 4–5. Racemes leaf-opposed, with a very thin rachis, 2–15 cm. Bracts caducous, lanceolate, acute, minute. Outer *sepals*  $\pm$  elliptic, blunt; *alae*  $\pm$  elliptic, narrow, 3-nerved. Lateral *petals* narrow ovate-lanceolate, attenuate to apex; keel with c. 6 appendages, the upper ones broadest. Staminal tube not hairy inside, free filaments very short. *Ovary* obovate to almost orbicular; style straight,  $1\frac{1}{2}$ –2 times as long as the ovary, the stigmatic part lateral, consisting of a wide cup the upper portion of which ends in a hair tuft while the stigma is sessile on the base of the cup. *Fruit* as long as or longer than the alae (these 2 mm), oblong, nearly wingless, at apex stunted and notched, glabrous. *Seed* black, oblong, with short white hairs; carunculus very small, with 2 membranous appendages.

**Type specimen:** Browne, Civil & Nat. Hist. Jam. (1756) 287 no 1 (without name), and Linnean herb.

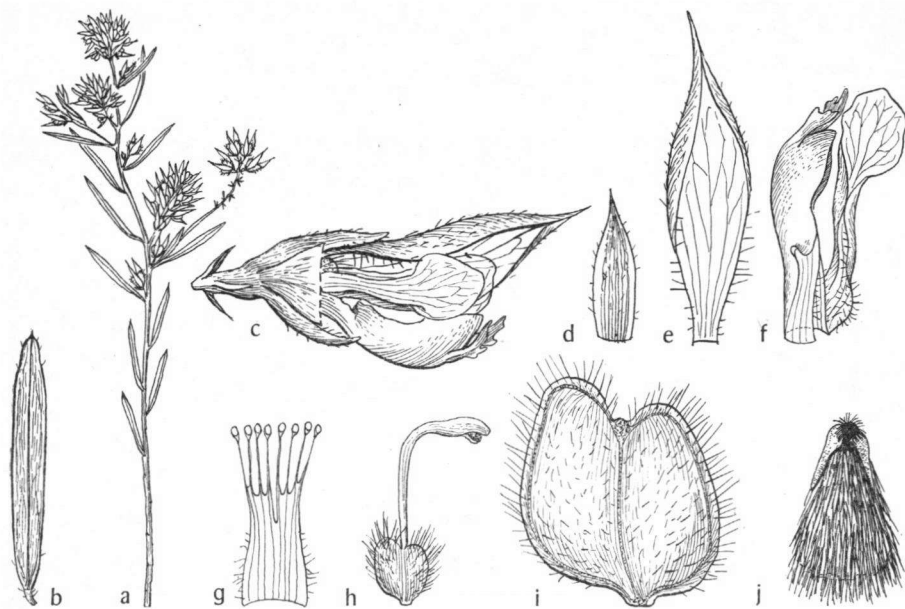


Fig. 13. *Polygala exsuarrosa* Adema. a. Habit, b. leaf, c. flower, one ala cut away, d. upper sepal, e. ala, f. keel enveloping staminal tube, at right one petal, g. opened staminal tube, h. pistil, i. fruit, j. seed. a  $\times 2/3$ , b  $\times 3$ , c—j  $\times 10$ . (*Buwalda 5344*).

**Distribution.** Tropical America from Brasil to Mexico, according to Backer (1930) known from Java as early as 1845 or 1846 as an unintentional import, but since then completely naturalized, often in great quantity and widely distributed; in Malesia: Sumatra, Malay Peninsula, Java, Lesser Sunda Islands (Flores), Celebes, and New Guinea (also Woodlark and Normanby Is.); also in Micronesia (Guam, Ponape), Solomon Islands (Ysabel, Vella Levella, New Georgia), Fiji (Viti Levu), and New Caledonia; but only recently reported from Malaya and not yet collected in for example the Philippines, Borneo, and the Moluccas.

**Ecology.** From sea-level to c. 1750 m (once in East New Guinea at 2050 m), in all kinds of waste places, often in profusion in estates or on fields, very tolerant to soil and climate, but avoiding the driest areas.

