

## A REVISION OF PELIOSANTHES (LILIACEAE)

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### SUMMARY

In the introduction a history is given of the development of the knowledge of the taxonomy of the genus *Peliosanthes* in the wide sense, including the generic names *Teta*, *Bulbospermum*, *Lourya* and *Neolourya*, in which altogether 35 specific epithets have been validly published, ranging from the Deccan Peninsula through S. E. Asia to West Malesia.

The characters defining these genera are scrutinized and it is found that only one genus can be distinguished.

The affinity of *Peliosanthes*, which is maintained in Liliaceae, is discussed and it is concluded that it should be arranged in the same tribe as *Ophiopogon* and *Liriope*.

A thorough examination is made of specific delimitation on the basis of the gross morphology which has shown that no satisfactory correlations can be found in the variability; this is illustrated by several histograms.

This has led to the conclusion that only one variable species, *Peliosanthes teta* Andr., can be distinguished, falling into two entities, the subspecies *teta*, confined to continental Asia with 2—6 flowers per bract and a subspecies *humilis* with only one flower per bract which is found throughout the range of the genus.

A full description of the genus and species is given, with their synonymy, and information is given on habitat and distribution; localities are mapped.

The few chromosome counts published agree in  $2n = 36$ .

### INTRODUCTION

In 1810, Andrews described the first species of a genus from India recently introduced into cultivation in England. This he called *Peliosanthes teta* (from the green flowers and 'teta' being an Indian name for the plant.) In the following year Andrews and Donn published two further names in *Peliosanthes*.

Roxburgh (1814), apparently unaware of Andrew's publication, proposed a new name, *Teta viridiflora*, for what Andrews had named *P. teta*. In this publication Roxburgh's name remained a *nomen nudum* and it was not until 1832 that he validated it. This generic name has not been taken up by subsequent authors.

A further new name for a species placed in *Peliosanthes* by later authors was proposed by Blume in 1823, *Bulbisperma ovigera* (*nomen nudum*). This name has never been validated, but in 1827 Blume described *Bulbospermum javanicum*, which he regarded as allied to *Peliosanthes*. No further species have been described in *Bulbospermum* and *B. javanicum* has been treated as a species of *Peliosanthes* by subsequent authors.

Two further genera have been described for species treated by most subsequent authors as belonging to *Peliosanthes*. In 1888 Baillon described *Lourya campanulata* which differed from *Peliosanthes* in having a distinct rhizome with spaced nodes. Most *Peliosanthes* specimens have a rosette of leaves arising at ground level from a much abbreviated horizontal axis. No further species have been described in *Lourya*. Krause (1930) recognised a single species in *Lourya* which he characterised as having five ovules in each locule of the ovary, while in *Peliosanthes* he believed, incorrectly, that there were always two.

Rodriguez (1934a) transferred *L. campanulata* to *Peliosanthes* but in the same publication described a new genus, *Neolourya*, with two species, *N. pierrei* and *N. weberi*. This genus was distinguished by its long slender style, as opposed to a short pyramidal or conical style in *Peliosanthes*.

No further species of *Neolourya* have been described. These two epithets have never been transferred to *Peliosanthes*, but Hutchinson (1959) treated *Neolourya* as a synonym of *Peliosanthes*.

The characters suggested for separating *Peliosanthes*, *Lourya* and *Neolourya* all grade from *Peliosanthes* into the other proposed genera. No other characters have been discovered on which to subdivide *Peliosanthes* (*sensu lato*) generically, and in this paper *Teta*, *Bulbospermum*, *Lourya* and *Neolourya* are treated as synonyms of *Peliosanthes* as was done by Hutchinson (1959).

In all, 35 binomials of *Peliosanthes* (*sensu lato*) have now been validly described from India, Thailand, Vietnam, southern China (including Taiwan) and through the Malay Peninsula to Sumatra, Java and Borneo. Of these, 10 were described by Ridley (1898—1920) from the Malay Peninsula and near-by islands. Ridley's publications are important not only for their quantity but also because he was probably better acquainted with the species in their natural habitat than any other author of new species has been.

No survey of the species over the entire range of *Peliosanthes* (*sensu lato*) has been published since Baker (1879) who recognised only 8 species. However, there have been several publications dealing with specific geographical areas. Hooker (1892) recognised 9 species for British India but said that 'the species of this genus are far from well defined'. Ridley (1924) recognised 9 species from the Malay Peninsula, but overlooked a further one which he had himself described, *P. hypogyna*. Rodriguez (1934b) recognised 2 species of *Neolourya* and 6 of *Peliosanthes* from Indo-China. Backer and Bakhuizen van den Brink Jr (1968) recognised a single species in Java. Chang & Hsu (1974) recognised 2 species in Taiwan.

The most recent reviews referring to the genus over its whole range, but not enumerating the species, are those of: — Krause (1930) who recognised 8 species in *Peliosanthes* and 1 in *Lourya*; Hutchinson (1959) who recognised only one genus; Airy Shaw (1966) who ascribed 2 species to *Neolourya* and 15 to *Peliosanthes* (including *Lourya*).

#### AFFINITIES

*Peliosanthes* is usually placed in the *Liliaceae* (e.g. Ridley, 1924; Krause, 1930; Hutchinson, 1959; Backer and Bakhuizen van den Brink Jr, 1968). Within the *Liliaceae* it is rather unusual in that most specimens have either an inferior or at least a semi-inferior ovary. It is because of this single, and not exclusive, character that some authors (e.g. Hooker, 1892; Rodriguez, 1934b) have preferred to place it in the *Haemodoraceae*. The biseriate arrangement of the ovules is regarded by some authors (e.g. Nakai, 1941, p. 190) as evidence of relationship with the *Liliaceae* rather than the *Haemodoraceae*. Chang and Hsu (1974) considered that the cytological evidence indicates a close affinity with certain *Liliaceae* genera.

I have not seen any comprehensive discussion of the separation of *Liliaceae* and *Haemodoraceae*. In the absence of any new evidence for referring *Peliosanthes* to the *Haemodoraceae* it is suggested that it be retained in the *Liliaceae* until the limits of these families are thoroughly re-examined.

A further unusual characteristic is the ovary wall which ruptures early in the development of the fruit which, therefore, results in the seeds' development occurring largely

outside the ovary. This is also a characteristic of *Ophiopogon* (*Mondo*) and *Liriope*. This character strongly indicates that *Peliosanthes* is closely allied to these two genera. Hutchinson (1959), however, placed *Peliosanthes* in the tribe *Peliosantheae* and the other two genera in the tribe *Ophiopogoneae*. In my opinion these genera should all be placed in the same tribe.

Cytological evidence is considered by Chang and Hsu (1974) to suggest an affinity between *Peliosanthes*, *Liriope*, *Ophiopogon* and *Aspidistra*. They proposed the inclusion of all these genera in the *Ophiopogoneae*. I believe that the fruit development sufficiently characterises the first three of these genera to exclude *Aspidistra* until a more thorough examination of a number of other genera is undertaken.

Difficulty has been experienced in separating *Ophiopogon* and *Peliosanthes*, especially when flowers are not available. *Ophiopogon* is characterised by the absence of a staminal corona and by having basifixed anthers. The fruits are indistinguishable. The majority of species of *Ophiopogon* can be easily distinguished by their linear or sublinear sessile leaves which have conspicuous membranous wings towards the base and by the absence of scale-like leaves on the rhizomes. *Peliosanthes* leaves are usually petiolate, lack the wings, and have scale-like leaves on the rhizomes. However, a small group of *Ophiopogon* species appear to have a vegetative morphology indistinguishable from that of many *Peliosanthes* specimens — for example *O. marmoratus* Pierre ex Rodriguez, *O. regnieri* Bois, and *O. dracaenoides* (Bak.) Hook. f.

#### ANATOMY

An examination of leaf epidermis preparations was undertaken to find out whether or not characters could be found to support the generic separation of these two genera.

