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# New Species of Lauraceae from Central Amazonia, Brazil

*Henk van der Werff*

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A.  
henk.vanderwerff@mobot.org

*Alberto Vicentini*

Bolsista do CNPq-Brasil, Biology Department University of Missouri-St. Louis,  
8001 Natural Bridge Rd., St. Louis, Missouri 63121, U.S.A.  
betovicentini@hotmail.com

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**ABSTRACT.** Fourteen new species of Lauraceae, belonging to the genera *Licaria*, *Ocotea*, and *Rhodostemonodaphne* and all occurring in or near the Reserva Florestal Ducke, near Manaus, Brazil, are described. The new species are *Licaria aureosericea* van der Werff, *L. hirsuta* van der Werff, *Ocotea cinerea* van der Werff, *O. delicata* Vicentini, *O. immersa* van der Werff, *O. ligulata* van der Werff, *O. minor* Vicentini, *O. nigrescens* Vicentini, *O. obliqua* Vicentini, *O. percurrans* Vicentini, *O. rhodophylla* Vicentini, *O. scabrella* van der Werff, *O. subterminalis* van der Werff, and *Rhodostemonodaphne recurva* van der Werff. A key to the 37 *Ocotea* species of the Reserva Florestal Ducke is provided.

During fieldwork by the second author in preparation of a field guide to the vascular plants of the Reserva Florestal Ducke (Ribeiro et al., 1999), near Manaus, Brazil, a number of Lauraceae were found that could not be identified. The proximity of the Reserva Ducke to Manaus made it possible to collect flowers and fruits from the same tagged trees and to search for, and find, staminate and pistillate trees of most dioecious species. Several of these species are here described. A number of the new species had earlier been recognized as undescribed, but a description was postponed until more complete material was available. Some of the new species, such as *Ocotea cinerea* and *O. nigrescens*, have a wide distribution throughout the Amazon lowlands. Others are only known from a few better-collected localities such as Saül in central French Guiana (for instance *Ocotea scabrella*) or the vicinity of Iquitos in Peru (for instance *Ocotea immersa*). The fact that intensive collecting in a relatively small patch of Amazonian rainforest has yielded so many undescribed species underscores our lack of knowledge about Lauraceae in the Amazon lowlands. Further collecting will no doubt lead to the discovery of more unknown species.

The habitat information is based on observations made at the Ducke reserve, with the exception of *Ocotea ligulata*, where it is based on label information.

In order to facilitate identification of *Ocotea* collections from central Amazonia, we have included a key to the *Ocotea* species known from the Ducke Reserve as well as a table listing the differences between nine of the new *Ocotea* species and four other species with which they had been confused. More details about the Lauraceae from the Ducke Reserve will be published in the Lauraceae treatment for the *Florula of the Reserva Florestal Ducke* (in prep.).

***Licaria aureosericea*** van der Werff, sp. nov.

TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W, tree 1755-06, 22 July 1994 (fl), A. Vicentini et al. 644 (holotype, INPA; isotypes, IAN, INPA, K, MO, NY, RB, SP). Figure 1.

*Licariae oppositifoliae* similis sed foliis alternis, subtus aureosericeis ramulisque tomentellis recedit.

Medium-sized trees, to 17 m. Twigs terete, solid, densely golden brown pubescent when young, the hairs erect, somewhat curled, completely covering the surface, the indument wearing off on older twigs; terminal buds densely pubescent with ascending hairs, the surface completely covered. Leaves 10–18 × 3–6.5 cm, alternate, elliptic, chartaceous; the apex acuminate or acute, acumen to 1 cm long; the base acute; upper surface moderately appressed pubescent when young, becoming glabrous with age; lower surface densely golden sericeous when young, the surface completely covered by the indument, this turning duller brown with age; midrib, lateral veins, and tertiary venation immersed on the upper leaf surface, midrib raised, lateral veins weakly raised and tertiary venation immersed on the lower surface, lateral veins 5 to 7

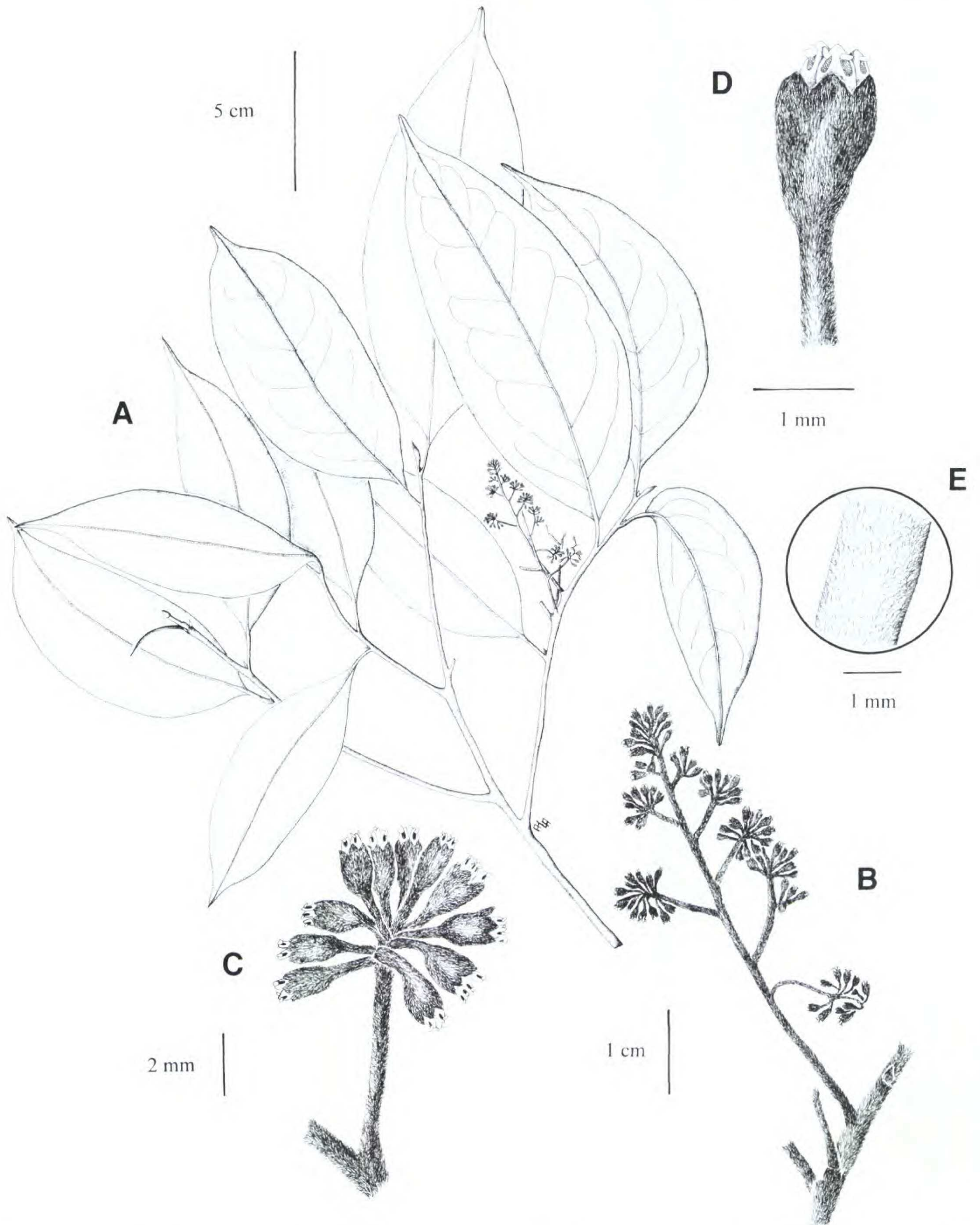


Figure 1. *Licaria aureosericea* van der Werff. —A. Habit. —B. Inflorescence. —C. Detail of inflorescence. —D. Flower. —E. Indument of young twig. (All from Vicentini *et al.* 644, isotype at MO.) Drawn by Alba L. Arbelaez.

on each side, arching upward and becoming loop-connected in the distal half, sometimes with a smaller, additional string of loops on top of the first one; domatia absent; petioles 8–15 mm long, flat above, with the same indument as the twigs. Inflo-

rescences 2.5–6 cm, paniculate-cymose, the cymes sessile, one or several together and then the flowers in dense clusters, densely brown or golden brown tomentellous, the surface completely covered, in the axils of bracts or rarely in the axils of leaves.