**9. *Polygala exsuarrosa* Adema, nom. nov. — *P. arvensis* var. *squarrosa* Benth., Fl. Austr. 1 (1863) 141 (*P. squarrosa* Sol., MS.), non *P. squarrosa* L. f., 1781. — Fig. 13.**

Small, branched annual. Stems puberulous, terete, erect or ascending, 2—10 cm. *Leaves* linear-lanceolate, 5—15 by 1 mm, acute, 1-nerved, with recurved margin, often provided with a few very lax, proportionally long hairs. Racemes lateral, leaf-opposed, short, conical, only c. 1 cm long. Bracts persistent, lanceolate, c. 1 mm, hairy. *Outer sepals* lanceolate, hairy; *alae* narrow-falcate, patent-hairy, 3-nerved. *Lateral petals* elliptic, hairy at the adnation with the staminal tube; keel with 2 more or less clavarioid appendages. Staminal tube split halfway into 2 bundles of 4 partly free filaments each, hairy at the adnation to the lateral petals. *Ovary* obovate-obtriangular, slightly asymmetric, patent-hairy; style curved, tip rounded-truncate, sterile; stigma lateral, sessile,  $\pm$  below apex or slightly lower down. *Fruit* smaller than the alae (these 4 mm), almost orbicular in

outline, deeply notched at apex, slightly asymmetric, patent hairy, not winged. Seed black, obovoid-oblong, with long, white, appressed hairs; carunculus minute, with 3 narrow appendages reaching halfway the seed.

*Type specimens:* Endeavour R. in herb. R. Brown; Upper Victoria R., F. v. Mueller (BM), not seen.

*Distribution.* North Queensland, N. Australia, and adjacent islands, in Malaysia: Aru Is. (Trangan), S. of West New Guinea (*Buwalda* 5344, 5517). Fig. 14.

*Ecology.* Sandy savannah in hilly country, a few m above sea-level.

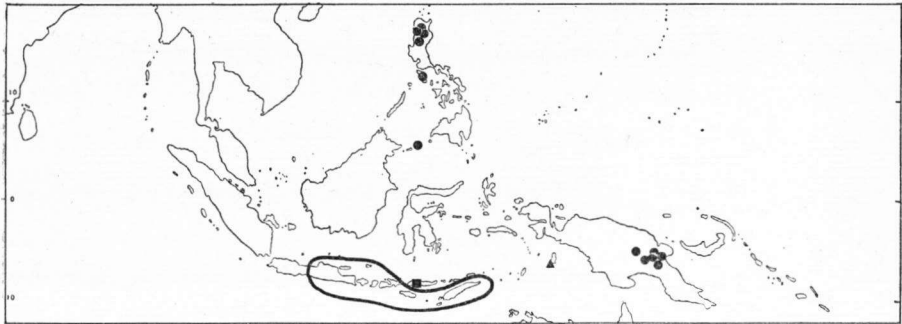


Fig. 14. Distribution in Malaysia of *Polygala javana* DC. (—), *P. japonica* Houtt. (●), *P. exsquamata* Adema (▲), and *P. wightiana* W. B. A. (■).

**10. *Polygala chinensis* Linné**, Sp. Pl. 1 (1753) 704; Hook. f., Fl. Br. Ind. 1 (1872) 204, excl. syn. *P. brachystachya* Bl. non DC.; F. v. M., Descr. Not. Pap. Pl. 9 (1890) 55; Chodat, Monogr. 2 (1893) 385, excl. syn. *P. tranquebarica* Mart., *P. brachystachya* Bl. non DC., et spp. affin.; K. Sch. & Laut., Nachtr. Fl. Schutzgeb. (1905) 284; Gibbs, J. Linn. Soc. Bot. 42 (1914) 59; Merr., En. Born. (1921) 324. — *P. telephioides* Willd., Sp. Pl. 3 (1803) 876 (type specimen: ex Ind. Or. Willdenowia, in B, not seen). — *P. arvensis* Willd., l.c.; W. & A., Prod. (1834) 236; Walp., Rep. 1 (1842) 233; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 162 (type specimen: ex Ind. Or. Willdenowia, in B, not seen). — *P. brachystachya* DC., Prod. 1 (1824) 326; Chodat, Monogr. 2 (1893) 313 (type specimen: Ind. Or., in herb. Prod.). — *P. polifolia* Presl, Rel. Haenk. 2 (1830) 101; Merr., En. Philip. 2 (1923) 384 (type specimen: Philippines, no numbers cited). — *P. buxiformis* Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 161 (type specimen: India, Hook. f. & Thomson 12, L!). — *P. warburgii* Chodat ex Warb., Bot. Jahrb. 13 (1891) 346; Chodat, Monogr. 2 (1893) 315 (type specimen: Papua, Finschhafen, Warburg, not seen). — prob. *P. simadai* Masam. J. Soc. Trop. Agr. Taihoku Imp. Un. 3 (1931) 114. — Fig. 15.