Herbarium material was used exclusively. The following identified (fertile) specimens were used: —

*Ophiopogon marmoratus* Pierre ex Rodriguez, Geesink 5560 (L), Thailand;

*O. caulescens* (Blume) Backer, Buwalda 3483 (L), Java;

*Peliosanthes teta* Andr. subsp. *teta* (typical form), Van Beusekom & Phengkhlai 828 (L), Thailand;

*P. teta* Andr. subsp. *teta* (narrow-leafed form), Kerr 17380 (L), Thailand;

*P. teta* Andr. subsp. *humilis* (Andr.) Jessop, Griffith s.n. sub Herb. E.I.C. 5835 (L), East Bengal; Meijer 3691 (L), Sumatra; Rabil 334 (L), Thailand.

Pieces of leaf c. 6—8 mm square were cut from the edges of leaves as near the middle as possible. These were boiled in water until all air was dispelled from the tissues. They were macerated in a 1:1 solution of glacial acetic acid and 30% H<sub>2</sub>O<sub>2</sub> at c. 60 °C for about 12 hours. They were stained in Sudan IV and mounted in glycerine jelly.

The material examined falls into two distinct groups anatomically, corresponding exactly with the taxonomic genera on the following characters. In *Ophiopogon* the stomata are concentrated in bands on the abaxial surface, and there are numerous papillae on the epidermal cells both in the bands with stomata and in the bands between them; in *Peliosanthes* the stomata are scattered and there are no papillae.

The anatomical characters were, therefore, found to support the separation of *Peliosanthes* and *Ophiopogon* and indicated that the floral characters should be used in determining the limits of the genera and not the vegetative morphology.

## MORPHOLOGY

The gross morphology does not appear to have been adequately explained in the literature. The principal structures are the rhizome, the inflorescence(s), the foliage leaves, and the scale leaves.

**The rhizome**

The rhizome varies considerably in length. In most material it forms a hard thick rootstock less than 2 cm long. It appears from herbarium specimens that this usually grows horizontally, but what appear to be vertical rhizomes do also occur. There is a smaller number of specimens with longer rhizomes (3—10 cm) from both Indonesia and continental Asia. In addition there are a few specimens with appreciably longer narrower rhizomes (up to 40 cm) which appear to be less woody. The plants with rhizomes more than 10 cm long are known from relatively few collections, namely: — Duphla Hills, Assam (*Lister 211*, BM); Northern Bengal (*Biswas 1995*, GH); and Yunnan (*Wang 74846*, 79161, 79400 & 80030, all in A).

It is possible that a well-developed long rhizome occurs more frequently than the herbarium collections suggest and that the leaf- and inflorescence-bearing apical portion is the only part collected. Alternatively it is possible that the rhizome is a phenotypic response to an unknown environmental factor.

Material with leaves along the rhizome and no rosette, from Sikkim (*Hooker s.n.*, CGH & L), were previously placed in *Peliosanthes* as no flowers have been collected, but on anatomical evidence have been found to belong in *Ophiopogon*.

**The inflorescence**

The inflorescence appears to be terminal in some material, but lateral, although arising very close to the apex of the rhizome, in other material. However, the origin could not be determined with certainty by an examination of herbarium material.

In a discussion of the origin of the inflorescence, Tomlinson (1970) stated, as have most authors on the subject (*e.g.* Chouard, 1931; Priestley and Scott, 1938; Bower, 1947; McLean and Ivimey-Cook, 1956; Brook, 1964; Rendle, 1963) that in *Liliaceae* the inflorescence is terminal; *i.e.* that the growth is sympodial. However, he pointed out that in *Aloe*, for example, 'it may not be at all obvious that inflorescences are always terminal, because evicision is very precocious and is repeated rapidly'.

While doubting if there is sufficient evidence to state that all *Liliaceae* show sympodial growth, I find Tomlinson's statement concerning *Aloe* perfectly acceptable. In *Aloe* some species (*e.g.* *A. ciliaris*) may appear to have lateral inflorescences (Reynolds, 1950, described them as such), while others (*e.g.* *A. pegleri*) may appear to have terminal inflorescences. I think it most likely that this results from different relative rates of growth of the inflorescence and vegetative axes and not from a difference in the origin of these axes. Within other genera of the *Liliaceae* (*e.g.* *Ornithogalum* and *Ledebouria*) plants with what appear to be terminal inflorescences and plants with apparently lateral inflorescences both occur.

It seems likely that in *Peliosanthes* growth is sympodial and the different positions of the inflorescence can be explained in the same way as in *Aloe*. However, the possibility that some or all inflorescences in *Peliosanthes* are lateral cannot be excluded at this stage.

**The foliage leaves**

Foliage leaves arise from the rhizome. In specimens with very short rhizomes they may

appear to form a terminal rosette. In specimens with longer rhizomes, however, the internodes are elongated and it is then evident that the foliage leaves are separated from one another by several nodes bearing only scale-leaves. Apparent rosettes may also result from the development of leaves on very short lateral branches of a rhizome.

### The scale-leaves

Scale-leaves occur on both vegetative axes (the rhizomes) and on the lower part of the inflorescence. They vary from less than 1 cm to c. 10 cm long, but eventually largely disappear leaving only the base. Unlike the foliage leaves and the bracts their bases encircle the stems to which they are attached, forming a sheath round the enclosed bases of the petioles of foliage leaves and/or of peduncles.

### VARIABILITY AND TAXONOMIC CONCEPTS WITHIN PELIOSANTHES

Hooker's comment on the species of *Peliosanthes*, quoted above, and the differences between the total number estimated by Krause (1934) and by Airy Shaw (1966) — 9 and 17 respectively — indicate that difficulties have been encountered in establishing a practical species concept in this genus.

The following are the principal characters that have been used by previous authors to distinguish species: —

*Leaves*: length of petiole; length, breadth, and shape of lamina distinctness of cross veins.

*Inflorescence*: length of peduncle; loose or tight arrangement of flowers; size and shape of bracts; number of flowers in axil of each bract; length of pedicel.

*Flowers*: length and shape (e.g. acute or obtuse apex) of perianth segments; shape (i.e. globose, campanulate or rotate) of perianth; colour of perianth; degree of fusion of filaments to one another; shape of style; ovary superior, half inferior, or inferior; number of ovules per locule; pentamerous (in the type of *P. tashiroi* Hayata only) or hexamerous; perianth free from staminal corona (in the type of *P. monticola* Ridley only) or fused; shape of seed globose or pyriform.

The examination of herbarium material of *Peliosanthes* is difficult as the plants are rather fleshy and often fragmentary. Flowers in one specimen are mostly all in the same stage of development and colours are seldom noted on the labels. The same can be said of the fruits. Hardly ever is the precise situation of the habitat given, which would have been desirable to determine whether there is a correlation between taxonomic characters and ecology, especially as to the shape and size of the leaves which show an enormous but grading variation. The number and prominence of veins appear to increase with the overall size of the leaf blade.

The length of the peduncle is more or less proportional to the size of the plant and its leaves, so that its absolute size cannot be used, the more so as the length of the peduncle also depends on the stage of its development.

The length of the pedicels equally depends on the stage of development; those which carry developing seeds increasing considerably in length and thickness towards maturity.

Flowers are often absent from herbarium material, and if present they are often in bud or an early stage of development. So far as could be observed all floral characters appear to vary continuously from one reported extreme to another. Colour, noted only in less than 10% of the flowering material, appears to be variable and in no way correlated with other characters.

There appears to be only one character which shows a distinct constancy and this is the number of flowers per bract. Plants with 2 or more flowers per bract (*teta* group) occur

only in continental Asia (including the Malay Peninsula), whereas plants with only one flower per bract (*humilis* group) occur over the entire range of the genus. Because they have never been collected together in one single locality this difference in range seems to be significant. However, this character cannot be correlated with other taxonomic characters, as will be shown in the following survey of the variation within these two groups.

