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PENTASTEMONA, A NEW 5-MEROUS GENUS OF MONOCOTYLEDONS FROM NORTH SUMATRA (STEMONACEAE)

C. G. G. J. VAN STEENIS

SUMMARY

A new, short-stemmed genus with two species is described in the Stemonaceae. It has regular, 5-merous flowers, obviously the first among the Monocots. The four genera of the family are discussed and their characters contrasted. The fruit and seed of *Stichoneuron* are for the first time described. Attention is called for the peculiar aril in the four genera. It is concluded that the family is a natural one, in vegetative characters and seed structure, and should not be split up. A new family description is given and an artificial key to the genera. Some observations on anatomical features were checked or established, especially concerning the crystals, by Dr. P. Baas. A concise account of the palynology of the four genera is given by Dr. J. Muller. Besides the new type species, *Pentastemona sumatrana*, there is one new combination for the second species, *P. egregia* (basionym *Cryptocoryne egregia* Schott).

In the course of his work towards a revision of the Araceous genus *Cryptocoryne* in 1959, Dr. H. C. D. de Wit rejected the type of *C. egregia* Schott (1863), based on a Korthals collection in Central West Sumatra, from this genus, even suggesting that it did not belong to Araceae, but to another family, possibly Liliaceae. Dr. R. C. Bakhuizen van den Brink *f.* still maintained some doubt (in 1968) because of the occurrence of raphide dots in the leaves, a feature common to Araceae, but otherwise rare in Monocots.

The smallish plant, with a short rhizomatous stem and ± rosulate leaves superficially suggested an Araceous habit, but the type (in L) is in bad and almost sterile condition. It was probably already so in Schott's time, as he did not describe any floral parts. In 1972 the type was submitted to Dr. Dan Nicolson, Washington, together with other unidentified Araceae and among them was a new collection of the same species, hailing from the well-known Anei canyon, Westcoast of Sumatra, collected at 600 m altitude in primary forest by Dr. W. Meijer in 1955, probably the type locality. Also in Nicolson's view the species would not belong to Araceae.

As I remained distinctly interested in the species, Dr. J. Muller, on my request, examined the pollen (in 1975) which according to him suggested a resemblance with Araceae-Philodendroideae. In 1978 Mr. J. Bogner examined the specimen collected by Meijer and suggested it to belong to Stemonaceae, *cf. Stichoneuron*. As a matter of fact we had also thought of that affinity because of the peculiar finely trabeculate veins connecting the curved nerves (Fig. 2d), but hesitated to come to a conclusion because of the sheathing leaf-base and the manifest difference in habit with the other known three genera of the family, *Stemona*, mostly a climber, and *Croomia* and *Stichoneuron*, erect herbs with a leafy stem, the leaves having no sheathing base. Meijer's material was also rather insufficient for accurate description.

In 1978 Dr. and Mrs. W. J. J. O. de Wilde made an expedition in the Gajo Lands, North Sumatra, and their material contained, to my pleasure, two collections apparently belonging to the same genus, though distinctly different specifically from the Anei canyon species. Though unfortunately no material was preserved in liquid, this new material proved to contain both flowers and fruit in excellent condition. In dissecting the flowers it appeared that in the one-celled ovary it would well fit into Stemonaceae, but that it differs manifestly from all three genera in the regular, 5-merous flowers with inferior ovary and fruit (Fig. 1c-d), the others having 4 tepals (mostly in two pairs) and a superior ovary. Also vegetatively it differs from the other genera, viz., in lacking a distinct leafy stem but having rather crowded leaves (? spirally) scattered on a short, erect, rhizomatous rooting stem, the leaves having instead of a narrow leaf-insertion, a sheathing leaf-base with wide insertion, a feature unknown in Stemonaceae (Fig. 1b).

Tomlinson & Ayensu (1968: 273) said that all three genera then known have distichous leaves without sheathing base. However, in their detailed exposé of *Croomia* they described in full the scale-leaves on the horizontal rhizome in *Croomia* to be sheathing. Thus one is tempted to identify the scale-leaves of *Croomia* with the normal leaves on the erect rhizomatous stem of the Sumatran genus, which then lacks the stem as present in *Stichoneuron* and *Stemona*. This induced me to check whether scale-leaves also occur on the stem in *Stichoneuron* and in *Stemona*, especially because Tomlinson & Ayensu (1968: fig. 35) depict their occurrence on the stem-base of *Croomia pauciflora* Torr. As a matter of fact they occur also on the stem-base of *C. japonica* Miq. in many sheets in the Leiden Herbarium. They occur also on the lower nodes or stem-base in *Stichoneuron caudatum* Ridl. and on the stem-base of *Stemona cf. kerrii* Craib *(BKF 32037)*, *S. sessilifolia* (Miq.) Franch. & Sav. (3 *Siebold* sheets), *S. pierrei* Gagn., and *S. minor* Hook. *f.* (*Wight 2821*). In *Stemona aphylla* Craib normal leaves are absent, the stem carrying only scale-leaves!

There is thus a most satisfactory agreement for all three genera, and this sustains the opinion that the difference with *Pentastemona* is largely the absence of a true stem in the latter. The observation strengthens the mutual affinity in Stemonaceae. The statement of Tomlinson & Ayensu (1968) that the leaves in Stemonaceae are always distichous, is in its generality not true (corrected by Ayensu, 1968). I feel doubt about the distichy of the scale-leaves on the stem-bases just mentioned, but the material is insufficient to make a decision. However, it certainly is not true in *Stemona*. In *Stemona japonica* (Bl.) Franch. & Sav. the leaves are opposite or in whorls of 3–4–5, and the same holds for *S. sessilifolia* (Miq.) Franch. & Sav. Furthermore, in *S. moluccana* (Bl.) C. H. Wright and in *S. tuberosa* Lour. they are opposite. Also in habit *Stemona* is more variable than mostly assumed. Gagnepain recorded from Indochina four small, erect species and also an aphyllous one only provided with scale-leaves.