Erect or more or less ascending or semi-prostrate, branched annual, ( $1\frac{1}{2}$ –)5–30 cm. Stem terete, puberulous. Leaves obovate, elliptic, or lanceolate, 2–20 by 1–7 mm, 1-nerved, acute or acuminate, very short petioled. Racemes lateral or leaf-opposed, mostly several on a stem or twig, shorter than the leaves, few-flowered and cluster-like, 2–10 mm. Bracts minute, acute, ciliate, persistent. Pedicels 1–1 $\frac{1}{2}$  mm. Outer sepals sometimes purple-tinged, ovate, acute, ciliate; alae falcate, 5-nerved, very acute, ciliate. Petals blue to violet; laterals much shorter than the keel, asymmetric, about obtriangular, apex shallowly emarginate; keel with mostly more than 20 straight, thickish, finger-like appendages. Staminal tube split halfway, with 2 single filaments and 2 bundles of 3 connate filaments and sessile anthers. Ovary obovate-orbicular, hardly notched at apex, ciliate, sometimes minutely puberulous; style curved, widened at apex proper, apex stunted,

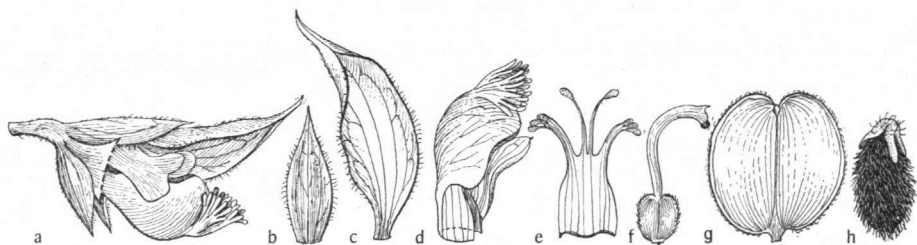


Fig. 15. *Polygala chinensis* L. a. Flower, one ala cut away, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 10$ . (Rahmat si Toroes 4561).

on one side with a sterile, more or less pronounced tip, the other edge or tooth with a more or less knob-like widening on which is the stigma. *Fruit* shorter than the alae (these 3 mm), almost orbicular, with a very narrow marginal wing only, slightly ciliate. *Seed* black, obovate-oblong, with short, white, patent hairs; carunculus short hood-shaped, with 3 membranous appendages up to half as long as the seed.

*Type specimen*: India, in the Linnean herbarium.

*Distribution*. Ceylon, India (Bengal, Madras, North India), Siam, Indo-China (Cambodia, Annam), S. China, Hongkong, in Malesia: northern half of Sumatra, Malay Peninsula (Johore), Java (1 doubtful sheet, see note), Lesser Sunda Islands (Sumba, once), Celebes (2 sheets), Philippines (Mindoro; Luzon: Benguet; Mindanao), Moluccas (Ceram, Ambon), New Guinea; also North Queensland and Micronesia (Ponape).

*Ecology*. Along road-sides, in grasslands, on waste places, from behind the beach to 750 m, exceptionally at 1800 m in Upper Goroka (Papua).

*Notes*. This species has often been confused with *P. tranquebarica* Mart. and with *P. linarifolia* Willd. and its synonym *P. aurata* Gagn. *P. tranquebarica* is more allied to *P. glomerata* Lour.

The only sheet from Java is an old specimen from Krawang without indication of the collector; besides it has monstrous flowers. It is suspected to be mislocalized, because no later collections have been made.

Chodat reduced *P. kleinii* Hassk. (recorded from the Deccan Peninsula) to *P. chinensis*. The only specimen in Hasskarl's herbarium in L consists of a small envelope containing a few detached, fragmentary flowers which are insufficient for identification.

**II. *Polygala glomerata* Lour.**, Fl. Coch. (1790) 426; DC., Prod. 1 (1824) 326; Miq., Fl. Ind. Bat. 1, 2 (1859) 125; Backer, Schoolfl. Java (1911) 78; Merr., En. Born. (1921) 324; En. Philip. 2 (1923) 353; Backer & Sloot., Handb. Thee. (1924) 158; Merr., Trans. Am. Phil. Soc. 24, 2 (1935) 228; Backer, Bekn. Fl. Java (em. ed.) 4A (1942) fam. 50, p. 3; Backer & Bakh. f., Fl. Java 1 (1963) 198. — *P. densiflora* Bl., Bijdr. (1825) 59; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 166; Chodat, Monogr. 2 (1893) 380; K. Sch. & Laut., Nachtr. Fl. Schutzgeb. (1905) 284 (type specimen: Java, Buitenzorg, L!). — *P. toxoptera* Turcz., Bull. Soc. Nat. Moscou 27, 2 (1854) 348 (type specimen: ? Java, Göring coll. 2, no 2, CWB, not seen). — **Fig. 16.**

