Flora and dynamics of an upland and a floodplain forest in Peña Roja, Colombian Amazonia = Flora y dinámica de bosques de tierra firme y de várzea en Peña Roja, Amazonia colombiana

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A new genus and species of Dipterocarpaceae from the Neotropics. I. Introduction, taxonomy, ecology, and distribution

Ana Catalina Londoño Vega, Esteban Álvarez, Enrique Forero & Cynthia M. Morton
3.1 Introduction

In 1986 the Tropenbos Foundation initiated activities in Colombia with the goal of promoting studies related to the management of tropical humid forests. In this context, two areas were selected in the Colombian Amazon for general pilot studies including floristic composition, diversity, structure, and biomass (Álvarez 1993; Londoño 1993). Among the specimens collected by Londoño, Álvarez, and collaborators from a "tierra firme" site near the town of Araracuara, during field work carried out between 1988 and 1991, was a large, ecologically important tree with long-winged fruits. So far the plants have not been collected in full flower, only in bud. Seedlings were observed and photographed elsewhere in the same vicinity by the Dutch forester H. F. M. Vester (pers. comm.) in 1990.

From the start, placement of the materials collected by Londoño, Álvarez, and collaborators in the appropriate taxonomic group, even at the family level, proved difficult. Contacts between Tropenbos and The New York Botanical Garden allowed Londoño to work with Brian Boom in NY on the identification of this obviously new genus and species. Based on external morphological features, the conclusion was reached that the plant probably belonged to the Dipterocarpaceae.

The family Dipterocarpaceae was until recently considered paleotropical (Maguire 1977). The discovery in Guyana of Pakaraimaea dipterocarpa Maguire & Ashton (Maguire and Ashton 1977) required a redefinition of the circumscription and content of the family. Maguire, Ashton, and de Zeeuw (in Maguire and Ashton 1977) described a new subfamily of the Dipterocarpaceae, subfam. Pakaraimoideae, to accommodate the new monotypic genus from the New World. In 1977, therefore, Dipterocarpaceae included two Old World subfamilies — Dipterocarpoideae of Tropical Asia and Malesia and Monotoideae of Tropical Africa and Madagascar — and the new Neotropical subfamily Pakaraimoideae.

Since the information available on the new taxon was scarce and consisted only of a few herbarium specimens which were mostly in fruiting condition, sterile, or in bud, accompanied by the field notes made by the
collectors, efforts were made to obtain additional data from pollen morphology and wood anatomy.

Pollen grains were studied by Londoño in Colombia and by Forero and Morton in New York. The short pollen description included in this paper is a summary of observations made by these researchers. Pollen grains were prepared following the usual procedure of acetolysis (Erdtman 1952; Nilsson and Praglowski 1992) and were examined by light and scanning electron microscopy.

A complete account of the wood anatomy, including a detailed comparison with plant families related to the Dipterocarpaceae, has been prepared by Morton at NY and is included as Part II of this paper. [see Morton 1995; addition this Thesis]. A molecular analysis has not been possible for a number of reasons but is currently being attempted by Dr. S. Dayanandan at Boston University. [After the publication of the taxon the analysis of phylogeny and biosystematics based on molecular and morphological data was done, and strongly supports the placement of Pseudomonotes within subfamily Monotoideae of the Dipterocarpaceae (Morton et al. 1999); addition this Thesis].

The excellent papers by Maguire (1977), Maguire and Ashton (1977), de Zeeuw (1977), and Giannasi and Niklas (1977) on Pakaraimaea have been instrumental for our evaluation of the information available on the new Dipterocarpaceae described here. Peter S. Ashton, the world expert on this family and one of the authors of Pakaraimoideae and Pakaraimaea, has given us considerable advice and has maintained an interest in the subject from the beginning.

The name proposed for this new entity is Pseudomonotes tropenbosii. The generic name serves to indicate closeness to the African subfamily Monotoideae; the specific epithet recognizes the work being carried out by the Tropenbos Foundation in the Colombian Amazon.

