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A REVISION OF HEMANDRADENIA STAPF (CONNARACEAE)

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CONTENTS

1. INTRODUCTION

Hemandradenia (Connaraceae) is a small genus, limited to tropical Africa.

The first revision of the genus was by SCHELLENBERG (1938) and was based on very few collections. Much of the material collected in later years was not fully identified and sometimes even confused with *Dichapetalaceae*. In a more recent revision of Malaysian *Connaraceae* by LEENHOUTS (1958), *Hemandradenia* was casually reduced to a synonym of *Ellipanthus*. Consequently a reappraisal of the genus seemed desirable.

As part of my training in plant systematics at Wageningen, it was decided that I should study this genus.

In addition to the morphological and nomenclatorial study of dried and living material, it appeared desirable to extend research into sister-disciplines, such as palynology, anatomy, and cytology. Therefore pollen were examined of the species of *Hemandradenia* and of some *Ellipanthus* for comparison and formal evaluation of their relative pollen-characters. This work was done under supervision of Dr. W. PUNT at Utrecht.

The anatomy needed special attention since recent anatomical publications (DICKISON, 1973) indicate controversy with the gross morphology of the genus.

The material examined for this present study includes the types of the four described species and with additional specimens represents the largest amount of specimens so far studied for its evaluation. It appeared that only two species in *Hemandradenia* can be maintained and that *Ellipanthus* is a separate genus.

2. HISTORY AND DELIMITATION OF THE GENUS

Hemandradenia is characterised by unifoliolate leaves and non-stipitate, indehiscent fruits.

STAPF (1908) described it on the basis of two different specimens collected in Ivory Coast and Equatorial Guinea and expressed some doubt whether his new genus was sufficiently distinct from the formerly Asiatic genus *Ellipanthus* HOOK.F. He, however, clearly indicated the main differences between the two genera as found in the fruits and seeds. He described two species based on the material at his disposal as *H. mannii* and *H. chevalieri*.

SCHELLENBERG (1938) selected *H. mannii* as the type species and described a third one: *H. madagascariensis*. As the latter species had no fruits, he could not vouch for its true identity in *Hemandradenia*.

In 1958 LEENHOUTS reduced *Hemandradenia* to a synonym of *Ellipanthus*, but did not make the necessary new combinations.

In the same year AUBRÉVILLE and PELLEGRIN described a fourth species from Ivory Coast: *H. glomerata*. CAPURON in KERAUDREN's revision of the family for Madagascar (1958) transferred SCHELLENBERG's species to *Ellipanthus*.

The genera *Hemandradenia* and *Ellipanthus* are indeed closely related, in that both share unifoliolate leaves, flowers with mostly 5 stamens and 5 staminodes, and a single carpel. The carpel, however, is stipitate in *Ellipanthus* and sessile in *Hemandradenia*, which makes it possible to distinguish between the two genera with flowering material only. The fruits of the former are true follicles, but indehiscent in the latter. The sarcotesta present in both genera, is restricted to a part of the seed in *Ellipanthus*, whereas in *Hemandradenia* the entire outer layer of the seedcoat is fleshy.

The main distinguishing characters of the two genera may be summarised thus:

Hemandradenia	*Ellipanthus*
Carpel not stipitate.	Carpel stipitate.
Fruit indehiscent.	Fruit dehiscent (true follicle).
Fruit wall thinly crustaceous.	Fruit wall woody.
Seedcoat completely fleshy.	Seedcoat partly fleshy.

In view of these differences *Hemandradenia* is maintained here as a distinct genus within the *Connaraceae*.

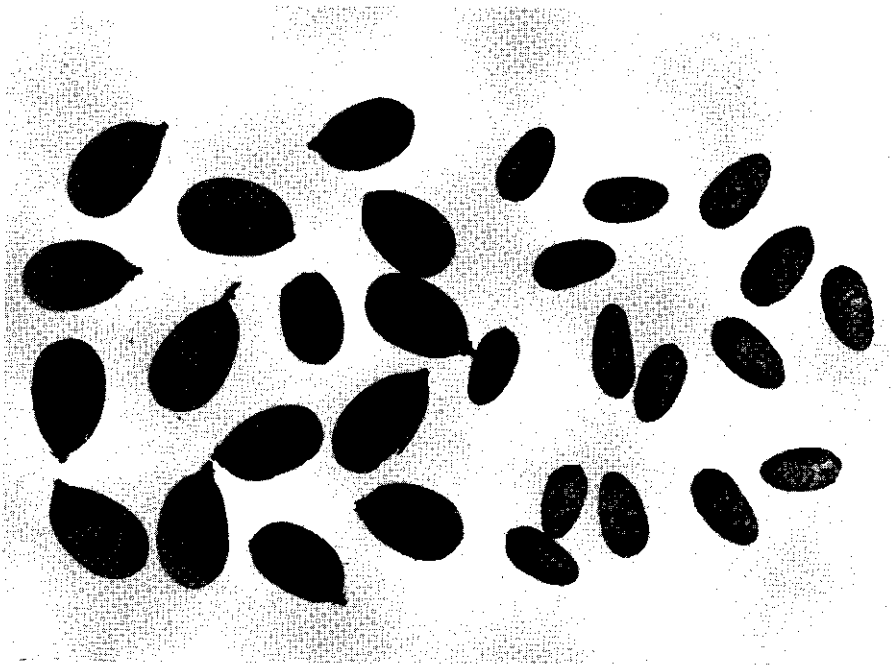
3. NOTES ON SEXUALITY, POLLINATION AND DISPERSAL

In both species of *Hemandradenia*, all the specimens examined showed the same floral dimorphism. In the greater part of the specimens, the flowers have stamens about twice as long as the style, in the other part the flowers are long-styled and the stamens about half as long as the style.

Although some ovaries of stamen-dominant flowers seemed under-developed, young fruits were observed in specimens with either type of flowers. In one specimen of *H. chevalieri, (Chevalier 19968)*, with short-styled flowers, it was observed that the stigma leads, when the flower is opening, but is superseded by the long stamens when fully opened. In this circumstance, cross fertilisation is probable.

This floral dimorphism may indicate a development towards dioecism in this genus. HEMSLEY (1956) and LEENHOUTS (1958) observed the same phenomenon throughout the *Connaraceae*. Field observations are, therefore, needed to ascertain whether the flowers are partly or wholly unisexual in function.

Pollination of the flowers may be performed by insects. Although flower



PHOTOGRAPH 1. Mature fruits (left) and seeds (right) of *H. chevalieri* as collected under a tree in Ivory Coast *(De Koning 6169)*. Phot.: J. W. MUGGE. See text p. 8.

smell has not been recorded, the staminal tube is occasionally gland-thickened outside and possibly secretes nectar. The flowers though small, are congested and could afford some attraction.

The ripe fruits are orange to brown and have a pleasant odour. The fleshy seedcoat (sarcotesta) is cream-coloured and has a pleasant sweet taste. Mr. DE KONING, who kindly made field observations on *H. chevalieri* in the Banco forest Arboretum near Abidjan, in Ivory Coast, reported that the fruits do not dehisce, as observed by other collectors and confirmed by studies of herbarium material. The fleshy seedcoat is eaten by animals; monkeys are keen on them and most probably rodents also eat them, as the seeds collected under the tree show the markings of gnaws (see Phot. 1).

As *Hemandradenia* fruits do not split to expose their fleshy, coloured seedcoats, as is generally seen in the *Connaraceae*, and the seeds of the fruits eaten by animals are usually left near the tree, effective dispersal may be strongly limited. Moreover, *Hemandradenia* is found only in the lower canopy of old secondary and primary forests. These facts may account for the small amount of herbarium material available so far.

4. ANATOMY

Anatomical investigations of the *Connaraceae*, including *Hemandradenia* have been published by SCHELLENBERG (1910), METCALFE and CHALK (1950) and more recently by DICKISON (1973). In all these treatments *Hemandradenia* has been assessed on the basis of a single specimen. A thorough survey covering a few members of each species has been lacking. On such a meagre premise DICKISON was convinced that *Hemandradenia* should be relegated to *Ellipanthus* as proposed by LEENHOUTS (1958). However, this view is not sustained in this revision on grounds of contrasting features of gross morphology between the two genera.

The anatomy of the twig and leaf blade of *Hemandradenia mannii* STAPF, *J. Léonard 583* (WAG), *H. chevalieri* STAPF, *Aubréville 1636* (P), *Ellipanthus tomentosus* KURZ ssp. *tomentosus*, *Bubong S. 26109* (L), were studied and the general account of *H. mannii* is described below.