Erect or ascending, mostly branched perennial herb, becoming woody at the base, with a thickened root-crown, 4–75 cm. Stem terete and hairy. *Leaves* obovate, elliptic, or lanceolate, 5–65 by 2–20 mm, very shortly laxly puberulous (rather thickish when fresh), nerves few, faint, high-ascending, margin only slightly recurved, acute or acuminate at apex, short-petioled (1 mm). Racemes stunted, fascicle-like, pauciflorous, shorter than

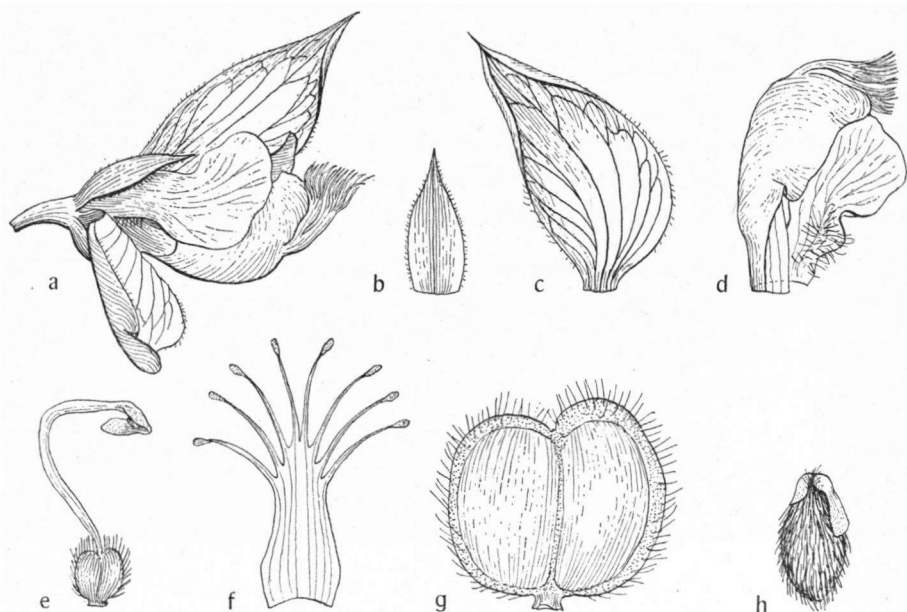


Fig. 16. *Polygala glomerata* Lour. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 7$ . (Adelbert 313).

the leaves,  $\frac{1}{2}$ — $1\frac{1}{2}$  cm long, distinctly supra-axillary, rarely in the axils. Bracts caducous before or during anthesis, minute (1 mm),  $\pm$  lanceolate, acute, ciliate, twice as long as the bracteoles. Pedicel  $1\frac{1}{2}$  mm. Outer *sepals* more or less ovate, elliptic, acute, with a long mucro on top, ciliate; *alae* falcate, very acute, ciliate. Lateral *petals*  $\pm$  obovate, about as long as the keel, at the adnation to the staminal tube hairy; keel with c. 16 filiform appendages in 2 bundles. Staminal tube inside at the adnation to the petals slightly haired, filaments free for  $\pm \frac{1}{3}$  of the staminal tube. *Ovary* about orbicular, emarginate, ciliate; style long, curved, somewhat thickened, apex horseshoe-shaped curved with the stigma inserted inside. *Fruit* c.  $1\frac{1}{2}$ —2 mm pedicelled, shorter than the *alae* (these 5—6 mm), almost orbicular, notched, with a very narrow marginal wing, ciliate. *Seed* black,  $\pm$  obovate, white hairy, carunculus  $\pm$  hood-shaped with 2 short appendages.

*Type specimen*: pr. Canton, Loureiro in herb. Mus. Paris, according to Merrill, *Commentary Loureiro* (1935) 228; not seen.

*Distribution*. SE. continental Asia (Assam, Tenasserim, Siam, Indo-China, S. China), in Malesia: Sumatra, Malay Peninsula (Penang), Java (very common in W. Java, much less so in Central and E. Java), SE. Borneo (3 sheets), Sarawak (1 sheet), Lesser Sunda Islands (Sumbawa, Sumba, Flores), Philippines (Luzon 2 sheets; Golo; Mindanao *sec.* Merrill), and New Guinea (2 sheets).