### 3.2 Anatomy-Morphology

**Habit.** Tree 25-30 m tall, to 70-80 cm diam.; bole straight, cylindrical, unbranched until 18-22 m; buttresses poorly developed, planks or slightly rounded; bark surface dark brown to yellowish brown, fissured longitudinally and flaky; slash light-brown-colored with brownish orange
laminations, oxidizing to dark brown; exudate watery, sparse, slowly
flowing, with a slightly sweet flavor; sapwood bone-colored, oxidizing to
light brown.

**Branchlets.** Branchlets terete, glabrous; stipule scars prominent,
amplexicaul, horizontal or slightly convex (Fig. 3-1A).

**Leaves.** Leaves alternate, conduplicate in vernation, in bud 4-8 x 2-3 mm,
ovo, acute; stipules 4-8 x 2-3 mm, triangular, glabrous, caducous; mature
blades 9-23 x 6-16 cm, broadly oblong-ovate, entire, upper surface with
rare glandular hairs, lower surface with sparse glandular hairs (Fig. 3-2A),
chartaceous, dark shiny green above, with a red point on the base of blade
on midrib appearing as a vestigial gland, light green below, drying pale
olive-green above and light brown below, base obtuse-subcordate, apex
refuse and apiculate, or rarely only apiculate; midrib prominent beneath,
evident but plane to shallowly depressed above, often projected in a short
apiculum; venation open at the base of the leaf, turning brachidodromous
toward the apex; secondary veins (10)11(16) pairs, parallel or obscurely
reticulate, alternate, ascending at 60-70° from perpendicular, the
connecting loops at 0.5-1.5 mm from the margin; plane or slightly
depressed above, prominent below, tertiary veins transverse, plane above,
prominulous below (Fig. 3-1A).

**Petioles.** Petioles 3-10 cm long, apically swollen, glabrous, with an adaxial
furrow (Fig. 3-1A).

**Inflorescence.** Inflorescence axillary, subcymose, 5-7 cm long; branches
alternating on peduncle (Fig. 3-1A); bracts caducous (not seen), bracteoles
small. Flowers bisexual, actinomorphic; flower bud 5-8 x 2-4 mm (flowers
observed only in bud), ovoid-lanceolate, calyx glabrous, forming a shallow
cup at the base, calyx lobes 5, 1.5 x 1.5 mm, equal, deltoid (Fig. 3-1B),
corolla glabrous, greenish white, petals 5, contorted, 5-8 x 1.5-3 mm,
oblong, apex obtuse (Fig. 3-1B).

**Stamens.** Stamens numerous, free, cyclic, filaments terete, varying from
short (1 mm) to long (4 mm), attenuate toward apex, anthers basi-versatile,
2-lobed, 4-celled, 2 outer cells longer than 2 inner cells, opening by ventral
longitudinal slits, introrse, connective broad (very expanded), continued
into a triangular appendage one-fourth to one-half as long as the body of the anther (Fig. 3-1C-E, Fig. 3-2B).

**Pollen grains.** Pollen grains monads, isopolar, radially symmetrical and medium sized. Grains circular in outline in polar view, tricolporate, rarely tetracolporate, sometimes trisyncolporate. Ectoapertures meridionally aligned, long, nearly approaching each other at the poles. Endoapertures elongate, located at the center of the colpus, approximately 8.6 µm long and 3.5 µm wide. Exine sculpturing minutely reticulate to foveolate, the lumina polymorphic in outline and more accentuated at the poles. Exine columellate, tectate-perforate (Fig. 3-2C-G).

**Ovary.** Ovary syncarpous, 3-locular, glabrous, ovoid, (articulating) with three minute, terminal styles (Fig. 3-1C); ovules apparently one per loculus, apparently anatropous; placenta axial, sub-basal; placenta relatively massive (Fig. 3-1G, Fig. 3-3A, B).