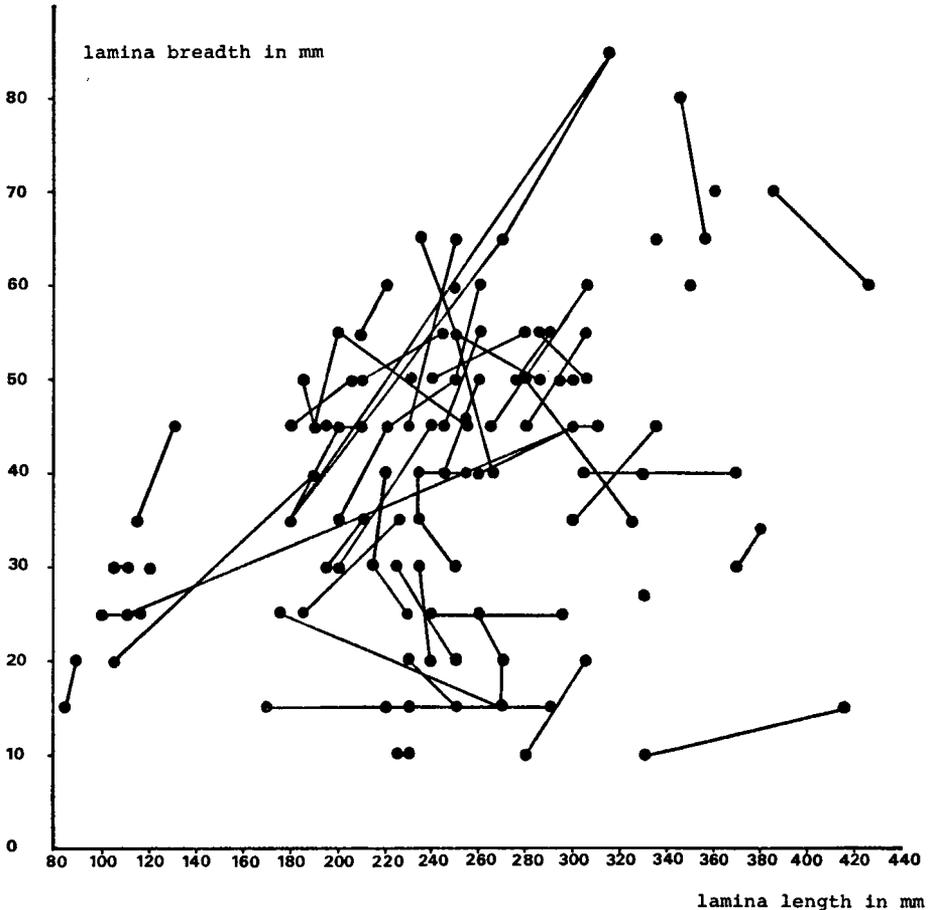


Fig. 1. Leaf lamina length and breadth for 67 specimens of the *teta* group. Each collection is represented by one or two leaves; if two then their dots are connected by a straight line.

### Variation in the *teta* group

Five specific names have been validly published by previous authors within the group of plants with two to six pedicels per bract.

On the evidence at present available it is not possible to determine the extent of phenotypic variation caused by growth in habitats ranging from near sea-level almost  $7^{\circ}$  north of the equator to at least 1200 m altitude more than  $27^{\circ}$  north of the equator.

Figure 1 shows diagrammatically the relationship between leaf lamina length and

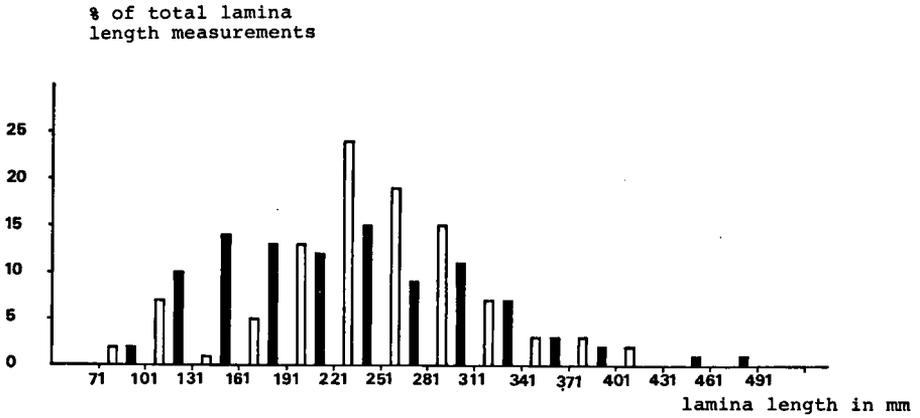


Fig. 2. Distribution of leaf lamina lengths in the *teta* group (open) and *humilis* group (black). One or two leaves were measured for each collection; 121 leaves of the *teta* group and 467 of the *humilis* group were measured.

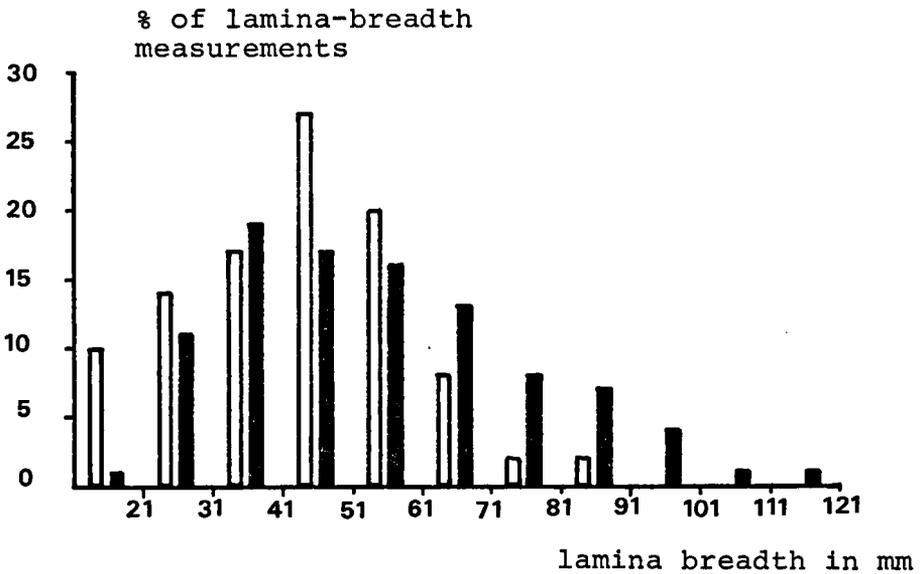


Fig. 3. Distribution of leaf lamina breadths in the *teta* group (open) and *humilis* group (black). One or two leaves were measured for each collection; 121 leaves of the *teta* group and 467 of the *humilis* group were measured.

breadth for 67 specimens. There is a problem in selecting leaves for measuring. Where possible, two apparently fully developed leaves have been measured from each collection and both plotted. A line connects points plotted for two leaves of the same collection. It can be seen from this diagram that there is generally a rather small range in leaf size in each collection, compared with total range for the group as a whole. There is no indication of any sufficiently well-defined groupings to suggest a taxonomic subdivision of the group on these characters.

Several other characters show considerable variation and have been examined with particular care for discontinuities. The following have been recorded for all available material and indicated in the form of histograms: — leaf lamina length (fig. 2), breadth (fig. 3), and the ratio of these two figures (fig. 4); petiole length (fig. 5); lowest fertile bract length (fig. 6); lowest bract length (fig. 6); lowest pedicel length at anthesis (fig. 7); and perianth segment length (fig. 8). Leaf measurements are based on two leaves for each collection where possible; other measurements are for a single organ for each collection. The figures for frequency are expressed in percentages of the total number of measurements recorded for that character.

The histograms do not suggest a subdivision on any of these characters. In leaf length there is a group representing 3% of the total sample showing a peak at less than 130 mm. However, figure 1 shows that two of the seven specimens involved also have leaves which fall outside this group. Four of the collections in which both leaves measured fell below 140 mm are from southern China.