Flowers perfect, cylindrical, 1.6–2.1 mm long, densely pubescent outside, the surface completely covered by the indument, brown or golden yellow, slightly constricted near the middle; tepals, measured from the point of constriction, ca. 1 mm long, united for most of their length, the free lobes 0.1–0.2 mm long, triangular, erect; stamens 3, 0.5–0.7 mm long, 2-celled, the cells extrorse, opening toward the tip, anthers exerted at anthesis, the filaments dorsally almost entirely pubescent, the anthers glabrous, glands present at the base of the filaments, sessile, flattened, only noticeable because of their dark color, or lacking; staminodia not seen; pistil 1.8 mm long, glabrous, the style twice as long as the slender ovary; receptacle glabrous or pubescent inside. Fruit and cupule unknown.

*Phenology.* Flowers: June, August, and September.

*Habitat.* Terra firme forest on clay soil.

*Licaria aureosericea* is characterized by the combination of alternate leaves, densely tomentellous twigs, cylindrical flowers with the anthers exerted and a dense, golden sericeous indument on the lower surface of the young leaves. The flowers are quite similar to those of *L. oppositifolia* (Nees) Kostermans, but that species has opposite or subopposite leaves, an appressed indument on the twigs, more pubescence on the upper leaf surface, and it lacks the golden sericeous indument on the leaves. Kurz (1983) only saw the Prance collection of *L. aureosericea* and included it in *L. oppositifolia*, noting that it differed in its alternate leaves. Additional recent collections have shown that this combination of alternate leaves, tomentellous twigs, and cylindrical flowers with exerted anthers is consistent and not restricted to collections from the Ducke Reserve, but also occurs elsewhere in Amazonian Brazil and in Guyana. The type specimen comes from a marked tree (1755-06), which hopefully will facilitate collecting fruiting material. The three collections from Guyana have a pubescent inner surface of the receptacles, while the Brazilian collections have a glabrous receptacle.

*Paratypes.* BRAZIL. Amazonas: Manaus, Reserva Florestal Ducke (fl), *Martins et al.* 16 (G, INPA, K, MBM, MG, MO, SP, U, UB), (fl), *Prance et al.* 9035 (INPA, NY); São Gabriel da Cachoeira, Morro dos Seis Lagos, 0°20'N, 66°45'W, 400 m (fl), *Nelson et al.* 2346 (INPA, MO). GUYANA. U. Takutu-U. Essequibo region: Sipu River, 01°25'N, 58°57'W (fl), *Clarke et al.* 7825 (MO, US); Acarai Mts., 01°22'N, 58°60'W, 700 m (fl), *Clarke et al.* 7242 (MO, US), (fl), *Clarke et al.* 7602 (MO, US).

***Licaria hirsuta*** van der Werff, sp. nov. TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W, 30 June 1993 (fl), *J. E. L. S. Ribeiro et al.* 950 (holotype, INPA; isotypes, MO, SP). Figure 2.

Ad subgenus *Licariam* pertinens, a congeneris foliis alternis, pinnatinerviibus subtus pilis erectis praeditis recedit.

Trees, to 15 m. Twigs terete or roundly angled, densely tomentose-hirsute, the surface of the twigs completely covered by the yellowish brown indument, this turning darker with age; terminal buds densely tomentose-hirsute. Leaves alternate, 7–18 × 3–6 cm, chartaceous, (narrowly) elliptic; apex (shortly) acuminate, the acumen 0.5–2 cm long; the base acute to angustate; the upper surface glabrous; the lower surface papillose, moderately erect pubescent, the surface largely visible, the indument denser along the major veins and midrib and covering these completely; midrib and lateral veins immersed or slightly impressed on the upper surface, raised on the lower surface; tertiary venation raised on lower, not visible on upper surface; lateral veins 5 to 7 on each side, arching upward near the margin and becoming loop-connected; domatia absent; petioles 6–12 mm long, canaliculate, with the same indument as the twigs. Inflorescences in the axils of bracts at the base of recent shoots or along leafless short shoots, 4–10 cm long, paniculate-cymose, densely pubescent. Flowers perfect, about twice as long as the pedicels, densely pubescent, turbinate, ca. 2 × 2 mm; tepals much shorter than the floral tube, broadly triangular, erect or incurved; the stamens included with only their tips with the anther cells visible; stamens 3, 2-celled, representing whorl III, the filaments densely pubescent, the cells apical and opening toward the center of the flower; staminodes representing whorls I and II present, glabrous or pubescent, sometimes with a glandular tip; glands present at the base of the stamens; pistil ca. 1.5 mm long, pubescent; the receptacle deeply urceolate, densely pubescent inside. Fruit unknown; cupule 1.5 × 2 cm, warty, deeply cup-shaped, with a double margin, the inner margin short, erect, without remnants of the stamens.

*Phenology.* Flowers: June and August.

*Habitat.* Terra firme forest on clay soil.

*Licaria hirsuta* can be readily recognized by the erect indument on lower leaf surfaces and along the twigs. No other *Licaria* species from Amazonian Brazil has such a hirsute indument. The papillose lower leaf surface is also a good character; it has been reported only in *L. chrysophylla* (Meisner) Kostermans (which has opposite leaves), *L. dolichantha* Kurz (which has flowers 3–6 mm long),

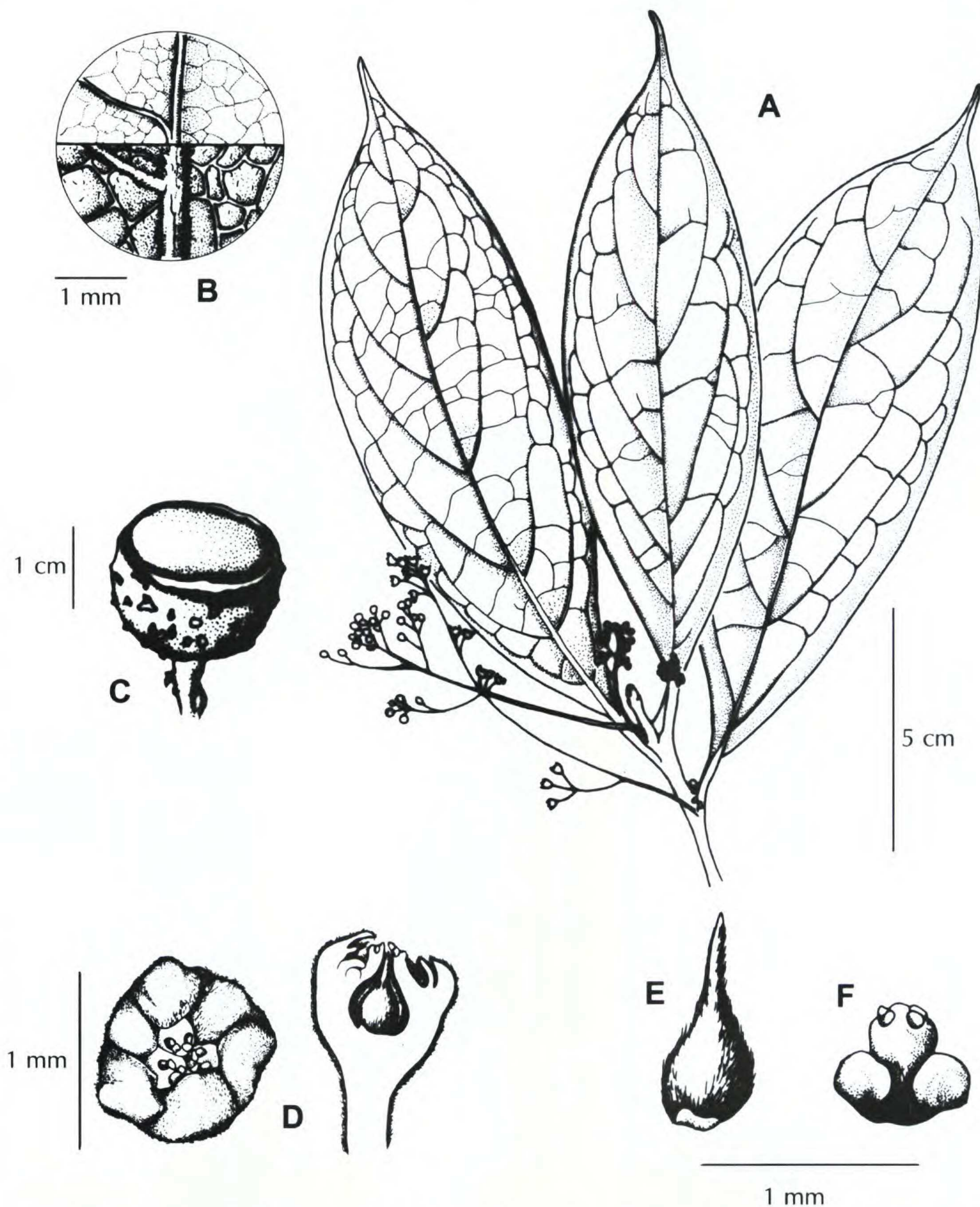


Figure 2. *Licaria hirsuta* van der Werff. —A. Habit. —B. Details of the upper (at top) and lower leaf surface. —C. Fruit cupule. —D. Flower. —E. Pistil. —F. Stamen. (C from Pires & Lima 66, otherwise from holotype, Ribeiro *et al.* 950.) Drawn by Angelic Katz Nara.