**Fruit.** Nut dry, 3-4 x 1.5-2 cm, glabrous, ovoid, pericarp woody (Fig. 3-1F). Seed 1 per fruit (Fig. 3-1G, H). Calyx in fruit persistent, all 5 segments accrescent, becoming thinly papyraceous at maturity, aliform, 10-16 x 1.5-2.5 cm, 1 or 2 slightly shorter than others, oblanceolate, apex rounded, base cuneate, lobes united at base into a shallow cup (Fig. 3-1F), green, maturing to brown colored. The pericarp splitting along three sutures at germination.

Germination epigeous, with the hypocotyl well developed and the cotyledons exposed, later becoming photosynthetic (Fig. 3-4A, B).

### 3.3 Phenology

This species is poorly known, but according to observations made in the field between December 1988 and April 1991, the species was encountered fertile on only one occasion, during a short period of time. Consequently, it is probable that the reproductive cycles are neither annual nor of long duration.
Fig. 3-1. *Pseudomonotes tropenbosii*. A. Habit sketch. B. Bud. C. Flower bud, median long section. D. Androecium. E. Stamens, lateral, dorsal and ventral views. F. Sepals subtending young fruit. G. Ovary, cross section. H. Seed. (A-E, Londoño et al. 1239; F-H, Londoño et al. 1698.)
3.4 Geography

This species is known only from the region of Araracuara (Colombia, Departamento del Amazonas), about 50 km downstream on the Rio Caquetá, near the locality of Peña Roja, ca. 00°34' S, 79°08' W, at 200-300 m elevation, from 5 collections gathered between October 1989 and April 1990. Seedlings belonging to this taxon were observed and collected by Álvarez in October 1990. H. F. M. Vester (pers. comm.) observed seedlings in November 1990 near the village of Puerto Santander, along La Morelia Creek, a few kilometers south of Araracuara.

3.5 Ecology

According to Londoño (1993), the vegetation corresponds to a mixed forest, with a canopy height of 25-30 m (Fig. 3-4C). The diversity of this forest is high, with 209 species/ha for plants with dbh of 10 cm or greater, and close to 700 species/ha of vascular plants (herbs, ferns, shrubs, palms, lianas, vines, except epiphytes). Using the method of Curtis and McIntosh (1951), when the importance value index (IVI) is calculated for the vegetation with a dbh of 10 cm or greater, this new dipterocarp has the highest of all IVIs (6%) and thus constitutes the most ecologically important species in this forest.
3.6 Climate

The climate of the region is classified as equatorial superhumid without a dry season (Type Af of Köppen (1936), cited by Duivenvoorden and Lips (1993)), with more than 60 mm of rain per month and with a difference in temperature of only 5°C or less between the hottest and coldest months. The region corresponds to the Tropical Humid Forest (bosque húmedo tropical, bh-T) life zone of Holdridge (1982). According to Duivenvoorden and Lips (1993), annual average rainfall is 3059 mm (data from 1979 to 1990), with highest precipitation in April, May, and June and slight decreases in August, December, January, and February. Annual average temperature is 26°C.

3.7 Geology and Soils

With respect to soils and geology, this species occurs in upland ("tierra firme," i.e., not flooded by rivers) that belongs to a dissected sedimentary plain built up by non-to slightly consolidated, clayey to sandy, Miocene fluvial sediments (Duivenvoorden and Lips 1993; Hoorn 1994). The species grows on summits of hills and along shoulders of slopes. The soils are deep and well-drained. They are loose and sandy at the surface and become increasingly clayey with depth. According to Duivenvoorden and Lips (1995: Profile 125)[Appendix 1; addition this Thesis], they are classified as Typic Kandiudults (SSS 1992) or Xanthic Ferralsols (FAO 1988). They are strong brown (7.5 YR 5/6) in the B horizon, acid (between 3.7 pH in horizon A and 4.9 pH in horizon B), with a very low cation exchange capacity (ca. 10 cmol(+)/kg clay). The levels of exchangeable cations and base saturation are very low (less than 15%), and there is a low level of available phosphorous (1 ppm P, according to Bray II). The presence of charcoal within the uppermost 30 cm indicates possible sites of ancient human occupation. The soil is covered by a thick, well-rooted (10 cm) humus form which consists of an L, F, and discontinuous granular H horizon.
Fig. 3-4. *Pseudomonotes tropenbosii*. A. Young fruits (Londoño et al. 1698). B. Seedlings. C. Mixed forest, type locality.