A peculiar feature of the ovary and fruit of *Pentastemona sumatrana* is the occurrence of flimsy but distinct wings (Fig. 1c-d), a rare feature in Monocots. It is also known, of course, in *Burmanniaceae*, *Ottelia* (Hydrocharitaceae), *Paris delavayi* (Franch. (Liliaceae), and possibly some other plants. In Dioscoreaceae there is also a wing, but much thicker in texture.

The very fine trabeculate venation between the curved nerves is not uncommon in Monocots, and occurs *e.g.* in Butomaceae (*Hydrocleis*). In Fig. 2a-d I have pictured the venation types for the four genera of *Stemonaceae*.

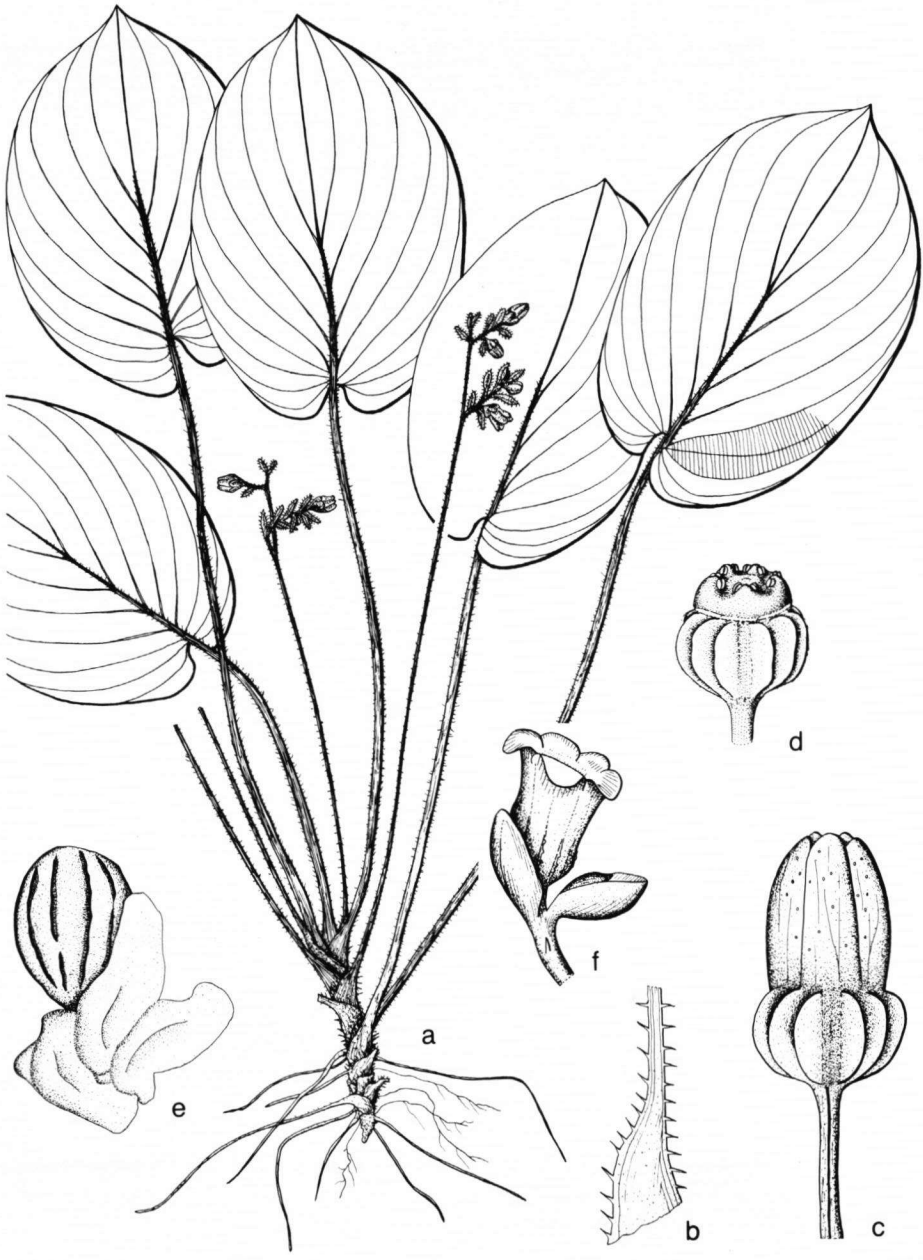

Fig. 1. *Pentastemona sumatrana* Steen. a. Habit, × ½; b. base of leaf sheath, × 1½; c. flower, × 6; d. flower, tepals removed, × 6; e. ribbed seed with funicular aril, × 25 (*W. J. J. O. de Wilde & B. E. E. de Wilde-Duyfjes 18695*). — *Pentastemona egregia* (Schott) Steen. f. Flower, × 2 (*W. Meijer 17010*).

Root-system of the Stemonaceae. — Tomlinson & Ayensu (1968: 273, fig. 35) gave an ample description of the root-system in *Croomia pauciflora* Torr. This has a long horizontal rhizome from which the stem is produced sympodially from one bud in the axil of a scale-leaf, leaving another bud to continue the rhizome.

