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TAXONOMIC STUDIES IN THE GENUS KAEMPFERIA (ZINGIBERACEAE)

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ABSTRACT. The taxonomic history of the genus *Kaempferia* L. (Zingiberaceae) is traced and nomenclatural confusion concerning typification of its subgenera and sections is clarified. This background information hopefully will provide a useful starting point for a much-needed taxonomic revision of the genus. Delimitation of the genus is discussed, the usefulness of various floral and vegetative characters is examined, and interspecific affinities are suggested. It is proposed that the genus *Cienkowskiella* Kam, *nom. nov.*, be used for those African species which are currently placed in the genus *Kaempferia* (*s.l.*), and that the Asiatic species be retained under *Kaempferia* L. (*s. str.*). A list of taxonomic transfers is presented.

The first edition of *Species Plantarum* (Linnaeus, 1753) contains 2 species of *Kaempferia*, *K. galanga* and *K. rotunda*. For purposes of valid publication, the generic name of *Species Plantarum* is associated with the subsequent description in the fifth edition of *Genera Plantarum* (Linnaeus, 1754). *K. galanga*, the plant described by Kaempfer, has been proposed as the lectotype by Hitchcock and Green [*Int. Bot. Congr. Cambridge* (*England*) 1930, Nom. Prop. 115, 1929] and by E. P. Phillips (*The Genera of South African Flowering Plants*, ed. 2:224, 1951).

Between 1800 and 1829, several new species of *Kaempferia* from India and the Far East were published (Roscoe, 1807, 1828; Roxburgh, 1812, 1814, 1819). A number of new species was described by Wallich (1830) in his *Plantae Asiaticae Rariores*. In this publication, as a note to the description of *K. elegans*, was the suggestion that "*K. secunda*, *K. linearis* and *K. elegans* ought perhaps be removed from *Kaempferia*, and formed into a distinct genus for which the name of *Monolophus* is proposed, in allusion to the entire crest of the anther". The genus *Monolophus* was eventually established by Endlicher (1837), who mentioned only 1 species, *Kaempferia elegans* Wall., (Endlicher, however, did not make a formal *comb. nov.*). This was followed by the publication of another species, *Monolophus scaposus*, by Dalzell (1850).

Horaninow (1862) published a monograph of the family maintaining *Monolophus* as a distinct genus, for which the type was *M. elegans* (Wall.)

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Horan., and dividing *Kaempferia* for the first time into two groups:— (A) *Soncorus* Rumph., characterized by the inflorescence produced terminally on the leaf-shoot; among members of this group was Linnaeus' *K. galanga*; (B) *Protanthium* Horan., which accommodated those species that produce radical flowers before the leaves appear; this group included *K. rotunda* L.

Plant-collecting expeditions in tropical Africa, starting from the 1850s, brought in new species which were either assigned to *Kaempferia*, or to another closely allied genus, *Cienkowskia*, established by Schweinfurth (1863). The genus *Cienkowskia* was maintained by Hooker for *C. kirkii* (Hooker, 1872), but later workers have tended to regard this generic name as a synonym of *Kaempferia*.

In Bentham and Hooker's *Genera Plantarum* (1883), the groups *Soncorus* and *Protanthium* (of Horaninow) were assigned the status of sections. *Monolophus scaposus* Dalzell was transferred to *Kaempferia* to become *K. scaposa* (Dalz.) Bentham, but it was considered to be distinct enough from other species to warrant the creation of a new section, *Stachyanthesis*, to accommodate it. Bentham and Hooker's infra-generic treatment of *Kaempferia* would read under modern nomenclature as follows:—

Sect. 1. *Protanthium* (Horan.) Benth.

This section is characterized by a short multiflorous inflorescence which appears earlier than the leaves. *Cienkowskia* was assigned to this section as a synonym of *Kaempferia*.

Sect. 2. *Stachyanthesis* Benth.

The inflorescence in this section is an elongate scape with bladeless sheaths, as seen in *Kaempferia scaposa* (Dalz.) Bentham, and *K. rosea* Schweinfurth.