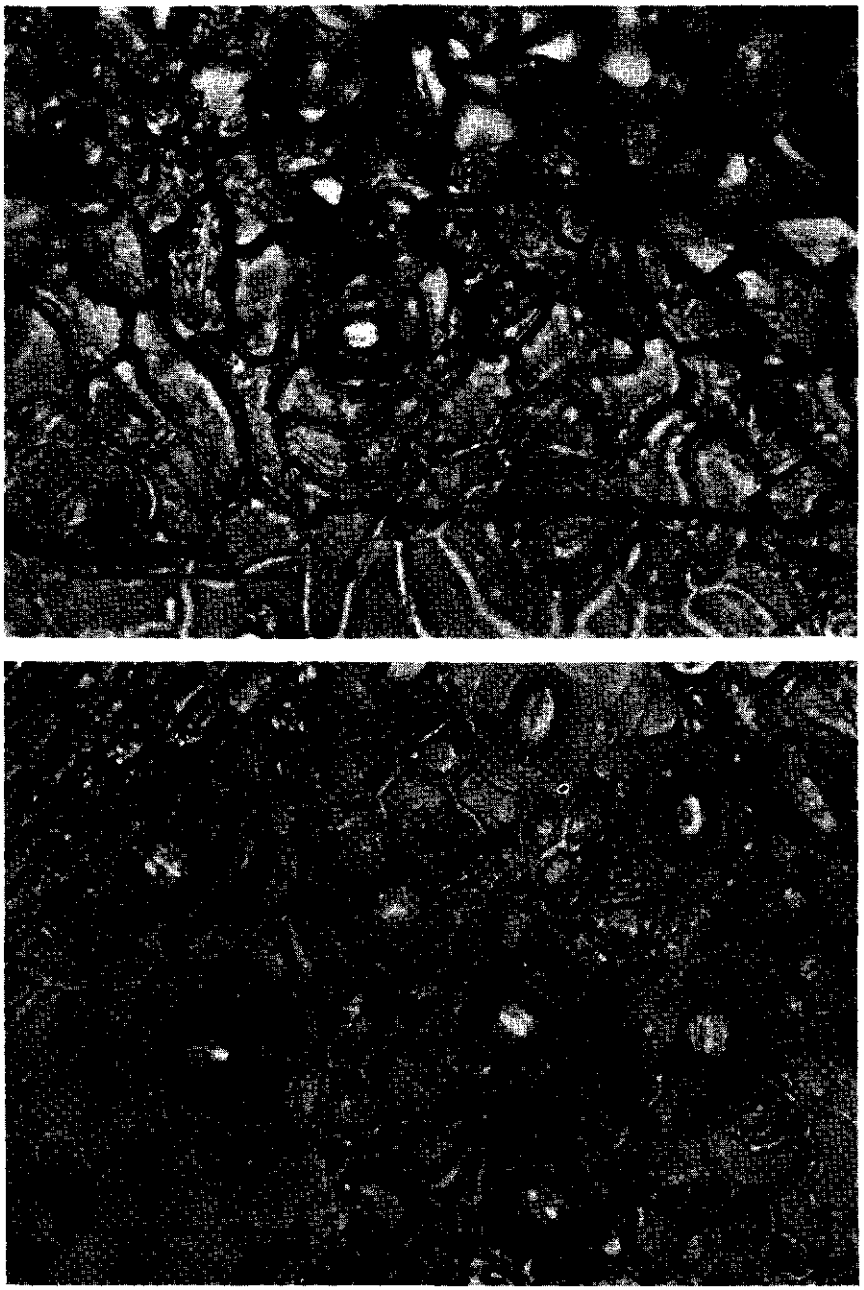
Anatomy perhaps does not lend great support to the taxonomic distinction of the two genera. But it was observed that *Hemandradenia* has straight anticlinal walls on both surfaces of the leaf, whereas *Ellipanthus* has wavy anticlinal walls on the lower surface of the leaf (Phot. 2, 3); see also NAPP-ZINN (1973). In *Hemandradenia* stomata per sq. mm is 240 but 130 in *Ellipanthus*. *Hemandradenia* has a medullated vascular tissue on the midrib with a ventral trace while *Ellipanthus* has a median trace with 3 ventral traces (Phot. 6, 7). The rays in the wood of *Hemandradenia* are uniseriate and biseriate and about 25 cells high whereas they are predominantly uniseriate and only 10 cells high in *Ellipanthus* (Phot. 4, 5).

Radial pore clusters are three or more in *Hemandradenia* but rarely up to three in *Ellipanthus*. Wood fibres of *Hemandradenia* are occasionally septate but always septate in *Ellipanthus*.

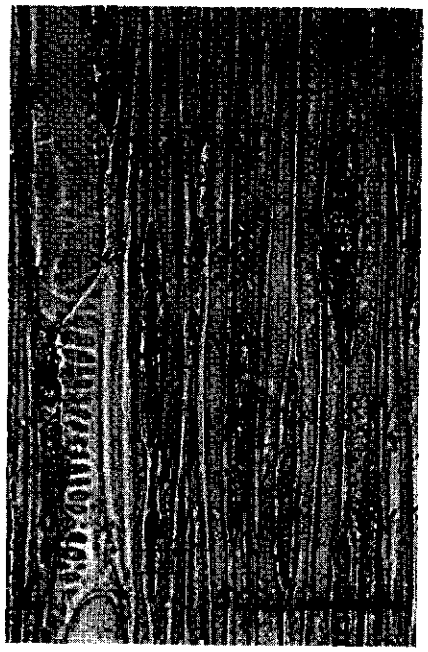
4.1. DESCRIPTION OF H. MANNII STAPF

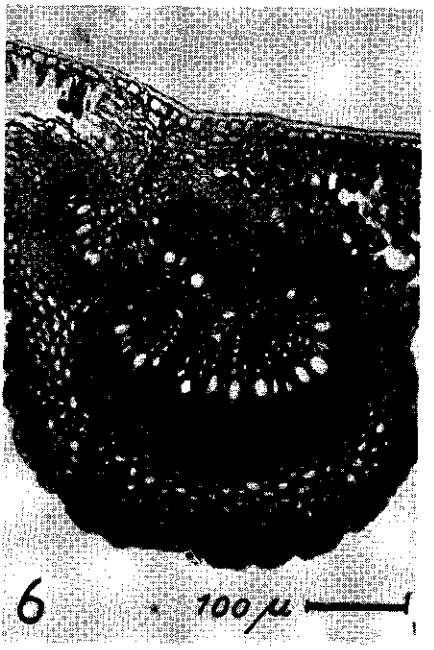
Twig: tranverse section

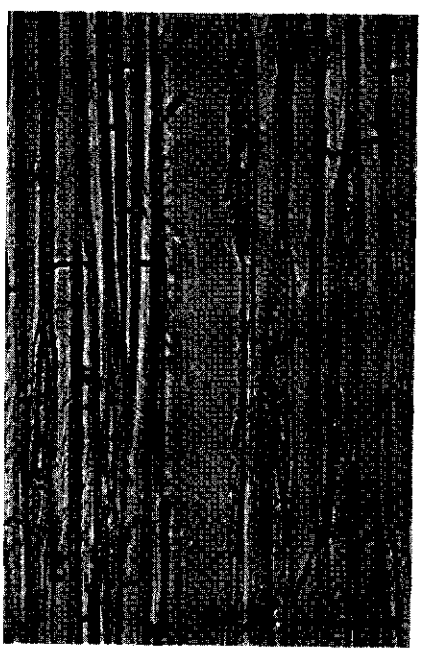
Diameter about 5 mm. Cuticle and epidermis being ejected. Cortex: Outer layer differentiated into periderm, up to 9 cells wide; the rest of the cortex is parenchymatous, cells in 4–9 layers. Central cylinder: Outer part composed of strands of sclerenchymatous fibres, 3–7 cells wide, alternating with strands of stone cells. Phloem: Primary phloem crushed. Outer cells of secondary phloem have brown contents, inner layer interspersed with stone cells, 2–6 cells per group. Cambial zone 4–5 cells wide. Xylem: Secondary xylem with numerous vessels, about 130 per sq. mm, very small, average radial diameter 40 μm, solitary and in radial multiples of 2–4 elements. Perforation plates simple, oblique; pitting alternate, librifrom with fibres often septate with simple

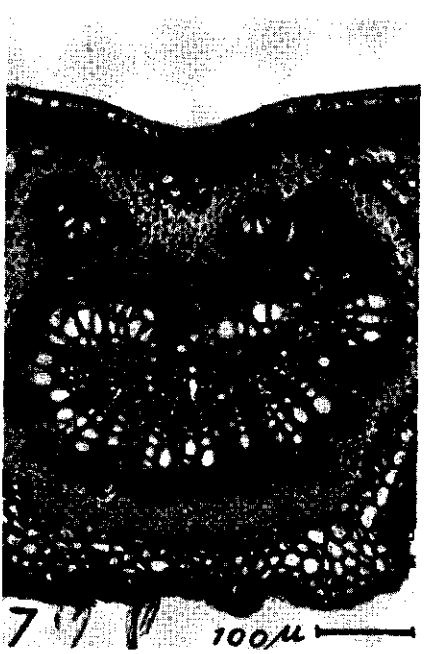


PHOTOGRAPH 2. *E. tomentosus:* leaf, lower surface. – 3. *H. chevalieri:* leaf, lower surface. Phot.: Department of Botany, Agricultural University, Wageningen.









PHOTOGRAPH 4. *H. mannii:* tangential section of twig. – 5. *E. tomentosus:* tangential section of twig. – 6. *H. mannii:* transverse section of midrib. – 7. *E. tomentosus:* transverse section of midrib. Phot.: Department of Botany, Agricultural University, Wageningen.

pits and intercellular spaces. Wood parenchyma scattered, often with simple crystals. Rays: uniseriate, occasionally biseriate and composed mainly of upright, with some square and procumbent, cells; 2–20 cells high. Primary xylem is composed of parenchymatous cells and vessels (in radial rows) with spiral thickenings. Pith homogeneous.

Leaf surface

Abaxial: Epidermal cells 4–6-sided, rarely circular, with average diameter of 16 μm. Anticlinal walls straight. Stomata anomocytic, 21 μm long and about 240 per sq. mm.

Adaxial: Epidermal cells circular to slightly elongated with average diameter of 15 μm. Anticlinal walls straight. Stomata absent. Simple crystals sometimes present.

Leaf: transverse section

Outline: bifacial, midrib prominent below with a groove above. Cuticle about 6 μm thick with tubes, resembling hair sockets, above the veins. Upper epidermal cells cuboidal to slightly elongated, vertically elongated above the midrib. Outer walls thicker than inner and anticlinal walls. Lower epidermal cells smaller, circular to triangular and vertically elongated.

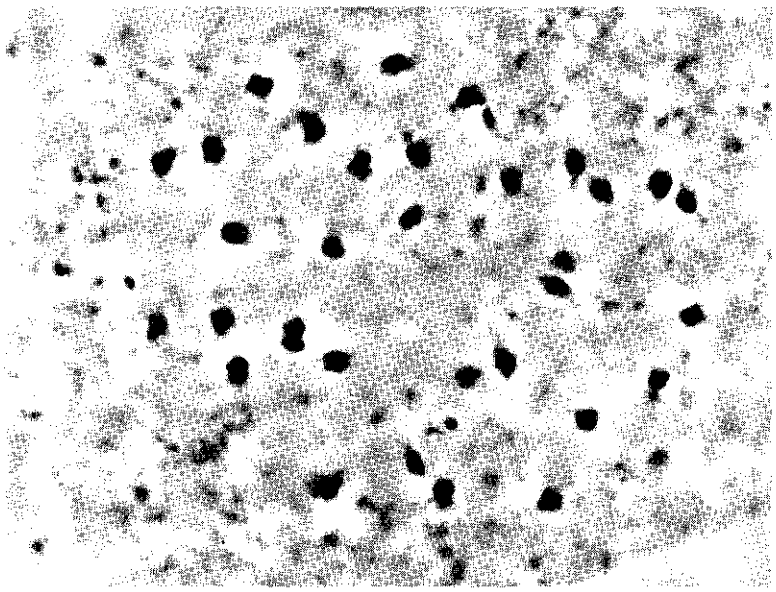
Mesophyll: composed of two cell layers, the upper more vertically elongated than the lower. The spongy layer consists of rather circular to elongated, irregularly arranged cells with many large intercellular spaces. Many prismatic crystals are present usually above and below the vascular bundles. Midrib: with medulated vascular cylinder. Bundle sheath sclerenchymatous and extends to the upper epidermis. Bundle sheath uniseriate, cells cylindrical to elongated. Pericyclic fibres thick walled with most of their lumen filled with yellowish brown substance. Phloem cells thin-walled. Metaxylem: vessels with alternate pits. Protoxylem elements with spiral thickenings.