Descriptions in this detailed way are not available for the other genera. From herbarium material I doubt whether this growth mode is also present in the other genera. There are rather few specimens in the herbarium with a root-system, and the ones there are, are mostly incomplete. In *Croomia japonica* Miq. I found in the Leiden Herbarium three specimens, all provided with a short rhizome with many long, thick roots, but it is possible, of course, that the long horizontal part was not collected. The latter is anyway not mentioned by Ohwi (1965). In *Stichoneuron* we have to rely on the excellent plate of Hooker f. (1888); he pictured a short erect rhizome with many roots. In published *Stemona* pictures one observes a short rhizome emitting a large number of thickened, spindle-shaped roots, without a creeping rhizome attached. In *Stemona cf. kerrii* Craib (*BKF 32037*) the situation is the same. These very much thickened (? storage) roots seem more or less characteristic for *Stemona*. In the complete plants of *Pentastemona egregia* collected recently by Meijer, the erect stem is thick, fleshy, c. 5–10 cm long, without any trace of stolons; this situation is also found in *P. sumatrana*.

Concluding, it remains to be studied in the field whether in *Croomia japonica*, in *Stichoneuron* and in *Stemona* subterranean stolons occur.

Fruit and seed of the Stemonaceae. — The fruit of Stemonaceae was incompletely known; in *Stichoneuron* fruit and seed were as yet undescribed. In *Stemona* the fruit is a superior, 2-valved capsule. So it is in *Croomia*, as stated and figured by Small (1933), who wrote that the fruit is superior and finally 2-valved in the American species; Ohwi (1965) confirmed this for the Japanese species of *Croomia*. This is rather surprising as the pericarp in *Croomia* is very thin.

In the Sumatran plant the fruit is inferior and the pericarp, with about the size of that in *Croomia*, is almost still thinner than in that genus, the seeds shimmering through it. Whether it is finally dehiscent remains unknown yet, but a thin pericarp is obviously no obstacle for dehiscence, as shown in *Croomia*. In view of the 3-zoned parietal ovules, the fruit of *Pentastemona*, if dehiscent, could be expected to be 3-valved, instead of 2-valved as in the other genera.

In *Stemona* the seed dangles on a long funicle and it is generally described as having an 'aril' consisting of a 'tuft of hairs'. Thus it is pictured by Krause (1930: fig. 30D). Swamy (1964), in a very accurate account of *Stemona*, has shown that this is obviously a serious error caused by studying only dry material in the herbarium. Actually, the aril is a complex hollow vesicular body, bulging and irregular in outline. In passing, Hutchinson (1959), obviously also studying dried material, figured a seed of *Stemona* with the aril, mistaking the latter for 'attached abortive ovules'.

Unfortunately Tomlinson & Ayensu (1968: 273) did not describe or figure the aril in *Croomia*, which they declare as being 'filamentous' against vesicular in *Stemona*. For the Japanese species of *Croomia* Ohwi (1965: 279) calls it a 'tuft of fleshy setose appendages' which certainly reminds of the situation in *Stemona*, by the use of the term 'fleshy'. Fortunately I had one collection with a ripe fruit of *C. japonica* Miq. (*Hatusima 19946*,

from the Ryukyu Islands) and to my satisfaction this contained two seeds with exactly matching arillar structures as figured by Swamy for *Stemona*.

In the Sumatran plant the seed is of the same shape and structure as that in *Stemona* and *Croomia*, ellipsoid, with lengthwise ridges. At its base it is provided with a structure exactly matching that pictured by Swamy (1964: fig. 41 & 42) in *Stemona*, bulging and inflated, hollow, but less coralloid and almost exceeding the seed in size (Fig. 1e). This occurrence is an excellent argument for affinity with *Stemona* and *Croomia*.

Of *Stichoneuron* the fruit and seed were undescribed, and they are extremely rare in the herbarium (as well as flowers), none being present on the eight sheets at Leiden. In the Singapore Herbarium there were three of the 15 with some fruits, respectively *Ridley 14582*, *Corner SF 20242* (in spirit, unlocalized), and *SF 30503*. Of the second number Holttum has (21-1-1947) made a very detailed description. From boiled material the diagnosis runs as follows: Fruit glabrous, spindle-shaped, when 2-seeded c. 16 by 4 mm, when 1-seeded c. 11 by 5–6 mm, supported by tepal remains and a stalk above the articulation of the pedicel, at the apex caudate for a few millimeters. Pericarp very thin. Funicle c. 3 mm, winged, at apex close to the seed with c. 5–6 narrow-lanceolate, very flimsy and wide-celled arillar, free, ± equal appendages surrounding the base of the seed up to halfway (c. 3–4 mm long). Seed broad-ellipsoid, sharply ridged lengthwise, the ridges appearing almost as narrow wings in the herbarium, 5–7 mm long. Fig. 2e-f.

This confirms the distinct uniformity of the seed structure in all four genera of Stemonaceae, irrespective of their insertion, basal in *Stemona* and *Croomia*, parietal in *Pentastemona*, and apical in *Stichoneuron*.

On account of the above given discussion and description of peculiar features of the Sumatran plant, I have definitely concluded that the latter represents a distinct new genus of the family Stemonaceae. *Pentastemona*, causing a widening of the circumscription of the family (cf. Krause, 1930) as follows:

Climbers or herbs, either with a developed stem, or with a (sometimes horizontal) scaly rhizome and erect leafy stem, which is in the basal part provided with scale-leaves, or a short, erect, leafy, rhizomatous stem and subrosulate leaves with sheathing petiole. *Leaves* entire, on the stems mostly distichous, with an intramarginal vein, and ascending or curved lateral nerves trabeculately connected by numerous crossbar veins; parenchyma with styloids and/or raphide dots, occurring also sometimes in other organs. Indumentum mostly absent, but present (as uniseriate hairs) in *Pentastemona* on the leaves or fruit ribs, and in *Stichoneuron* on nodes and internodes. *Flowers* pedicelled, 2-merous with 4 tepals or 5-merous with 5 tepals, whether or not connate at base. Inflorescences axillary, peduncled, with rarely solitary flowers, mostly in (probably cincinnate) pauciflorous bracteate inflorescences. *Tepals* persistent, valvate or imbricate, 4–5. *Stamens* 4 or 5 in a whorl, free or connate inside a narrow, shallow ring. Anthers on a filament or sessile, free or on a shallow staminal tube, epitepalous, the connective sometimes enlarged apically or widened between the loculi, latrorse. Pollen inaperturate or monosulcate with a granular or reticulate surface. *Ovary* superior, semi-inferior, or inferior, 1-celled. Ovules either few or many, either pendent from the apex or in 3 parietal zones, or basal, anatropous, with 2 integuments. *Fruit* a capsule, 2-valved (? always). Seeds on a