Monolophus [Wall. ex] Endlicher was reduced to a synonym of *Kaempferia* L., and with 2 species quoted as examples, *K. linearis* Wall. and *K. secunda* Wall., was considered to be the connecting link between sect. *Stachyanthesis* and the next section, *Soncorus*. No mention was made of the type species of *Monolophus*, *M. elegans* (Wall.) Horan.

Sect. 3. *Kaempferia* [Syn.: sect. *Soncorus* (Horan.) Benth.]

In this section were placed species in which the inflorescence is few-flowered and terminal on the leaf-shoot. The genus *Tritophus* Lestib. (Lestiboudois, 1841) was regarded as synonymous with *Kaempferia* sect. *Soncorus*.

In the account of *Kaempferia* by Baker (1890) in Hooker's *Flora of British India*, the sections of Bentham & Hooker were raised to subgenera. *Monolophus* was revived as a subgenus and its members included *Kaempferia elegans* Wall. Baker's system did not involve any major taxonomic change in the infra-generic arrangement of the genus, and each of his subgenera includes the correct type. Baker (1898) subsequently described the Zingiberaceae for Thiselton-Dyer's *Flora of Tropical Africa*, in which the African species of *Kaempferia* were maintained in this genus and no mention was made of their disposition in any infra-generic taxon.

A monograph of the whole family Zingiberaceae was published by Schumann (1904) in Engler's *Das Pflanzenreich*. Whatever may be the merits, or otherwise, of this work, it represents a summary of knowledge of the family till then, after a period of 42 years since Horaninow's monograph, during which time the number of purported species of *Kaempferia* had increased tremendously.

Schumann recognised 5 subgenera within *Kaempferia*, thus:—

Subgen. I. *Cienkowskia* (Schweinfurth) K. Schum.

Subgen. II. *Stachyanthesis* (Benth.) Baker

[This is nomenclaturally incorrect as the earliest name for this group at subgeneric rank must be taken from *Hedychium* subgen. *Siphonium* Wall. (see Burtt & Smith, 1972)].

Subgen. III. *Monolophus* (Wall.) Baker

[This is nomenclaturally incorrect as Schumann referred the type species of *Monolophus*, *M. elegans*, to subgen. *Soncorus* (see Burtt & Smith, 1972.)].

Subgen. IV. *Soncorus* (Horan.) Baker

[Includes the generic type and therefore now becomes subgen. *Kaempferia*].

Subgen. V. *Protanthium* (Horan.) Baker

Delimitation of the Genus

The limits of *Kaempferia* as presently circumscribed are not well-defined, and its relationship to, and separation from closely allied genera, namely, *Haplochorema* K. Schum., *Scaphochlamys* Baker, *Stahlianthus* O. Kuntze, and *Boesenbergia* O. Kuntze, are not clearly understood (see Holttum, 1950). This uncertainty has been due largely to lack of information on the variation of these plants in the field, aggravated by a scarcity of well-preserved herbarium material.

The characters often associated with *Kaempferia* are a short, compact inflorescence, the presence of a single flower to each bract and bracteole, the expanded petal-like lateral staminodes, the bilobed labellum, and the continuation of the filament beyond the anther sacs to form an expanded anther crest (or appendicular connective). The labellum, at least in the Asiatic species, is separate from the lateral staminodes almost to the base, and is itself bilobed. The depth of lobing varies from one-third to two-thirds of its length and in those species with a deeply bilobed labellum the lobes spread in the same plane as the staminodes, forming a quadrate flower, as in *K. pulchra* Ridley (Fig. 1). The ovary is characterized as trilocular with axile placentation.

Currently the genus is said to consist of about 70 species, approximately two-thirds of which are found in Asia, with the remaining one-third in Africa. The circumscription of the genus to encompass both Asiatic and African representatives results in very heterogeneous generic characters and the separation of the African species as the genus *Cienkowskiella* is justified below.