and *L. brasiliensis* (Nees) Kostermans (which has an appressed indument); these three species are all known from the Amazonian lowlands. Two species from Venezuelan Guayana also have an erect indument, *L. tomentosa* van der Werff, a poorly known species that has opposite leaves, and *L. trinervis*

van der Werff, which has small, tripliveined leaves. An unidentified *Licaria* specimen from Amazonas (Rio Maués-Açu), Hill 13106 (INPA), also has erect hairs on the lower leaf surface, but differs in having somewhat tripliveined leaves, a sparser, shorter indument on the leaves, a shorter indument on the

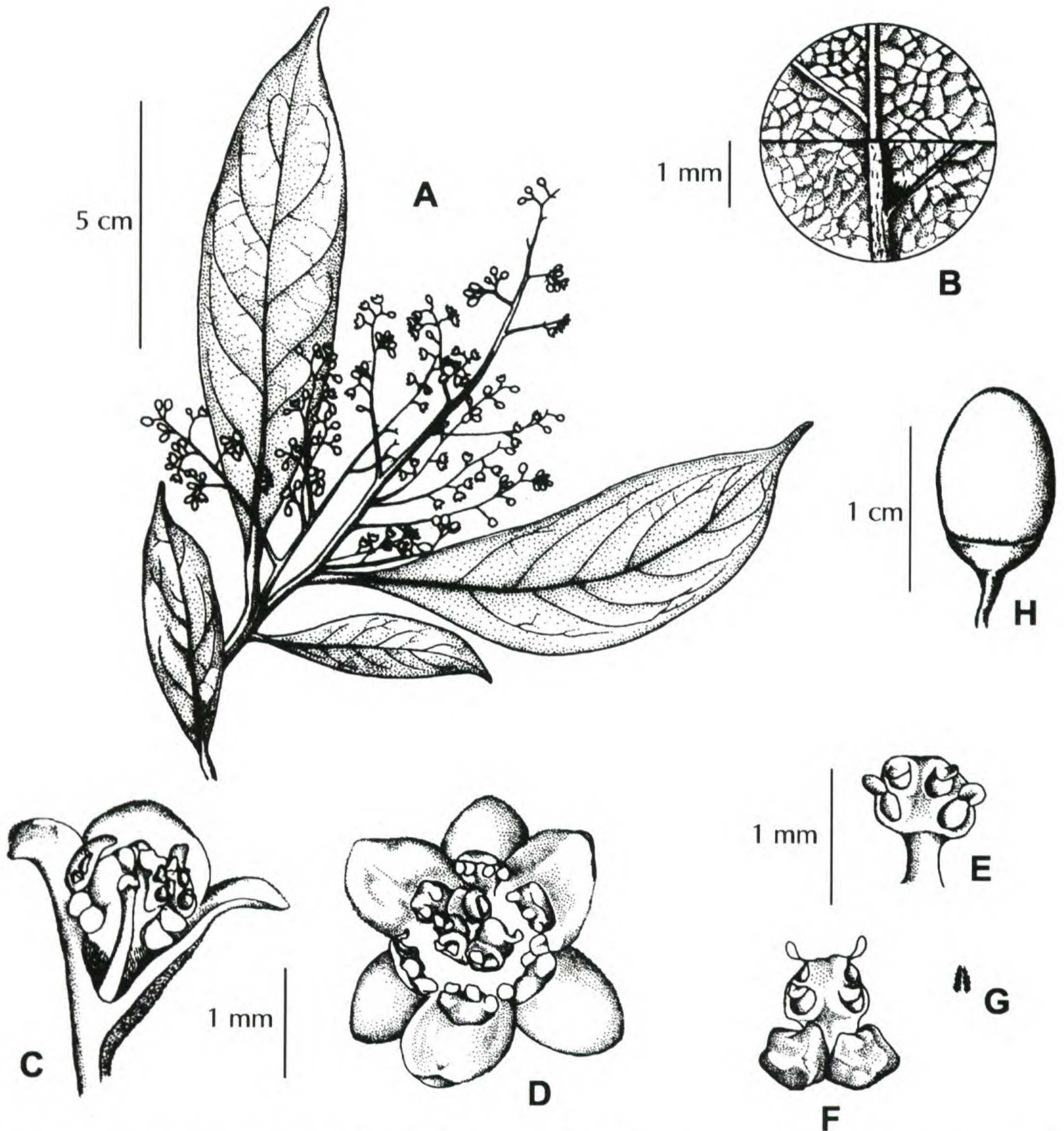


Figure 3. *Ocotea cinerea* van der Werff. —A. Habit. —B. Details of the upper (at top) and lower leaf surface. —C, D. Staminate flower. —E. Stamen of whorls I and II. —F. Stamen of whorl III. —G. Staminate whorl IV. —H. Fruit. (A, B from holotype, Nascimento *et al.* 742; C–F from Vicentini 826; H from Ribeiro 1127.) Drawn by Angelic Katz Nara.

inflorescences and flowers, and a raised reticulation on the upper leaf surface. It probably represents an undescribed species, but more material is needed for its description.

*Paratypes.* BRAZIL. Amazonas: Manaus–Caracará road, km 115 (fl), Prance *et al.* 21638 (INPA, MO, NY); km 137 (fr), Pires & Lima 66 (INPA); km 69 (st), Rodrigues & Chagas 1752 (INPA); Distrito Agropecuário da Suframa, Fazenda Esteio, Reserva 1301 of the Projeto Dinâmica Biológica de Fragmentos Florestais (PDBFF), 02°23'S, 59°51'W (fl), tree 1015, Martins *et al.* s.n. (INPA, MO).

***Ocotea cinerea*** van der Werff, sp. nov. TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W, 6 Feb. 1995 (fl), tree 801–06, J. R. Nascimento *et al.* 742 (holotype, INPA; isotypes, MO, SP). Figure 3.

*Ocoteae schomburgkianae* similis, sed receptaculo florum masculorum intus pubescente, staminodiis parvis, pubescentibus, statura maiore et cupulis minus profundis recedit.

Dioecious trees, to 40 m. Twigs angular, when

young with some minute appressed hairs, soon becoming glabrous; terminal buds densely, whitish appressed pubescent. Leaves 5–11 × 1.8–4 cm, alternate, stiffly chartaceous, elliptic or elliptic-obovate, glabrous or nearly so; the apex obtuse or acuminate, the acumen to 1 cm long; the base acute or somewhat decurrent on the petiole; the margin flat or incurved near the base; midrib (slightly) raised, lateral veins and reticulation immersed on the upper surface, midrib and lateral veins raised, reticulation immersed, but visible due to its lighter color on the lower surface; lateral veins 5 to 7 on each side; domatia frequently, but not always present, inconspicuous, consisting of a few hairs or a slight depression; petioles 5–7 mm long, not always clearly distinct from the decurrent leaf bases. Inflorescences in the axils of normal leaves, 4–8 cm long, sparsely appressed pubescent, paniculate-cymose. Flowers unisexual. Male flowers glabrous or sparsely puberulous outside, ca. 5 mm diam.; tepals spreading, glabrous on the inner surface, ca. 2 mm long, broadly ovate-elliptic; stamens 9, all 4-celled, the outer 6 with the anther cells in 2 pairs, introrse, the anther about twice as long as the narrow filament, the inner three with free filaments, the cells extrorse-lateral, in 2 pairs; glands at the base of the inner stamens conspicuous, the two glands of each stamen slightly fused at the base; staminodia present, stipitiform, densely pubescent, about as long as or slightly longer than the glands; pistillode slender, 2 mm long, glabrous, the tip dark; receptacle rather deep, pubescent inside. Female flowers with 9 larger staminodia, representing the outer 3 whorls, these glabrous; staminodia of whorl IV stipitiform, small, pubescent; pistil glabrous, 1.5 mm long, the ovary ca. 1.2 mm long; receptacle urceolate, glabrous inside. Fruits 1–1.5 × 0.8–1.0 cm, ellipsoid, largely exserted from the shallow, bowl-shaped cupule, this 6–8 × 2–3 mm; the peduncle not or scarcely swollen and abruptly widened in the cupule.

**Vernacular.** Peru: “Moena negra.” Brazil: “Louro-preto.”

**Phenology.** Flowers: November, January, February, March, and April. Fruits: August, September, October, and November. *Ocotea cinerea* flowers every two years at the Reserva Florestal Ducke according to field observations by A. Vicentini and supported by the collection dates.