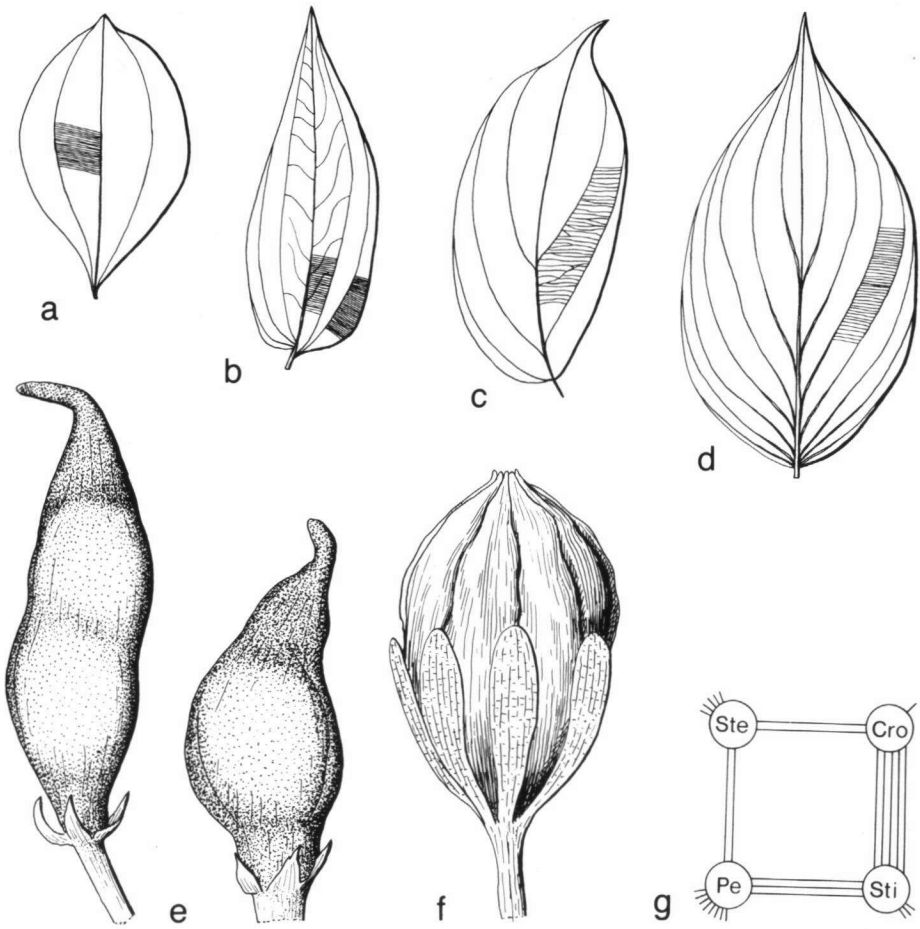

Fig. 2. Venation types in the four genera of Stemonaceae, all × ⅔. — a. *Stemona sessilifolia* (Miq.) Franch. & Sav.; b. *Croomia japonica* Miq.; c. *Stichoneuron caudatum* Ridl.; d. *Pentastemona egregia* (Schott) Steen.

Fruit and seed of *Stichoneuron caudatum* Ridl. — e. Two fruits, 1- and 2-seeded, × 4; f. ribbed seed with funicular arillar lobes, × 8 (*Corner SF 30503*); g. Scheme of affinities among the four genera of Stemonaceae: Ste = *Stemona*, with five unique characters, two common with *Croomia*, and two common with *Pentastemona*; similar ratios for Cr = *Croomia*, Sti = *Stichoneuron*, and Pe = *Pentastemona*.

short or long funicle, broad-ellipsoid, grooved or ribbed, at the base with a fleshy, inflated, bulging coralloid or lobed hollow aril; endosperm copious; embryo very small.

S t e m o n a c e a e, a n a t u r a l f a m i l y. — Tomlinson & Ayensu (1968: 274), who knew only three genera, stated that 'It is not evident that they form a natural assemblage. Similarities between the genera are few but differences many', and 'Even with this limited evidence it is clear that we are not dealing with a homogeneous

assemblage.' This can be said of many families, however, e.g. Olacaceae. And what does 'homogeneous' mean? It is always a matter of weighing characters and considering what character-set the genera have in common. The conclusion of Tomlinson & Ayensu was also mostly based on the vegetative anatomy and morphology.

I can only partly endorse their opinion: *Croomia* and *Stichoneuron* are very similar in habit and the venation and gross anatomy of the leaves are extremely similar to that of *Pentastemona*, while all four genera share a surprisingly similar seed structure with a characteristic aril. To me the situation appears illustrative of the essential thesis in taxonomy, that taxonomic characters carry no absolute weight, even though this is, genetically, not well comprehensible. Whereas the peculiar seed structure is, for all four genera of Stemonaceae, exactly matching, the placentation varies from basal to parietal and apical, a feature which at family level is used for example to distinguish Moraceae and Urticaceae. Even within one family important characters sometimes do not hold, e.g. a superior ovary in the Rubiaceous genus *Mastixiodendron* and an inferior ovary in the Theaceous genus *Anneslea*, or several ovaries in the Leguminous genus *Archidendron*.