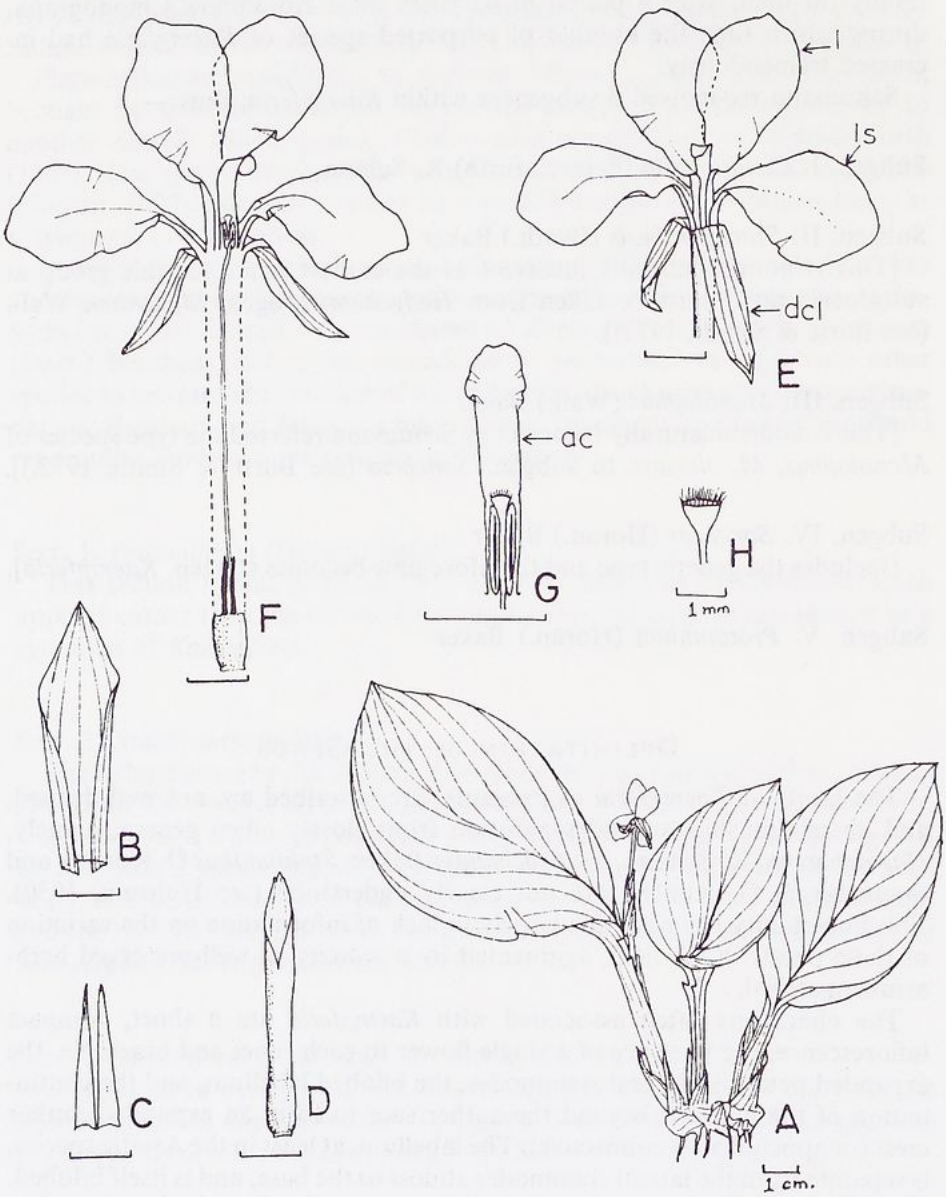

FIG. 1. *Kaempferia pulchra* Ridl. (Malaya: Langkawi Is., *Burtt & Woods* B. 1771): A, habit; B, primary bract; C, bracteole, bifid to the base; D, calyx and ovary; E, flower, one lateral corolla lobe removed; F, flower, dissected showing epigynous glands; G, anther; H, stigma, with ciliate rim. (From spirit material; ac, anther crest; dcl, dorsal corolla lobe; l, labellum; ls, lateral staminode; lines represent 5 mm unless otherwise stated).

Axile placentation was considered by Schumann (1899) to be such a distinctive generic character that he established another genus, *Haplochorema*, to accommodate those Bornean species with unilocular ovaries. The character of the ovary, however, seems to be inconstant, and the status of *Haplochorema* will remain in doubt until the Bornean plants are better known.

