FLORAE MALESIANAE PRECURSORES IV.
NEW SPECIES OF TERMINALIA FROM MALAYSIA

by

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The following new species of *Terminalia* will be included in the forthcoming account of the Combretaceae for the Flora Malesiana where their respective positions in the key will indicate more clearly their relationship to already described species.

Terminalia capitulata Exell, sp. nov.

Arbor 17 m alta, ramulis dense rufo-sericeo-pilosis. *Folia* spiraliter ordinata ad apices ramulorum conferta, petiolata, petiolo 3—7 mm longo rufo-sericeo, lamina subcoriacea obovata, usque 4.5 × 2.6 cm, omnino primo dense demum sparse rufo-sericeo-pilosa, supra conspicue subtus vix conspicue minute verruculosa, apice plerumque rotundata basi cuneata vel nonnunquam rotundata, costis lateralibus utrinsecus 5—7 domatiis in axillis instructis. *Flores* albi sessiles in pseudo-capitulis 3—6-floris longe et graciliter pedunculatis, pedunculo ad 4 cm longo rufo-sericeo apice bracteato, bracteis 2—3 mm longis dispositi. *Receptaculum* inferius 1.5—2 mm longum rufo-sericeum, superius obsoletum. *Calycis lobi* triangulares vel ovato-triangulares acuti, 2 mm longi, apice recurvati extus rufo-sericei intus glabri. *Stamina* 10, filamentis 2 mm longis glabris, antheris 0.3 mm longis. *Discus* barbatus. *Stylus* 2 mm longus glaber. *Fructus* ignotus.

NETHERLANDS NEW GUINEA. Balim River, alt. 1600 m, in relic strip of forest on bank of river, Dec. 1938: *Brass & Versteegh 11173* (A, *type;* BM; L). "Tree 17 m high, 120 cm diam.; crown wide-spreading; bark 7 mm thick, black, scaly, rough; flowers white".

The rhachis of the inflorescence is extremely abbreviated so that the flowers appear to be in long-stalked capitulae. The indumentum is reddish and silky in the dried specimens but it is possible that the red colour appears only on drying as often happens in this type of indumentum.

The nearest relative seems to be *T. archboldiana* Exell from Papua which is similar in appearance but with less congested inflorescences and shorter petioles.

Terminalia kjellbergii Exell, sp. nov.

Arbor 15 m alta, ramulis crassiusculis apicem versus 4- vel 5-angulatis nonnumquam fere alatis primo fulvo-sericeis mox glabrescentibus. *Folia*

coriacea spiraliter ordinata ad apices ramulorum conferta breviter petiolata, petiolo crasso 3—5 mm longo primo fulvo-tomentoso mox glabrescente, lamina obovato-elliptica vel anguste elliptica, 5—15 × 2—6.5 cm, apice obtusa vel rotundata basi rotundata vel subcordata biglandulosa, juventute sparse sericeo-pilosa mox omnino glabra nitidula supra minute verruculosa, costa media utrinque prominula, costis lateralibus utrinsecus 11—12. *Flores* sessiles in spicas axillaribus ad 17 cm longis, rhachide crassiusculo minute appresse pubescente, bracteolis filiformibus 1.5 mm longis, dispositi. *Receptaculum* inferius 3.5—4 mm longum fulvo-sericeum, superius cupuliforme, 3—3.5 × 5—5.5 mm, extus viscidum fere glabrum intus sericeo-pilosulum. *Calycis lobi* ovato-acuminati 3 mm longi glabri. *Stamina* 10, filamentis 12—13 mm longis glabris, antheris 1 mm longis. *Discus* fere glaber. *Stylus* 11 mm longus glaber. *Fructus* vide infra.

CENTRAL CELEBES. Lake Towuti, shores of the lake, in a swamp, alt. 300 m, 30 Aug. 1929: *Kjellberg 2212* (BO, *type*). "Baum bis 15 m hoch; Kelch aussen rötlich; Frucht geplattet".