There is a distinct reticulate affinity between the four genera, each of which, of course, possesses in addition unique features. For example:

Stemona:	Unique:	mostly scandent; roots spindle-shaped thickened; flagellate-produced connective appendage; very long funicles; pro ratio large flowers; basal placentation.
	Shares:	with *Croomia* basal curved nerves and dehiscent fruit; with *Pentastemona* often numerous ovules and seeds; the shallow staminal tube.
Croomia:	Unique:	a horizontal rhizome with sheathing bracts (subterranean stolons not yet reported in other genera but not unlikely to occur).
	Shares:	with *Stichoneuron* the habit; the short thick filaments; the simple inflorescence, the few, pendent ovules with apical placentation, and the reticulate exine structure of the pollen; with *Stemona* the basal curved nerves and dehiscent fruit.
Stichoneuron:	Unique:	valvate tepals; the dense, apically crowded raceme with stiff, erect, setaceous, articulate pedicels spirally arranged; aril consisting of c. 5–6 free, lanceolate lobes, appressed to lower half of seed.
	Shares:	with *Pentastemona* lateral nerves in part above the base; thecae separated by a broad connective; presence of uniseriate hairs; with *Croomia* the simple inflorescence; the habit; short thick filaments; few ovules and seeds; apical placentation; reticulate exine structure of the pollen.
Pentastemona:	Unique:	5-merous flowers; mostly compound inflorescences; anthers sessile; leaf-base sheathing; no leafy stem proper; ovary inferior, as is the fruit, winged in *P. sumatrana*; ovules in 3 parietal zones. Pollen inaperturate.
	Shares:	with *Stichoneuron* the suprabasal lateral nerves; thecae separated by connective; uniseriate hairs; with *Stemona* the numerous ovules and seeds; stamens inserted on a shallow staminal ring-like tube.

Counting the characters mentioned the diagram (Fig. 2g) illustrates the occurrence of these characters, unique and shared. From this it appears that *Stemona*, and even more so *Pentastemona*, stand apart from the *Croomia*/*Stichoneuron* pair. And furthermore, that *Stemona* and especially *Pentastemona* have the most unique characters. This is confirmed by pollen morphology.

Nakai (1937) with his tendency to inflate ranks proposed to raise the *Croomia*/*Stichoneuron* pair to family rank, Croomiaceae, on the ground that the pair has small flowers, short filaments, unappendaged anthers and apical placentation. If he had known *Pentastemona*, I have no doubt that this was then also raised to family rank, as the above characters would not hold.

I feel more impressed by the characters which hold the four genera together, viz., the morphological and anatomical vegetative characters, the anatropous ovules, the one-celled ovary, and the striking similarity in the peculiar seed structure, exactly matching in all four genera, whatever they may differ in placentation. One could of course propose three tribes for the four genera, but I still find this in such a small family an exaggeration, at least not useful.

Affinity of Stemonaceae. — The subject of the affinities of the Stemonaceae has been treated by Ayensu (1968: 164). This remains still obscure. As in the traditional systems, the affinity with Liliaceae is accepted, though possibly in a remote sense. On anatomical grounds Ayensu favours also affinity with Dioscoreaceae and this is also the view of Burkill (1960), who suggested the origin of Stemonaceae 'to have been from the Proto-Liliales in the general neighbourhood of Dioscoreaceae', which seems a rather vague, but wise conclusion. One of the most striking features of the new genus *Pentastemona* are the 5-merous flowers and a paragraph should be devoted to occurrence of 5-merousness in Monocots.

The occurrence of 5-merous flowers in Monocots. — In the Monocots regular 3-merous, cq. 6-merous flowers prevail. Flowers with 5 anthers occur, but then the flowers are bisymmetrical and one anther is either reduced or represented by a staminode, as is found in Zingiberaceae, Lowiaceae, etc., but this occurs in regular 3- or 6-merous flowers. Besides, quite some Monocots have regular 2- or 4-merous flowers. Therefore, *Pentastemona* with its 5-merous flower is quite an exception to the rule.

Mr. J. Bogner wrote to me that on the spadix of *Urospatha* (*Araceae*) flowers occur with 4 or 6 tepals, but that between these he had also observed occasional flowers with 5 tepals. This genus belongs to the Araceae tribe Lasieae, for which Hutchinson (1959: 632) also mentions that the ovary is 4–5-locular.

Another instance is found in *Sciaphila* of the Triuridaceae, where the perianth is usually 3- or 6-partite, less often 4–5-partite. The female flowers of *S. nana* Bl. are mentioned to have 5 to 6 segments. Martius described in Flora Brasiliensis (3, 3: 313, t. 116, ii) the flowers of *Sciaphila albescens* Bth.: the males are 4- or 6-merous, and also the females are usually 4- or 6-merous, but he wrote that 5-merous female flowers with 5 tepals also rarely occur. The plate was copied by Hutchinson (1959: 547, fig. 348).

A similar instance of occasional 5-merous flowers occurs in the genus *Paris* (Liliaceae, tribe Parideae), especially in the section *Euthyria* Franch. subsection *Submuticae* Franch., where flowers may vary from 4- to 5-merous. Krause (1930: 374, fig. 152F) pictured such a 5-merous flower in *Paris polyphylla* J. Sm. and so did Hutchinson (1959: 615, fig. 381). In the Leiden Herbarium I found the flowers to vary in this species from

3–4–5–6–7–8-merous, without a preponderance of the 4-merousness, which is usual in the genus. Even in one collection specimens may vary in merousness. This variability is not geographic but occurs throughout its wide range from the Himalaya to Japan.