Single diagnostic characters do not provide a sound basis for taxonomic decisions, and are especially unreliable for use in the Zingiberaceae where the range of character variation is not well known (Burtt, 1972; Lock and Hall, 1975). However, it seems possible to diagnose those Asiatic species which are presently accommodated in the subgenera *Kaempferia* and *Protanthium* by using a combination of characters based on the morphology of the inflorescence and the flower. In these species, the following observations have been noted:—

(1) The inflorescence is either terminal on, and contemporaneous with, the leaf-shoot; or if it arises radically from the rhizome it precedes the appearance of the leaf-shoot.
(2) The inflorescence, if terminal on the leaf-shoot (sect. *Kaempferia*) is a pedunculate head, and all its primary bracts are fertile; if radical (sect. *Protanthium*) it is either sessile or very shortly pedunculate, and possesses two to four sterile sheathing bracts.
(3) Each flower is protected by one primary bract which is always non-tubular, and one bracteole which is either shortly bilobed or bilobed to the base.
(4) The labellum is separate from the lateral staminodes almost to the base and is bilobed.
(5) The lateral staminodes are petaloid, often with a narrow basal part which widens abruptly to an elliptic, oblong or obovate expanded portion.
(6) The anther crest is always conspicuous, and may be entire or dentate, straight or reflexed, narrow or orbicular.
(7) The stigma is cup-shaped, and the rims are ciliate.
(8) The epigynous glands are paired and are needle-like.

In all specimens of Asiatic *Kaempferia* seen by the author, this combination of characters is remarkably constant and reveals a pronounced discontinuity from the African species. Cytological data (Spearing and Mahanty, 1964) appear to complement these morphological observations, and show that this group of kaempferias contains a preponderance of diploids ($2n = 22$), as well as suggesting a derivation from a basic number of $x = 11$. This combination of characters serves to define the genus *Kaempferia* L. *s. str.* quite clearly.

Classification of the Asiatic Species

The three groups into which the Asiatic species fall may tentatively be recognised as sections—at which rank a valid nomenclature is available.

1. Sect. **Kaempferia** (*K. galanga* and *K. pulchra* group).
Syn.: [*Soncorus* Rumph. in Herb. Amboin. 5:137, t.69 (1747).]
Kaempferia Group A, *Soncorus* [Rumph.] Horan., Monogr. 21 (1862).
Monolophus [Wall. ex] Endl., Gen. Pl. 225, n.1636 (1837).
Tritophus Lestib. in Ann. Sc. Nat. 15:341 (1841).

Kaempferia sect. *Soncorus* (Horan.) Benth. in Benth. & Hook. f., Gen. Pl. 3:642 (1883).

Kaempferia subgen. *Monolophus* (Endl.) Baker in Hook. f., Fl. Brit. Ind. 6:222 (1890).

Type species: *Kaempferia galanga* L., Sp. Pl. 1:2 (1753); Hort. Cliff. t.2 (1737).

In this section the inflorescence is terminal on the leaf-shoot; the lateral staminodes are large and more or less equal in size to the lobes of the deeply divided labellum; the anther crest is large and reflexed; the rhizome consists of fleshy elements, and root tubers if present are often subglobose and filipendulous.

At the species level, whether the leaves are accumbent sessile or erect short-petiolate was at one time considered to be of some taxonomic importance. From the specimens studied this character is found to be variable within a species. Holttum (1950) also stated that this feature varies with environmental conditions.

In this section, three species stand apart and seem to form a close-knit group—*K. fissa* Gagnep., *K. fallax* Gagnep. and *K. filifolia* Larsen, (Larsen, 1962). All three species have filiform leaves and have been collected only in the lowland open deciduous forests of central Laos and eastern Thailand.

2. Sect. **Protanthium** (Horan.) Benth. in Benth. & Hook. f., Gen. Pl. 3:642 (1883). Lectotype (proposed here): *Kaempferia rotunda* L., Sp. Pl. 1:3 (1753).

This section contains the *K. rotunda* group. Flowering is not contemporaneous with leaf formation; the inflorescence is separate from, and precedes, the leaf-shoot, and is protected by sterile bracts. The rhizome consists of swollen elements and filipendulous subglobose root tubers are present. *Kaempferia rotunda* is illustrated in Fig. 2.