In order to avoid possible future confusion I have drawn up the description entirely from *Kjellberg 2212*. I did not see any fruit with this specimen. A fruiting specimen, also from Central Celebes (Malili, Tapukulemo, ± 400 m alt., *NIFS bb. 24487* (A; BO) seems to be conspecific and from it the following further details are added: *Folia* ad 20 × 7.5 cm. *Fructus* ambitu ovatus, 2.5 × 1.7 cm, bialatus, alis 5 mm latis, glaber.

This species resembles *T. supitiana* Koord. in appearance but differs in the sericeous lower receptacle, the almost glabrous disk, rare in this genus, and the much smaller fruits.

The branchlets show typical sympodial growth, first elongating (for some 20—30 cm in *Kjellberg 2212*) and then producing a crowded tuft of leaves with inflorescences in their axils. One or two side shoots arise in the axils of these leaves, continue the vegetative growth and produce in their turn further tufts of leaves and inflorescences.

Terminalia slooteniana Exell, sp. nov.

Arbor 25 m alta, ramulis crassis glabris. *Folia* coriacea spiraliter ordinata ad apices ramulorum conferta petiolata, petiolo 1—2 cm longo glabro apice (nonnunquam inconspicue) biglanduloso, lamina spathulata oblanceolata vel anguste obovato-elliptica, 10—20 × 4—8 cm, omnino glabra supra nitidula supra subtusque minute verruculosa conspicue reticulata, apice rotundata basi anguste cuneata in petiolum decurrente, costis lateralibus utrinsecus 9—12. *Flores* ignoti. *Fructus* viridis valde distinctus cheloniformis ambitu suborbicularis, 7.5 × 6—6.5 × 3 cm, anguste circumalatus.

NETHERLANDS NEW GUINEA. W. Rauna, 4 Apr. 1937: *Salverda 558* = *NIFS bb. 22544* (BO, *type*); Fakfak, Agonda, in primary forest, *Lundquist 263* = *NIFS bb. 32982* (BO).

This species has the same kind of sympodial growth described above under *T. kjellbergii*.

The affinity seems to be with *T. supitiana* Koord. The fruits are very remarkable having a comical resemblance to diminutive tortoises.

I have pleasure in naming this interesting species after the late Dr. D. F. van Slooten who first recognised it as new.

Terminalia clemensae Exell, sp. nov.

Arbor. *Folia* coriacea petiolata, petiolo 1.5—2 cm longo glabro, lamina elliptica apice rotundata vel breviter acuminata basi cuneata, 20 × 8 cm, supra nitidula omnino glabra, costis lateralibus utrinsecus 12—14. *Flores* ignoti. *Fructus* valde lignosus complanato-ovoideo-ellipsoideus vel complanato-ellipsoideus, 6—7 × 3—4 × 1.5—1.8 cm, primo verisimiliter appresse-pubescens demum glaber anguste circumalatus, ala rigida 4 mm lata.

BRITISH NEW GUINEA. Morobe, Quembung, 650—950 m, 14 May 1936: *Clemens 3087* (A, *type*).

This species is related to *T. supitiana* Koord. and *T. slooteniana* Exell both of which have circumalate fruits. *T. clemensae* is distinguished by its large flattened-ellipsoid fruit surrounded by a narrow, stiff wing.

Terminalia macadamii Exell, sp. nov.

Arbor alta, ramulis primo rufo-tomentellis demum glabrescentibus. *Folia* spiraliter ordinata petiolata, petiolo 1—3 cm longo rufo-tomentello, lamina chartacea elliptica vel late elliptica vel obovato-elliptica apice basique paullo acuminata, ad 18 × 9 cm, supra fere glabra subinconspicue minute verruculosa, pellucido-punctata, subtus praecipue ad nervos rufo-tomentella, costis lateralibus utrinsecus 9—12. *Flores* ignoti. *Fructus* oblongo-ellipsoideus, 2.5—3.5 × 1.3—1.5 cm, nonnunquam anguste circumjugosus nonnumquam paullo tetragonus, primo tomentellus demum glabrescens.