3.8 Economic Use

No known use by the Nonuya Indians.
3.9 Vernacular Names

*Berye-m+qu+* (Muiname dialect, spoken by the Nonuya Indians). This name translates into Spanish as “árbol de madera astillosa”. There is, however, no known Spanish name.

3.10 Taxonomic Treatment

**Pseudomonotes** (Dipterocarpaceae subfam. Monotoideae) Londoño, Álvarez & Forero, gen. nov.

**TYPE**: *Pseudomonotes tropenbosii* Londoño, Álvarez & Forero.

Omnibus ab aliis Dipterocarpaceis trichomatum fasciculatorum defectu, sepalis insigniter aliformibus (10-16 cm usque longis), necnon ovulis in quoque loculo solitariis subbasaliter affixis diversae, insuper distributione neotropica praestantes.

**Pseudomonotes tropenbosii** Londoño, Álvarez & Forero, sp. nov. (Fig. 3-1).

**TYPE**: COLOMBIA. Amazonas: Araracuara, Rio Caquetá, margen izquierda, frente a la isla Sumaeta, 00°39' S, 72°08' W, 26 Apr 1990 (fr), Londoño et al. 1698 (*HOLOTYPE*: COL; *ISOTYPES*: A, COAH, FMB, JAUM, NY).

Notulis supra sub genere expositis in familia unica.

Tree 25-30 m tall, to 70-80 cm diam.; branchlets terete, glabrous. Leaves alternate, stipulate, stipules 4-8 mm long, 2-3 mm wide, triangular, glabrous, caducous; mature blades 9-23 cm long, 6-16 cm wide, broadly oblong-ovate, entire, chartaceous, upper surface with rare glandular hairs, lower surface with sparse glandular hairs, dark shiny green above, with a red point on the base of blade on midrib appearing as a vestigial gland, light green below, drying pale olive-green above and light brown below, base obtuse-subcordate, apex retuse and apiculate, or rarely only apiculate; midrib prominent beneath, evident but plane to shallowly depressed above, often projected in a short apiculum; secondary veins (10)11(16) pairs, alternate, plane or slightly depressed above, prominent below; tertiary veins transverse, plane above, prominulous below; petioles 3-10 cm long, glabrous. **Inflorescence axillary**, subcymose, 5-7 cm long. **Flowers** bisexual, actinomorphic; flower bud 5-8 mm long, 2-4 mm wide (flowers
only observed in bud). *Calyx* glabrous, forming a shallow cup at the base, calyx lobes 5, deltoid, 1.5 mm long, 1.5 mm wide. *Corolla* glabrous, greenish white, petals 5, contorted, 5-8 mm long, 1.5-3 mm wide, oblong, apex obtuse. *Stamens* numerous, cyclic, hypogynous, free, filaments terete, anthers basi-versatile, 2-lobed, 4-celled, introrse, connective broad (very expanded), continued into a triangular appendage one-fourth to one-half as long as the body of the anther; pollen grains isopolar, tricolporate, rarely tetracolporate, and sometimes trisyncolporate, exine minutely reticulate to foveolate, columellate, tectate-perforate. *Ovary* glabrous, 3-locular, placentation axial, sub-basal, ovules one per loculus (as far as known), apparently anatropous; styles terminal, minute. *Fruit* a dry nut, 3-4 cm long, 1.5-2 cm wide, glabrous, ovoid, pericarp woody. Calyx in fruit persistent, all 5 segments accrescent, thinly papyraceous, aliform, 10-16 cm long, 1.5-2.5 cm wide, ob lanceolate, apex rounded, base cuneate, lobes united at base. *Seed* 1 per fruit.