**Habitat.** Terra firme forest on clay to sandy-clay soil.

*Ocotea cinerea* is an inconspicuous species, best recognized by its almost glabrous, roundly angular twigs, which usually have a grayish color (hence

the specific epithet), the elliptic-obovate or elliptic leaves with frequently an inrolled base and decurrent on the petiole, the pubescent receptacle of the staminate flowers, and the pubescent staminodia of whorl IV. In Rohwer's (1986) treatment it keys to *O. schomburgkiana* (Nees) Mez, which differs in its roundish twigs, elliptic to elliptic-ovate leaves, glabrous receptacle, and smaller size (*O. schomburgkiana* is a shrub or small tree, rarely exceeding 10 m, while *O. cinerea*, when fertile, ranges from 15 to 40 m). An additional difference is that the tertiary venation tends to be slightly raised on the upper leaf surface of *O. schomburgkiana*, while it is immersed in *O. cinerea*. Label data suggest that *O. schomburgkiana* predominantly occurs on white sand, while *O. cinerea* is usually found on clay or sandy-clay soil.

**Paratypes.** BRAZIL. **Amapá:** Mun. de Macapá, Cupixi, 0°32'N, 51°52'W (fl), *Rabelo et al.* 3226 (MG, MO, NY); Mun. de Macapá, Estrada Perimetral Norte, 1°21'N, 53°15'W (buds), *Mori & Cardoso* 17577 (MG, MO, NY). **Amazonas:** Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W (fl), *Rodrigues & Osmarino* 8314 (INPA, MO, NY), (fl), *Rodrigues & Osmarino* 6869 (INPA, NY), *Rodrigues & Osmarino* 6874 (INPA, NY), (fl), *Nascimento et al.* 743 (INPA, MO, SP), (fl), *Nascimento et al.* 749 (INPA, MO, SP), (fr), *Ribeiro et al.* 1127 (INPA, MO, SP), (fl), *Vicentini et al.* 803 (INPA, MO, SP), (fl), *Vicentini et al.* 826 (INPA, MO, SP); Distrito Agropecuário da Suframa, Reserva 1501 (km 41) of the PDBFF project, 02°24'S, 59°43'W (buds), *Oliveira et al.* A 512 (INPA, MO, NY), (fl), *Oliveira et al.* A1917 (INPA, MO, NY), (fl), *Mori* 22864 (INPA, MO, NY), (fr), *Mori & Mora Cardoso* 20711 (INPA, MO, NY), (fr), *Mori et al.* 20542 (INPA, MO, NY); Distrito Agropecuário da Suframa, Reserva 3304 of the PDBFF project, 2°22'S, 59°57'W (fr), tree 3118, *da Silva et al.* s.n. (INPA, MO); CEPLAC, km 29, Manaus–Itacoatiara Rd. (fl), *Pennington et al.* P22757 (INPA, MO, NY); km 154, Manaus–Caracará Rd. (fr), *Prance et al.* 22724 (INPA, MO, NY); km 26, Manaus–Caracará Rd. (buds), *Prance et al.* 3069 (INPA, MO, NY); Mun. Presidente Figueiredo, UHE Balbina, (fl), *Cid Ferreira et al.* 6618 (INPA, MO). FRENCH GUIANA. **Saül:** Sentier Botanique, 3°37'N, 53°12'W (fr), *Mori et al.* 23734 (CAY, MO, NY), (fr), *Mori et al.* 23898 (CAY, MO, NY), (fr), *Mori et al.* 22712 (CAY, MO, NY), (fr), *Mori et al.* 24691 (MO, NY). PERU. **Depto. Loreto:** Jenaro Herrera, 1 Oct. 1981 (young fr), tree 2/216, *sine coll.*, s.n. (MO), (young fr), tree 5/227, *sine coll.*, s.n. (MO), (fl), *Encarnación* 26151 (MO), (young fr.), *Castillo* 2 (MO).

***Ocotea delicata* Vicentini, sp. nov. TYPE:** Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W, 5 May 1995 (fl), tree 2534–06, *A. Vicentini et al.* 952 (holotype, INPA; isotypes, K, MG, MO, SP). Figure 4.

*Ocoteae laxae* et *O. tarapotanae* foliis subtriplinerviis, nervis parum impressis similis, foliis edomatiatis ramulisque dense tomentellis recedit.

Small tree, to 10 m. Branching presents contin-

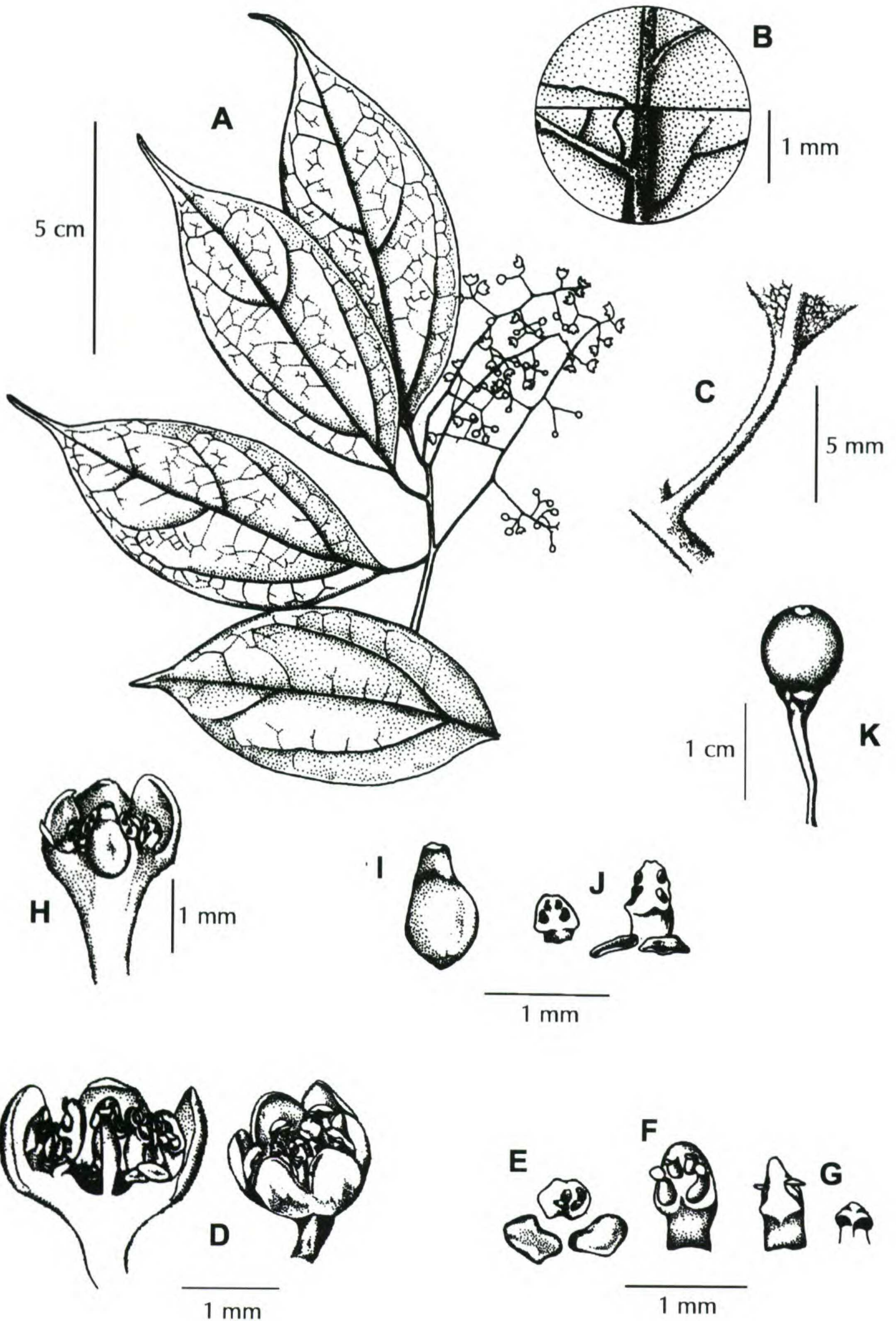


Figure 4. *Ocotea delicata* Vicentini. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Detail of the dense indument on the petiole. —D. Staminate flower. —E. Stamen of whorl III with lateral glands (upper