5. CYTOLOGY

Root tips of seedlings of *H. chevalieri* grown from seeds collected in Ivory Coast *(De Koning 6169)* were analysed. The materials were prepared according to the method outlined by AREND S (1976). The seedlings *(Eimunjeze s.n.)* are conserved in the Herbarium Vadense (WAG).

The observed somatic metaphase chromosomes are small and variable in size from about 0.5 to 1.0 micron. In most of the cells, a number of 2n = 32 was counted. However, in the other cells only 2n = 31 was observed. A cell having 2n = 32 is shown in Phot. 8.

The count of 2n = 32 chromosomes does not corroborate the results of MANGENOT and MANGENOT (1962), who published 2n = 28 for this species. As only seedlings from one mother tree have been analysed, the possibility that some intraspecific chromosomal variation occurs in *H. chevalieri* cannot be ruled out.



PHOTOGRAPH 8. *H. chevalieri:* 2n = 32 chromosomes in a root tip cell *(Eimunjeze s.n.)* ×2700. Phot.: J. C. AREND S.

6. POLLEN MORPHOLOGY

6.1. MATERIALS

Pollen grains were obtained from herbarium specimens, which were loaned from herbaria indicated below, after each taxon investigated.

Materials of *Hemandradenia* were certified by the present author and those of *Ellipanthus* by LEENHOUTS (1958) and HEMSLEY (1956).

Hemandradenia mannii Stapf: Nigeria, *Latilo FHI 30960* (K); Central African Republic, *Tisserant (Equipe) 316* (P); Zaïre, *Léonard 583* (BR); *Wagemans 466* (BR). Syn.: *H. glomerata* Aubréville & Pellegrin: Ivory Coast, *Aubréville 4123* (P).

H. chevalieri Stapf: Ivory Coast, *Aubréville 1495* (P); *Chevalier 19968* (P).

Ellipanthus tomentosus Kurz ssp. *tomentosus* var. *luzoniensis* (Vidal) Leenhouts: Indonesia. *Neth. Ind. For. Service bb 19816* (L).

E. tomentosus Kurz ssp. *kingii* (Boerlage & Koorders) Leenhouts: Indonesia, *Koorders 24021 B* (L).

E. beccarii Pierre var. *peltatus* (Schellenberg) Leenhouts: Sabah, *Mikil 41911* (L).

E. hemandradenioides Brenan: Tanzania, *Faulkner 2158* (K).

6.2. METHODS

The pollen grains were prepared according to the acetolysis method described by REITSMA (1969). They were mounted in glycerine jelly and covered with a cover-slip, supported on two granules of modelling clay, to prevent the grains from being crushed. The preparation was finally sealed with paraplast.

The pollen grains were studied with a Leitz Ortholux microscope (Apo oel 100/1.32 objective). Photomicrographs were made with a Leitz Orthomat in combination with Leitz Ortholux microscope (Apochr. 90/1.40 objective) and an interference green filter (AL 546). The film was a Kodak Recordak, AHU-microfilm 5,460. Besides a few scanning-electron micrographs were taken using the Cambridge scanning electron microscope in the State University of Utrecht.

The terminologies used in this study are according to REITSMA (1970) and PRAGLOWSKI and PUNT (1973).

6.3. General morphology

The pollen grains of *Hemandradenia* and *Ellipanthus* can be distinguished and therefore break up into two pollen types. They, however, belong to the same pollen class – tricolporate and are usually 3-aperturate. In species of both genera *(H. mannii* and *E. hemandradenioides)* 4-aperturate pollen grains do occur very rarely. The pollen grains are all zonoaperturate and the apertures are compound.

The ectoapertures are all colpi and their membranes are often granulate. These ectoapertures have an equatorial bridge of thin, sexine material, usually granulate, which partly covers the endoaperture. Ectoapertures are sunken in the *Hemandradenia* type and slightly or not sunken in *Ellipanthus* pollen grains.

Endoapertures are mostly lalongate colpi. In *E. tomentosus* ssp. *tomentosus* var. *luzoniensis*, porus-like endoapertures were occasionally observed. In the *Hemandradenia* type, these endoapertures are bordered by costae; whereas costae are less distinct in *Ellipanthus* pollen grains.

Ornamentation is reticulate and variation, though diagnostic, is in the extent of reticulation. In *Hemandradenia* the reticulum is fine – muri narrow, lumina (1–1.5 μ) circular to rather elongated, whereas in *Ellipanthus* the reticulum is coarse with broad muri and angular lumina (1.5–2μ) except in the African material of *E. hemandradenioides*, which has a fine reticulum similar to *Hemandradenia* type.

The exine is rather thick, usually about 3μ, and nexine and sexine are about equally thick in *Ellipanthus* pollen grains. The thickness of the nexine varies between the two species in *Hemandradenia*.

6.4. Key to the species of Hemandradenia

Endocolpi with indistinct costae in the middle part only. Reticulum rather fine, lumina about 1 μ in diameter. Columellae shorter than or equal to capita. 3-zonocolporate . . . . . **H. chevalieri**

Endocolpi bordered by distinct costae. Reticulum rather coarse, lumina about 1.5 μ in diameter, up to 2 μ. Columellae longer than capita. 3(–4)-zonocolporate . . . . . **H. mannii**

6.5. Descriptions of the species of Hemandradenia and some of Ellipanthus

6.5.1. *Hemandradenia chevalieri Stapf (Plate I)*

Pollen class: 3-zonocolporate.
P/E ratio: Transverse to subtransverse.
Apertures: Ectoapertures – colpus, long, rather broad to broad, sunken, margins indistinct, ends more or less distinct and obtuse. Colpus membrane granulate. Endoapertures – colpus, lalongate, broad, margins partly distinct, ends diffuse; costae in the middle part only.
Exine: About 4 μ thick. Nexine thicker than sexine, more so at the mesocolpium. Columellae thin, short, about as long as capita. Capita rather circular to slightly elongated laterally, forming a semitectum.
Ornamentation: Reticulate, rather coarse, lumina more or less circular to elongated in outline. Muri simplicolumellate and fused into a reticulum at the top. In L-0 analysis columellae distinct and circular in outline.
Outline: Equatorial view – elliptic; polar view – circular to triangular with convex sides and the apertures are situated in the angles, which are obtuse.
Measurements: Exine c. 4 μ; longest axis (E) 39–42 μ; P/E ratio 0.71–0.90.

Plate I. *Hemandradenia chevalieri* Stapf *(Chevalier 19968)*.
1. Polar view; cross-section, nexine a little thicker in the mesocolpium.
2. Ornamentation; reticulum at low focus, muri simplicolumellate, columellae distinct, circular in outline.
3. Ornamentation; reticulum at high focus, rather coarse.
4. Endoaperture; colpus broad, distinct in the middle, diffuse towards the ends.
5. Bridge: a thin sexine layer with granules, covering the endoaperture.
6. Scanning electron micrograph: polar view (×1500).
7. Scanning electron micrograph; equatorial view (×1500).

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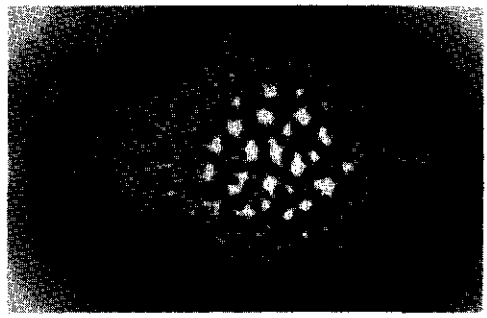

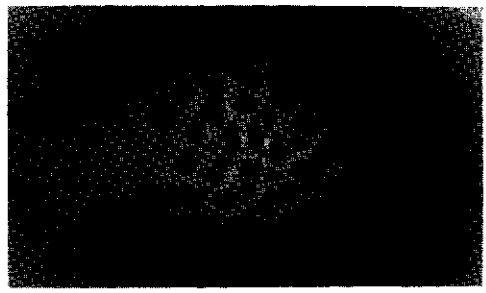

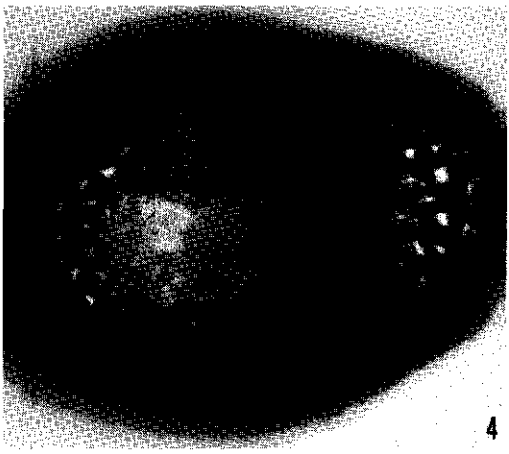

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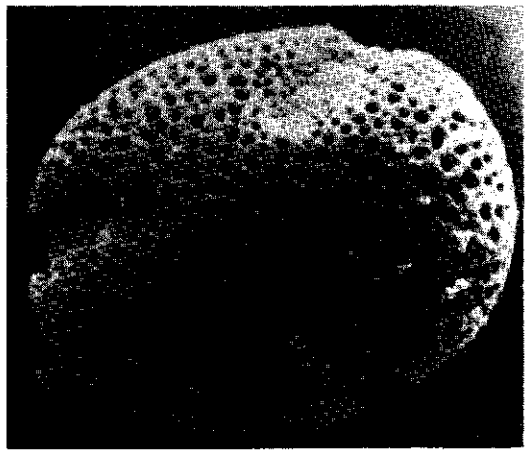