**Distribution:** Known only from the type locality in the vicinity of Araracuara, Department of Amazonas, Colombia, at 200-300 m elevation. No open flowers have been seen. The plants have been collected in bud in November and in fruit in April.

Paratypes: COLOMBIA. Amazonas: Araracuara, Villazul, Río Caquetá, margen izquierda, frente a isla Sumaeta, 00°34' S, 72°08' W, 200-300 m, 20 Oct 1990 (sterile), Álvarez et al. 1184 (COAH); detrás maloca J. Moreno, 00°34' S, 72°08' W, 9 Oct 1989 (sterile), Londoño et al. 899 (A, COAH, NY); frente a isla Sumaeta, 00°34' S, 72°08' W, 200-300 m, 31 Oct 1989 (sterile), Londoño et al. 983 (COAH, NY), 3 Nov 1989 (sterile), Londoño et al. 1097 (COAH, JAUM, NY), 7 Nov 1989 (buds), Londoño et al. 1239 (A, COAH, COL, NY), 1239A (COAH).
Table 3-1. Features of *Pseudomonotes* and subfamilies of Dipterocarpaceae.

<table>
<thead>
<tr>
<th></th>
<th>Dipterocarpoideae</th>
<th>Monotoideae</th>
<th>Parkaraimoideae</th>
<th><em>Pseudomonotes</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood rays</td>
<td>Multiseriate</td>
<td>Uniseriate (sometimes biseriate)</td>
<td>Biseriate (sometimes uniseriate)</td>
<td>Uniseriate (sometimes biseriate)</td>
</tr>
<tr>
<td>Resin or secretory ducts</td>
<td>Wood with resin canals; secretory cavities in pith absent</td>
<td>Wood without resin canals; secretory cavities in pith</td>
<td>Wood without resin canals; secretory cavities in pith</td>
<td>Wood without resin canals; secretory cavities in pith</td>
</tr>
<tr>
<td>Stipules</td>
<td>Small or large, often fugacious</td>
<td>Small, fugacious</td>
<td>Small, fugacious</td>
<td>Small, fugacious</td>
</tr>
<tr>
<td>Leaf venation</td>
<td>Secondary veins commonly strongly parallel and connecting with primary; sometimes reticulate</td>
<td>Secondary veins obscurely parallel (transverse), or reticulate</td>
<td>Secondary veins reticulate</td>
<td>Secondary veins parallel or obscurely reticulate</td>
</tr>
<tr>
<td>Pubescence</td>
<td>Trichomes fasciculate, commonly single-celled or multi-cellular; often glandular</td>
<td>Trichomes fasciculate, commonly single-celled; often granular</td>
<td>Trichomes fasciculate, commonly single-celled; neither granular nor granular</td>
<td>Trichomes glandular</td>
</tr>
<tr>
<td>Sepals</td>
<td>5, in flower imbricate or valvate and connate forming a tube at base; often becoming accrescent and aliform in fruit</td>
<td>5, in flower imbricate not connate; becoming aliform and accrescent in fruit</td>
<td>5, in flower imbricate not connate; becoming accrescent and shortly aliform in fruit</td>
<td>5, in flower connate forming a shallow cup at base; accrescent and aliform in fruit</td>
</tr>
<tr>
<td>Petals</td>
<td>5, variously pubescent</td>
<td>5, variously pubescent</td>
<td>5, glabrous</td>
<td>5, glabrous</td>
</tr>
<tr>
<td>Stamens</td>
<td>5-numerous, 1-several-cyclic; filaments sometimes united below the middle</td>
<td>Numerous, several-cyclic; filaments free</td>
<td>Numerous, several-cyclic; filaments free</td>
<td>Numerous, cyclic; filaments free</td>
</tr>
<tr>
<td>Anthers</td>
<td>2-lobed, basifixed, (2)4-</td>
<td>2-lobed, basifixed, 4-thecate,</td>
<td>2-lobed, basifixed, 4-</td>
<td>2-lobed, basifixed, 4-</td>
</tr>
<tr>
<td>Pollen</td>
<td>Tricolpate, rarely tetracolpate, exine 2-3 layered</td>
<td>Tricolporate, exine 4-layered</td>
<td>Tricolporate, exine (‘) layered</td>
<td></td>
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<tr>
<td>----------------</td>
<td>---------------------------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td>Ovary</td>
<td>2(3)-celled, each locule 2-ovulate; ovules pendulous anatropous; placentation midaxial</td>
<td>3(4)-celled, each locule 2-ovulate; ovules pendulous, anatropous; placentation midaxial</td>
<td>3 celled, each locule probably 1-ovulate; ovules pendulous, anatropous; placentation axial, sub-basal</td>
<td></td>
</tr>
<tr>
<td>Fruit</td>
<td>Normally 1-seeded by abortion of 5 ovules; indehiscent or loculicidally tardily splitting along sutures</td>
<td>Normally 1-seeded by abortion of 5 ovules; indehiscent or loculicidally splitting along sutures</td>
<td>1-seeded; probably tardily loculicidally dehiscent</td>
<td></td>
</tr>
<tr>
<td>Ecology</td>
<td>Trees of primary rain forest and savanna woodland</td>
<td>Trees of savanna or savanna woodland</td>
<td>Trees of mixed forest</td>
<td></td>
</tr>
<tr>
<td>Geography</td>
<td>Tropical Asia, Malesia, 13 genera with ca. 550 species</td>
<td>Tropical Africa and Madagascar; 2 genera, 57 species</td>
<td>Tropical America, one genus; unspecific</td>
<td></td>
</tr>
</tbody>
</table>