*Ecology*. Waste places, rubber estates, grasslands, road-sides, and teak-forests (Java), largely restricted to everwet areas, from near sea-level up to 1300 m, several times in Java reported from limestone.

*Notes*. The 3 sheets I saw from SE. Borneo (Winkler, *Hub.* 3360, Van Loenen 9, Gandrup 11) are exceptionally hairy, but are otherwise not different.



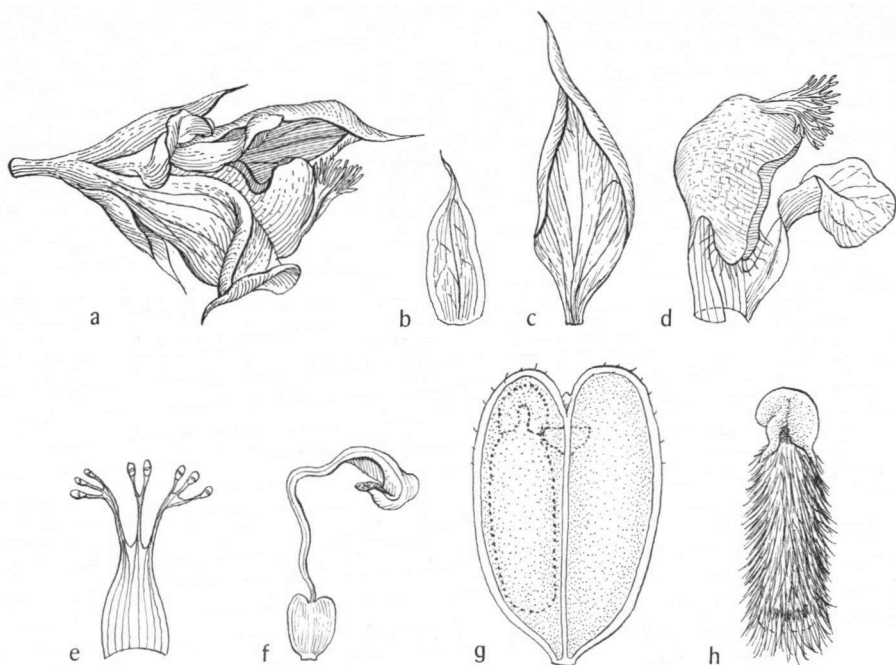


Fig. 17. *Polygala wightiana* W. & A. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 10$ . (Wallich 4190).

Chodat distinguished several varieties, based on different leaf-shapes; I do not believe this is necessary. Merrill in his Commentary on Loureiro's 'Flora Cochinchinensis' (1935) 228, reduced *P. glomerata* to *P. chinensis*. I agree with Bennett (Fl. Br. Ind.) and several other authors that they are different species.

**12. *Polygala wightiana* W. & A., Prod. (1834) 38; Walp., Rep. 1 (1842) 232; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 170; Chodat, Monogr. 2 (1893) 358. — Fig. 17.**

Annual, erect or ascending, branched, 15–30 cm. Stem terete, glabrous. *Leaves* narrow-lanceolate, subsessile, 1-nerved, top acute, mucronate, at margin slightly recurved, glabrous, 7–20 by 1–2 mm. Racemes lateral, leaf-opposed, many-flowered, 5–17 cm. Bracts persistent, small,  $\pm$  lanceolate, acute-mucronate, glabrous, twice as long as the bracteoles. Pedicel in flower  $1\frac{1}{2}$  mm, in fruit 2 mm. *Outer sepals*  $\pm$  lanceolate, mucronate, near top somewhat ciliate. *Alae* asymmetric, subfalcate, long-acute, mucronate, 3-nerved. Flowers pale yellow to pale red. Lateral *petals* spatulate-oblong, auriculate on the side towards the staminal tube, both lateral petals and staminal tube ciliate at the adnation; keel with c. 10 forked appendages, auricles ciliate. Staminal tube split halfway with 2 single filaments and 2 bundles of 3 connate filaments and sessile anthers. *Ovary* oblong, symmetric, slightly emarginate, almost glabrous. Style curved, hook-like, with 2 wings, one in the lower part in the curve, the other below the apex at the outer side of the curve; stigma terminal. *Fruit* somewhat shorter than the alae (these c. 5 mm), oblong, scarcely marginate, almost glabrous. *Seed* black, flattened cylindrical, with long white hairs; carunculus hood-shaped with 3 very small appendages.