3. Sect. **Stachyanthesis** Benth. in Benth. & Hook. f., Gen. Pl. 3:642 (1883).

Syn.: *Hedychium* subgen. *Siphonium* Wall. in Hook., J. Bot. & Kew Misc. 5:375 (1853).

Kaempferia subgen. *Stachyanthesis* (Benth.) Baker in Hook. f., Fl. Brit. Ind. 6:224 (1890).

Type species: *Kaempferia scaposa* (Dalz.) Benth. in Gen. Pl. 3:642 (1883); Baker in Hook. f., Fl. Brit. Ind. 6:224 (1890); K. Schum. in Pflanzenr. Zingib. 72 (1904).

Basionym: *Monolophus scaposus* Dalz. in Hook., J. Bot. & Kew Misc. 2:143 (1850); Wight, Icon. 6:20 t.2030 (1853); Horan. Monogr. 22 (1862). Type: "crescit in rivulorum ripis prov. Malvan; fl. Julio", *Dalzell.*

Taxonomic syn.: *Hedychium scaposum* Nimmo in Graham, Cat. Pl. Bombay 205 (1839); Wallich in Hook., J. Bot. & Kew Misc. 5:375 (1853). Type: "Southern Concan: marshy parts of Karlee plain and on the west border of Lanowlee grove", *Nimmo.*