Whether the ovary is superior, inferior, or intermediate in position has been used by

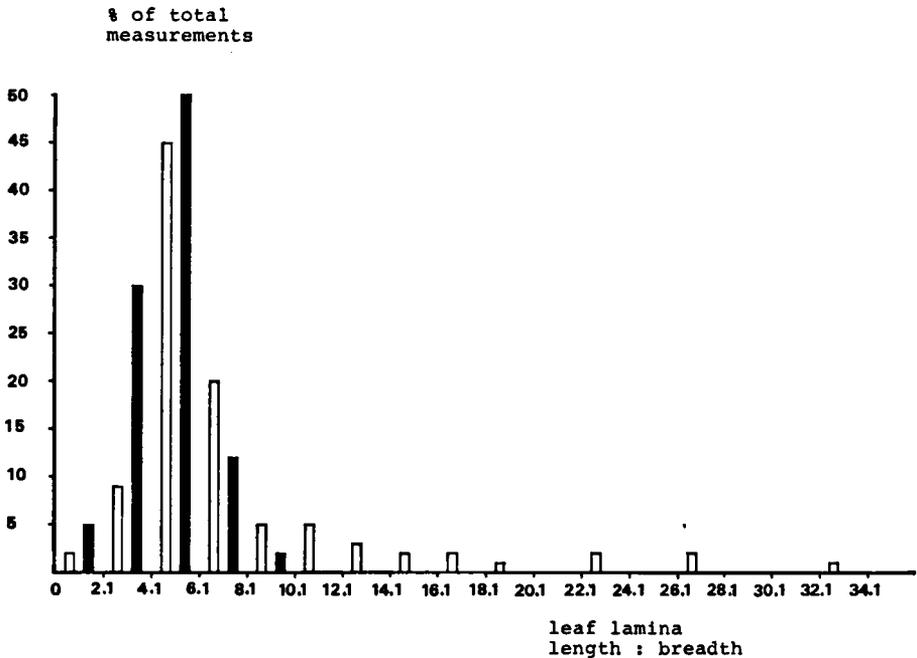


Fig. 4. Distribution of leaf lamina length: breadth ratios for the same data as used in figs. 2 & 3.

% of total specimens

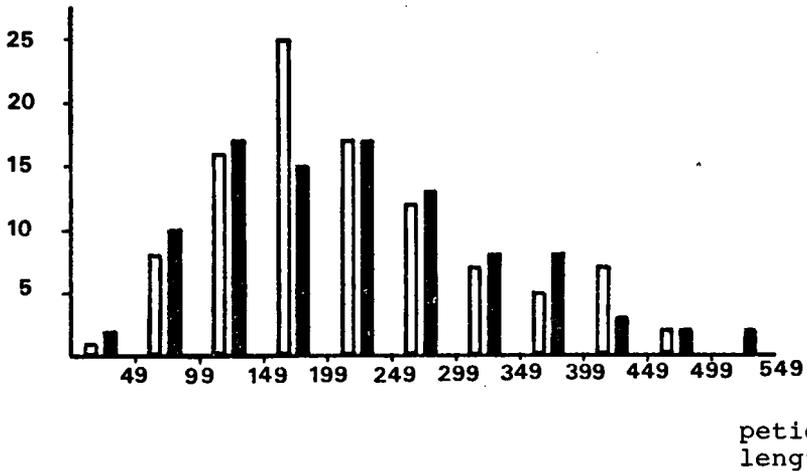


Fig. 5. Distribution of petiole lengths in the *teta* group (open) and the *humilis* group (black). One or two leaves were measured for each collection; 116 petioles of the *teta* group and 453 of the *humilis* group were measured.

% of total specimens

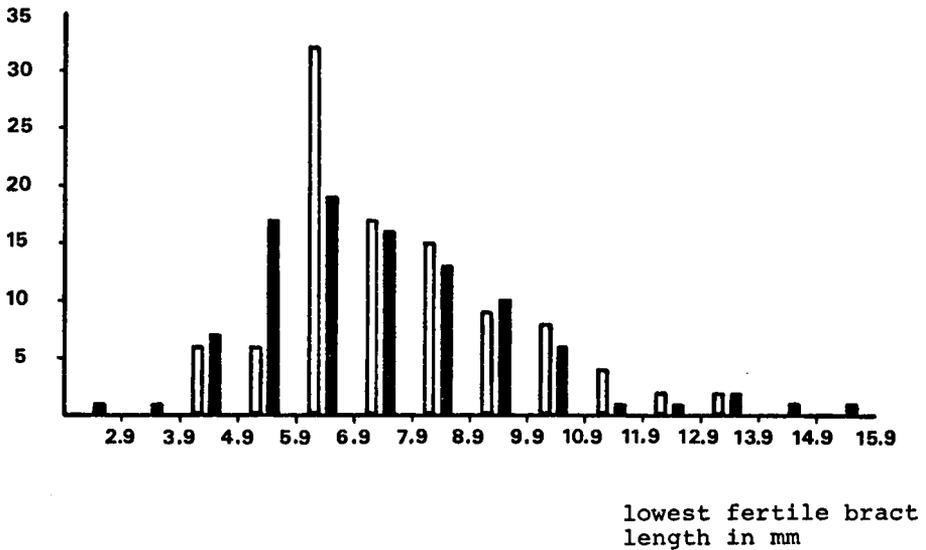


Fig. 6. Distribution of lengths of the lowest fertile bracts in the *teta* group (open) and the *humilis* group (black). One bract per collection was measured; 56 specimens of the *teta* group and 152 of the *humilis* group were measured.

various authors in defining species of *Peliosanthes*. Although the ovary does vary from superior to inferior in the *teta* group, no species in this group has ever been recognised on this character. As far as could be ascertained from herbarium material all flowers on a plant are consistent for this character at all stages from buds to old flowers. Nevertheless, all intermediate states exist between plants with flowers with superior ovaries and plants with inferior ovaries and no correlation was found between this character and any other character.

Flower size and ovule number were used by Wang and Tang (1936) in defining *P. tonkinensis*. Flower size is variable and the size cited by these authors (6 mm diam.), although distinctly larger than average, falls within the continuous range of variation for the group. Similarly, the ovule number recorded in *P. tonkinensis* (four per locule) is not likely to prove to be of significance in the taxonomic subdivision of this group. Although the commonest number is two, both three and four have been found in several specimens.

It is concluded that there is at present no evidence that the specimens of *Peliosanthes* with more than one flower per bract can be usefully placed in more than a single taxon.

% of total  
specimens

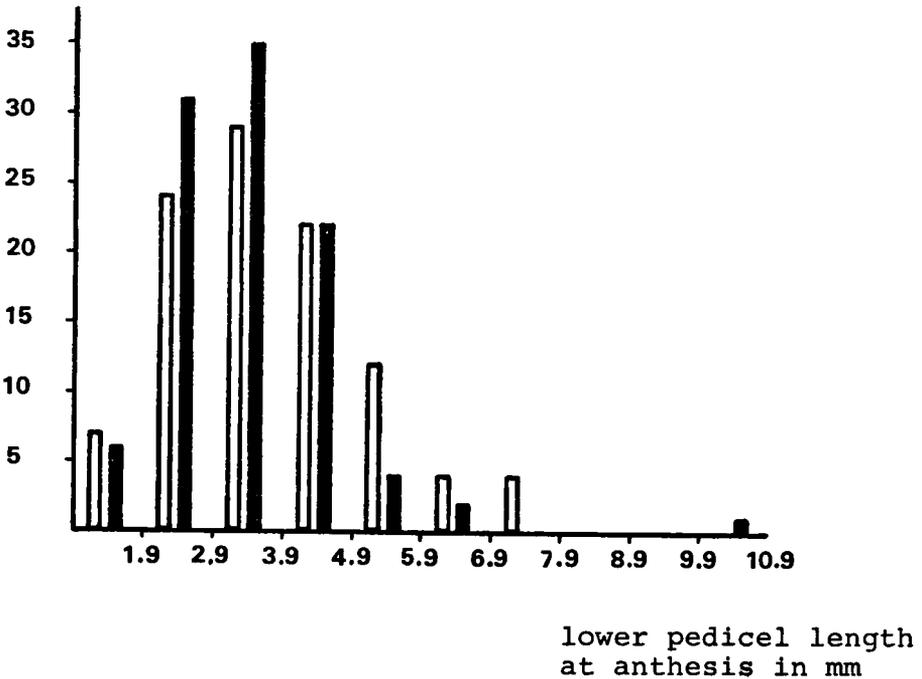


Fig. 7. Distribution of lengths of the lowest pedicels at anthesis in the *teta* group (open) and the *humilis* group (black). One pedicel per collection was measured; 59 specimens of the *teta* group and 147 of the *humilis* group were measured.