uous growth. Twigs subcylindrical, 1–1.5 mm diam. 5 cm below the terminal bud, completely covered by short light brown (grayish) erect hairs, slowly becoming sparse with age; terminal buds ca. 2 mm long, covered by the same erect indument. Leaves alternate, pseudo-distichous, evenly distributed in  $\pm$  pendulous branches (field observation), 5–14  $\times$  2–5.5 cm, chartaceous, elliptic; the apex caudate (acumen 7–18 mm long), rarely acute; the base acute with recurved margins; margins otherwise flat; lamina not clearly gland-dotted, usually drying dull green, the lower surface with short erect hairs on the venation, denser on the midrib and sparse to absent on the surface, persisting on mature leaves; midrib and secondary veins also pubescent on the upper surface of mature leaves, at least on the lamina base, midrib and secondary veins prominent on both surfaces; secondary veins 4 to 5 pairs, basal veins distinct, more acute arching and longer than rest, forming a sub-tripliveined venation, essentially all veins clearly loop-connected, but sometimes the basal ones free; tertiary veins slightly prominent beneath and inconspicuous above,  $\pm$  perpendicular to midvein in the inner and lower half, elsewhere reticulate, or completely reticulate, the reticulation coarse; domatia absent; petiole 0.7–1.4 cm long, slender (ca. 1 mm thick), subcylindrical and completely covered by the same indument as twigs. Inflorescence in the axils of normal leaves, 4–10 cm long, paniculate-cymose, 2 or 3 orders of branching; branches  $\pm$  perpendicular to the main branch; pedicels and distal internodes of cymes well developed, individual flowers clearly separate at the tips of inflorescence branches, pedicels with same short erect hairs as twigs, the indument dense and becoming sparser toward the flowers; bracts and bracteoles caducous at anthesis. Flowers unisexual, ca. 2 mm diam.; pedicels longer than flowers, 2–2.5 mm long, with erect hairs, sparse or dense but not completely covering the surface; all tepals equal, yellow, erect at anthesis, ovate, ca. 1.5 mm long, hyaline, pubescent on outer surface and almost glabrous inside. Staminate flowers with 9, 4-celled stamens (sometimes whorl IV also fertile, if so with 2 anther cells); outer 6 stamens ca. 0.8 mm long, filament ca. 0.4 mm long, glabrous, as wide as the anther's base, the cells introrse in two rows, completely filling the anther, upper ones smaller than the lower ones; inner 3 stamens ca. 0.8 mm long, the filaments as long as and slightly narrower

than anthers, glabrous, anthers triangular, lower cells extrorse-latrorse, upper ones clearly latrorse, opening toward the connective, with two flattened glands at the base, shorter than filaments; whorl IV variable in flowers of the same inflorescence, completely absent, or stipitiform, sterile and pubescent, or fertile with only two anther cells, or with a glandular head, and sometimes also presenting glands at the base; pistillode glabrous with a conspicuous stigma, as high as inner stamens; the receptacle shallow, almost flat, and densely pubescent inside. Pistillate flowers with 9 staminodes, these ca. 0.2 mm long, filaments glabrous, with small flattened glands at the base of the inner 3; the pistil glabrous, ca. 1 mm long, the style shorter and almost indistinct from ovary, these half inside a pubescent receptacle, the stigma triangular. Fruits globose, ca. 1 cm diam.; cupule small, ca. 7 mm diam., shallow and with persistent tepals; pedicel claviform and ca. 1.5 cm long.

*Phenology.* Flowers: May and June. Fruits: August.

*Habitat.* Terra firme forest on clay soil.

*Ocotea delicata* is a small tree that can be easily recognized by its tripliveined leaves, slightly impressed major veins, and the densely tomentellous twigs and inflorescences. It shares with *Ocotea laxa* (Nees) Mez and *Ocotea tarapotana* (Meisner) Mez, both members of the *Ocotea cernua* group (sensu Rohwer, 1986), tripliveined leaves with slightly impressed major veins. However, these two species have glabrous or sparsely appressed pubescent twigs (the indument not obscuring the surface as in *O. delicata*), glabrous or almost glabrous flowers and inflorescence branches, and domatia in the axils of the lowermost lateral veins. These vegetative characters alone allow an easy distinction of these species. In addition, in staminate flowers of *O. laxa* and *O. tarapotana* the pistillode is reduced to absent or at least without a conspicuous stigma, and the glands of inner stamens are globose, not flattened as in *O. delicata*. The fruits and cupules of *Ocotea tarapotana* are not yet known; *O. laxa* has a fruit and cupule (with persistent tepals) similar to those of *O. delicata*. *Ocotea delicata* is only known from the vicinity of Manaus and toward the east until the Rio Trombetas, on the north side of the Amazon Basin.

*Paratypes.* BRAZIL. Amazonas: Manaus, Reserva

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view). —F. Stamen of whorl I. —G. Stamen (left) and staminode of whorl IV. —H. Pistillate flower. —I. Pistil. —J. Staminodes of whorls I and III (right, note flattened glands). —K. Fruit. (A–G from holotype, *Vicentini et al.* 952; H–J from *Rodrigues & Osmarino* 6935; K from *Vicentini* 658.) Drawn by Angelic Katz Nara.



Florestal Ducke, 02°53'S, 59°58'W, Santos & Lima 959 (INPA, K, MG, MO, SP), (fr), tree 1757-06, *Vicentini et al.* 658 (INPA, K, MG, MO, SP), (fl), tree 1757-06, *Vicentini et al.* 1186 (INPA, K, MG, MO, SP), (fl), *Rodrigues & Osmarino* 6935 (MO, NY), (fl), *Ramos & Oliveira* 730 (INPA). **Pará:** Oriximiná, Porto Trombetas, km 60 Road Mineração do Norte (fr), *Cid et al.* 1888 (INPA).

***Ocotea immersa*** van der Werff, sp. nov. TYPE: Peru. Depto. Loreto: Prov. Requena, Arboretum Jenaro Herrera, tree 4/36, A. Castillo s.n. (holotype, MO). Figure 5.

Ad gregem *Ocoteae minarum* pertinens, ab illis speciebus foliis edomatiatis, laevibus, apice rotundatis differt.

Trees, to 25 m. Twigs with rounded ridges, the apices densely and finely appressed pubescent, the indument light brown and covering the distal few cm completely but the twigs quickly glabrescent with age; terminal buds densely and finely appressed pubescent. Leaves 13–25 × 4.5–7 cm, alternate, evenly distributed along the twigs, (narrowly) obovate, firmly chartaceous; the apex obtuse or rounded; the base gradually narrowed and decurrent on the petiole; the margins frequently inrolled; very young leaves with some appressed hairs, but soon glabrous on both surfaces; upper surface with midrib, lateral veins, and tertiary venation immersed or faintly raised; lower surface with midrib raised, lateral veins and tertiary venation immersed or nearly so; lateral veins 5 to 8 on each side; domatia lacking; petioles not distinct from the decurrent leaf bases, flat on the upper side, appressed pubescent when young, glabrescent with age. Inflorescences in the axils of normal leaves, 10–20 cm long, panicle-cymose, minutely puberulous, the indument becoming denser toward the flowers. Flowers hermaphrodite or unisexual, 4.0–4.5 mm diam.; the tepals spreading at anthesis, elliptic-ovate, ca. 2 mm long, very sparsely puberulous outside, inner 3 tepals densely pubescent inside, outer 3 moderately pubescent inside. Hermaphrodite flowers with 9, 4-celled stamens; the outer 6 ca. 1 mm long, the filament ca. 0.2 mm long, pubescent, the anther rectangular, glabrous, with the introrse cells in two rows; the inner 3 stamens ca. 1.2 mm long, the filament ca. 0.4 mm long, with a few hairs, the anther glabrous, the cells lateral-extrorse, in 2 rows; the inner 3 stamens with 2 small glands at the base; staminodia not seen; pistil 1.5 mm long, with a few small, appressed hairs and a distinctly swollen base; receptacle shallow, densely pubescent inside. Pistillate flowers with 9 staminodia, these ca. 0.5 mm long, the cells not opening, filaments ± pubescent, glands present at the base of the inner 3 stamens; pistil glabrous, ca. 1.5 mm

long, the stigma distinct, papillose; receptacle shallow, glabrous inside. Fruits ellipsoid, 2 × 1.4 cm; cupule a small plate (ca. 6 mm diam.) on a thickened pedicel.

*Vernacular.* Peru: “Palta moena.”

*Phenology.* Flowers: July, November, and December. Fruits: December.

*Habitat.* Campinarana forest on white-sand soil.

*Ocotea immersa* belongs to the *O. minarum* group of Rohwer (1986) because of its small, plate-like cupule and thickened pedicel in fruit, its seemingly hermaphrodite and pistillate flowers, and the long, slender terminal buds with dense, appressed pubescence. Within this group it stands apart by its leaves with a rounded or obtuse apex, the absence of domatia, and its immersed venation. Only one other species, *O. obovata* (Ruiz & Pavón) Mez, has a rounded leaf apex and lacks domatia, but that species occurs in the Peruvian Andes and has clearly raised venation (in the original description its leaves are described as venosissima). Other useful characters for *O. immersa* are its glabrous leaves, the finely appressed pubescence on the young twigs, the dense pubescence on the inner surface of the tepals, and the pubescent receptacle of the hermaphrodite flowers, while pistillate flowers have a glabrous receptacle.