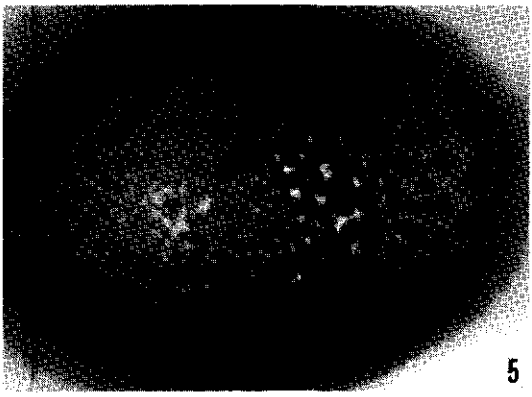

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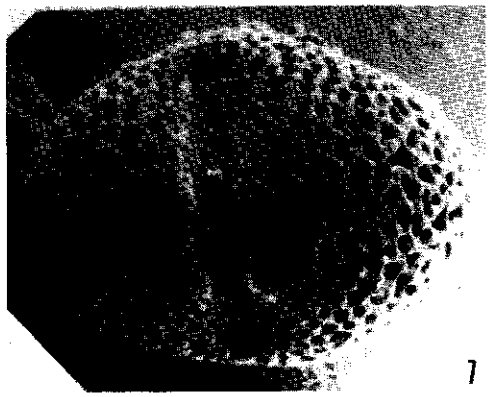

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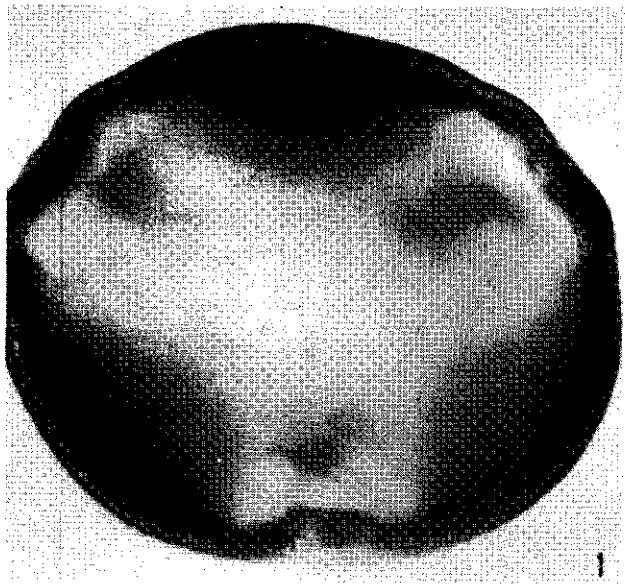
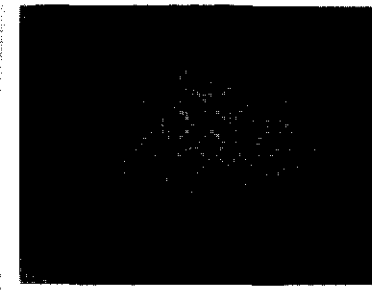
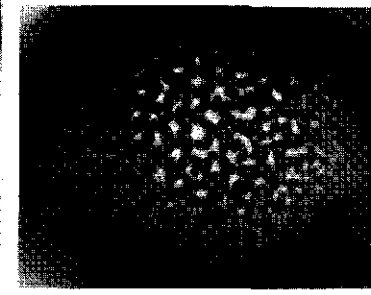
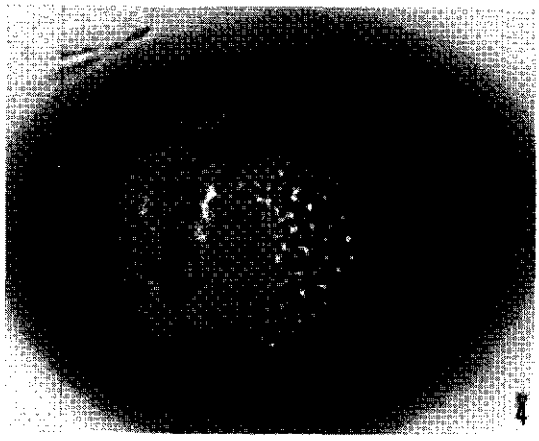
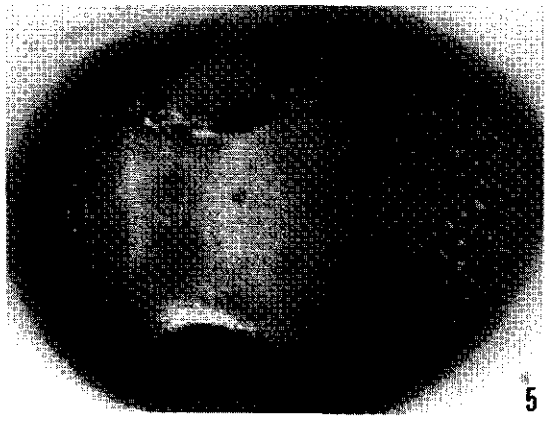
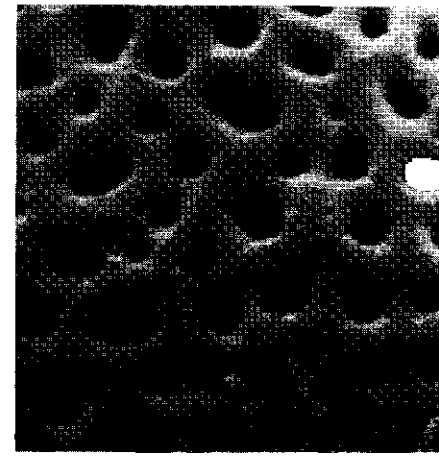












6.5.2. *Hemandradenia mannii Stapf (Plate II)*

Pollen class: 3(–4)-zonocolporate.
P/E ratio: transverse to semitransverse.
Apertures: Ectoapertures – colpus, long, rather broad, sunken, margins indistinct; ends distinct, obtuse, colpus membrane granulate. Endoapertures – colpus, very broad, lalongate, bordered by costae; margins often distinct, ends diffuse. A thin, often granulate, bridge of sexine material partly covers the endocolpus.
Exine: Usually thicker in the mesocolpium than in apocolpium. Sexine thicker than nexine. Columellae thin, longer than the capita; capita circular to more or less elongated longitudinally.
Ornamentation: Reticulate, rather fine, lumina more or less circular to elongated in outline; muri simplicolumellate and fused at the top into a semitectum. In L-O analysis columellae distinct and circular in outline.
Outline: Equatorial view – elliptic; polar view – triangular or rarely quadrangular, with usually convex sides and the apertures situated in the angles, which are obtuse.
Measurements: Exine c. 3 μ; longest axis (E) 38–47 μ; P/E ratio 0.72–0.87.

Note. The pollen grains of *H. mannii* and *H. glomerata* cannot be distinguished from each other. This points to a close taxonomic relationship between the two species, as observed by the present author that *H. glomerata* is conspecific with *H. mannii*.

PLATE II. *Hemandradenia mannii* Stapf (1–5: *Tisserant 316*; 6, 7: *Wagemans 466*).
1. Polar view; cross-section, nexine a little thicker in the middle of the mesocolpium.
2. Ornamentation; reticulum at high focus, fine.
3. Ornamentation; reticulum at low focus, muri simplicolumellate, columellae distinct, circular in outline.
4. Bridge; a thin sexine layer with small granules, covering the endoaperture.
5. Endoaperture; colpus broad, distinct in the middle, diffuse towards the ends.
6. Scanning electron micrograph; polar view (×1500).
7. Scanning electron micrograph; ornamentation (×7500).

6.5.3. *Ellipanthus hemandradenioides Brenan (Plate III)*

Pollen class: 3(–4)-zonocolporate.

P/E ratio: Transverse to semitransverse.

Apertures: Ectoapertures – colpus, broad, not sunken, margins indistinct, ends diffuse. Equatorial bridge present and granulate. Colpus membrane granulate. Endoapertures – colpus, lalongate, margins partly distinct, no costae, ends diffuse.

Exine: About 3 μ thick. Nexine about as thick as sexine. Columellae thin, about equal to the capita, which are circular to slightly elongated laterally.

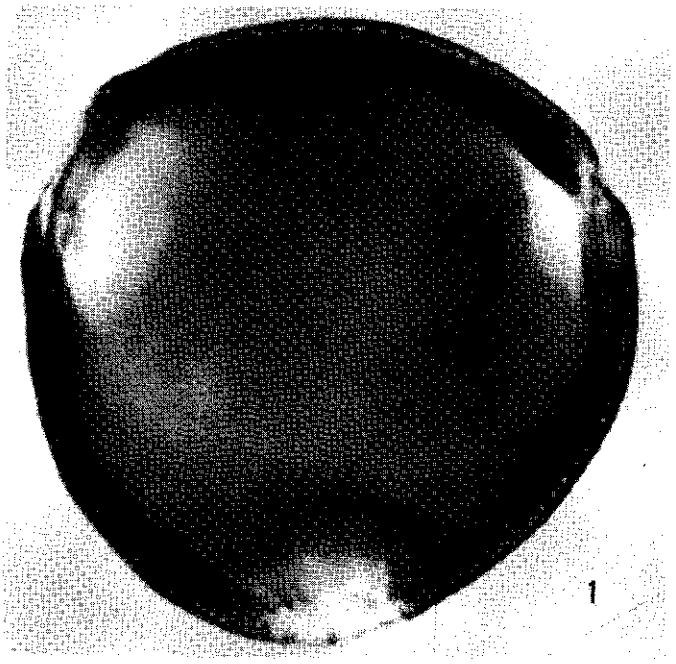
Ornamentation: Reticulate, rather fine, lumina irregular and variable in size. Muri simplicolumellate and fused at the top into a semitectum. Columellae circular in L–O analysis.

Outline: Equatorial view – elliptic; polar view – circular or triangular with convex, rather equilateral sides and the apertures situated in the angles, which are obtuse.

Measurements: Exine c. 3 μ; longest axis (E) 42–45 μ; P/E ratio 0.74–0.83.

PLATE III. *Ellipanthus hemandradenioides* Brenan *(Faulkner 2158)*.

1. Polar view; cross-section; nexine thicker than sexine.
2. Scanning electron micrograph; polar view (×1500).
3. Endoaperture; colpus, broad, distinct in the middle, diffuse towards the ends.
4. Ornamentation; reticulum at high focus, fine, lumina irregular in outline.
5. Ornamentation; reticulum at low focus; muri simplicolumellate, columellae distinct, circular in outline.