### Variation in the *humilis* group

Thirty one species have been validly described in this group. The variation is comparable to that in the *teta* group, but is slightly greater. Vegetative structures appear no more likely to provide taxonomically useful characters than in the *teta* group. A similar set of histograms has been prepared and superimposed on the same axes as for the *teta* group (figs. 2—8). Plants from Sumatra, Java, and Borneo are rather homogeneous and have not been included. Again there is no likelihood that any of these characters is of taxonomic value.

One vegetative character which does require consideration, however, is the presence or absence of a well-defined *rhizome*. It was on this character that the monotypic genus *Lourya* was described. *L. campanulata* was described from Cochinchina (Vietnam). The

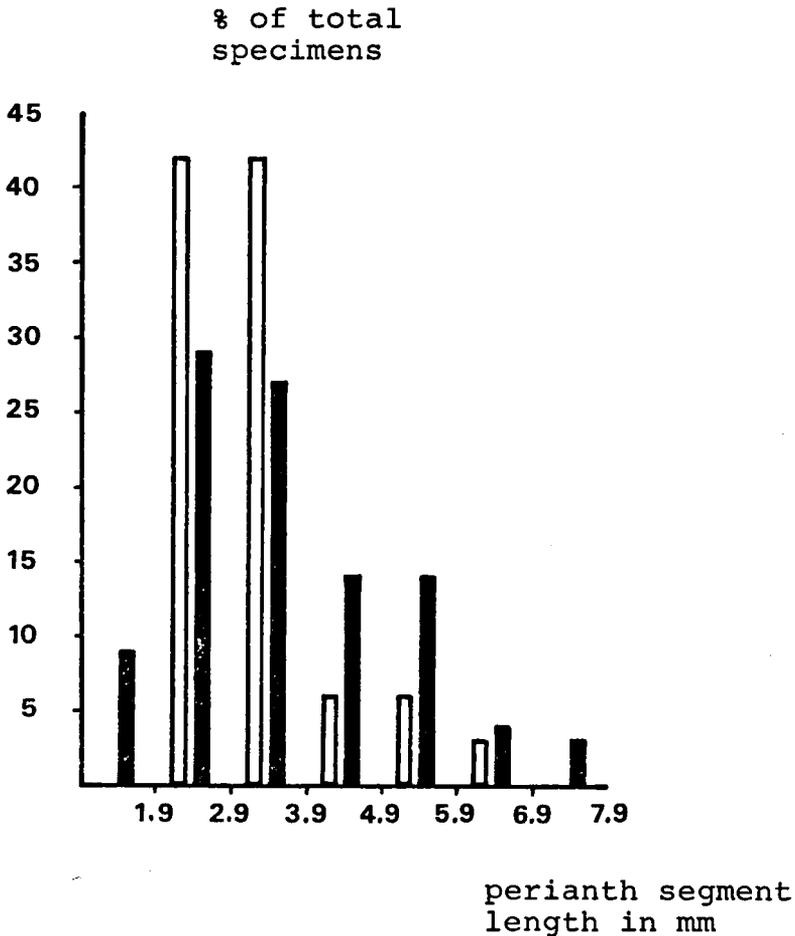


Fig. 8. Distribution of perianth segment lengths in the *teta* group (open) and the *humilis* group (black). One flower per collection was measured; 36 specimens of the *teta* group and 100 of the *humilis* group were measured.

only other material which has a well-developed rhizome and which probably belongs to the *humilis* group of *Peliosanthes* was collected in Yunnan by Wang (e.g. numbers 74846, 79161, 79400 & 80030; all in A). Unfortunately none of the sheets of these collections has flowers, but anatomical characters show them to belong to *Peliosanthes*. In this material there is an apical rosette of leaves and usually one or a few leaves along the rhizome. The nodes bearing leaves are separated from one another by several bearing scale-like leaves. In the type material of *L. campanulata* (in P) the basal part of the plant is not preserved; it consists only of a leaf and some loose flowers. It is considered that the available information about the occurrence of elongated rhizomes in *Peliosanthes* is too incomplete to allow the use of this structure in defining taxa.

*P. longibracteata*, from Upper Burma, was described on the basis of three characters, but especially by its elongated, persistent, 1–4 cm long, linear or linear-lanceolate bracts. On two inflorescences on type material (Ward 170, Ngawchang Valley, north of Htwagaw; GH) the lowest bract measures 26 and 32 mm respectively. On other collections from Upper Burma (Ward 7362, 10185 & 13529), closely resembling the type, the lower bracts measure 20–24 mm, but the plants are otherwise very similar to Ward 170. The lowest bracts of other collections from Burma are 5–10 mm long, but plants of the *humilis* group from S. India (e.g. Bourne 1531 & 3031 and Barnes 1822 & 1823; K) have bracts up to 23 mm long. Merrill (1941), in his original description, also mentioned the exceptionally long petioles and inflorescence. He gave a petiole length of up to 40 cm, whereas the type specimen has petioles up to 50 cm long. The petioles of Barnes 1823 are also c. 50 cm long. His figure for the length of the inflorescence was c. 70 cm, and the type material agrees with this figure. Bourne 3031 has the longest inflorescence of the specimens from S. India mentioned above, but the actual figure is only c. 50 cm. Ward 13529 (one of the Burmese specimens closely resembling the type of *P. longibracteata*) also has a peduncle approximately 70 cm long, but the other similar Burmese specimens have peduncles not exceeding 50 cm which is shorter than many specimens collected in India. It is, therefore, concluded that, although the Ward collections from Upper Burma do appear to form a distinct group in that area and although they do have exceptionally long bracts, they do not form a taxonomically recognisable entity when material from India is also considered.

The shape of the *perianth* varies from rotate to campanulate or subglobose. It is often difficult to distinguish these features in herbarium material and it is likely that in at least some material these forms may represent different stages in the development of a flower. However it may be significant that the shape of the flowers of the *teta* group is less variable. Flower shape, colour, and size (fig. 8) appear to be a matter of degree and cannot be correlated with any other characters.

Flower colour is admittedly very poorly known as few collectors have recorded this information.

In much of the fruiting material the perianth is persistent, but somewhat withered and rather inconspicuous. Other specimens show a considerable enlargement and even a cork-like appearance of the persistent perianth e.g. Bourne 1531 (K) from the Pulneys in the western Deccan Peninsula; Williams 220 (BM) from Nepal; and Ridley 14484 (BO) from Perak. Material with this enlargement of the perianth also tends to have rather large leaves, often over 30 cm long. No specimen with both fruits and flowers has been seen so that it is not possible to correlate the persistent perianth character with other floral characters. However, there are a number of specimens which do in other characteristics resemble these plants. They are characterised by having particularly large flowers, the perianth segments up to 7 mm long, and anthers up to 2 mm long [e.g. Lobb s.n. (K)

from Moulmein, *Kloss s.n.* (BM) from Selangor and *Hooker & Thomson s.n.* (K) from Khasia]. Neither on flower size nor in the development of the persistent perianth have I been able to define taxonomic groups.

In most flowers the *ovary* is semi-inferior, but completely inferior and superior ovaries do occur. As in the *teta* group these do not appear to represent developmental stages and are consistent for each specimen. The gradation between inferior and superior is such that it is not possible to define discontinuities within it, and the position of the ovary does not appear to be correlated with any other characters of the available material.

Variation occurs in *seed* shape and colour. The mature seed may, however, always be pyriform and blue, and globose or ellipsoid green seeds are possibly always immature.

### Status of the *humilis* and *teta* groups

In the preceding discussion it has been shown that there is considerable variation in both the *humilis* and *teta* groups. I have not, however, been able to subdivide either group taxonomically.

It has also been shown that this variation follows very similar patterns in both groups. Figures 2 to 8 have been presented in a form which facilitates comparison of the variation patterns for 7 characters. In all these characters, except leaf lamina length and to a lesser extent the leaf lamina length: breadth ratio, there is a marked similarity in the shapes of the histograms. Even in leaf lamina length the differences are too slight to justify the use of this character in separating the two groups.

The only character on which these two groups can be separated is in the number of pedicels per bract, namely 1, or 2—6 respectively. Other characters not only do not support this subdivision, but show a strong similarity in the two groups. It is considered that there is, therefore, more reason to unite these two groups than to separate them and it is concluded that *Peliosanthes* should be treated as a monotypic genus.

