

pient ridges and spicules. Flagellum to c. 1 m long. Leaf ecirrate to 70 cm, including the petiole to 13 cm; petiole semicircular in cross section, to 4×2 m at the base, armed with a few scattered horizontal spines along the 2 edges and short spinose ridges on the abaxial surface near the base and a few scattered reflexed spines to 2.5 mm along the mid-line of the abaxial surface; leaflets 9–13 on each side of the rachis, rather distant but \pm regularly arranged; proximal leaflets the longest, to 25×1.5 cm, leaflet size decreasing distally to 14×1.2 cm; leaflets with 3 main veins, sometimes acuminate in a long filiform drip tip, and/or rather densely armed with brown bristles to 4 mm at the tip, the margins armed with scattered minute bristles, transverse veinlets sinuous, rather conspicuous, adaxial surface unarmed, abaxial surface armed with rows of extremely small short brown hairs with pale swollen bases. Inflorescences 1–2 m long, staminate and pistillate superficially similar; partial inflorescences 2–3 only, the terminal flagellum to c. 45 cm long; primary bracts armed with short spiny ridges and scattered very short spines with swollen base; distal portion of inflorescence with reflexed spines, scattered or arranged in grape-like groups; proximal partial inflorescence lax, \pm triangular in outline, to 15×6 cm, the distal partial inflorescence smaller; second order branches c. 6 on each side, the most proximal 1 or 2 on each side in the staminate inflorescence bearing 1 or 2 third order branches; staminate and pistillate rachillae very slender, zig-zag, the longest c. 5 cm long, bearing very sparse brown scales. Staminate flowers c. 2–3 mm distant; rachilla bract triangular c. 1 mm long; involucre c. 0.5 mm long; scar of the staminate flower c. 0.8 mm diam. Staminate flower c. 4.5×1.5 mm in bud, bullet-shaped; calyx striate, \pm glabrous, c. 3.5 mm, tubular in basal 2 mm, with 3 acute triangular lobes to 1.5×1 mm; corolla glabrous, tubular in basal 2 mm, with 3 narrow acute petals to 2.5×0.7 mm; filaments c. 1 mm, anthers 1.0×0.2 mm; pistillode apparently absent. Pistillate flowers not known at anthesis. Almost mature fruit \pm obpyriform, 8×6 mm, tipped with a beak to 1×1 mm, and covered in c. 16 vertical rows of reddish-brown scales. Seed spherical, c. 4 mm diam., shallowly pitted; endosperm homogeneous; embryo lateral. Eophyll unknown. (Fig. 6).

BORNEO. Sarawak, 4th Division, Lambir Hills National Park, *Awang Morshidi* S 24059 (holotype K; isotypes BH, SAR), *Dransfield et al.* JD 5937 (BH, BO, K, L, PNH, SAR), JD 5939 (BH, K, L, SAR). Brunei, Bt. Biang, *Ashton* A 90 (K).

Calamus lambirensis is a slender, thicket-forming rattan of ridge tops on Tertiary sandstones at about 50–500 m. Because of its slender lax inflorescence with few large flowers borne on expanded areolae it clearly belongs to Furtado's Section *Macropodus*, being related to *C. sarawakensis*, *C. hispidulus* and *C. gibbsianus*. It is unusual in the presence of muricate leaf sheaths, thus resembling superficially *C. zonatus* Becc., *C. muricatus* and *C. divaricatus*; these last three are, however, quite different in inflorescence structure, and belong to Furtado's Section *Coleospathus*.

Calamus nanodendron *J. Dransf.* sp. nov. egregia, robusta, erecta non scandens, foliis magnis, inflorescentia brevissima, inflorescentia floribus et fructibus *C. conirostri* Becc. et *C. lobbiano* Becc. affinis sed fructu oblato vice obpyriformi rostratoque; a *C. lobbiano* foliolis concoloribus et caule magno et



FIG. 6. *Calamus lambirensis*. **A** portion of sheathed stem $\times \frac{2}{3}$; **B** portion of leaf $\times \frac{2}{3}$; **C** part of staminate inflorescence $\times \frac{2}{3}$; **D** part of staminate rachilla $\times 4$; **E** staminate flower $\times 6$; **F** staminate flower bud in section $\times 6$; **G** part of infructescence $\times \frac{2}{3}$; **H** mature fruit $\times 3$. **A** & **B**, **G** & **H** from Dransfield et al. JD 5939, **C**–**F** from Dransfield et al. JD 5937. Drawn by Heather Wood.

a *C. conirostri* habitu non scandenti statim distinguibilis. Typus: Borneo, Sarawak, *Dransfield et al.* JD 6092 (holotypus K; isotypi BH, SAR).