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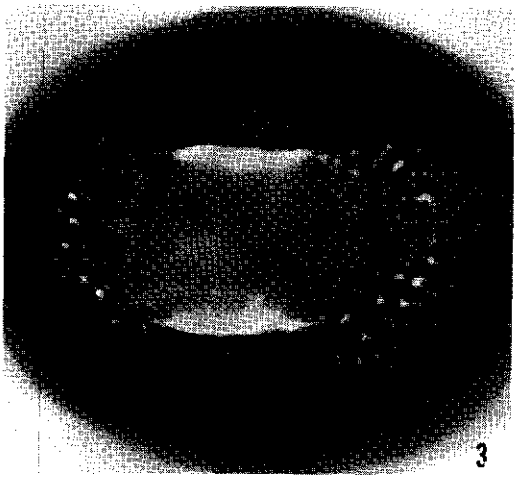

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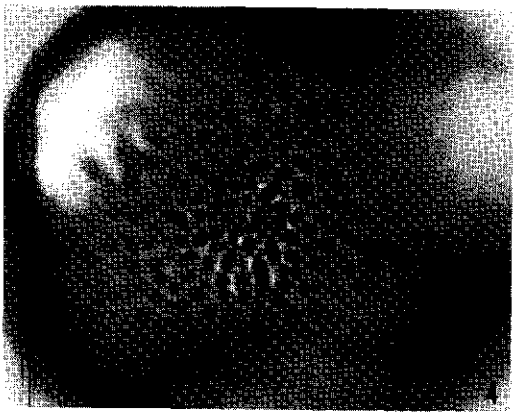

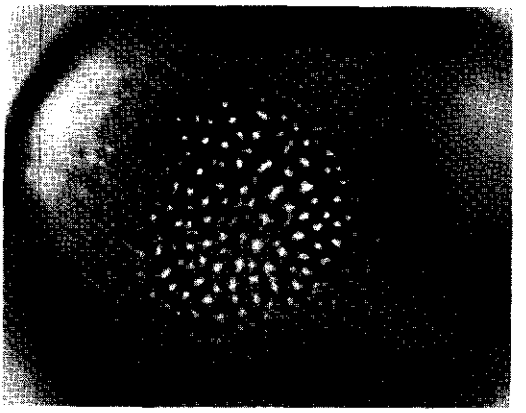

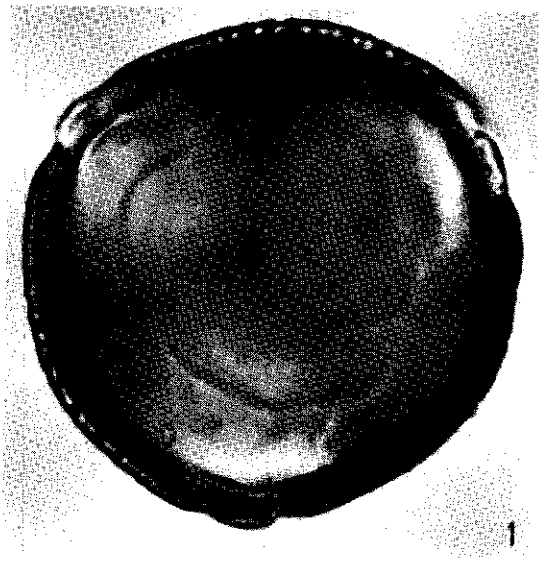

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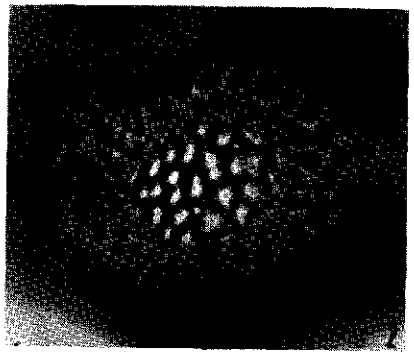

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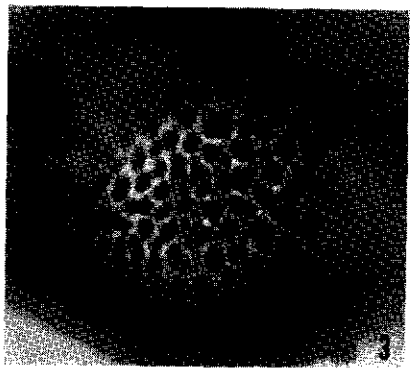

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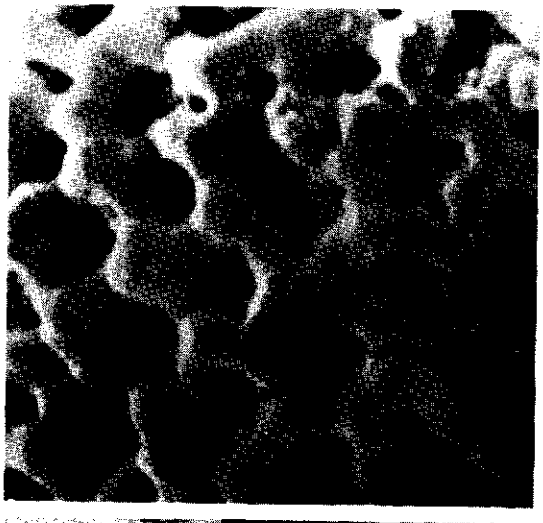

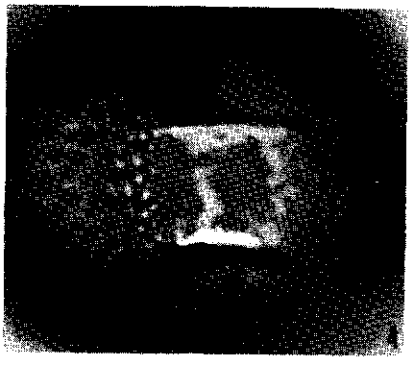

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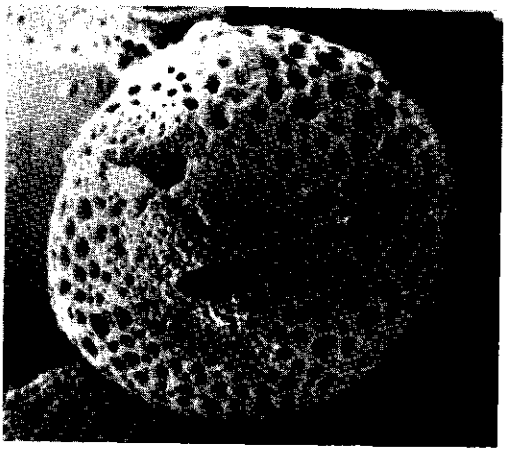
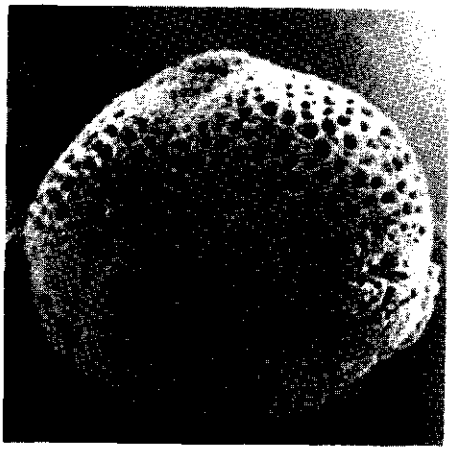




6.5.4. *Ellipanthus tomentosus type (Plate IV)*

Pollen class: 3-zonocolporate.
P/E ratio: Transverse to semitransverse.
Apertures: Ectoapertures – colpus, long, rather broad, not sunken, margins indistinct, ends diffuse or obtuse; colpus membrane granulate. Endoapertures – lalongate colpus, rarely a circular porus, broad, margins clear at the middle part only, no costae, ends diffuse. Endocolpus covered by a granulate, thin, bridge of sexine material.
Exine: About 3 μ thick; sexine about as thick as nexine, rarely thicker at the mesocolpium. Columellae thin, as long as or slightly longer or shorter than the capita. Capita circular to slightly laterally elongated and fused into a semitectum.
Ornamentation: Reticulate, rather coarse to coarse. Lumina up to 2 μ in diameter, irregularly angular and variable in size. Muri simpli- or duplicolumellate. In L–O analysis, columellae rather indistinct and more or less circular in outline.
Outline: Equatorial view – elliptic; polar view – circular to triangular with convex sides and the apertures are situated in the angles, which are obtuse.
Measurements: Exine c. 3 μ; longest axis (E) 35–40 μ; P/E ratio 0.74–0.85.
Taxa: *E. tomentosus* ssp. *kingii*, *E. tomentosus* ssp. *tomentosus* var. *luzoniensis*, *E. beccarii* var. *peltatus*.

PLATE IV. *Ellipanthus beccarii* Pierre var. *peltatus* (Schellenberg) Leenhouts *(Mikil 41911)*.
1. Polar view; cross-section, nexine about as thick as sexine.
2. Ornamentation; reticulum at low focus, muri simpli- or duplicolumellate, columellae rather indistinct.
3. Ornamentation; reticulum at high focus, lumina coarse.
4. Endoaperture; colpus, broad, distinct in the middle, diffuse towards the ends.
   Ellipanthus tomentosus Kurz ssp. *kingii* (Boerlage et Koorders) Leenhouts *(Koorders 24021 B)*.
5. Scanning electron micrograph; ornamentation (×7500).
   Ellipanthus tomentosus Kurz ssp. *tomentosus* var. *luzoniensis* (Vidal) Leenhouts *(Neth. Ind. For. Service bb 19816)*.
6. Scanning electron micrograph; equatorial view, colpus with distinct bridge, partly covering the endoaperture.
7. Scanning electron micrograph; polar view, coarse reticulum.

Phot.: Division of Palaeobotany and Pollen Morphology, State University, Utrecht.

7. TAXONOMIC TREATMENT OF HEMANDRADENIA

7.1. Description of the genus

Hemandradenia Stapf, 1908: 288; Schellenberg, 1910: 21, 103; 1938: 64; Thonner, 1915: 244; Leenhouts, 1958: 520; Aubréville, 1959: 194; Hutchinson, 1964: 168; Dickison, 1973: 121–138.

Type species: *H. mannii* Stapf.