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3.11 Relationships

A review of the relationships between Dipterocarpaceae and other families of angiosperms was carried out by Maguire and Ashton (1977) and is not attempted again here. Closely related families include the Ochnaceae, Sphaerocephalaceae, Sarcolaenaceae, Caryocaraceae, and Quinaceae of the Theales; and Elaeocarpaceae, Tiliaceae, Sterculiaceae, Bombacaceae, and Malvaceae of the Malvales. Similarities in wood anatomy between the Dipterocarpaceae and the Crypteroniaceae, Combretaceae, Myrtaceae, Vochysiaceae, Lecythidaceae, Caryocaraceae, Quinaceae, and Sarcolaenaceae were explored by Morton in part II of this paper. [see Morton (1995). The phylogeny and biosystematics based on molecular and morphological data were studied by Morton et al. 1999; addition this Thesis]

The family Dipterocarpaceae is pantropical in distribution and is known to grow well in primary rain forest, savannas, and savanna woodlands. The family consists of some 16 genera and nearly 600 species (Cronquist 1981), organized in three well-marked subfamilies that, until the discovery of *Pseudomonotes*, were clearly segregated geographically (Table 3-1). Subfamily Dipterocarpoideae, which was present in East Africa at least during the Upper Tertiary (Ashton 1982), is currently known from Tropical Asia and Malesia and includes 13 genera and around 550 species. Monotoideae has so far been recognized as having African and Madagascan distribution. Two genera and 57 species of Monotoideae have been described until now. Pakaraimoideae is a monotypic subfamily confined to a small portion of the old Roraima Formation of northeastern South America.

The Dipterocarpaceae are trees or, seldom, shrubs with simple, alternate leaves and with stipules that are for the most part small and caducous, leaving persistent scars. The indument of scarce glandular trichomes found on the upper and lower surface of the leaves in *Pseudomonotes* is common in the Dipterocarpoideae but is absent from the Monotoideae and the Pakaraimoideae. The new entity differs from the rest of the Dipterocarpaceae in the absence of fasciculate trichomes. The leaf venation shows alternate secondary veins common to most
Dipterocarpaceae, while the transverse tertiary veins are absent in Pakaraimoideae.

The inflorescence of all family members is axillary, and the flowers can be arranged in racemes, panicles or cymes, the latter being fairly uncommon. In general, bracts and bracteoles are small and fugacious.