Robust solitary rattan with short erect or sometimes decumbent stem to c. 1 m only. Stem without leaf sheaths to 5 cm diam., with sheaths to 10 cm diam.; internodes very short, c. 3 cm long. Leaf sheaths tubular at first, becoming split opposite the petiole for much of their length, dull green, densely covered with robust triangular, flattened green spines, c. 5–70 × 3–6 mm, sometimes with black tips and caducous black scales between the spines; spines along margin of the leaf sheath mouth sometimes more slender and ± erect; ocrea inconspicuous, tattering; knee absent. Flagellum absent. Leaf arcuate, robust, to 2.5 m including the petiole to 50 cm; petiole channelled adaxially, c. 10–13 mm wide, ± densely armed with horizontal, triangular flattened pale green spines, 5–60 × 3–6 mm with swollen bases and sparse caducous blackish scales; rachis armed as petiole but more sparsely so. Leaflets c. 50 on each side of the rachis, narrow, regular, concolorous, the longest c. 50 × 2 cm at about the middle of the rachis, decreasing to c. 16 × 1 cm at the very tip, very sparsely armed along margins, transverse veinlets conspicuous, very fine and close. Staminate inflorescence rarely exceeding 30 cm, branching to 2–3 orders; peduncle short, ± hidden among the sheaths; first order branches c. 5 to 20 cm, usually much less, each subtended by a somewhat inflated primary bract to 9 × 1.5 cm, with a long triangular limb and densely covered with dull brown tomentum; rachillae ± arcuate, up to 50 × 5 mm, dull brown; rachilla bracts strictly distichous, tubular with conspicuous triangular limb to 6 × 3 mm, striate, the margins lightly toothed, the whole covered in caducous brown tomentum. Pistillate inflorescence similar to the staminate but branching to 1–2 orders only, or rarely 'spicate'; primary bracts as in the staminate; rachillae few, c. 55 × 10 mm or less. Staminate flower c. 7.5 mm long; calyx with a basal tube to 3 × 3 mm, and 3 triangular lobes to 1 × 1.2 mm, the tube often splitting deeply, the whole striate and bearing sparse silvery flat scales; corolla to 7 mm, tubular in basal c. 1 mm, with 3 petals c. 1.5 mm wide, bearing sparse silvery flat scales; stamens epipetalous at the mouth of the corolla tube, filaments elongate, ± fleshy, c. 8 mm long, inflexed in bud, anthers basifixed, c. 2.0 × 0.5 mm; pistillode c. 3 mm long, trifold. Pistillate flower c. 9 × 4.5 mm; calyx tubular in basal c. 4 mm, apically with 3 triangular lobes to 4 × 4 mm, striate, the surface bearing caducous scales; corolla striate, split to c. $\frac{1}{2}$, the lobes ± triangular, c. 4 × 3.5 mm, caducously scaly; staminodal ring 6-dentate; ovary obpyriform, c. 8 mm long, c. 3.5 mm diam., tipped with 3 sinuous stigmas to 3 mm. Mature fruit (based on a reconstruction) globose to turbinate, c. 20 mm diam., covered in c. 26 vertical rows of dull straw-coloured scales. Seed ± oblate, 15 × 20 mm in diam., very deeply grooved and pitted; endosperm otherwise homogeneous; embryo subbasal. Eophyll unknown. (Fig. 7).

BORNEO. Sarawak, 1st Division, Serian District, Sabal Tapang Forest Reserve, slopes of G. Gaharu, *Dransfield et al.* JD 6092 (holotype K; isotypes BH, SAR), JD 6093; Kuching District, Semengoh, *Dransfield et al.* JD 5983 (BH, K, SAR), JD 5984 (BH, K, SAR).