Shrubs or small trees. *Leaves* alternate, entire, unifoliolate. Petiole terete and jointed to a petiolule, each with a pulvinus. *Inflorescences* axillary, glomerate or paniculate. Bracts minute, subtriangular. *Flowers* small, subsessile, predominantly 5-merous, bisexual. *Sepals* 5, basally connate, slightly imbricate to valvate. *Petals* 5, shortly coherent in the lower part to completely free, valvate to slightly imbricate. *Stamens* usually 5 fertile, opposite the sepals, alternating with 5 staminodes opposite the petals, both shortly connate at the base into a ring. *Pistil* 1; ovary sessile, ovoid to ellipsoid, with 2 collateral ovules; style short and fairly stout or long and filiform; stigma capitate to lobulate. *Fruits* ellipsoid, ovoid or obovoid, indehiscent, tomentose, yellow to brownish when ripe. Calyx persistent in fruit. Fruit wall thinly crustaceous. *Seed* 1, outer layer of seedcoat fleshy (sarcotesta), inner layer thin; endosperm thin to copious; embryo with flat cotyledons. Germination epigeous.

Distribution: 2 species in West and Central Africa.

Habitat: Primary and old secondary rain forest, or semi-deciduous forest, at low and medium altitudes.

Note. The endosperm is very thick in *H. mannii* (Fig. 3: 16) and the cotyledons are thin and narrow, whereas in *H. chevalieri* the figure shows that the endosperm is thin and cotyledons are very thick. This discrepancy may be attributed to differences in state of maturity of the seeds. *H. mannii* seeds as shown are probably less mature than *H. chevalieri* seeds, although the former had, at collecting time, already the colour of mature fruits.

7.2. Key to the species

Leaf margin not revolute; flowers in panicles, axillary and subterminal; sepals 1–2 mm long; petals free; fruits obovoid . . . . . **H. chevalieri**

Leaf margin revolute near base; flowers in axillary glomerules; sepals 3–4.5 mm long; petals coherent in lower part; fruits ellipsoid or ovoid . . **H. mannii**

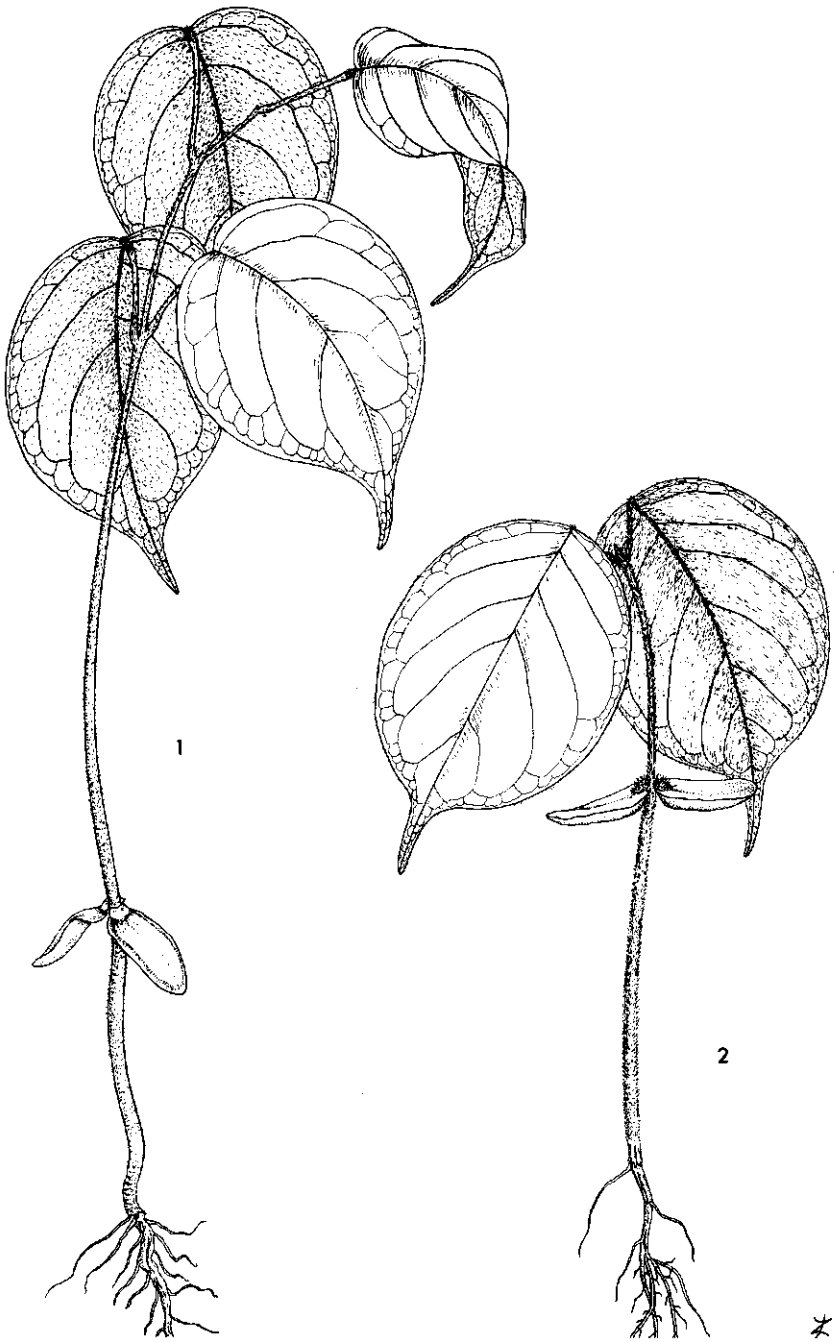


FIGURE 1. Seedlings of *Hemandradenia*, $^{2}/_{3}\times$: 1. *H. chevalieri;* 2. *H. mannii.* (1. *Eimunjeze s.n.*; 2. *De Bruijn 2038).*

The seedlings of the two species can easily be distinguished as follows (see Fig. 1):

Hypocotyl shorter than epicotyl; cotyledons completely glabrous; first leaves cordate at base . . . . . **H. chevalieri**

Hypocotyl longer than epicotyl; cotyledons hairy at inner base; first leaves obtuse at base . . . . . **H. mannii**

7.3. H. CHEVALIERI STAPF (FIG. 2, MAP 1)

STAPF, 1908: 289; SCHELLENBERG, 1938: 65; KEAY, 1958: 749; AUBRÉVILLE, 1959: 194.

Type: Ivory Coast, basin of Cavally R., shore between Tabou and Béréby, *Chevalier 19943* (holotype: P).

Description: Shrub or small tree. *Branches* dark-brown, with few scattered or many lenticels. Branchlets pale-brown tomentose, soon glabrescent. *Leaves:* petiole 5–7 mm long, terete pale-brown tomentose, glabrescent; petiolule terete, sometimes grooved above, 2.5–3 mm long, pale-brown tomentose, glabrescent; blade thinly coriaceous, oblong-elliptic, sometimes narrowly so, (7.5–)9–14(–18) cm long, (2–)3–6 cm broad; glabrous above, sparsely appressed-pubescent beneath; usually rounded, rarely broadly cuneate and subpeltate at base, apex acuminate; acumen c. 0.5–1.3(–2) cm long, with rounded or rarely truncate tip; leaf margin thickened, very slightly undulate; midrib prominent beneath with 5–9(–10) rather prominent lateral nerves; areolation large (see Fig. 2). *Inflorescences* paniculate, many-flowered, subterminal and/or in the axils of the upper leaves, c. 2–7(–10) cm long; peduncles up to 4 cm long, pale-brown tomentose. *Flowers* 5(–7)-merous, 5–8 mm long, subsessile; pedicel up to 1.5 mm long, pale-brown tomentose. *Sepals* slightly spreading or erect, triangular, c. 1.5 mm long, shortly connate at base, valvate, pale-brown tomentose outside, glabrous inside, apex acute. *Petals* free, imbricate, erect or slightly spreading and finally reflexed and once or twice coiled, narrowly elliptic, 5–5.5 mm long, c. 1 mm broad, finely tomentose both sides, apex acute. *Stamens* 3.5–7 mm long; filaments filiform, pubescent up to c. 1 mm below anther. *Anthers* cordate, c. 1 mm long. *Staminodes* 5, narrowly ovate to narrowly elliptic, c. 1.5 mm long, glabrous, entire or shortly dichotomously branched and slightly beaked. *Staminal ring* usually puberulous inside, sometimes glabrous, generally glabrous outside. *Pistil* 3.5–7 mm long; stigma capitate to lobulate, exserted or not; style appressed-pubescent, occasionally only lower half and then upper half puberulous to glabrous; ovary ellipsoid, densely hirsute. *Fruit* obovoid, 2.6–2.9 cm long, 1.5–1.8 cm in diameter, densely tomentose, yellowish to brownish when ripe. *Seed* obovoid, 1.8–2.4 cm long, 0.9–1.2 cm in diameter; inner seedcoat thin and brittle; endosperm car-