The flowers are generally bisexual and actinomorphic. The sepals of *Pseudomonotes* provide one of the strongest connections between the new taxon and the Dipterocarpaceae because of their aliform nature. There are 5 sepals in all Dipterocarpaceae, and they are variously free or connate at the base, then forming a cupule or shallow cup. Aliform sepals may or may not be present in the Dipterocarpoideae but are universal in Monotoideae; they are present but short in Pakaraimoideae (Ashton, pers. comm.). In *Pseudomonotes*, on the other hand, sepals become conspicuously aliform; the calyx is persistent in fruiting condition as with all Dipterocarpaceae, with its segments accrescent, thinly papyraceous, reaching 10-16 cm in length. The corolla has 5 petals which are longer than the sepals, convolute in bud and contorted as in Monotoideae. In *Pakaraimaea* the petals are shorter than the sepals. The Monotoideae allegiance is further supported by the numerous free stamens, with basi-versatile anthers that are introrse and provided with a broad connective continued into a triangular appendage one-fourth to one-half as long as the body of the anther. To be sure, similar character combinations are also found in some Dipterocarpaceae (*Vatica* and some species of *Shorea*, according to Maguire and Ashton 1977).

Pollen grains in the family range in size from 17 µm to 87 µm (Maury et al. 1975) and can be tricolpate or tricoporate, with a 2-, 3-, or 4-layered exine. Pseudomonotes pollen grains are tricolporate (rarely tetracolporate) and small (19.4-21.7 µm). Monotoideae agrees with the new taxon in having tricolporate grains, although the grains are somewhat larger.

The gynoecium of the Dipterocarpaceae consists of (2)3(5) carpels united to form a compound, plurilocular ovary with a terminal style that can be entire or shortly lobed. Placentation is for the most part axial, median, with 2(4) ovules per locule. The overwhelming majority of dipterocarps have 3 carpels, each with 2 ovules. Strikingly, our observations suggest that the new taxon has one ovule per locule, and the placentation, while axial, is
clearly nearly basal (sub-basal). The 1-ovuled ovary cells should therefore be regarded as tentative until more and better flowers are obtained. The ovary is 3-locular and the ovules are pendulous and anatropous as in the rest of the family. The style appears as three minute, terminal styles.

The fruit of *Pseudomonotes* is, as in all members of the family, dry, usually with a woody pericarp that splits along three sutures at germination, and 1-seeded.

Morton (Part II, below) compared the anatomy of the wood, bark, and pith of *Pseudomonotes* with those of several families of flowering plants belonging to the subclasses Dilleniidae and Rosidae (Cronquist 1981). Wood anatomical features indicate close relationships to the Monotoideae with which it shares the mostly uniseriate wood rays, the lack of resin canals in the wood, and the presence of secretory cavities in the pith (Bancroft 1935). Resin canals are absent but mucilage cavities are present in Pakaraimoideae (De Zeeuw 1977), while resin canals are present and secretory cavities are absent in Dipterocarpoideae (Guerin 1906, Gottwald and Parameswaran 1966).

On the basis of the information gathered in the field, herbarium, and laboratory, it is concluded that the new taxon belongs to subfamily Monotoideae of the Dipterocarpaceae. These two groups share the uniseriate (or rarely biseriate) wood rays, presence of secretory cavities in the pith, lack of resin canals, single gland on the upper surface of the lamina at the base of the midrib, and basi-versatile anthers.

The new entity differs from the rest of the Dipterocarpaceae in the absence of fasciculate trichomes and in having sepals in fruit conspicuously aliform (reaching 10-16 cm in length), and one ovule per locule with nearly basal (sub-basal) placentation.

The addition of *Pseudomonotes tropenbosii* to subfamily Monotoideae makes this the only subfamily of the Dipterocarpaceae with different taxonomic elements currently growing in the Old as well as the New World. The new taxon appears to be confined to a small area in the southwesternmost limit of the Guayana Highland and the superposed Roraima Formation sediments in Amazonian Colombia.
3.12 Acknowledgements

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