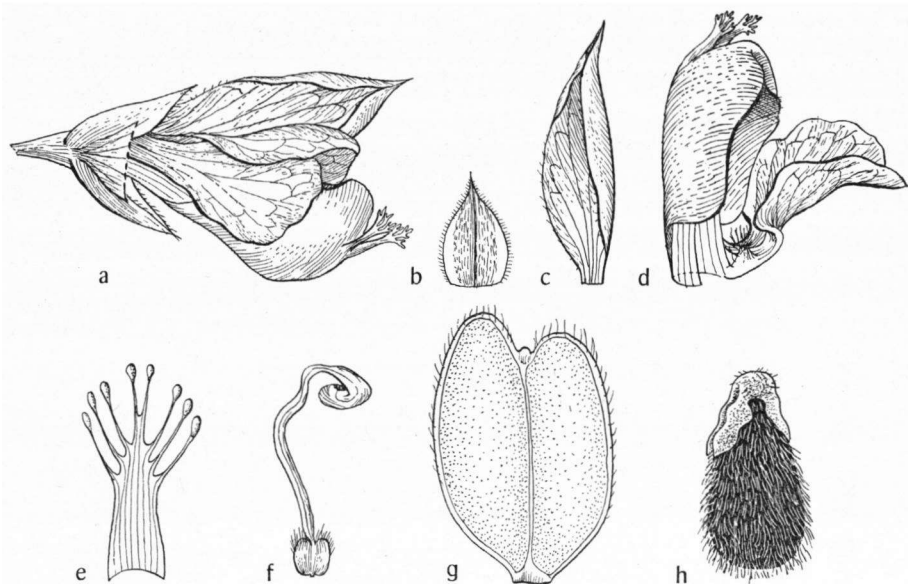


Fig. 18. *Polygala elongata* Willd. a. Flower, one ala cut away, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. All  $\times 7$ . (*Fénix* BS 26016).

*Type specimen:* Wall 4190 (L!, CGE!, E!); paratype Wight proper 134 (CGE!, E!).

*Distribution.* India: Deccan Peninsula (apparently rare), in Malaysia: Lesser Sunda Islands: Flores (J. A. J. Verheyen n. 1918/19). Fig. 14.

*Ecology.* Obviously with a preference to drier areas.

*Notes.* A similar disjunct distribution of drought plants is not rare (cf. *Reinwardtia* 5, 1961, 428).

Bennett in Fl. Br. Ind. 1 (1875) 203, included this species in *P. elongata* Klein, but they are undoubtedly different species.

**13. *Polygala elongata* Klein ex Willd., Sp. Pl. 3 (1803) 879; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 172; Benn. in Hook. f., Fl. Br. Ind. 1 (1875) 204, excl. syn. *P. wightiana*; Chodat, Monogr. 2 (1893) 387; K. Sch., Nachtr. Fl. Schutzgeb. (1905) 289; Merr., Philip. J. Sc. 13 (1918) Bot. 20; En. Philip. 2 (1923) 383. — *P. macrostachya* Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 171 (type specimen in L). — *P. eumekes* Hassk., l.c. 172 (type specimen in L). — Fig. 18.**

Weak but apparently fairly slender, erect annual, branches apparently ascending from the base or prostrate, 9–45 cm. Stem terete, short-hairy, at base becoming hard and somewhat woody. Leaves lanceolate to linear, sessile or very shortly petioled, mucronate, margin mostly slightly recurved, midrib beneath with a few hairs or almost glabrous, 5–50 by 1–5 mm. Racemes lateral, or  $\pm$  leaf-opposed, or terminal, slender and fairly straight, often with one flower at the base, (3–)10–19 cm. Bracts persistent, lanceolate, acute, ciliate. Pedicels c. 2 mm, in fruit c. 3 mm. Outer sepals  $\pm$  ovate, short-mucronate, ciliate; alae falcate, long-acute, mucronate, sometimes ciliate. Lateral petals  $\pm$  obovate, slightly hairy inside at the adnation to the staminal tube,  $\pm$  as long as the keel; keel with 2 bundles of 4–8 fairly thick appendages inserted halfway the curve

of the keel and thus the appendages at  $\pm$  right angles with the keel, each appendage shortly forked at apex. Staminal tube somewhat hairy inside at the adnation to the petals, filaments free for  $\pm \frac{1}{3}$  of their length. *Ovary* obovate, cordate at apex, asymmetric; style curved, apex horseshoe-shaped hooked, with the stigma inside the hook. *Fruit* shorter than the alae (these 4—5 mm),  $\pm$  rhomboid in outline by the unequal halves, emarginate, glabrous or (Philippine specimen) slightly ciliate along the narrowly winged edge. *Seed* black, obovate-oblong, with long white hairs, carunculus  $\pm$  hood-shaped, with 2 short membranous appendages reaching down only to  $\frac{1}{3}$  of the seed (in the Philippine specimen 3 appendages reaching halfway).