There are two reasons for believing that the number of pedicels is genetically controlled. First, no collections have been seen in which plants of both types occur. Second, although widespread on the Asian continent, no plants with 2—6 pedicels per bract have been collected on any of the islands where solitary pedicelled plants do occur. It appears therefore that although having a broadly similar distribution pattern these two forms are largely isolated from one another, perhaps by ecological factors. These taxa are, therefore, treated here as subspecies, namely subsp. *teta* for the 2—6 pedicelled form and subsp. *humilis* for the solitary pedicelled form.

## PELIOSANTHES

*Peliosanthes* Andr., Bot. Repos. 10 (1810) t. 605; Hassk. in v. d. Hoeven & de Vriese, Tijdschr. Nat. Gesch. & Phys. 10 (1843) 121 ('*Peliosanthes*'). — Type: *P. tetra* Andr.

*Teta* Roxb. [Hort. Beng., 1814: 24, *nom. nud.*] Fl. Ind. ed. Carey 2 (1832) 165—166. — Type: *T. viridiflora* Roxb.

[*Bulbisperma* Reinw. ex Blume, Cat. Gew. Buitenz. (1823) 59, *nom. nud.* — Type: *B. ovigera* Reinw. ex Blume, *nom. nud.*]

*Bulbospermum* Blume, Enum. Pl. Jav. 15 (1827). — Type: *B. javanicum* Blume.

*Lourya* Baill., Bull. Soc. Linn. Paris 1 (1888) 743. — Type: *L. campanulata* Baill.

*Neolourya* Rodriguez, Bull. Mus. Hist. Nat. Paris, II, 6 (1934) 96. — Syn types: *N. weberi* Baill. and *N. pierrei* Baill.

Perennial *herbs* with a usually very short horizontal rhizome, with thick roots; rhizome rarely up to 40 cm long, but most frequently less than 5 cm long. *Leaves* separated from one another by several nodes bearing scale-leaves, but often several crowded at the apex

and sometimes several more spaced from each other behind the apex, almost linear to oblong, ovate, or obovate, usually with a rather well-defined petiole, glabrous. Petioles and inflorescences surrounded at the base by often long, scarious, imbricate, scale-like leaves, up to 10 cm. *Inflorescence* an unbranched raceme. *Flowers* pedicelled. Perianth white, green, blue, violet, or purple, rotate, campanulate, or subglobose; perianth segments  $\pm$  free above the corona, fleshy, equal, up to 8 mm long. Stamens inserted medially on the interior side of a  $\pm$  wavy, fleshy, short annular tube (corona) which largely conceals the anthers; anthers sessile, introrse. Ovary superior to inferior, 3-celled, each cell containing 2—4(—5) basal ovules; style simple, conical and thick or more slender to cylindrical, with emergent stigma undifferentiated to subcapitate or subpeltate; pericarp almost not developing after fertilisation, ruptured at an early stage and exposing the young seeds. Seeds blue when mature, ellipsoid to pyriform.

*Distribution:* A monotypic genus ranging from S. India, E. Himalayas, and N. E. India to southern China, including Taiwan, through Thailand and Indo-China into the Malay Peninsula, Sumatra, Java, and Borneo.

#### **Peliosanthes teta** Andr.

See for synonyms under the subspecies.

*Leaves* (2—)4—8(—12). Petioles usually well-defined, (4—)7.5—45(—55) cm long, slightly compressed, with *c.* 4—6 distinct longitudinal ridges when dry. Lamina almost linear or elliptic to ovate or obovate, rarely slightly arcuate, usually acute, less often obtusely acuminate, (7.5—)12.5—37.5(—47.5) cm long, 1.5—8.5(—11.5) cm broad. *Peduncles* flattened at least at the base, usually solitary, up to 35(—75) cm long, with 0—4(—15) lower sterile bracts up to 15(—40) mm long; fertile bracts sublinear to ovate, usually spreading at the base and ascending distally, usually entire, rarely fimbriate or lacerate, the lower (2—)5—15(—30) mm long, decreasing in size towards the apex of the raceme, sometimes with a smaller bract in their axil. *Pedicels* 1—6-nate, erect-spreading to recurved, 1—6(—10) mm long, increasing in thickness and up to twice their former length during seed development, articulated usually just below the flower. *Perianth* segments with a single vein, suborbicular, broadly ovate, elliptic, or obovate to linear, 1.5—6(—8) mm long. Staminal corona forming a disc *c.* 3—4 mm diameter, entire, wavy, or with 6 teeth. Anthers usually rather closely adpressed to the style, *c.* 0.5—2.0 mm long. Ovary usually semi-inferior, conical to ovoid. Style often 3- or 6-ridged or fluted, 0.75—1(—2) mm long. Seeds up to 10—12 mm long. Perianth enlarging during the early stages of seed development.

*Ecology:* Wet evergreen forest, from sea-level to 1600 m in the Himalayas and over 3000 m in China. Probably it prefers shady habitats, sometimes found on rocks and apparently often near running water. The subspecies appear to occur in similar localities, and to flower throughout the year (especially January to April).

*Chromosome:* Several counts representing both subspecies have been published, all agreeing in  $2n = 36$ . See: Sato (1942), Larsen (1966), Jones & Smith (1967-68), and Chang & Hsu (1974).

*Economic uses:* An uncommon garden or pot plant.

#### KEY TO THE SUBSPECIES

- Flowers 2—6-nate in the axils of the bracts . . . . . a. subsp. **teta**  
 Flowers solitary in the axils of the bracts . . . . . b. subsp. **humilis**

**a. subsp. teta**

*Peliosanthes teta* Andr., Bot. Repos. 10 (1810) t. 605 — T y p e: Introduced by Lady Amelia Hume, origin not cited; in absence of preserved plant material the plate is chosen as the type.

*Teta viridiflora* Roxb. [Hort. Beng. (1814) 24, *nom. nud.*]; Fl. Ind. 2 (1832) 165—166. — T y p e: the description. Plants found by Dr. Buchanan at Chittagong and on the eastern border of the Delta of the Ganges and introduced into the Botanic Garden at Calcutta; no specimen seen.

*P. teta* var. *mantegazziana* Pampan., Nuov. Giornale Bot. Ital., n.s. 11 (1904) 151. — *P. mantegazziana* Pampan., *ibidem* 13 (1906) 138. — T y p e: *ex hort.* Mantegazza, Florence; originally from Penang, Malaya (FI).

*P. graminea* Ridl., J. Ass. Soc. Straits 59 (1911) 207—208. — T y p e: Malaya, Tongkah, Gunong Toxai, near the town of Puket, cultivated in Penang and Singapore gardens; no specimens cited.

*P. tonkinensis* Wang & Tang, Bull. Fan Mem. Inst. Biol., Bot. 7 (1936) 83. — T y p e: Vietnam, Tonkin, *Balansa 280* (K).

Leaf lamina 2—24(—34) times as long as broad. *Pedicels* 2—6 in the axil of each fertile bract. *Flowers* usually green, rarely blue. *Anthers* c. 0.5—0.6 mm long.

**D i s t r i b u t i o n:** Mountains of SW. India and from near sea-level to 1600 m alt., from NE. India into S. China, Hainan, and the Malay Peninsula.

**V e r n a c u l a r n a m e s:** The specific name *teta* was derived from an Indian vernacular name, but no further reference to the use of this name has been found.

**Selected specimens:**

CHINA. Yunnan: Szemao, *Henry 9402B* (E). — Kwangsi: Lungchow, *Morse 516* (FI). — Hainan: Yaichow, *How 71058* (GH, K).

BANGLADESH. Chittagong Division, *Cowan 1362* (E).

INDIA. Sikkim: *D'Alleizette 7210* (L). — West Bengal: Serampore, *Voigt s.n.* (CGE). — Assam: Khasia, 0—4000 ft, *Hooker & Thomson s.n.* (CGE). — Madras: S. E. Wynaad, *Gamble 15699* (K).

BURMA. Maymyo, *Lace 5376* (E).

THAILAND. Nakhon Si Thammarat, *Van Beusekom & Phengkhilai 828* (L).

VIETNAM. Tonkin, *Balansa 280* (K).