Calamus nanodendron is a most unusual and distinctive species, although in the forest it might easily be overlooked as a very robust sterile rattan sapling.

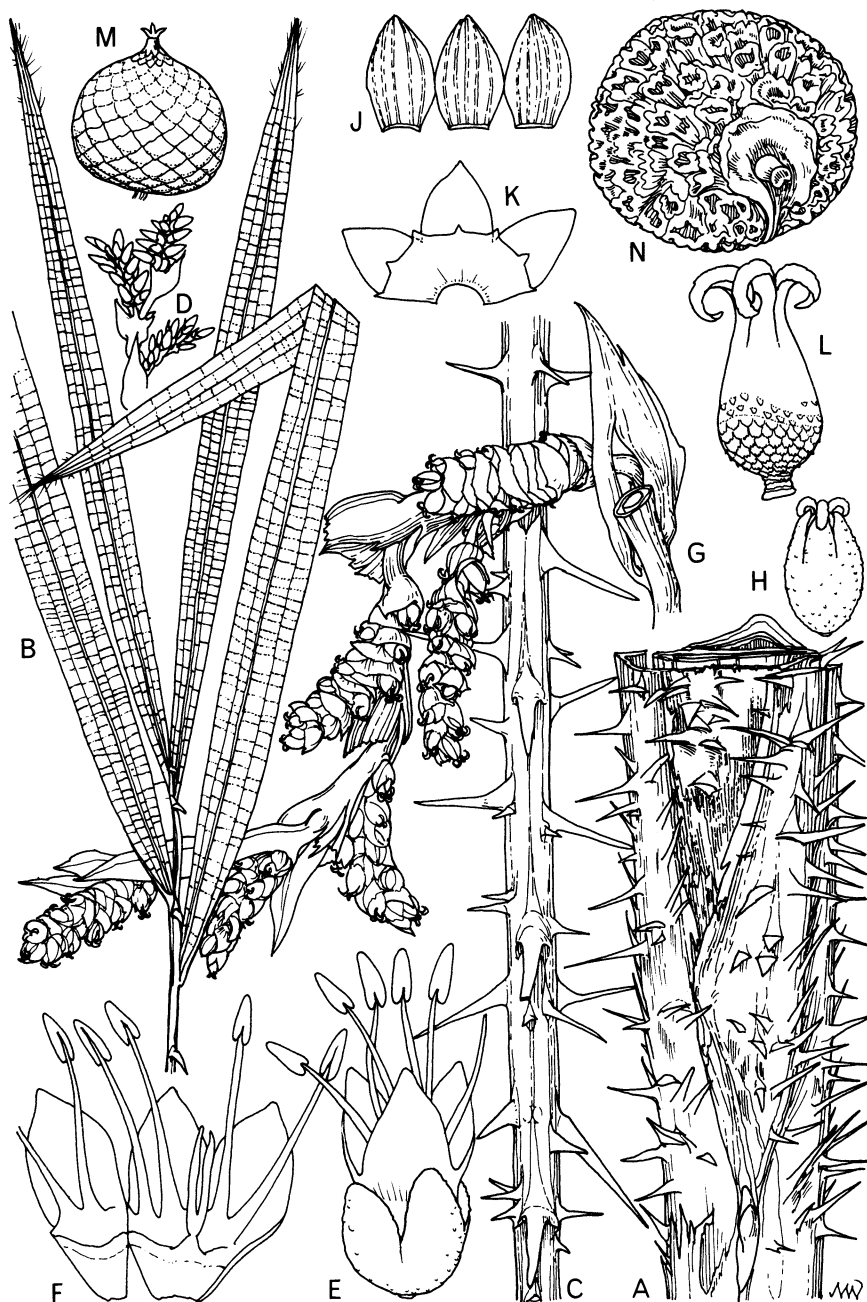


FIG. 7. *Calamus nanodendron*. **A** portion of sheathed stem $\times \frac{1}{3}$; **B** leaf tip $\times \frac{2}{3}$; **C** petiole $\times \frac{2}{3}$; **D** part of staminate inflorescence $\times \frac{2}{3}$; **E** staminate flower $\times 4$; **F** staminate flower opened up $\times 4$; **G** pistillate inflorescence $\times \frac{2}{3}$; **H** pistillate flower $\times 2$; **J** sepals of pistillate flower $\times 2$; **K** corolla of pistillate flower $\times 2$; **L** gynoecium $\times 3$; **M** fruit $\times 1$; **N** seed $\times 2$. **A-C, G-N** from *Dransfield et al.* JD 6092, **D-F** from *Dransfield et al.* JD 6093. Drawn by Mary Millar-Watt.