Also in the genus *Trillium* of the same tribe of the Liliaceae variation occurs in the merousness of the flowers, which are usually 3-merous. Gates (1917: 69–83) in his monographic study of the North American species, devoted a large appendix to the occurrence of variations and noted a number of cases where flowers were 5-merous. He commented, however, that all of them were single individual specimens which deviated in merousness and that they were often found amidst large, normally 3-merous populations. The situation seems similar to, for example, that in *Tulipa*, where sometimes a single individual with 2-merous flowers occurs.

In conclusion, regular 5-merous flowers are found in Monocots, but extremely rarely, and only occasional or confined to odd specimens, or in a range of greater variability. As all the flowers in the two *Pentastemona* species are 5-merous, I can only conclude tentatively that it seems the first genus of Monocots which is normally regular 5-merous.

A n a t o m y. — Dr. P. Baas reported to me in 1980 on the anatomy of *Pentastemona egregia* (*Meijer 3214*): anticlinal epidermis cell walls straight; stomatal complex tetracytic; crystals as abundant styloids and raphides. Also minute druses throughout the mesophyll. *Pentastemona sumatrana* (*de Wilde & de Wilde-Duyfjes 18532*): anticlinal epidermis cell walls straight; stomatal complex tetracytic to cyclocytic; crystals as abundant styloids and raphides, also as minute irregularly shaped, solitary crystals. Doubtlessly related to *Meijer 3214*.

Baas concluded that the combination of styloids and raphides is suggestive of Stemonaceae or *Dioscorea*, but that the stomata are different. He checked also the occurrence of crystals in the leaves in conjunction with those in *Pentastemona* and the occurrence of styloids and raphides in *Stemona*. He confirmed that in *Croomia* the leaf only contains raphides (no styloids).

In *Stichoneuron caudatum* Ridl. (*Kerr 10082*) Baas found in the leaves irregular crystalline conglomerates ('clustered needle-shaped + diamond-shaped + irregularly shaped crystals') ± related to raphide bundles but certainly not identical, while styloids were absent. In *S. membranaceum* Hk. f. (*Koelz 5835*) he found the same rather undefined crystals, but also raphide bundles.

P o l l e n m o r p h o l o g y. — The pollen of both species of *Pentastemona* was examined by Dr. J. Muller and found to be inaperturate with a very thin exine which is densely covered by minute granules. Similar pollen grains occur in Araceae-Philodendroideae.

In contrast, the pollen of *Stemona*, *Croomia* and *Stichoneuron* is monosulcate. The fine structure of the exine of *Stemona australiana* Wright, *S. japonica* (Bl.) Franch. & Sav., and *S. tuberosa* Lour. is comparable to that of *Pentastemona*, but of *Stemona gloriosa* J. J. Smith it is characterized by the presence of a thin layer of columellae.

Croomia and *Stichoneuron* clearly differ from both *Stemona* and *Pentastemona* in their reticulate exine structure.

ARTIFICIAL KEY TO THE GENERA

1a. Proper leafy stem absent, leaves crowded on a short, erect rhizomatous stem, with sheathing petioles ciliate by coarse uniseriate hairs. Flowers 5-merous. Fruit inferior, winged. Ovules and seeds many, inserted in 3 parietal zones . . . . . **Pentastemona**

b. Proper leafy stem present. Flowers 2–4-merous. Fruit superior, not winged 2

2a. Usually scandent. Roots usually spindle-shaped thickened. Anthers with a flagellate produced connective. Ovules numerous, basal. Seeds on long funicle. Leaves curvinerved . . . . . **Stemona**

b. Small erect herbs with leafy stem. Roots not spindle-shaped thickened. Anthers without appendage, on short thick filaments. Ovules and seeds few, apically inserted 3

3a. Leaves curvinerved. Flowers if more than one spaced, few, nodding, not on stiff, articulated pedicels. Anther-cells parallel, not separated by a thick connective **Croomia**

b. Leaves with suprabasal lateral nerves. Flowers numerous, crowded in a raceme on erect, stiff, articulated pedicels at apex of peduncle. Anther-cells divergent, separated by a thick connective . . . . . **Stichoneuron**

PENTASTEMONA Steen., *gen. nov.* — **Fig. 1.**

Caulis rectus, brevis, rhizomatosus, foliis radicibusque numerosis obtectus. *Folia* petiolata, integra, sparsa, probabiliter spiraliter aggregata, basi spatha lata margine hyalina instructa pilisque robustis uniseriatis ciliata; lamina ovalis, nervo intramarginali, ultro nervis pinnatis 3–4-paribus paullo suprabasalibus aliisque superioribus usque ad laminae mediam 3–5-paribus, omnibus arcuatis ad marginem apicemque laminae ascendentibus, ultro inter se nervis (vel venis) numerosis densis parallelis trabeculatis conjunctis, apicibus venularum haud liberis; mesophyllum punctis rhaphidum ornatum. *Inflorescentia* axillaris, pedunculo sat elongato, bracteato. *Flores* 2–3 ad racemos (vel cincinnos?) terminales solitarios usque ternos densos dispositi, racemo ultimo in specie typica foliis paucis reductis instructo et prolifero. Flores bisexuales, regulariter 5-meri, breviter pedicellati. *Tepala* 5, in sicco membranacea, plus minus libera vel basi connata, imbricata, persistentia, punctis rhaphidum nervisque 3 longitudinalibus obsita. Tubus staminum breviter annularis, sub-5-lobatus, intus staminibus 5 epitepalis sessilibus instructus; antherae subglobosae, thecis 2 parallelis lateralibus latrorsis connectivo conspicuo separatis. *Ovarium* (et fructus) inferum, 1-loculare, zonis parietalibus 3 longitudinalibus, ovulis numerosis modo hippocrepiformi formatis, zonis ipsis cum lobis stigmatosis brevibus bene visibilibus alternantibus; stigmata 3 brevia basi in stylum conicum confluentia. *Hypanthium* vasculis 5 primariis instructum, tribus eorum in ovula transgredientibus. *Fructus* inferus, pericarpio membranaceo, in specie typica alis 10 longitudinalibus membranaceis instructo. Semina numerosa, late ellipsoidea, costulis longitudinalibus ornata; funiculus brevis, arillo ad locum insertionis magno, irregulariter lobato vesiculari instructo. Endospermium magnum; embryo minutus. — T y p u s: *Pentastemona sumatrana* Steen.