MALAY PENINSULA. Pahang: near Kuala Aur, *Shah & Noor 1935* (SING.) — Selangor: Batu Caves, *Ridley s.n.* (BM). — Pulau Penang: West Hill, *Curtis s.n.* (SING.). — Langkawi Islands: *Robinson 6281* (BM, K).

**b. subsp. humilis (Andr.) Jessop, stat. nov.**

*P. humilis* Andr., Bot. Repos. 10 (1811) t. 634. — T y p e: introduced in the collection of T. Evans at Stepney in 1808 from Pinang; in absence of preserved plant material the plate is chosen here as a lectotype.

[*Bulbisperma ovigera* Reinw. *ex Blume*, Cat. Gew. Buitenz. (1823) 59, *nom. nud.*]

*Bulbispermum javanicum* Blume, Enum. Pl. Jav. (1827) 15. — *P. javanicum* Dietr., Synopsis plantarum 2 (1840) 1123. — T y p e: Java, no specimen seen.

*P. violacea* Wall. [Cat. (1828) n. 5084, *nom. nud.*] *ex Bak.*, J. Linn. Soc., Bot. 17 (1879) 504. — S y n t y p e s: Himalaya, *Griffith 5842* (K, P), *Hooker f. & Thomson s.n.*, *Keenan s.n.*; Birma, *Wallich s.n.*, *Lobb s.n.* (?K), *Parish s.n.*

*P. courtallensis* Wight, Icones 6 (1853) t. 2052. — T y p e: India, Neilgherries, *Wight 2819* (K, L).

*P. griffithii* Bak., J. Linn. Soc., Bot. 17 (1879) 506. — T y p e: India, Darjeeling, *Griffith 5840* (K, holo).

*P. macrophylla* Wall. *ex Bak.*, J. Linn. Soc., Bot. 17 (1879) 505. — S y n t y p e s: Himalaya, Sikkim, *Hook. f. & Thomson* (K & P, *sub Hooker f. s.n.*), *C. B. Clarke s.n.*; Mishmi, *Griffith 5841* (K, P).

*P. macrostegia* Hance, J. Bot. 23 (1885) 328. — T y p e: China, Canton Prov., Lo-fau-shan, *Ford in Hance 22282* (BM).

*Lourya campanulata* Baill., Bull. Soc. Linn. Paris 1 (1888) 743. — *P. campanulata* Rodriguez, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 96. — T y p e: Cochinchina, cultivated at Paris under the name *Tupistra* (P).

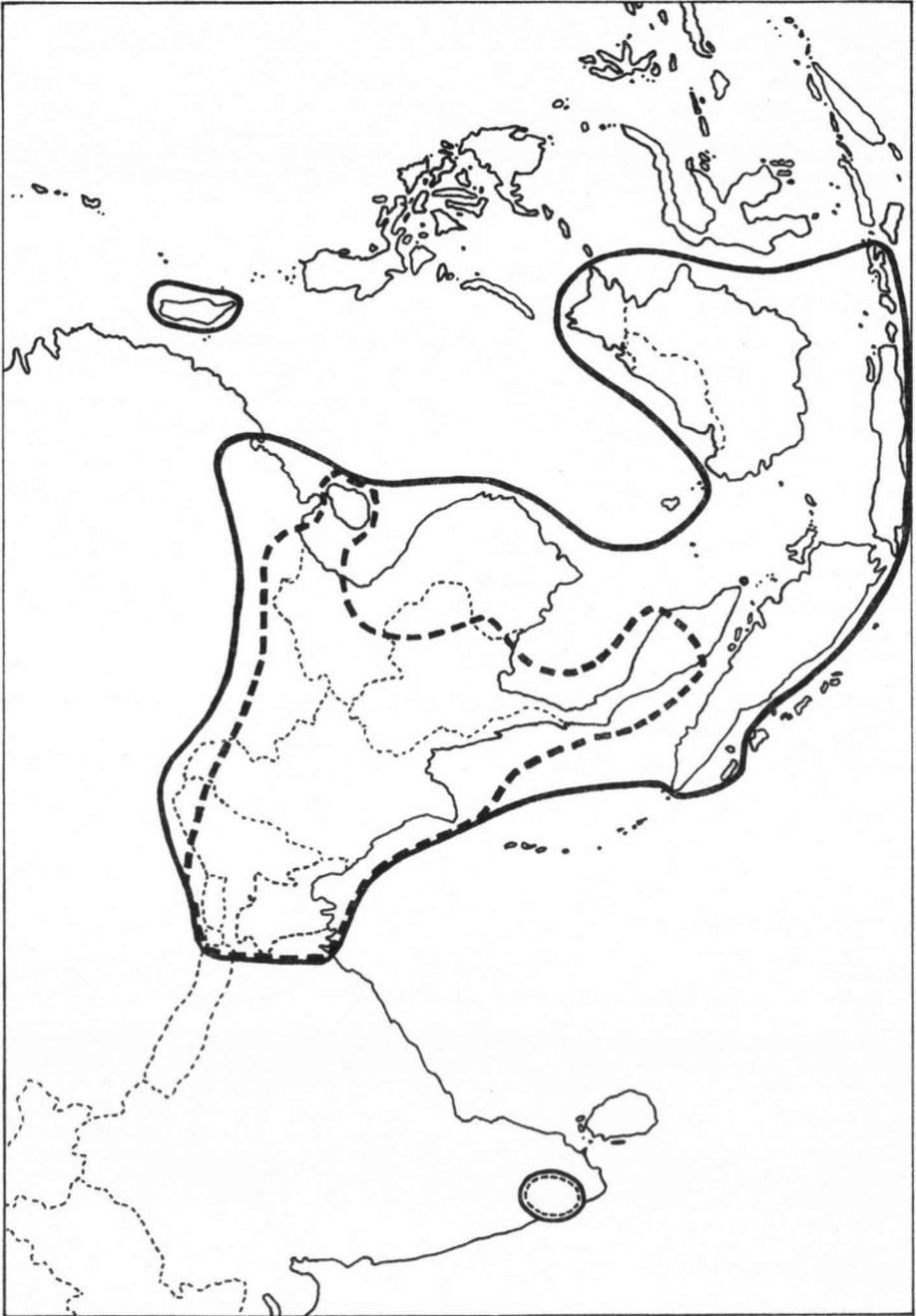


Fig. 9. Geographical distribution of *Peliosanthes tetra* subsp. *tetra* (broken line) and subsp. *humilis* (solid line).