In describing this species as having both hermaphrodite and pistillate flowers I follow Rohwer (1986). Whether the flowers with functional stamens are really hermaphrodite is still not clear. These flowers possess a pistil with a clearly swollen base, suggesting the pistil is functional. In most *Ocotea* species with unisexual flowers the staminate flowers either lack a pistillode or the pistillode is very slender to thread-like and does not have a swollen base. The two collections with young fruits have a few staminodia attached to the cupule, and have the inside of the receptacle glabrous, indicating these fruits developed from pistillate flowers. Therefore, it remains to be demonstrated that fruits develop from the flowers which I describe here as hermaphrodite. The fruiting collection from the Reserva Florestal Ducke (*Vicentini et al.* 784) has irregularly swollen, corky pedicels, which are partly hollow. This seems to be a result of a fungal infection. The collection *Vasquez et al.* 1012 has nondiseased fruits and pedicels; it was used in making the description.

*Paratypes.* BRAZIL. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W (fr), *Vicentini et al.* 784 (INPA, MO, SP), (fl), *Vicentini et al.* 798 (INPA, MO, SP), (fl), *Vicentini et al.* 1225 (INPA, MO, SP). PERU.

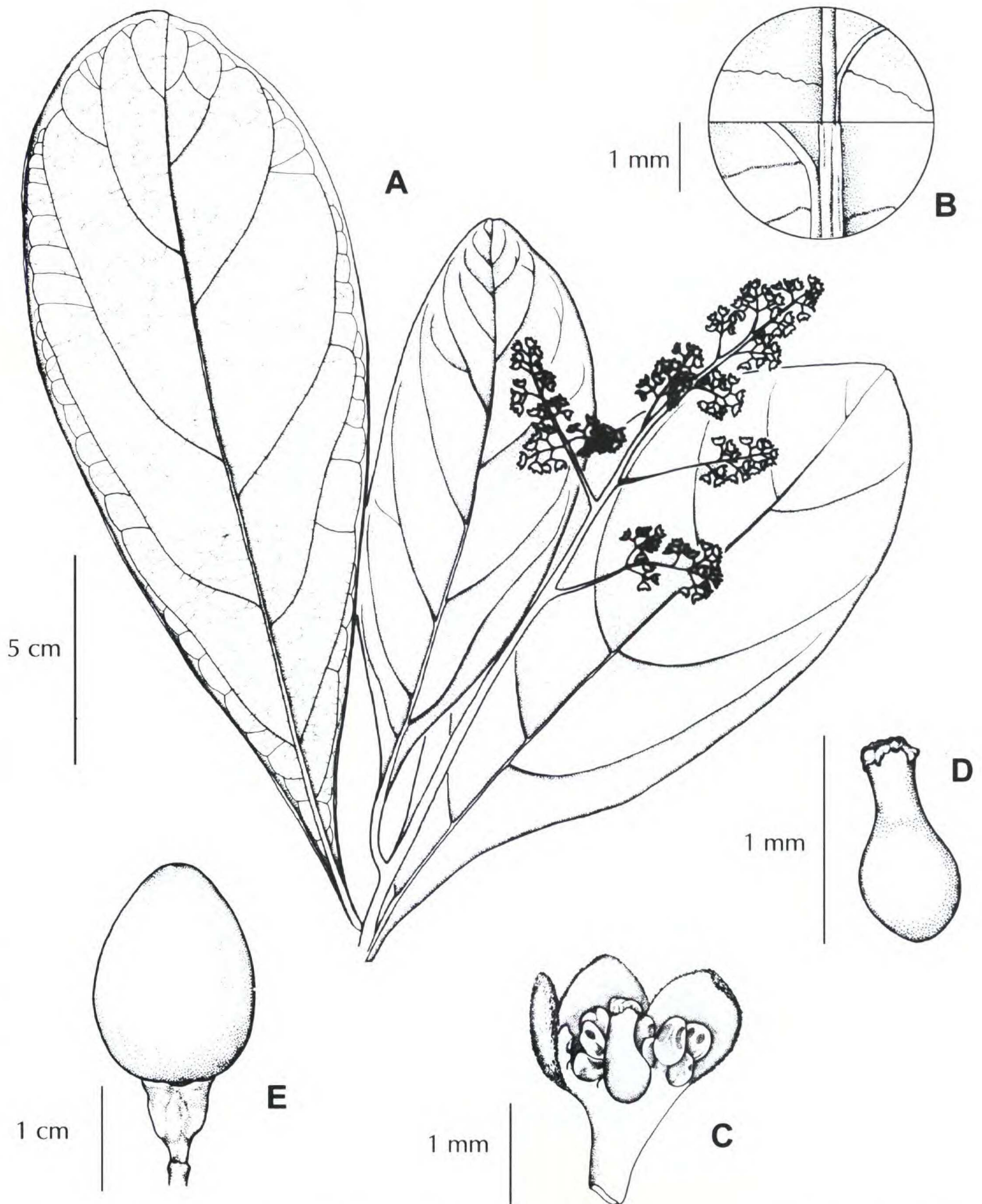


Figure 5. *Ocotea immersa* van der Werff. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Longitudinal section of a pistillate flower. —D. Pistil. —E. Fruit. (A–D from Vicentini 798; E from Vazquez 1012.) Drawn by Angelic Katz Nara.

**Depto. Loreto:** Prov. Requena, Arboretum Jenaro Herrera, 4°50'S, 73°45'W, without date (fr), tree 5/43, *sine coll.*, *s.n.* (MO), (buds), *sine coll.*, *s.n.* (MO), (fl), tree 4/36, A. Castillo *s.n.* (MO), (fr), Grández & Aguilar 6041 (MO), (fr), Vazquez *et al.* 1012 (MO), (young fr), van der Werff *et al.* 9965 (MO), (young fr), van der Werff *et al.* 10041 (MO), (fl & young fr), van der Werff *et al.* 10097 (MO).

***Ocotea ligulata* van der Werff, sp. nov.** TYPE: Brazil. Amazonas: Distr. Agropecuário, Reserva 1501 (km 41) of the WWF/INPA MCS Project, 6 Dec. 1988 (fl), S. Mori *et al.* 20190 (holotype, MO; isotypes, INPA, NY). Figure 6.