Persistent searching and poking around among the leaf sheaths revealed inflorescences. It seems to be confined to 'kerangas' forest at low elevations. It bears a superficial resemblance in habit to *C. castaneus* Griff. of Peninsular Malaysia, but the inflorescence and fruit suggest that its affinities are with the species of *Calamus* included by Furtado (1955) in the separate genus *Cornera* but subsequently retransferred to *Calamus* (Dransfield 1977)—species such as *C. lobbianus* Becc. and *C. conirostris* Becc. Among these it is immediately distinguishable by its unusual habit, that of a short squat 'tree'.

Calamus crassifolius J. Dransf. sp. nov. ad sectionem *Coleospathum* pertinens *C. insigni* speciei Malayana verosimiliter affinis sed folio unijugato foliolis crassis divergentibus distinctissima et ceteris speciebus *Calami* Sarawakensibus dissimillima. Typus: Borneo, Sarawak, *Dransfield et al.* JD 6035 (holotypus K; isotypus SAR).

Clustering, slender rattan climbing to 10 m tall; stem without sheaths c. 7–10 mm diam., with sheaths c. 10–18 mm diam., internodes c. 7–12 cm. Leaf sheath rich mid-green, armed with short, scattered or grouped, triangular green spines to 3 mm with conspicuous swollen bases, scattered caducous pale brown scales present between the spines; knee conspicuous, sparsely armed; ocrea present in emerging leaf, soon tattering and becoming inconspicuous. Flagellum to 1.5 m. Leaf ecirrate, to 75 cm; petiole 4–11 cm, adaxially flattened, rounded or keeled abaxially, very sparsely armed along the mid-abaxial line with reflexed black-tipped green hooks to 4 mm, with swollen bases; rachis very short, 5–7 cm, very sparsely armed as the petiole; leaflets a single pair only, to 60 × 12 cm, spatulate, stiff, cucullate, dark shining green when fresh, drying pale green, concolorous, of a very thick texture, with 7 major ribs, ± unarmed except for a few bristles at the tips, transverse veinlets very numerous, close, conspicuous. Inflorescence, only young pistillate known, to 27 cm, bearing 3 partial inflorescences and without a well developed terminal flagellum; primary bracts strictly tubular, the longest to 130 × 4 mm, with a short triangular blade, the whole covered in pale brown indumentum; first order branches to 8 cm, bearing c. 15 distichous scabrid tubular acuminate bracts to 7 mm, each subtending a rachilla; rachillae rather close, of ± equal length, c. 20 × 2 mm, drying blackish; rachilla bracts distichous, c. 1 mm long, minutely scabrid, striate, the margins finely toothed; involucre and involucrophore similar to the rachilla bract, together forming a cup c. 1.5 mm diam. Sterile staminate flower bud c. 1.8 × 0.9 mm; calyx striate, shortly 3-lobed, c. 1.8 × 0.9 mm; corolla c. 1.4 × 0.6 mm; sterile stamens with filaments c. 1.2 mm; pistillode c. 0.5 mm. Pistillate flower of size and shape similar to that of the sterile staminate flower; staminodes and pistil still very immature. Other parts unknown. (Fig. 8).

BORNEO. Sarawak, 1st Division, Sematan, Pasir Jangka Forest Reserve, *Dransfield et al.* JD 6035 (holotype K; isotype SAR), JD 6032 (BH, BO, K, L, PNH, SAR); Lundu, Sempadi Forest Reserve, Mile 23, *Dransfield et al.* JD 6045 (BH, K, L, SAR).

Calamus crassifolius is confined to 'kerangas' forest in the lowlands of the 1st Division of Sarawak. It is known from only three collections, of which one, the type, is fertile and at a very early stage of flower development. Nevertheless, this is a very distinctive taxon with its relatively large thick deeply and