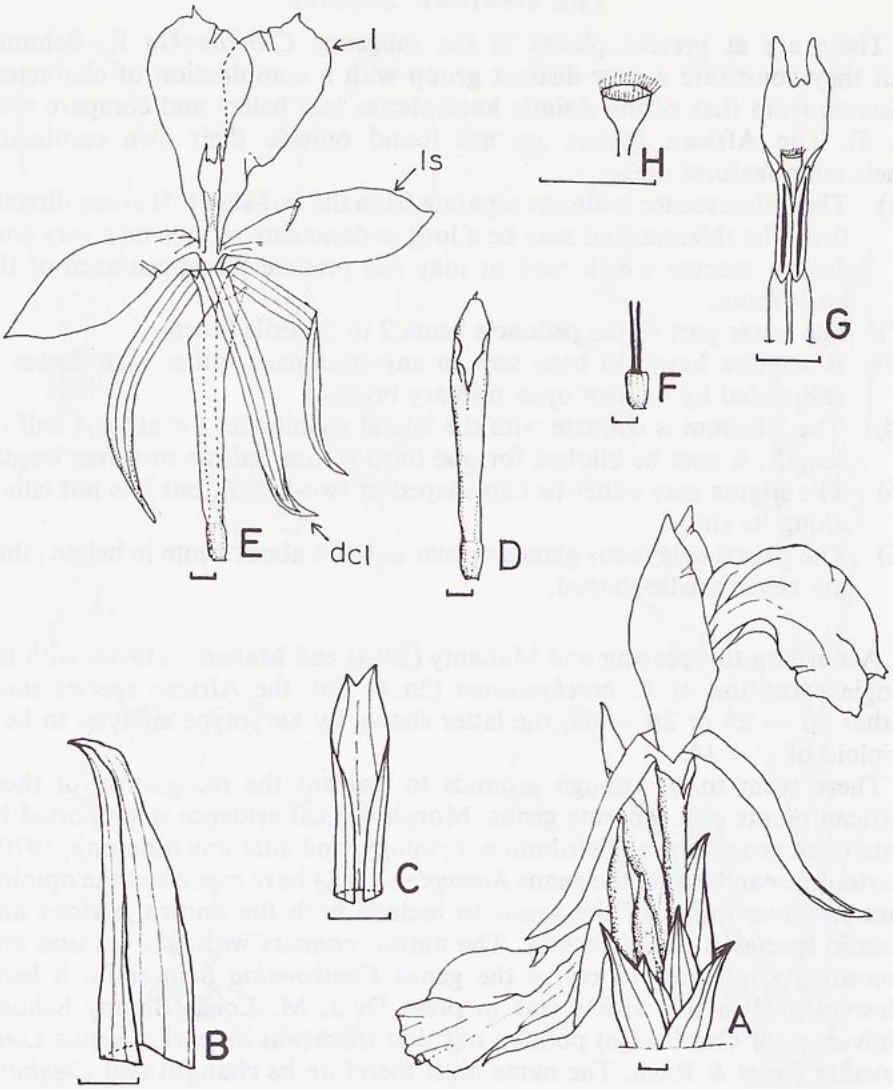

FIG. 2. *Kaempferia rotunda* L.: A, inflorescence; B, primary bract; C, bracteole, bidentate; D, calyx and ovary; E, flower; F, epigynous glands and ovary; G, anther; H, stigma, with ciliate rim. (From spirit material, R.B.G. Edinburgh, C4219; dcl, dorsal corolla lobe; l, labellum; ls, lateral staminode; lines represent 5 mm).

The sole member of this section is *Kaempferia scaposa* (Dalz.) Bentham. From Dalzell's collection and from his original description of the species, and from the illustration in Wight (1853), this species seems to possess several features which preclude its inclusion in the genus *Kaempferia*. The most striking of these are the long scape of the inflorescence (about 60 cm), the elongate floriferous portion of the inflorescence, the presence of two to three flowers per primary bract (that is, cincinni are present) and the short, obtuse anther crest.

Further studies are needed to substantiate the above opinion.

The African Species

These are at present placed in the subgenus *Cienkowskia* K. Schum., but they constitute a very distinct group with a combination of characters discrete from that of the Asiatic kaempferias (see below and compare with p. 5). The African species are not found outside their own continent; their main features are:—

(1) The inflorescence is always separate from the leaf-shoot. It arises directly from the rhizome and may be a long pedunculate raceme or a very condensed raceme which may or may not precede the appearance of the leafy shoot.
(2) The lower part of the peduncle bears 2 to 5 sterile bracts.
(3) Bracteoles have not been seen in any specimen; rather each flower is subtended by its own open primary bract.
(4) The labellum is connate with the lateral staminodes for at least half its length; it may be bilobed for one third to one half its own free length.
(5) The stigma may either be cup-shaped or two-lipped, but it is not ciliate along its rim.
(6) The paired epigynous glands appear as stubs about 1 mm in height; they are never needle-shaped.

According to Spearing and Mahanty (1964) and Mahanty (1970), with the single exception of *K. brachystemon* ($2n = 26$), the African species show either $2n = 28$ or $2n = 42$, the latter shown by karyotype analysis to be a triploid of $x = 14$.

There seem to be enough grounds to warrant the recognition of these African plants as a separate genus. Morphological evidence is supported by data from geographical distribution, cytology, and anatomy (Olatunji, 1970). Various researchers on the genus *Kaempferia* (*s.l.*) have expressed the opinion that circumscription of the genus to include both the known African and Asiatic species is unsatisfactory. The author concurs with this opinion and accordingly intended to revive the genus *Cienkowskia* Schweinfurth here. However, when this article was in press Dr J. M. Lock (Botany School, University of Cambridge) pointed out that there was an earlier genus *Cienkowskia* Regel & Rach. The name must therefore be changed and *Cienkowskiella* is proposed.

Cienkowskiella Kam, **nom. nov.**

Syn.: *Cienkowskia* Schweinfurth [In Sitzungsbericht des Ges. naturf. Freunde Juli 1863, S.14], Beitr. Fl. Aeth. t. 1 (1867); Solms in Schweinfurth, *op. cit.*, 197 (1867).
Kaempferia subgen. *Cienkowskia* K. Schum. in Engler's Pflanzenreich, Zingib. 67 (1904).

Type species: *Cienkowskiella aethiopica* (Schweinfurth) Kam

Syntypes: "Am Khor el Scherif und bei Famaka in Fesoghlu, 23 v 1848, bl. *Cienkowski*; Bei Wochni in nordwestl. Abyss., 31 v und 3 vi 1862, bl. *Steudner*."

Cienkowskiella aethiopica is illustrated in Fig. 3.