*Type specimen*: India orient. pr. Haiderabad, ? Heyne, in herb. Willdenow (B, not seen, possibly dupl. in L).

*Distribution*. Ceylon, Deccan Peninsula, and possibly Malesia (see note).

*Note*. The supposed occurrence of this species in Malesia rests upon 5 specimens cited in literature, of which I have seen 2. Merrill, l. c., mentioned two specimens, viz. *Fenix* BS 26016 and *Copeland s. n.*, both from Mindanao. I have seen the former of these; it differs from specimens from the Deccan and Ceylon by the slightly ciliate fruit and the 3 longer appendages of the carunculus. Though with some doubt, I have included it in this species. K. Schumann & Lauterbach, l. c., cited 3 specimens from New Guinea, viz. *Nyman* 757 and 825 and *Schlechter* 13853. Of these I could study fragments of the former which is undoubtedly *P. longifolia*. In view of the distinct differences between that species and *P. elongata* it is hardly conceivable that the other two specimens would represent true *elongata*.

**14. *Polygala linearifolia*** Willd., Sp. Pl. 3 (1803) 877; DC., Prod. 1 (1824) 326 ('*linearifolia*'). — *P. brachystachya* Bl., Bijdr. (1825) 59, non DC. 1824; Miq., Fl. Ind. Bat. 1, 2 (1859) 125; King, J. As. Soc. Beng. 59, ii (1890) 131; Ridl., Fl. Mal. Pen. 1 (1922) 139 (type specimen in L.). — *P. monspeliaca* (non L.) Blanco, Fl. Filip. (1837) 557; ed. 2 (1845) 388; ed. 3, 2 (1879) 350. — *P. humilis* Span., Linnaea 15 (1841) 167, Ic. 39 (ined.) (*non vidi*); Walp., Rep. 1 (1842) 234; Miq., Fl. Ind. Bat. 1, 2 (1859) 125; Hassk. in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 160 (type specimen: Timor, *Spanoghe s.n.*, L!). — *P. javana* (non DC.) Hassk., Retzia (1855) 148. — *P. chinensis* var. *brachystachya* (Bl.) Benn. in Hook. f., Fl. Br. Ind. 1 (1875) 204; Backer, Schoolfl. Java (1911) 78. — *P. chinensis* var. *linearifolia* (Willd.) Chodat, Monogr. 2 (1893) 386; Merr., Sp. Blanc. (1918) 214. — *P. aurata* Gagn., Bull. Soc. Bot. Fr. 56 (1909) 220; Fl. Gén. I.-C. 1 (1909) 260; Craib, Fl. Siam. En. 1 (1931) 100 (type specimen: Cochinchina, *Thorel* 1314, P. K!). — *P. chinensis* (non L.) Backer, Bekn. Fl. Java (em. ed.) 4A (1942) fam. 50, p. 3; Backer & Bakh. f., Fl. Java 1 (1963) 198. — **Fig. 19.**

Annual or perennial herbs, with a woody root-top or stembase in older specimens, erect, prostrate, or ascending, often profusely branched especially when main stem is broken, damaged, or removed, 5—40 cm. Stem terete, puberulous. *Leaves*  $\pm$  lanceolate to narrow-lanceolate, 3—45 by 1—8 mm, 1-nerved, almost glabrous, mucronate. Racemes axillary or supra-axillary, rather few-flowered, usually with a filiform rachis, (0.5—)1—9 cm. Bracts c. 1 mm,  $\pm$  lanceolate, ciliate, persistent, twice as long as the bracteoles. Pedicels c. 2 mm, in fruit 3 mm. *Sepals* sometimes hairy; outer ones  $\pm$  ovate, acute, ciliate; alae falcate, long-acute, mucronate, ciliate. Corolla yellow; lateral *petals* broad-obovate,  $\pm$  as long as or somewhat shorter than the keel, slightly hairy inside at the adnation to the staminal tube; keel with 2 bundles of (1—)2—4 appendages each of which is forked at the tip. Staminal tube hairy inside at the adnation to the petals; filaments free for  $\pm \frac{1}{3}$ . *Ovary* obovate, slightly emarginate, ciliate, style curved, horseshoe-shaped