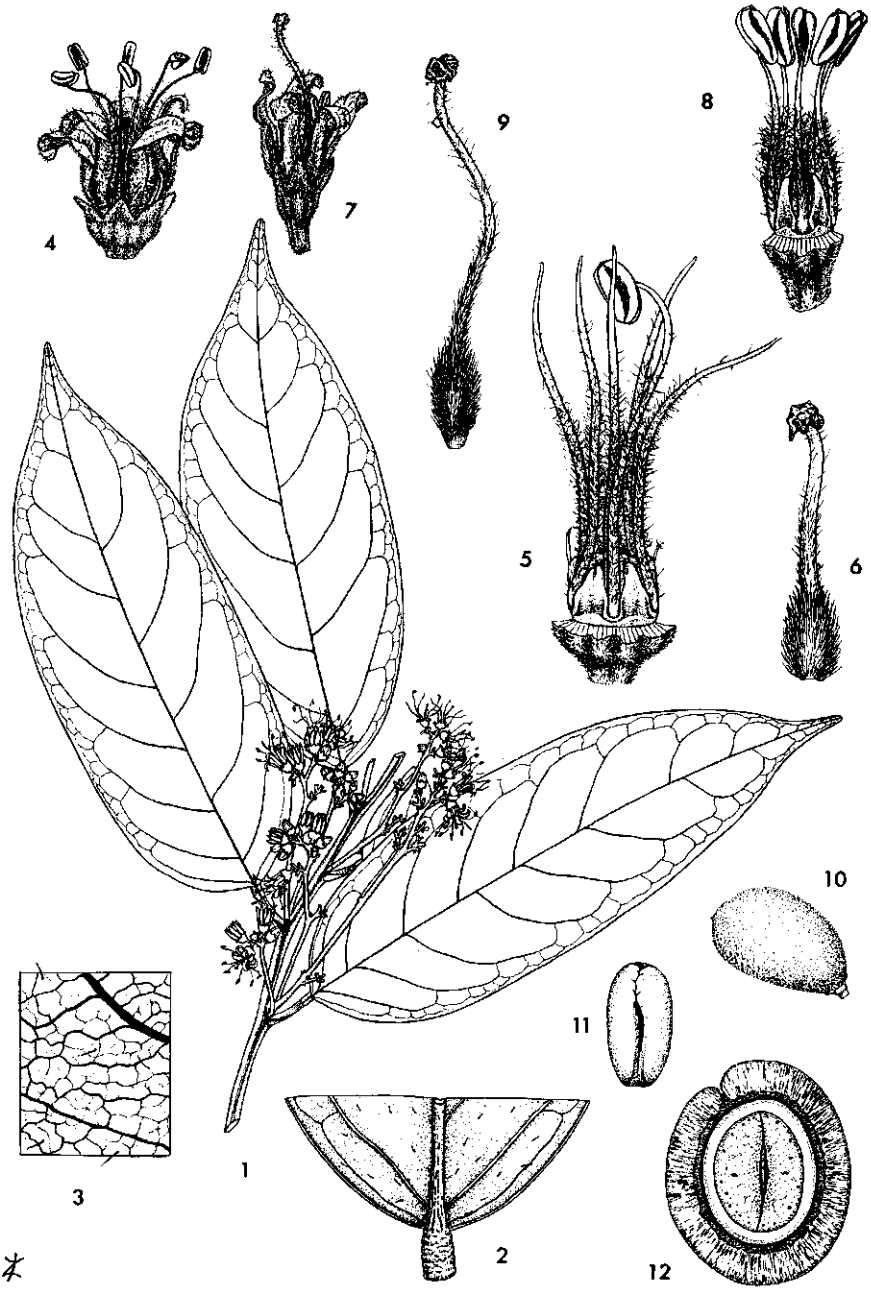
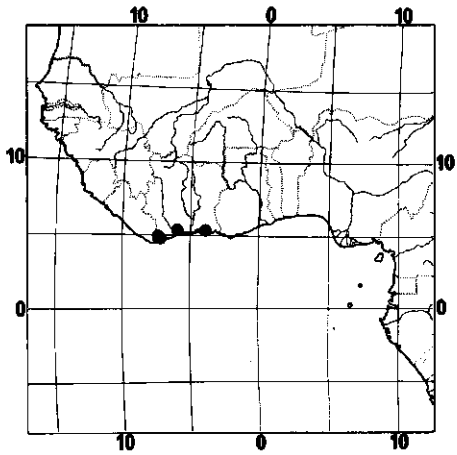


FIGURE 2. *Hemandradenia chevalieri* STAPF: 1. flowering branch, $^2/_3$ ×; 2. leaf base beneath, 2 ×; 3. detail of venation, 4 ×; 4. stamen-dominant flower, 4 ×; 5. long stamens with staminodes, 8 ×; 6. short pistil, 8 ×; 7. pistil-dominant flower, 4 ×; 8. short stamens with staminodes, 8 ×; 9. long pistil, 8 ×; 10 fruit, $^2/_3$ ×; 11. seed, $^2/_3$ ×; 12. cross section seed, 2 ×. (1, 3–6, *Chevalier 19968;* 2, *De Wit 9020;* 7–9, *Aubréville 1495;* 10–12, *De Koning 6169*).

tilaginous; radicle short and stout, 3 mm long, 2 mm in diameter, protruding at the micropylar end, slightly beyond the endosperm; cotyledons obovoid, cream coloured, turning reddish-brown on exposure, up to 2.3 cm long, 1.0 cm broad, c. 6 mm thick, rather mealy.

Seedling: Viable seeds germinate in 2–3 weeks. *Primary root* well developed. *Hypocotyl* (2–)3–5.6 cm long, pale-brown appressed-pubescent. *Cotyledons* obovate, c. 2.4 × 1.1 cm, equal, opposite, horizontally spread, very shortly petiolate, swollen at inner base, glabrous, red outside, greenish-yellow inside, soon completely reddish. *Epicotyl* 7–9.7(–11) cm long, terete, pale-brown appressed-pubescent. *First leaves* opposite, unifoliolate; petiole and petiolule together 1–1.6 cm long, pale-brown appressed-pubescent. Blade ovate, 4.5–7 cm × 3.9–5.1 cm, top acuminate to subcaudate, cordate at base, glabrous above, sparsely appressed-pubescent beneath, more densely so on the midrib and main lateral nerves. *Subsequent leaves* alternate, both petiole and petiolule 2–2.8 cm long; blade ovate to elliptic, 5.8–6.5 × 4–4.3 cm, obtuse at base; otherwise similar to the first leaves.



MAP. 1. *H. chevalieri.*

Distribution: Ivory Coast.
Habitat: Rainforest and semideciduous forest.

Specimens examined: IVORY COAST: Port-Bouët, *Aubréville 1495* (BR, P); (fr. April), *1636* (P); Embouchure du Sassandra (fr. April), *Aubréville 2803* (BR, P); between Tabou and Bérèby (fl. Aug.), *Chevalier 19943* (P, type); (fl. Aug.), *19968* (BR, P); Banco Forest, *Cremers 395* (BR); *445* (P); *Toilliez 334* (BR); *347* (BR); (fr. Jan.), *De Wit 9020* (WAG); (fr. Nov.), *De Koning 6169* (WAG).

CULT. Wageningen: *Eimunjeze s.n.* (motherplant *De Koning 6169*) (WAG, seedling); *De Wit et De Bruijn We 28* (WAG, seedling).

Note: Herbarium records show that this species has been collected in Banco forest reserve. This is not shown on the distribution map, because according to Mr. J. DE KONING, presently in Ivory Coast, *H. chevalieri* does not occur naturally in the Banco forest reserve, but it is present only in cultivation in the Banco forest Arboretum.

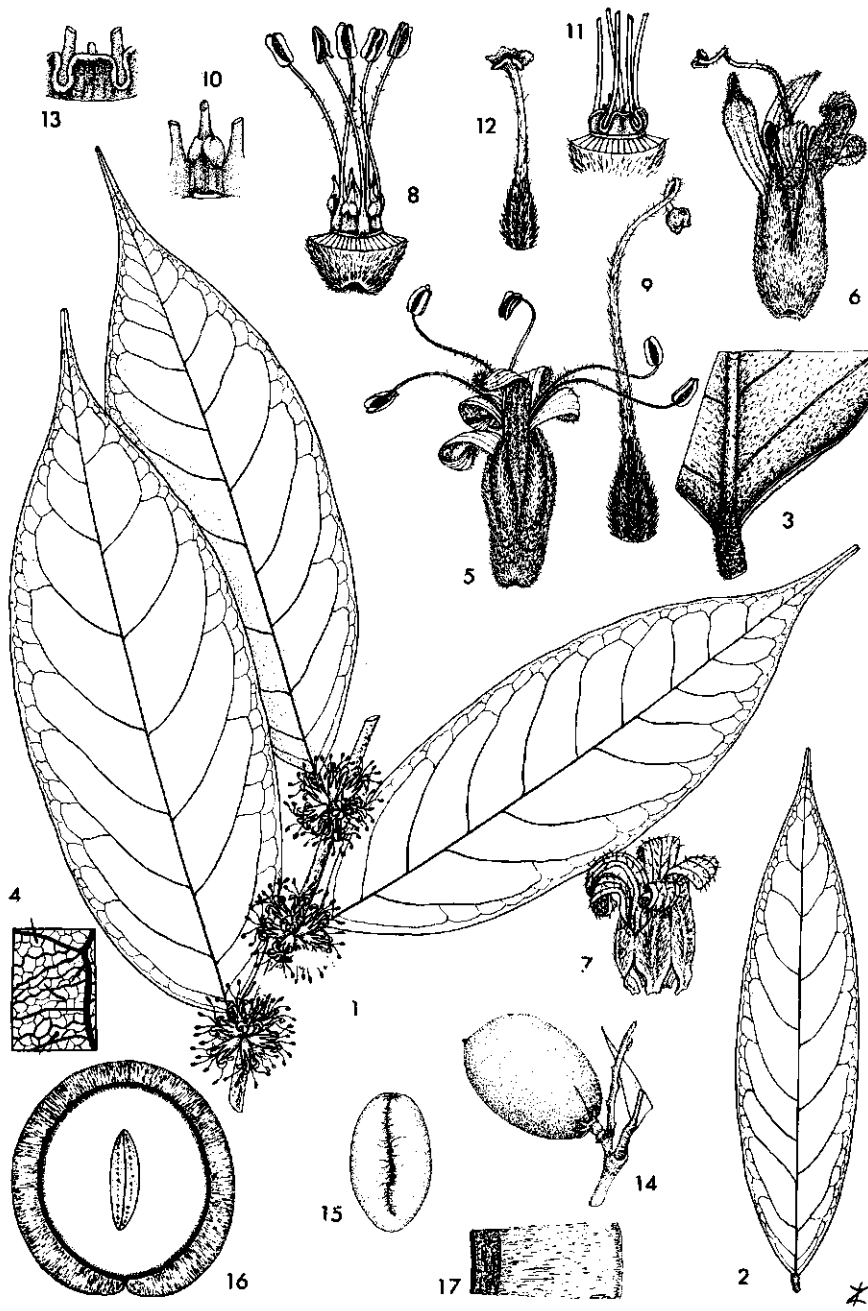
7.4. H. MANNII STAPF (FIG. 3, MAP 2)

STAPF, 1908: 288; SCHELLENBERG, 1910: 21, 103; 1938: 64; KEAY, 1958: 749; DICKISON, 1973: 121–138.

Type: Equatorial Guinea, Muni river, *Mann 1763* (holotype: K).

H. glomerata AUBRÉVILLE et PELLEGRIN, 1958: 35; Aubréville, 1959: 194. Type: Ivory Coast, Haute-Niouniourou, *Aubréville 4123* (holotype: P; isotype: WAG).