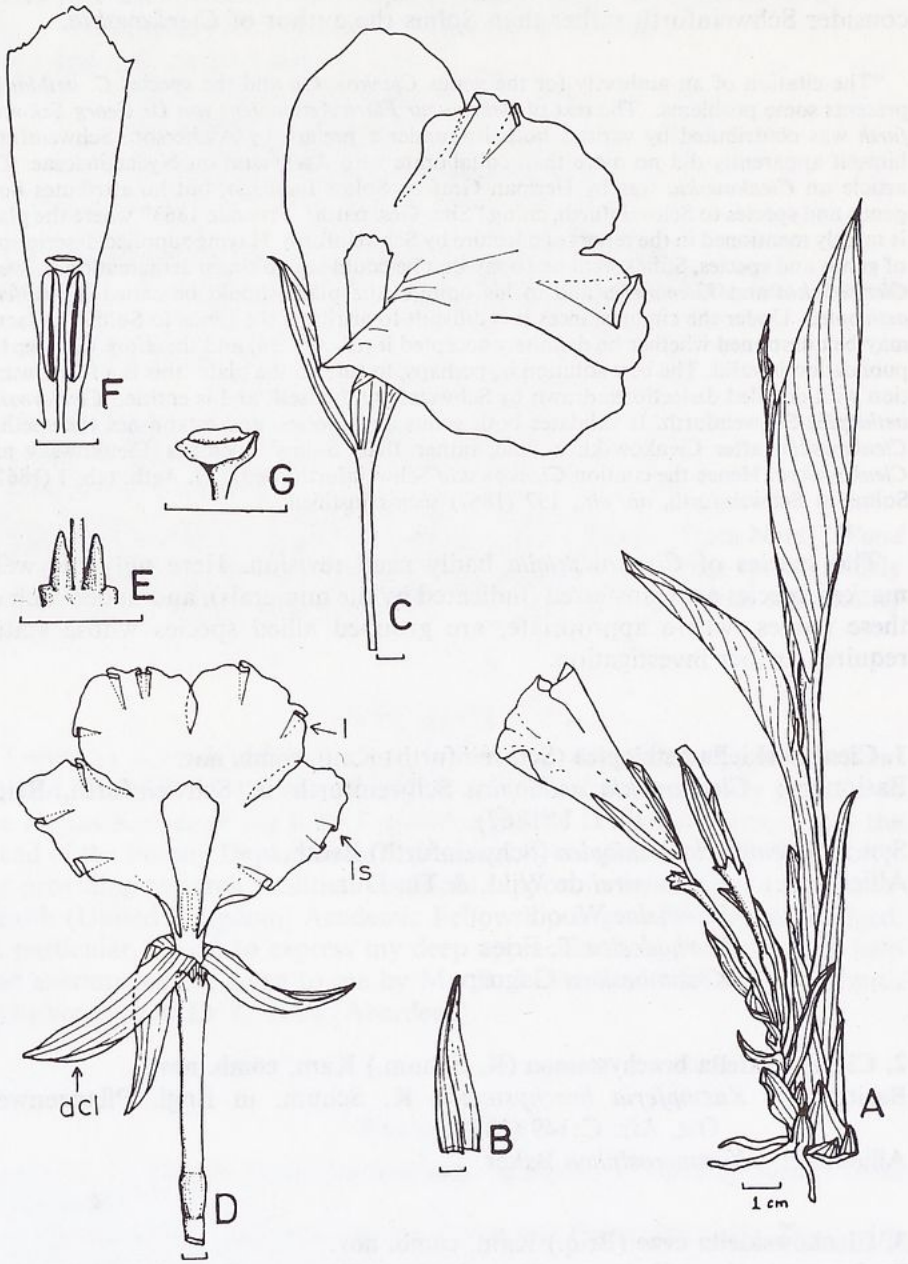

FIG. 3. *Cienkowskiella aethiopica* (Schweinfurth) Kam (A, Abyssinia: *Schweinfurth* 1341; B,D,E, Tanganyika: *Bullock* 1991; C,F,G, Br.E. Afr.: *Schweinfurth* ser. II, 131): A, habit; B, primary bract; C, flower, calyx and ovary removed; D, flower; E, epigynous glands; F, anther; G, stigma. (From dried material; dcl, dorsal corolla lobe; l, labellum; ls, lateral staminode; lines represent 5 mm unless otherwise stated).