- P. albida* Bak., Bot. Mag. 116 (1890) t. 7110. — Type: Penang, cultivated at Kew, Curtis 142 (K).  
*P. bakeri* Hook. f., Fl. Brit. India 6 (1892) 267. — Syn types: Eastern Himalaya, J. D. Hooker s.n. (K), Clarke s.n. (K); Mishmi Hills, Griffith s.n. (K); Khasia Hills, Hooker & Thomson s.n. (K, L).  
*P. delavayi* Franch., Bull. Soc. Bot. Fr. 43 (1896) 43. — Syn types: Yunnan, Longki, Delavay 4989, 5141 (P).  
*P. viridis* Ridley, J. Str. Br. Roy. As. Soc. 31 (1898) 95. — Type: Singapore, Chan Chu Kang, Ang Mo Kio, Changi, etc. no specimens cited, (?BM sub Ridley 163, ?SING sub Ridley s.n. 1889, Ang Mo Kio).  
*P. lurida* Ridley, J. Str. Br. Roy. As. Soc. 31 (1898) 95. — Type: Penang, no specimens cited (BM, K, SING, sub Ridley 7095).  
*P. grandifolia* Ridley, J. Str. Br. Roy. As. Soc. 31 (1898) 97. — Type: Malay Peninsula, cultivated in the Botanic Gardens, Singapore, no specimens cited.  
*P. stelaris* Ridley, J. Str. Br. Roy. As. Soc. 31 (1898) 97. — Syn types: Malay Peninsula, Penang, Ridley 7253 (K); Prov. Wellesley, Tasek Gelugur (?SING 48103, 48077); Pahang, Tahan River, Ridley s.n. (K).  
*Ophiopogon gracilipes* Craib, Kew Bull. (1912) 411. — Type: Thailand, Chiengmai, Doi Sootep, Kerr 1087 (K); assigned to *Peliosanthes* by Van Steenis & Geesink, Blumea 20 (1973) 434.  
*P. parviflora* Ridley, J. As. Soc. Straits 61 (1912) 61—62. — Type: Rawi Island, Ridley 15769 (K).  
*P. arisanensis* Hayata, Icon. Pl. Formos. 6 (1916) 94. — Syn types: Taiwan, Mt. Arisan, Karapin, Hayata & Sasaki s.n., Nakahara s.n.  
*P. tashiroi* Hayata, Icon. Pl. Formos. 6 (1916) 96. — Type: Taiwan, cult. at Taihoku, Tashiro s.n.  
*P. sumatrensis* Ridley, J. Fed. Malay States Mus. 8 (1917) 118. — Syn types: Sumatra, Barong Bharu, W. side of Barisan Range, Robinson & Kloss s.n. (BM); without locality, Forbes 3221a (BM, GH, L).  
*P. sessiliflora* Ridley, J. Fed. Malay States Mus. 8 (1917) 118. — Type: Sumatra, Kumpang River, Robinson & Kloss s.n. (BM).  
*P. hypogyna* Ridley, J. Fed. Malay States Mus. 10 (1920) 121. — Syn types: Malay Peninsula, Tasan, Kloss 7016 (K); Pulau Mohea, Kloss 6534 (K).  
*P. monticola* Ridley, J. Fed. Malay States Mus. 10 (1920) 155. — Syn types: Malay Peninsula, Perak, Gunong Kerbau, Nat. Coll. F. M. S. Mus. Robinson s.n. (K).  
*P. labroyana* Pierre ex Rodriguez, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 96. — Type: Tonkin, cultivated at Paris, Regnier s.n. (P).  
*P. serrulata* Rodriguez, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 96. — Syn types: Cochinchina, Phu Quoc I., Pierre 6688 (P); Cambodia, Kampot, Chevallier 31824 (P).  
*Neolourya weberi* Rodriguez, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 96. — Type: Tonkin, Weber s.n. (P).  
*N. pierrei* Rodriguez, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 97. — Type: Cochinchine, Phu Quoc I., Pierre s.n., 6688 (a second sheet of Pierre 6688 is identified as *P. serrulata*) (P).  
*P. dasystachys* Diels ex Rodriguez, Fl. Gén. I.-C. 6 (1934) 672. — Type: Tonkin, Cho-ganh, Pételot s.n. (P).  
*P. longibracteata* Merrill, Brittonia 4 (1941) 30. — Type: Upper Burma, Ngawchang Valley, north of Htawgaw, Ward (Vernay-Cutting expedition) 170 (GH).  
*P. kaoi* Ohwi, J. Jap. Bot. 42 (1967) 317—319. — Type: Taiwan, Kao 6870 (TNS, n.v.).

Leaf lamina 2—10 times as long as broad. Pedicels solitary in the axil of each fertile bract. Flowers sometimes green, but often white, blue, violet, or purple. Anthers c. 0.5—2.0 mm long.

Distribution: Mountains of SW India and from near sea-level to 1600 m alt. in NE India as does subspecies *teta*; elsewhere on the mainland it has a similar distribution as subsp. *teta*, but it extends further north in China, into Taiwan, and into Sumatra, Java, and Borneo.

Vernacular names. Burmese: *Taw-nagazet* (Forest Botanists Collector 1555, K).

#### Selected specimens:

CHINA. Kweichow: Pin-fa, Cavalerie 995 (E). — Yunnan: Mengtze S. Mts., Henry 9402 (E, MO). — Kwangtung: Tsengshing District, Naam Kwan Shan, Laan Fa, Tsang 20110 (A). — Kwangsi: Lungchow, Morse 516 (FI, K). — Hainan: Po-ting, How 73466 (A, BO, SING).

TAIWAN. Raisha, Faurie 965 (BM).

BANGLADESH. Namroa jungle, Griffith 5842 (K, P).

NEPAL. Chula Chuli, Williams 220 (BM).

INDIA. Sikkim: below Rishap, Gamble 1313A (K). — Assam: Nongprang, Khasia, Clarke 15221

(K). — **M a d r a s**: Periya Shola, Palmi, *Bourne* 3031 (K).

**BURMA**. Spur to Mulegit, *Lace* 6320 (E, K).

**THAILAND**. Nakhon Ratchasima, Khao Yai Nat. Park, *Van Beusekom & Phengkhilai* 66 (K, L).

**LAOS**. Attopeu, *Joseph s.n.* (L).

**VIETNAM**. Sai Wong Mo Shan, Lomg Ngong Village, Dam-ha, Tonkin, *Tsang* 30457 (BO, E, K).

**MALAY PENINSULA**. **K e d a h**: G. Keriang, Alor Star, *Kiah SFN* 35426 (A, BM, BO, K, SING). — **P e r a k**: Lenggong, *Ridley* 14484 (BM, SING). — **T r e n g g a n u**: Ulu Ayam, *Corner SFN* 30354 (K, SING). — **K e l a n t a n**: Kota Baharu, *Ridley SING* 048099 (SING). — **P a h a n g**: Lubok Temang, *Henderson* 23645 (SING). — **S e l a n g o r**: Ginting Simpah, *Hume* 8693 (SING). — **N e g r i S e m b i l a n**: G. Tampin, *Burkill SFN* 3105 (SING). — **J o h o r e**: Kota Tinggi, *Teruya* 1124 (BO, L, SING). — **L a n g k a w i s**: Kisap, near Kuah, *Henderson* 29180 (BO, K, SING). — **P. P e n a n g**: Penara Bukit, *Ridley* 7095 (BM, SING). **S i n g a p o r e**: Chinchin Kang, *Corporal s.n.* (BM). — **P. T i o m a n**: B. Surin, *Henderson* 21709 (BO, SING).

**SUMATRA**. **A t j e h**: G. Kemiri, *Van Steenis* 9538 (BO, L). — **T a p a n o e l i**: Padang Lawas, near Aek Si Olip, *Rahmat Si Toroes* 5287 (A, L). — **W e s t C o a s t**: G. Singgalang, *Beccari* 231 (FI, K). — **E a s t C o a s t**: Bandar Bahru, *Nur* 7309 (SING). — **B e n k o e l e n**: Bengkulu, *Ajoeb Exp. Jacobson* 282 (BO). — **P a l e m b a n g**: G. Dempoe, *Ajoeb Exp. Jacobson* 540 (BO). — **S i m a l o e r**: Tapah, *Achmad s.n.* (L). — **B i l l i t o n**: *Riedel s.n.* (FI).

**J A V A**. **W e s t**: G. Tjibodas, near Tjampea, *Backer* 32992 (BO). — **C e n t r a l**: G. Merbaboe, *Docters van Leeuwen* 318 (BO). — **E a s t**: Soemberpoetjoeng, *Beumée* 2713 (BO).

**LESSER SUNDA IS.** Soemba wa, *Achmad* 1709 (BO).

**BORNEO**. **S a r a w a k**: Matang, *Ridley* 12418 (BM, K, SING). — **W e s t**: Bt. Mulu, *Winkler* 471 (L). — **S o u t h - E a s t**: Bandjarmasin, *Motley* 1031 (K). — **S a b a h**: Mt. Kinabalu, Penibukam ridge, *Clemens* 40298 (BM, GH, K).

**ANAMBAS ISLANDS**: Siantan, near Terampa, *Henderson SFN* 20116 (SING).

**KARIMATA ISLAND**: *Hondi* 207 (BO, L).

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*P. mairei* Léveillé, Bull. Géogr. Bot. 25 (1915) 25. — **T y p e**: Yunnan, Lo-Chan, *Maire s.n.* (E). Identification uncertain; differs from *Peliosanthes* in having an aerial stem bearing alternate leaves and in lacking the staminal corona. Probably *Smilacina spec.*

*P. stenophylla* Merrill, Philipp. J. Sc., Bot. 13 (1918) 134. — **T y p e**: China, Kwangtung Prov., Loh Fau Mt., *Merrill* 10757 (GH). Transferred to *Ophiopogon stenophyllum* by Rodriguez, Bull. Mus. Hist. Nat. Paris II, 6 (1934) 95.

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