BRITISH NEW GUINEA. Papua: Eastern District, Milne Bay, 28 Feb. 1944: *MoAdam 8* (BRI, *type*). "Large tree, 8 ft girth, 60 ft to first limb and 120 ft overall with rusty brown crown. Roots keel out below 3 ft, hardly spurs. Green bole is longitudinally lined with rows of lenticels. Bark green longitudinally lined with rows of slightly raised lenticels, ½—¾ inch thick. Outside layer brittle and on chipping up exposes surface of deep red meat colour with lighter lines marking lenticels. Blaze is distinctive yellow, radial lines under lenticels separated by red areas which pale to cream at inner edge. Wood is creamy, porous". Vernacular name: Muru muru widi.

Most of the New Guinea species with a rufous tomentum on the lower surface of the leaf have laterally compressed fruits. Those of *T. macadamii* are, however, olive-shaped and scarcely compressed, though they occasionally have a narrow rim or ridge surrounding them. In cross-section the endocarp (stone) shows a considerable band of sclerenchymatous tissue extended radially in spoke-like projections. Before drying the outer layer was probably fleshy but considerably fibrous.

Terminalia molii Exell, sp. nov.

Arbor 30 m alta, ramulis primo rufo- vel fulvo-tomentellis mox glabrescentibus. *Folia* spiraliter ordinata petiolata, petiolo 8—15 mm longo puberulo apicem versus biglanduloso, lamina subcoriacea opaca obovato-elliptica, 2.5—7 × 1.5—3.2 cm, supra ad nervos sparse puberula, apice rotundata basi subrotundata vel subcuneata, costis lateralibus utrinsecus 5—6, domatiis glabris instructis. *Flores* ignoti. *Fructus* subglobosus, 3.5 × 3 cm, nitidus glaber suberosus.

SUMATRA. Riouw and Dependencies, Indragiri Upland, ± 8 m alt., 25 Oct. 1938: *Mol 207* (BO, *type*); Tapanuli, Sibolga and vicinity, sea-level, 1 Dec. 1939: *De Haan 914* (BO), *915* (BO); Priaman: ex *Heyne* s.n. (BO).

This is probably related to *T. foetidissima* Griff. but it has smaller leaves and fruits.

The fruit, when dried, is light and corky showing in cross-section only a narrow band of sclerenchymatous tissue around the loculus.

Terminalia celebica Exell, sp. nov.

Arbor 20 m alta, ramulis glabris. *Folia* spiraliter ordinata ad apices ramulorum plus minusve congesta petiolata, petiolo 1.5—3 cm longo glabro, lamina chartacea elliptica vel anguste elliptica, 7—15 × 3.5—7 cm, apice acuminata basi anguste cuneata, omnino glabra, supra densissime minute verruculosa obscure pellucido-punctata vel opaca, costis lateralibus utrinsecus 9—12, domatiis vix conspicuis glabris. *Flores* flavidi in spicas axillares 6—13 cm longas uniti, rhachide fulvo-tomentello, bracteolis primo conspicuis filiformibus 3—9 mm longis recurvatis mox caducis; ♂ numerosissimi stipitati, stipite 1.5—3 mm longo appresse pubescente, ad apices spicarum dispositi; ♀ pauciores sessiles basilari. *Receptaculum* inferius 2—2.5 mm longum apice angustatum dense sericeum, superius late cupuliforme, 1 × 2 mm, sparse pubescens vel fere glabrum. *Calycis lobi* triangulares, 2 × 1.2 mm, fere glabri. *Stamina* 10 exserta, filamentis glabris 4—5 mm longis, antheris 0.5 mm longis. *Discus* barbatus. *Stylus* 4 mm longus glaber. *Fructus* oblongo-ellipsoideus paullo lateraliter compressus, in sicco 4—4.5 × 1.8—2 × 1.4—1.6 cm glaber, apice apiculatus.