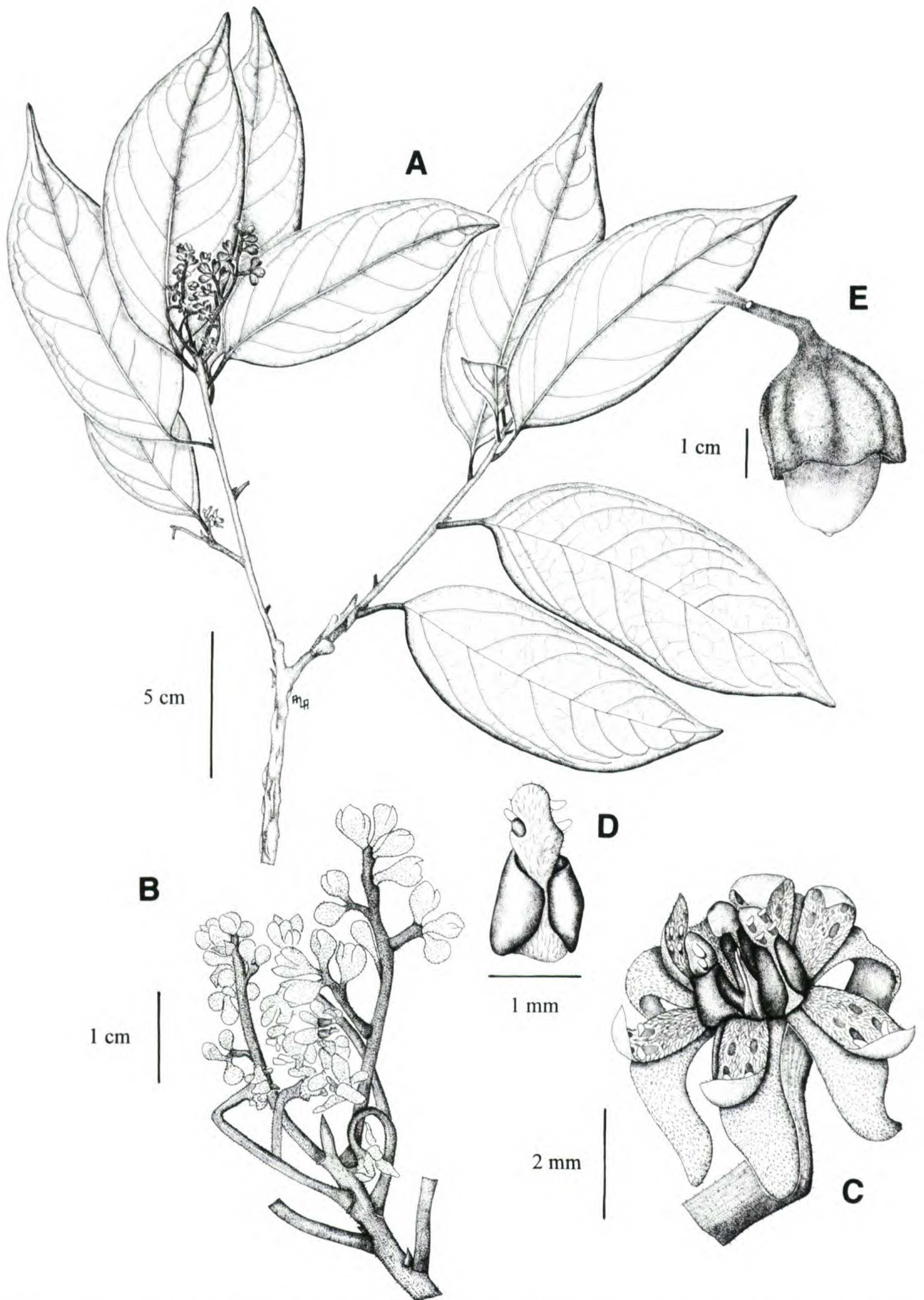


Figure 6. *Ocotea ligulata* van der Werff. —A. Habit. —B. Inflorescences near tip of twig. —C. Flower. —D. Stamen of whorl III with large glands. —E. Cupule with fruit. (A–D from Mori 20190; E from Mori 20574.) Drawn by Alba L. Arbelaez.

*Ocoteae cymbarum* affinis sed floribus dense pubescentibus, cupula profunda, simplici-marginata recedit.

Trees, to 35 m. Twigs angular-ridged, the very tip sparsely appressed pubescent, but very soon becoming glabrous, solid; terminal buds rather sparsely appressed pubescent. Leaves 8–13 × 3–4.5 cm, elliptic or elliptic-oblong, alternate, stiffly chartaceous; apex acute or somewhat acuminate; base acute to obtuse; leaves glabrous; midrib weakly raised on upper surface, raised on lower surface; lateral veins and tertiary venation immersed on both surfaces, tertiary venation forming a fine reticulum, this and the lateral veins lighter in color than the laminae; lateral veins 6 to 8 on each side, poorly visible; domatia lacking; petioles 1–1.5 cm long, darker than the twigs, canaliculate, glabrous. Inflorescences to 5 cm long, paniculate-cymose, in the axils of bracts near the tips of the branches, moderately pubescent near the base, more densely so toward the flowers, the hairs ascending. Flowers hermaphrodite, 7–9 mm diam., greenish yellow; tepals ca. 3.5 mm long, elliptic-ovate, spreading to reflexed at anthesis, the outside completely covered by a gray-brown indument, the inside moderately papillose but the very base pubescent; stamens 9, 4-celled; the outer 6 ca. 2 mm long, tongue-shaped, somewhat narrowed near the base but without a distinct filament, the sterile tip ca. 0.5 mm long, papillose and with some hairs near the base, the cells introrse and arranged in 2 pairs; the inner 3 stamens slender, ± columnar, ca. 2 mm long, the anthers ca. 0.8 mm long, papillose, the cells lateral in 2 pairs, the filament covered by the large (1.2 mm long) glands; staminodia 3, stipitiform, ca. 0.6 mm long, densely pubescent; pistil ca. 2.5 mm long, glabrous; receptacle deeply cup-shaped, glabrous inside. Fruits ellipsoid, ca. 2 × 1.5 cm, purple at maturity; cupule deeply cup-shaped, 2.5 × 2.5 cm, with a single margin, enclosing half or more of the fruit.

*Phenology.* Flowers: December. Fruits: July.

*Habitat.* Terra firme forest on clay soil.

The ligulate stamens with a sterile tip place *Ocotea ligulata* in the subgenus *Dendrodaphne* (Beurling) Mez, a small group of less than 10 known species. Additional characters of this subgenus, not present in all species, are the position of the inflorescences in the axils of bracts, the presence of a cupule with a double margin, the papillose indument on the stamens and inner surface of the tepals, and the dark color of the petioles in dried specimens, usually darker than the twigs. Three of the species belonging to this subgenus are relatively common, *O. dendrodaphne* Mez and *O. vera-*

*guensis* (Meisner) Mez from Central America and *O. cymbarum* HBK from the lowlands of Venezuela, Colombia, and Brazil. A few species are rarely collected, *O. fragrantissima* Ducke from Amazonian Brazil, *O. quixos* (Lamarck) Kostermans from eastern Ecuador, *O. staminea* (Grisebach) Mez from Jamaica, and the recently described *O. morae* Gomez-Laurito from Costa Rica. Vegetatively, *O. ligulata* most resembles *O. cymbarum* and *O. quixos*. The latter two species differ in having sparsely pubescent flowers with part of the outer surface of the tepals always visible and in their different cupules. *Ocotea cymbarum* has a shallow, funnel-shaped cupule, this becoming plate-like at maturity with a double margin (the inner and outer margin have the same length), while *O. quixos* has a funnel-shaped cupule with the outer margin up to 1 cm longer than the inner margin. Twigs and leaves of *O. quixos* have a strong smell of cinnamon, which is lacking in *O. cymbarum* and *O. ligulata*. *Ocotea cymbarum* frequently has hollow twigs (especially older twigs) and occurs in flooded forest, whereas *O. ligulata* has solid twigs and is only known from terra firme forest. *Ocotea rhynchophylla* (Meisner) Mez has a small sterile tip of the stamens and can be confused with *O. ligulata*, but differs in having glabrous stamens (papillose in *O. ligulata*), a smaller cupule (1.5 × 1.5 cm vs. 2.5 × 2.5 cm), and spreading to half-erect (vs. reflexed) tepals. *Ocotea ligulata* is only known from the vicinity of Manaus. The two Mori collections were previously determined as *Aniba rosaeodora* Ducke and *Ocotea aciphylla* (Nees) Mez and may have been distributed under those names.

*Paratypes.* BRAZIL. Amazonas: Distrito Agropecuário, Reserva 1501 (km 41) of the PDBFF project, 2°24'S, 59°43'W (fr), Mori et al. 20574 (MO, NY), Fazenda Porto Alegre, Reserva 3402, tree 637 (fr), Dick 133 (MO, NY).

***Ocotea minor*** Vicentini, sp. nov. TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W, 3 Apr. 1997 (fl), tree 1211-06, P. A. C. L. Assunção et al. 485 (holotype, INPA; isotypes, MO, SP). Figure 7.

Ad gregem *Ocoteae cernuae* pertinens et *Ocoteae pauciflorae* affinis, sed inflorescentiis multifloris foliisque domatiis praeditis recedit.

Dioecious trees to 20 m. Branching presents continuous growth. Twigs initially angular, soon becoming cylindrical, 1.5–2 mm diam. 5 cm below terminal bud, with extremely short appressed hairs, indument light brown, moderate, becoming sparse with age; terminal buds completely covered by longer appressed hairs. Leaves alternate, evenly dis-