The following personal communication from Mr B. L. Burtt, written before it was pointed out to us that the name is a later homonym, indicates why we consider Schweinfurth rather than Solms the author of *Cienkowskia*.

"The citation of an authority for the genus *Cienkowskia* and the species *C. aethiopica* presents some problems. The text of *Beitrag zur Flora Aethiopiens von Dr Georg Schweinfurth* was contributed by various botanists under a preface by Ascherson. Schweinfurth himself apparently did no more than collaborate with Ascherson on Nyctaginaceae. The article on *Cienkowskia* was by Herman Graf zu Solms Laubach, but he attributes both genus and species to Schweinfurth, citing "Sitz. Ges. naturf. Freunde 1863" where the plant is merely mentioned in the report of a lecture by Schweinfurth. Having supplied descriptions of genus and species, Solms went on to say that he could see no sharp demarcation between *Cienkowskia* and *Kaempferia* and in his opinion the plant should be called *Kaempferia aethiopica*. Under the circumstances it is difficult to attribute the genus to Solms; in fact it may be questioned whether he definitely accepted it (cf. Art. 34) and therefore whether the publication is valid. The best solution is, perhaps, to turn to the plate: this is a full illustration with detailed dissections, drawn by Schweinfurth himself, and is entitled *Cienkowskia aethiopica* Schweinfurth. It validates both genus and species, and establishes the spelling *Cienkowskia*, after Cienkowski, a Pole, rather than Solms' spellings Cienkowsky and *Cienkowskya*. Hence the citation *Cienkowskia* Schweinfurth, Beitr. Fl. Aeth. tab. 1 (1867); Solms in Schweinfurth, *op. cit.*, 197 (1867) seems justified".

The species of *Cienkowskiella* badly need revision. Here only the well-marked species are transferred (indicated by the numerals), and under each of these names, where appropriate, are grouped allied species whose status requires further investigation.

1. Cienkowskiella aethiopica (Schweinfurth) Kam, **comb. nov.**
Basionym: *Cienkowskia aethiopica* Schweinfurth in Schweinfurth, Beitr. Fl. Aeth. t. 1 (1867).
Syn.: *Kaempferia aethiopica* (Schweinfurth) Benth.
Allied spp.: *K. dewevrei* de Wild. & Th. Dur.
K. ethelae Wood
K. rhodesica T. Fries
K. zambesiaca Gagnep.

2. Cienkowskiella brachystemon (K. Schum.) Kam, **comb. nov.**
Basionym: *Kaempferia brachystemon* K. Schum. in Engl. Pflanzenwelt Ost. Afr. C:149 (1895).
Allied sp.: *K. macrosiphon* Baker

3. Cienkowskiella evae (Briq.) Kam, **comb. nov.**
Basionym: *Kaempferia evae* Briq. in Ann. Conserv. & Jard. Bot. Genève 6:3 (1902).
Syn.: *K. homblei* de Wild.
K. puncticulata Gagnep.

4. Cienkowskiella nigerica (Hepper) Kam, **comb. nov.**
Basionym: *Kaempferia nigerica* [Hutch. ex] Hepper in Kew Bull. 22:465 (1968).

5. Cienkowskiella kirkii (Hooker) Kam, **comb. nov.**
Basionym: *Cienkowskia kirkii* Hooker in Bot. Mag. 98, t. 5994 (1872).
Syn.: *Kaempferia kirkii* (Hooker) Wittmack & Perring
Allied spp.: *K. carsonii* Baker
K. decora van Druten
K. montagui Leighton
K. pallida de Wild.
K. rosea Schweinfurth

6. Cienkowskiella kilimanensis (Gagnep.) Kam, **comb. nov.**
Basionym: *Kaempferia kilimanensis* Gagnep. in Bull. Soc. Bot. France 53:352 (1906).
Syn.: *K. cecilae* N. E. Brown

7. Uncertain spp.:
K. pleiantha K. Schum.
K. stenopetala K. Schum.

The latter species was based on an unlocalised specimen from Natal (*Wood* 1942). It seems to be simply *Kaempferia rotunda* L., which has spread widely in cultivation and may well have been introduced by the Indian community in Natal.

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