CENTRAL CELEBES. Malili, in primary forest, alt. 250 m, 17 Sept. 1932: *Waturandang 26* (BO), 14 Mar. 1933, *Waturandang 324* (BO, *type*), 28 Mar. 1933, *Waturandang 333* (BO). Vernacular name: Tolike puteh.

The fruit shows in cross-section a band of sclerenchymatous tissue 3—4 mm thick enclosing in it some isolated air-chambers, especially in a narrow ring round the loculus. The sclerenchyma is extended radially into 9—10 spoke-like projections between them. As far as can be seen from examination of dried fruits of various species such air-chambers start as masses of foveolate tissue, more or less irregular in shape. This seems to break down, at least in some species, leaving empty spaces; so that whether such structures are described as foveolate tissue or air-chambers may depend on the age of the fruit. The structure here described is much the same as in *T. solomonensis* Exell but the fruit of *T. celebica* is larger and somewhat more compressed. The buds of the male flowers are also much more pointed in *T. celebica*. When more material is available it may be possible to make some sort of synthesis of the species of this affinity (*T. celebica, T. kanaeanensis, T. papuana* and *T. solomonensis*) but at present the only satisfactory course seems to be to describe the plants from the various islands as different taxa.

Terminalia beccarii Exell, sp. nov.

Arbor, ramulis juventute sparse appresse pubescentibus mox glabrescentibus. *Folia* spiraliter ordinata petiolata, petiolo sparse appresse pubescente vel fere glabro, 2—4 cm longo, lamina chartacea elliptica vel obovato-elliptica, 7—14 × 4—7.5 cm, vix conspicue verruculosa opaca, ad nervos sparse appresse pubescente ceteroque glabra, apice acuminata basi obtusa, costis lateralibus utrinsecus 8—9 supra paullo impressis subtus prominulis,

glandulis duobus basin versus instructa. Flores ♂ delapsi stipitati glabri, ♂ + ♀ sessiles in spicas axillares ad 17—18 cm longas dispositi, rhachide glabro vel fere glabro, bracteolis nullis vel delapsis. *Receptaculum* inferius 2 mm longum glabrum, superius fere nullum. *Calycis lobi* ovati acuti, 2 × 1.5 mm extus glabri intus pilosi apice recurvati. *Stamina* 10, filamentis glabris 4 mm longis, antheris 0.5 mm longis. *Discus* barbatus. *Fructus* ignotus.

NETHERLANDS NEW GUINEA. Mt. Arfak, Putat, Oct. 1872: *Beccari 819* (FI, *type*).

This species differs from *T. papuana* Exell and *T. solomonensis* Exell by the long almost glabrous spikes and glabrous lower receptacle. The flowers are very similar to those of *T. nitens* Presl, but the latter species has shorter inflorescences and more distinctly obovate leaves with shorter petioles.

The two glands near the base of the lamina are rather peculiar as each extends for 2—3 mm either along or in the direction of a lateral nerve. They differ somewhat both from the petiolar glands and the domatia commonly found in the genus.

To what extent these 'glands' and the structures called 'domatia' are produced "naturally" by the plant or to what extent their formation or structure is due to insect stimuli would be an interesting study; but no light can be thrown on the problem by examination of dried specimens.

In *T. beccarii* the two glands near the base of the midrib are the most conspicuous and the most constantly developed but others, less well-developed, sometimes occur further up the midrib. Their development is accompanied by some disturbance of the general pattern of the secondary veins and the tertiary reticulation. In *Terminalia* it is not easy to divide the series extrafloral nectary — domatium — gall into clear-cut categories or to decide what is, or is not, pathological or even to decide the exact meaning of 'pathological' when structures are formed by a complicated interaction of insect and plant.

Terminalia lundquistii Exell, sp. nov.