N o t e: It is noteworthy that a remarkable new genus is found in Sumatra, which, though a large island, is manifestly poorer in endemic genera as compared with Malaya and Borneo. It is, of course, not impossible that *Pentastemona* may be found in the latter areas; the specimens are small and not conspicuous, and may have escaped the attention of collectors.

The beautiful new collection of Meijer of *P. egregia* showed a remarkable character of the seed, viz. that it seems to possess a distinct, proportionally thick sarcotesta, which will in dried condition escape observation. It would be interesting to know whether this prevails in the family; field observations must give the solution. A peculiarity is further

the occurrence of 5 rather deep pouches in the receptacle between the style base and the staminal ring. This was observed in both species and it seems likely that they represent nectarial structures.

KEY TO THE SPECIES

1. Flowers in branched inflorescences, consisting of 2–3 apical, spaced, pauciflorous racemes, at apex often with 2–5 reduced leaves; peduncle *c.* 10–30 cm. Leaves 9–13 by 6–9 cm, distinctly cordate at base, very short-acuminate at apex, very watery when fresh, filmy when dried, with spaced oblong cystoliths; nerves beneath and petioles with spaced uniseriate hairs. Petiole 6–20 cm. Tepals 3 mm long, thin, oblong, connate at base. Fruit with filmy, entire wings . . . . . **1. P. sumatrana**
1. Flowers in pauciflorous condensed racemes, in the axil of uninerved, sessile, oblong, foliaceous (in sicco scarious) bracts 5–10 mm long; peduncle *c.* 3–5 cm. Leaves 7–9 by 5–5.5 cm, emarginate at base, rather well acuminate at apex, glabrous, papyraceous when dried, densely dotted with punctate cystoliths; only the sheath of the petiole with uniseriate hairs. Petiole 4–15 cm. Tepals thick, *c.* 11–13 mm long, halfway connate in a thick tube, lobes 6 by 9 mm, recurved. Fruit with 10 strong ribs, fringed by short, often antler-like branched, hair-like emergences . . . . . **2. P. egregia**

1. Pentastemona sumatrana Steen., *sp. nov.* — **Fig. 1.**

Planta aquifero-membranacea; caulis 5–10 cm altus. *Folia* statu sicco membranacea, late ovata vel elliptica, interdum subinaequilateralibus, breviter acuminata, basi cordata, 9–13(–16) cm longa, 6–9 cm lata, supra glabra, subtus ad nervos pilis uniseriatis instructa, mesophyllo punctis rhaphidum tenuibus dispersis ornato, nervis inferioribus (basalibus et suprabasalibus) 3–4-, superioribus 4–5-paribus; petioli 6–20 cm longi, pilis robustis uniseriatis disperse, ad marginem spathae densius obsitis. *Inflorescentiae* 10–30 cm longae, apice racemulos 2–3 praebentes, interdum apice foliis reductis 2–5 multinervosis 1–4 cm diam. instructae; bracteae oblongo-lanceolatae, 1-nerviae, membranaceae, in nervo mediano dorso pilosae, 6–9 mm longae. Pedunculi 10–30 cm longi, in vivo, ut videtur, 3–4-angulati, in sicco plani, ad angulos distanter pilis robustis uniseriatis obsiti. Pedicelli haud articulati, 2–3 mm longi. *Tepala* obovato-oblonga, albida, nervis longitudinalibus, disperse punctis rhaphidum albidis ornata, 3 mm longa. *Ovarium* late cylindricum, *c.* 2.5 mm altum, alis 10 longitudinalibus membranaceis 1 mm latis. *Fructus* seriiformis, ut videtur haud dehiscens, c. 3 mm altus, pericarpio tenuiter membranaceo. *Semina* ellipsoidea c. 20, sessilia, c. 1 mm longa, costulis longitudinalibus 8–10 obscurioribus subgranulosis ornata, basi arillo magno irregulariter lobato albido; endospermium oleosum. — T y p u s: *W. J. J. O. de Wilde & B. E. E. de Wilde-Duyfjes 18695*, southern Alas Lands, North Sumatra (holo in L, iso in A, BO, K).

SUMATRA. N o r t h: southern Alas Lands, c. 3° N, 97°50' E, G. Leuser Nature Reserve, Alas River valley, near the mouth of the tributary Bengkong R., *c.* 50 km south of Kota Tjane, in primary lowland rain forest at *c.* 50–125 m alt., on rich soil over basalt rock, in a very shaded damp place along a small stream, *W. J. J. O. de Wilde & B. E. E. de Wilde-Duyfjes 18695*, plant juicy, bright green, bracts green, corolla white. Same place, about 1 km further on, on damp shaded slope, among basalt rocks, juicy green herb, bracts green, flowers 5-merous, tepals white, anthers yellow, often young plants developed from the inflorescences, *W. J. J. O. de Wilde & B. E. E. de Wilde-Duyfjes 18532* (BO, L, US).

N o t e s: I have chosen *Pentastemona sumatrana* as the type of this new, remarkable genus, because the material, though only available in the dried state, is complete. In some specimens the inflorescences are crowned by reduced leaves, resembling proliferation; when fruiting inflorescences sag, their tips may form new plants in reaching the soil. A

similar proliferation is shown in the Malayan *Echinodorus ridleyi* Steen. (Alismataceae), cf. Fl. Males. I, 5: 326, fig. 5. The occurrence of a sarcotesta observed in *P. egregia* I have possibly missed in *P. sumatrana*, of which I had only dried material. This calls for further field observation.