Description: Shrub or small tree 3–15 m tall and up to 8 cm in diameter. *Branchlets* terete, pale-brown appressed-pubescent, glabrescent. *Leaves:* petiole (3–)4–7 mm long, petiolule 2–3.5 mm long, both usually terete, sometimes grooved above, mostly pale-brown appressed-pubescent in young leaves and puberulous or glabrescent in older ones; blade thinly coriaceous, narrowly elliptic or elliptic, 7–18.5 cm long, 1.5–6.5 cm broad, glabrous above, pale-brown appressed-pubescent and finally glabrescent beneath; obtuse to cuneate at base, slightly caudate to acuminate at apex; margin thickened, slightly undulate, revolute in the basal part; acumen c. (0.2)0.4–1.8 cm long, usually rounded, very rarely faintly emarginate at the tip; main lateral nerves 6–10(–11) pairs, areolation small and distinct (see Fig. 3). *Inflorescences* glomerate, few- to many-flowered, pale-brown appressed-pubescent. *Flowers* (4–)5-merous, subsessile, pedicel up to 1 mm long, appressed-pubescent. *Sepals* erect or slightly spreading, slightly imbricate or valvate, narrowly triangular, 3–4.5 mm long, c. 1 mm broad, pale-brown appressed-pubescent outside, glabrous inside, apex acute. *Petals* slightly spreading, narrowly ovate to narrowly obovate or narrowly elliptic, (5–)6–8 mm long, coherent in the lower part for 2–3 mm length, apical part erect or reflexed and once or twice coiled, pale-brown appressed-pubescent outside, inside glabrous or tomentulose to puberulous or partly so. Corolla often detaching as a unit at the end of anthesis. *Stamens* usually 5 fertile, 5–9(–10.5) mm long, filaments filiform, variously partly pubescent, rarely completely pubescent or glabrous. *Staminodes* 5, 1–1.5(–3.5) mm long, usually triangular, rarely oblong and beaked, or occasionally with broad base and upper half filiform and beaked, in the latter case thickened glands between the stamens and staminodes may be observed. *Anthers* yellow c. 1 mm long, usually ovate, rarely elliptic, occasionally the base and/or connective pilose. *Pistil* 3.5–6.5(–11) mm long, stigma capitate to lobulate, exserted in long-styled flowers, style short and fairly stout in short-styled flowers, long and filiform in long-styled flowers, pale-brown appressed-pubescent, often sparsely so in the upper half; ovary ovoid to obovoid, densely hirsute, rarely appressed-pubescent. *Fruits* ellipsoid or ovoid, 3.3 cm long, 2 cm in diameter, densely tomentose, yellowish-brown when ripe. Fruit wall crustaceous, 1.5 mm thick, glabrous inside. *Seed* ellipsoid or ovoid, c. 2.3 cm long, c. 1.3 cm in diameter;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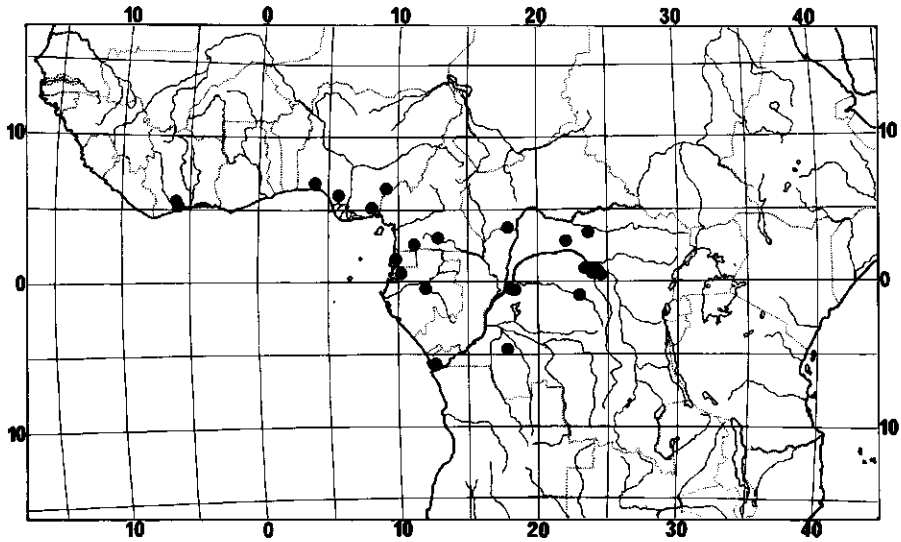
sarcotesta greyish-violet or cream; endosperm very hard. Radicle short and stout, 3.5 mm long, 2.5 mm in diameter, cotyledons thin, flat and narrow, 17 mm long, 7 mm broad.

Seedlings: *Primary root* well developed. *Hypocotyl* 7.5–8 cm long, terete, densely pale-brown appressed-pubescent. *Cotyledons* elliptic, c. 1.3 × 0.8 cm, horizontally spread, equal, opposite, fleshy, very shortly petiolate, hirsute at inner base. *Epicotyl* c. 4.5 cm long, terete, densely pale-brown appressed-pubescent. *First leaves* opposite, unifoliolate, petiole and petiolule together 0.7–1 cm long, densely pale-brown appressed-pubescent. Blade elliptic, c. 7.5 × 5 cm, obtuse at base, caudate at apex, glabrous above, appressed-pubescent beneath, more densely so on the midrib and main lateral nerves.



MAP 2. *H. mannii*.

Distribution: Ivory Coast, Nigeria, Cameroun, Central African Republic, Equatorial Guinea, Gabon and Zaïre.

Habitat: Rain forests and semi-deciduous forests at low and medium altitudes.

Specimens examined: IVORY COAST: Haute-Niouniourou (fl. Feb.), *Aubréville 4123* (P, WAG, type of *H. glomerata)*; 38 km N.E. of Sassandra (fr. Nov.), *Breteler 6116* (WAG).

FIGURE 3. *Hemandradenia mannii* STAPF: 1. flowering branch, $^2/_3$ ×; 2. leaf beneath, $^2/_3$ ×; 3. revolute leaf base, beneath, 2 ×; 4. detail of venation, 4 ×; 5. stamen-dominant flower, 4 ×; 6. pistil-dominant flower, 4 ×; 7. corolla, 4 ×; 8. stamens and staminodes, 6 ×; 9. long pistil, 6 ×; 10. detail staminode pistil-dominant flower, 12 ×; 11. staminodes stamen-dominant flower, 6 ×; 12. short pistil, 6 ×; 13. detail staminode stamen-dominant flower, 12 ×; 14. fruiting branchlet, $^2/_3$ ×; 15. seed, $^2/_3$ ×; 16. cross section of seed, 2 ×; 17. detail of seed-coat, 10 ×. (1, 3–5, 11–13, *Tisserant (Equipe) 316*; 2, *J. Léonard 583*; 6, 8–10, *Germain 7450*; 7, *Latilo FHI 30960*; 14–17, *Breteler 6116)*.

NIGERIA: Benin, Okomu F.R. (fr. Dec.), *Brenan 8561* (BM, BR, FHI, K); *9160* (FHI); (fr. Feb.), *Brenan and Onochie 9026* (FHI, K); Obudu, Okwangwo F. R. (fl. May), *Latilo FHI 30960* (K); Eluji, Shasha F.R. (fl. April), *Ross 193* (BM, BR); Calabar, Ikoromo (fr. July), *Ujor FHI 31629* (FHI).

CAMEROUN: Bitye nr. R. Dja (fl. Sept.), *Bates 1881* (BR, K); Akonekye, 15 km N.W. d'Ambam (fr. March), *Letouzey 10206* (P).

CENTRAL AFRICAN REPUBLIC: Mbaiki and Boukoko Region (fl. Oct.), *Tisserant (Equipe) 316* (P); (fl. Oct.), *1157* (P); (fl. Sept.), *1891* (P); (fr. Jan.), *2337* (P).

EQUATORIAL GUINEA: River Muni, *Mann 1763* (K, type).

GABON: Monts de Cristal, River Sanga (fr. Feb.), *Hallé and Villiers 5287* (P); Lastoursville (fl. June), *Le Testu 8867* (BM, P).

ZAÏRE: Binga, *Croeqaert 46* (BR); Ikela (fr. May), *Dubois 823* (BR); Tumba lake, Elema Isl. (fl. March), *Evrard 3779* (BR, K); *3786* (BR); Kimbili Mts, *Flamigni 10446* (BR); between Yafela and Yandjali (fl. and fr. Dec.), *Germain 4559* (BR); Yabibi, towards Basoko (fr. Oct.), *Germain 4637* (BR); Yandjali, between Isangi and Ligasa, *Germain 4924* (BR); Ikela, (fl. June), *Germain 7413* (BR); R. Lukenzu, Ikela (fl. June), *Germain 7450* (BR); Yangambi, *Gilbert 7869* (BR); *8255* (BR); Mpotia, Tumba Lake (fl., fr. Sept.), *Léonard 583* (BR, L, WAG); Basukutu, nr. Lubilu (fl. Nov.), *Léonard 1547* (BR); Dundusana, *Mortehan 504* (BR); (fl. Dec.), *877* (BR); Gimbi, Fuka Valley (fl. Feb.), *Toussaint 842* (BR); Inéac, Gimbi (fl. Jan.), *Wagemans 466* (BR); (fr. Jan.), *467* (BR, WAG).

CULT. WAGENINGEN: *De Bruijn 2038* (WAG, seedling of *Breteler 6116*).

Note: Comparative studies of the holotype and isotype of *H. glomerata* (*Aubréville 4123*) with material of *H. mannii* showed that the former only represents a short-styled (stamen-dominant) specimen of *H. mannii*, and in conjunction with other characters, perfectly fits into the variability of *H. mannii*.

7.5. EXCLUDED SPECIES

Hemandradenia madagascariensis SCHELLENBERG (1938) = *Ellipanthus madagascariensis* (SCHELLENB.) CAPURON (1958).

Note: Examination of the type material (*Baron 5626*) preserved in the Kew herbarium leaves no doubt that this material belongs in *Ellipanthus*.

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BR – Brussels, Belgium: Nationale Plantentuin.
FHI – Ibadan, Nigeria: Forest Herbarium.
K – Kew, Great Britain: Royal Botanic Gardens.
L – Leiden, Netherlands: Rijksherbarium.
LISC – Lisboa, Portugal: Centro de Botanica da Junta de Investigaçoes do Ultramar.
P – Paris, France: Muséum National d'Histoire Naturelle, Laboratoire de Phanérogamie.
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