Arbor 21 m alta, ramulis crassiusculis primo rufo-sericeus demum glabrescentibus. *Folia* spiraliter ordinata petiolata, petiolo minute appresse puberulo vel fere glabro plerumque eglanduloso, 1.5—2 cm longo, lamina subcoriacea elliptica vel obovato-elliptica, 8—13 × 4.5—8.5 cm, supra glabra haud verruculosa subtus verisimiliter resinosa vel glutinosa nonnunquam ad nervos pubescente vel nonnunquam glabra, apice paullo acuminata basi cuneata, costis lateralibus utrinsecus 8—11 supra leviter impressis subtus prominulis domatiis axillaribus vix pubescentibus. *Flores* (delapsi) in spicas axillares, 14 cm longas, rhachide fere glabro, dispositi. *Fructus* ellipsoideus irregulariter verrucosus et minute verruculosus glaber, 4—5 × 1.5—2 cm, apice rostratus.

NETHERLANDS NEW GUINEA. Mimika, Siere, alt. 5 m, 16 June 1941: *Lundquist 105* (BO, *type*). "In primary forest on sandy soil". Vernacular name: Keari.

The fruit is curiously irregularly warty (possible pathological?) and the surface further covered fairly densely with minute warts resembling those commonly met with on the leaves of *Terminalia* spp., which are said to be due to accumulations of crystals of calcium oxalate. In cross-section

the fruit appears to have some foveolate tissue round the loculus surrounded by a thick band of sclerenchyma with short radial, spoke-like projections.

The relationship seems to be with *T. soembawana* Van Sloot. and *T. nitens* Presl from both of which it can be distinguished not only by the warty fruits, a character which may not be constant, but also by their structure in cross-section as described above.

Terminalia steenisiana Exell, sp. nov.

Arbor 10—15 m alta, ramulis primo appresse rufo-pubescentibus mox glabrescentibus. *Folia* and apices ramulorum conferta, petiolata, petiolo 10—20 mm longo, glabro, lamina subcoriacea elliptica obovato-elliptica obovata vel oblanceolata, 8—13 × 2.5—6 cm, supra nitida glabra opaca, apice rotundata obtusa vel breviter acuminata, basi cuneata, costis lateralibus utrinsecus 6—10. *Flores* albidi in spicas axillares 6—8 cm longas, rhachide glabro, bracteolis filiformibus 1 mm longis, dispositi; ♂ stipitati, stipite glabro 2 mm longo; ♂ sessiles basin versus orti. *Receptaculum* inferius 2 mm longum glabrum, superius late cupuliforme glabrum, 1 × 3 mm. *Calycis lobi* deltoidei 1.5 mm longi glabri. *Stamina* 10, filamentis 2.5 mm longis glabris, antheris 0.5 mm longis. *Discus* dense pilosus. *Fructus* maturus ruber glaber in sicco ambitu ellipsoideus, 2.5—3.5 × 1.5—2.6 cm, ventrale planus dorsale convexus et paullo carinatus vel utrinsecus convexus plus minusve carinatus longitudinaliter circumalatus, ala rigida 2—3 mm lata.

BRITISH NEW GUINEA. Papua: Central Division, Nakeo District, alt. 30 m, 10 April 1933: *Brass 3759* (BM, *type*); Kanosia, edge of mangrove swamp, sea-level, 9 Febr. 1935, *Carr 11228* (A, BM, L). "Common; rain-forests; alt. 30 m; tree 10—15 m; grey-brown scaly bark; hard brown wood; leaves shiny; flowers white; fruit fleshy, red when ripe."

When I first saw the specimen Brass 3759 I thought it might be *T. foveolata* White & Francis (see Exell in Brittonia 2: 138, 1938) from the description but after seeing fruiting specimens of the latter at Kew I realize that the fruits are not the same and that *T. foveolata* is probably a glabrous form of *T. microcarpa* Decne.

T. steenisiana, which I have much pleasure in naming after my friend Dr. C. G. G. J. van Steenis, to whom I am much indebted for his valuable assistance and advice in my work on the Malaysian Combretaceae, seems to be related to *T. oreadum* Diels and *T. supitiana* Koord., differing from the former by the glabrous receptacle and from the latter by the smaller fruit.