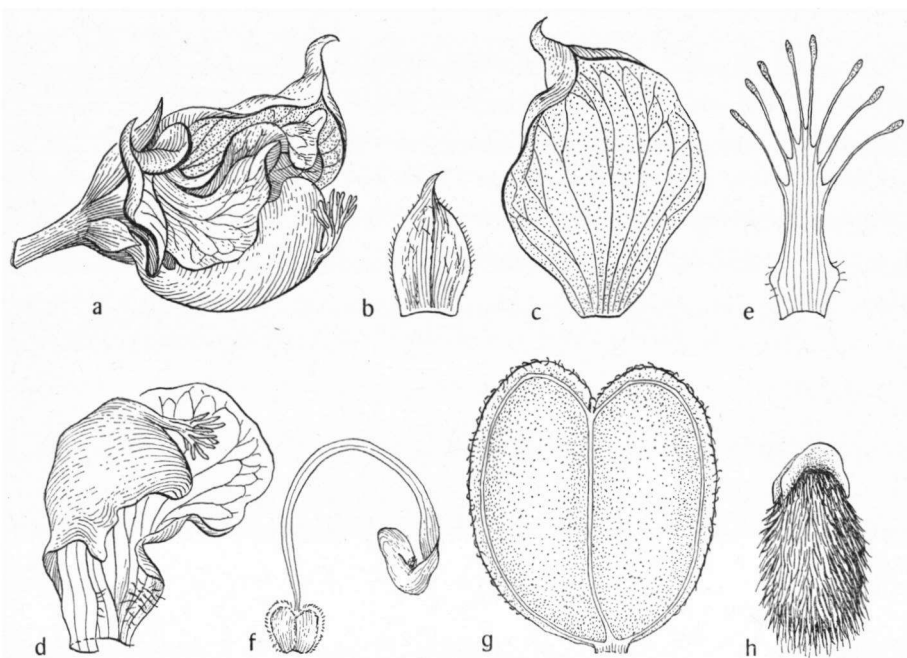


Fig. 19. *Polygala linearifolia* Willd. a. Flower, b. upper sepal, c. ala, d. keel enveloping staminal tube, at right one petal, e. opened staminal tube, f. pistil, g. fruit, h. seed. a-f  $\times 13$ , g and h  $\times 10$ . (Backer 23143).

hooked, stigma inside the hook. Fruit obovate-obcordate, surrounded by a narrow, ciliate wing. Seed black, with long white hairs, obovate; carunculus  $\pm$  hood-shaped, with 3 short membranous appendages to halfway the seed or shorter.

*Type specimen*: Philippines (Mindanao), Willdenow 12958 (B; photograph, some flowers and fruit seen by courtesy of the Director of the Berlin Herbarium).

*Distribution*. China, Siam, Indo-China, in Malesia: Sumatra, Malay Peninsula (Singapore, Malacca, Pahang, Perlis), SE. Borneo (1 sheet), Java (common in the West), Madura I., SW.-W. Celebes, Lesser Sunda Islands (Timor), Philippines, and New Guinea.

*Ecology*. Waste places, grasslands, and road-sides, once noted on limestone, below 400 m, once from Sumatra at 1275 m.

*Notes*. Chodat muddled with the identity of this species, as he accepted it on p. 379 of his monograph, adding additional records from Ceylon, but had it also as a variety of *P. chinensis* in the same work on p. 386.

Most of New Guinea and Philippine material (including the type) shows an erect habit, but when the main stem is damaged or destroyed, plants assume a more prostrate habit by the development of lower branchings; there are several transitions between the extremes.

## EXCLUDED SPECIES

*Polygala undulata* Roxb., Hort. Beng. (1814) 98, *nomen*; Fl. Ind. ed. Carey 3 (1832) 219.

Type: Penang.

Due to the courtesy of the Director of the Royal Botanic Gardens, Kew, where no specimen is preserved, I received a photograph of the drawing n. 2528 mentioned in Sealy's List (Kew Bull. 1956, 371, Roxb. MS 2534, painting 2528). Though the drawing shows a crest on the keel and 8 partly free filaments, the habit, fruit shape, and calyx show that this is *Salomonina cantoniensis* Lour., a common plant, also recorded from Penang in recent time.