2. Pentastemona egregia (Schott) Steen., *comb. nov.* — **Fig. 1f, 2d.**

Cryptocoryne egregia Schott, in Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1863) 122.

Stem 5–10 cm, terete, thick, fleshy, c. 1 cm ø, with some scarious bracts between the petioles, emitting many long roots; no trace of stolons. *Leaves* papyraceous (in sicco), glabrous, broad-ovate, the base shallowly emarginate, apex short or distinctly acute-acuminate, beneath densely dotted by punctate raphide dots, 7–17 by 5–10 cm; nerves at the base 3–4 pairs, higher up 3–4 pairs, all shallowly depressed above (in life); petiole 4–6(–15) cm long, terete, the sheath margin hyaline and fringed-hairy by coarse uniseriate hairs. *Peduncle* glabrous, 2–3 cm long, somewhat flattened, with one filiform, sometimes downwards curved setaceous appendage, c. 1.5 mm long below the lowest bract. *Flowers* crowded, c. 3–4 in the axil of uninerved, raphide-dotted, scarious, 1-nerved bracts 5–12 by 4–6 mm. *Pedicel* c. 3–4 mm, in the axil of a lanceolate, 1-nerved bract 5 mm long. *Perianth* rather thick and fleshy, pale greenish yellow or whitish, connate a little over halfway in a tube, in all c. 13 mm long, the lobes roundish, imbricate, c. 6 mm long, 7–8 mm wide, recurved at apex. *Stamens* 5, inside a very low fleshy staminal tube on the receptacle, the thecae more or less separated. *Ovary* shorter than the perianth, c. 5 mm high, fleshy, in fruit enlarging to c. 13 mm, with 10 firm ribs which are fringed by short, sometimes antler-like branched, hair-like emergences. *Style* short, cylindric, thickish, c. 1.5 mm high. Between the style and the staminal ring 5 distinct pouches (nectaries?). *Ovules* very many on the three placentas, not all developing into seed. *Seeds* almost globular, c. 1.5 by 1.25 mm, 1 mm when dry, glossy, with a rather thick transparent sarcotesta through which the ribbed endocarp shimmers through; larger than the vesicular arilloid.

SUMATRA. West Central: *Korthals s.n.*, holotype in L sub 898-88.409; ditto, Anei canyon, *c.* 600 m alt., *W. Meijer 3214*, flowering 22 April 1955, on hill slope in primary forest; same locality, *W. Meijer 17010*, flowering and fruiting 8 Nov. 1981, also material in liquid).

Notes: Meijer's new collection has now clarified many points and has shown how poor the other two collections were. I have amplified the description with this new material, realizing that in some points the comparison with sizes and texture will exceed those of herbarium material. A marked character is the occurrence of a sarcotesta; when dried it shrinks so much that it will easily escape observation. The apex of the pedicel and base of the midrib and some loose leaves sent had produced a small adventive shoot with its own small roots, obviously a means of vegetative reproduction; in *P. sumatrana* this was observed in the inflorescence.

P. egregia is distinctly different from *P. sumatrana*, being much coarser, much larger flowers in a more simple inflorescence, the ribbed ovary, etc.

There is a rather striking resemblance in habit with a completely different plant genus, viz. *Pentaphragma*, of the Campanulaceae or Pentaphragmataceae, and the two could be

found in the same habitat, on the forest bottom in loose earth, and this is especially valid for *P. egregia* because of the size of its flowers. *Pentaphragma* can easily be distinguished by the mostly asymmetric, cuneate leaf-base, the mostly toothed leaf margin, the lateral nerves which do not emerge in decussate pairs from the midrib, the reticulate (not trabeculate) venation, the not sheathing petiole base, the absence of the white crystal raphid dots, the boragoid inflorescence, the stalked anthers, the thick, large, solid style, the celled ovary with axile placentas, and non-ribbed seeds without arilloid appendage at the apex of the funicle.

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REFERENCES

AYENSU, E. S. 1968. Comparative vegetative anatomy of the Stemonaceae. Bot. Gaz. 129: 160–165, 9 fig.

BURKILL, I. H. 1960. The organography and the evolution of Dioscoreaceae, the family of the yams. J. Linn. Soc. Bot. 56: 319–412.

GATES, R. R. 1917. A systematic study of the North American genus Trillium, its variability and its relation to Paris and Medeola. Ann. Missouri Bot. Gard. 4: 43–87.

HOOKER, J. D. 1888. Stichoneuron membranaceum. In: HOOKER, Icon. Pl. 18: t. 1776.

HUTCHINSON, J. 1959. The families of flowering plants. 2. Monocotyledons: 657, fig. E. Oxford.

KRAUSE, K. 1930. Stemonaceae. In: A. ENGLER & K. PRANTL, Die natürlichen Pflanzenfamilien, ed. 2, 15a: 224–227, fig. 80.

NAKAI, T. 1937. Croomia kiusiuna Makino. Iconographia plantarum Asiae Orientalis 2(3): 159–160, t. 60.

OHWI, J. 1965. Flora of Japan: 279. Washington, D.C.

SMALL, J. K. 1933. Manual of the Southeastern Flora: 309, fig.

SWAMY, B. G. L. 1964. Observations on the floral morphology and embryology of Stemona tuberosa Lour. Phytomorphology 14: 458–468, 44 fig.

TOMLINSON, P. B., & E. S. AYENSU. 1968. Morphology and anatomy of Croomia pauciflora (Stemonaceae). J. Arn. Arbor. 49: 260–275, 48 fig.