Carr 11495 (A; BM) from Lolorica, growing in forest at 30 m, and *Carr 11255* (BM), from light forest at Kanosia, are probably the same species but with much younger, thinly papyraceous leaves and without fruits.

Terminalia canaliculata Exell, sp. nov.

Arbor 30 m alta, ramulis primo appresse pubescentibus mox glabrescentibus. *Folia* spiraliter ordinata ad apices ramulorum conferta petiolata, petiolo 1.5—3 cm longo, sparse appresse pubescente vel glabro, lamina chartacea obovata, obovato-elliptica vel elliptica, 8—15 × 4—7 cm, apice rotundata et acuminata basi cuneata, nitidula, canaliculis mucilaginosis pellucidis instructa, juventute sparse appresse pubescente mox glabrescente, costis lateralibus utrinsecus 9—13 in axillis domatiis conspicuis perforatis.

Flores in spicas axillares ad 13 cm longas, rhachide appresse pubescente, bracteolis caducis, dispositi, ♂ stipitati, stipite 1—1.5 mm longo appresse pubescente, apicem versus orti, ♂ sessiles basin versus dispositi. *Receptaculum* inferius sericeum 2—2.5 mm longum, superius fere nullum. *Calycis lobi* triangulares, 2.5 × 1.5 mm, extra pubescentes vel fere glabri intus pilosuli. *Stamina* 10, filamentis glabris 3 mm longis, antheris 0.5 mm longis. *Discus* barbatus. *Stylus fructusque* ignoti.

BRITISH NEW GUINEA. Papua: Palmer River, 2 miles below junction with Black River, July 1936: *Brass 7350* (A; BM, *type*); Eastern District, Milne Bay area, ½ mile south of Waigani, alt. 10 m, Mar. 1945: *L. S. Smith N.G.F. 1379* (BRI). "Abundant in forests of lower ridges. Large semi-deciduous canopy tree; trunk spur-buttressed; bark brown, thin, flaky; wood pale, of cedar-like appearance; leaves (still young) concave; flowers white" (L. J. Brass). "Tree 90 ft overall. Bole 60 ft clear, buttressed to $3^1/_2$ ft and slightly channelled above. Bark $^1/_8$ to $^3/_{16}$ in. thick; outer pale brown, papery, scaly and also shedding in thin, curled, irregular flakes; inner green on the back, pale red within, concentrically layered and somewhat fibrous. Sapwood $1^1/_2$ in. thick, pale; heartwood red-brown. Native name: Kama". (L. S. Smith).

This species is remarkable for the linear, canal-like markings which are translucent when the leaves are held up to the light. Dr. C. A. Reinders-Gouwentak, Wageningen, has kindly investigated the structure of these cavities and has sent me the following report of which I have only very slightly modified the wording:

"In the leaves of *Terminalia* species there appear to be two kinds of transparency. One of them is due to large cells with large cluster crystals in the mesophyll and the other one to canal-like cavities containing mucilage and occurring above or within the xylem of the veins, or, without any such association, in the mesophyll. In the case of *Brass 7350* both features are present, but the crystals are rather inconspicuous and the peculiar appearance is due entirely to the large cavities. In transverse section the cavities are sometimes almost united, with very little mesophyll tissue between them. They are found not only above the xylem of the smaller veins or within the xylem of the larger and medium-sized veins but also in the mesophyll, with or without accompanying sclerenchymatous tissue. They are lined, at least in the herbarium material, with yellowish-brown epithelial cells. Heiden (Bot. Centralbl. 56: 10, 1893) mentions that *Terminalia pellucida* Presl has mucilaginous cavities and adds (tom. cit.: 70) that these are above the large veins".

T. pellucida seems to be the only other Malaysian species with this character; but the canal-like cavities are not nearly so striking as in *T. canaliculata*.