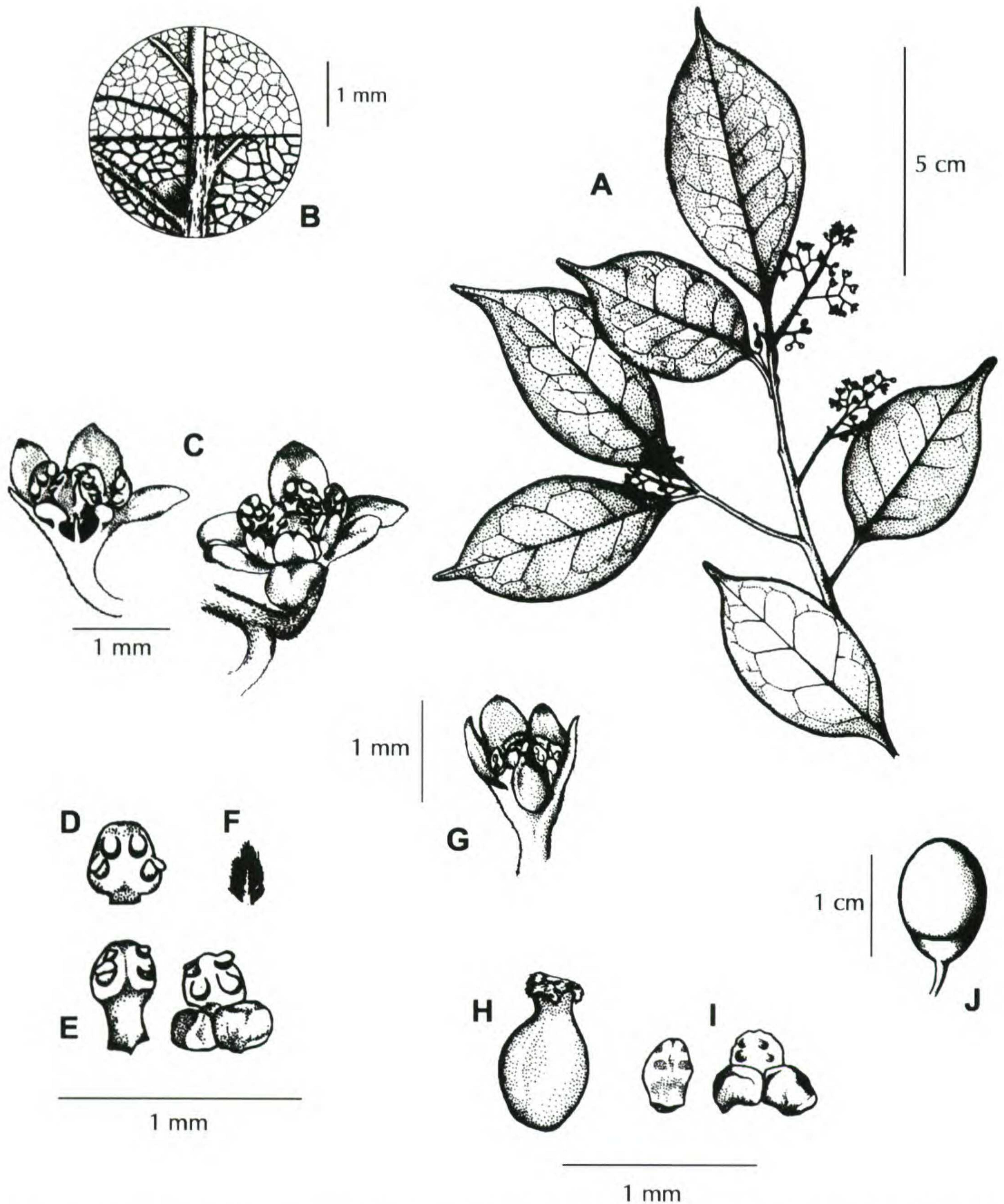


Figure 7. *Ocotea minor* Vicentini. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Staminate flower. —D. Stamen of whorl I. —E. Stamen of whorl III (left, with glands removed). —F. Staminate flower detail. —G. Pistillate flower. —H. Pistil. —I. Staminate flower detail. —J. Fruit. (A–F from holotype, Assunção 485; G–I from Loureiro *et al. s.n.*; J from Assunção 662.) Drawn by Angelic Katz Nara.

tributed along branches, 4–9 × 1.2–2.7 cm, firmly chartaceous, usually obovate; the apex caudate (acumen 7–17 mm); the base narrowly attenuate and flat beneath; the margins flat; lamina not clearly gland-dotted, glabrous or nearly so, usually drying dull grayish on the upper and light brown on

the lower surfaces, not waxy; midrib prominent on both surfaces, more clearly on the upper one; secondary veins 5 to 7 pairs, all veins loop-connected at ca. 2 mm from margins, essentially straight but most basal ones evenly arching and more acute, slightly prominent on both surfaces; tertiary vena-

tion randomly reticulate, slightly raised beneath and almost inconspicuous above, the reticulation coarse; domatia consisting of small depressions, these sometimes with a hairy margin; petiole 0.6–0.7 cm long, sulcate, same color as stem, with sparse appressed hairs. Inflorescences in the axils of normal leaves, 1–5 cm long, 3 orders of branching; peduncle and lateral branches with patent hairs, the indument dense but leaving surface visible and becoming sparser toward flowers; bracts and bracteoles caducous at anthesis. Flowers unisexual, ca. 2–3 mm diam.; pedicels as long as flowers, ca. 1–1.5 mm long, with sparse appressed hairs; tepals equal, cream, erect at anthesis, narrowly ovate, ca. 1 mm long, glabrous on both surfaces. Staminate flowers with 9, 4-celled stamens; the outer 6 ca. 0.7 mm long, filament ca. 0.2 mm long, glabrous, distinctly narrower than anthers, and partially fused with tepals, anthers widely ovate, glabrous, with introrse cells in two rows, the connectives flat, not extended beyond cells; inner 3 stamens ca. 0.7 mm long, filaments as long as and slightly narrower than anthers, with a few hairs at the base, anthers rectangular, glabrous, lower cells introrse, upper ones latrorse or  $\pm$  apical, then opening toward the connective, the connectives flat, not extended beyond cells, with two reniform glands at the base, these as long as filaments; staminodes of whorl IV absent, pistillode pubescent with a blackish but not well developed stigma; receptacle shallow, densely hairy inside. Pistillate flowers with 9 staminodes (those of whorl IV sometimes also present, stipitiform and hairy), these ca. 0.5 mm long, filaments glabrous, inner ones with two glands at the base; pistil glabrous, ca. 1 mm long, style shorter and almost indistinct from ovary, these half inside a pubescent receptacle, stigma distinct, 3-lobed, and papillose. Fruit ellipsoid, ca. 1  $\times$  0.6 cm; the cupule shallowly cup-shaped, smooth, with a single margin, ca. 5 mm high  $\times$  6 mm wide.

*Phenology.* Flowers: March and April. Fruits: September.

*Habitat.* Terra firme forest on sandy-clay soil.

*Ocotea minor* is similar to *Ocotea cinerea*, and the two species can be separated in the following way: *O. minor* has a pubescent pistillode, erect tepals at anthesis, small flowers (up to 3 mm diam.), and the filaments of the outer 6 stamens partly fused with the tepals; on the other hand, *O. cinerea* has a glabrous pistillode, spreading tepals at anthesis, larger flowers (4.5 mm diam.), and the filaments of the outer 6 stamens free. *Ocotea cinerea* also often has slightly obovate leaves, which are a little larger than the elliptic leaves of *O. minor*.

*Ocotea minor* shares with the *O. cernua* group (sensu Rohwer, 1986) filaments of the outer 6 stamens that are partly fused with the tepals. Although species delimitation within the *O. cernua* group is problematic (Rohwer, 1986), *O. minor* most closely resembles *O. pauciflora* (Nees) Mez of the species in this group. *Ocotea pauciflora* differs from *O. minor* in its few-flowered inflorescences, somewhat nodding flowers, and the absence of domatia. *Ocotea minor* is known from the central and eastern Amazon basin in Brazil.

*Paratypes.* BRAZIL. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W (fr), tree 821-06, Assunção et al. 662 (INPA, MO, SP), (fl), tree 821-06, Ribeiro et al. 1889 (INPA, MO, SP), (fl), Rodrigues & Osmarino 6887 (INPA, NY), (st), Gentry & Nelson 69094 (INPA, MO); Manaus–Itacoatira road, km 145 (fl), Loureiro et al. s.n. (INPA 35846) (INPA). Maranhão: Sta. Luiza, Bom Jesus on BR 222, Fazenda Batuta, km 2 (fl), Taylor et al. E1181 (MG, MO, NY); Fazenda Agripec (Varig Airlines), 7 km W of Buriticupu on BR222 (buds), Taylor et al. E1140 (MG, MO, NY).

***Ocotea nigrescens* Vicentini, sp. nov.** TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W, 2 Dec. 1964 (fl), W. Rodrigues & Osmarino 6767 (holotype, INPA; isotype, NY). Figure 8.

*Ocoteae bofo* et *O. rubrinervis* similis, sed foliis glabris, non glandulo-punctatis, tepalis post anthesin deciduis recedit.

Tree up to 30 m tall. Twigs angular, soon becoming cylindrical, ca. 2 mm diam. 5 cm below terminal bud, with extremely short erect hairs (minute, the orientation not evident), the indument moderate to sparse, minute, leaving surface visible and glabrescent, the surface smooth and usually drying blackish; terminal bud completely covered by appressed hairs. Leaves alternate, evenly distributed along twigs, 7–16  $\times$  2.5–6.5 cm, ca. 2 times longer than wide, rigid chartaceous, broadly elliptic to ovate; the apex acuminate, ca. 1–1.6 cm long; the base obtuse, rounded to cuneate; the margin flat or only at the base slightly recurved; lamina not clearly gland-dotted, glabrous or nearly so, the upper surface usually drying dull blackish with whitish reticulation and veins; midrib above slightly prominent, becoming flat toward the base, strongly prominent beneath; secondary veins 4 to 7 pairs, penninerved, evenly arching, the basal pairs longer, diverging more acutely from midrib than rest, all loop-connected in the distal part of lamina, the two most basal pairs closer together than rest, above slightly raised and strongly prominent beneath; tertiary venation reticulate and slightly raised be-

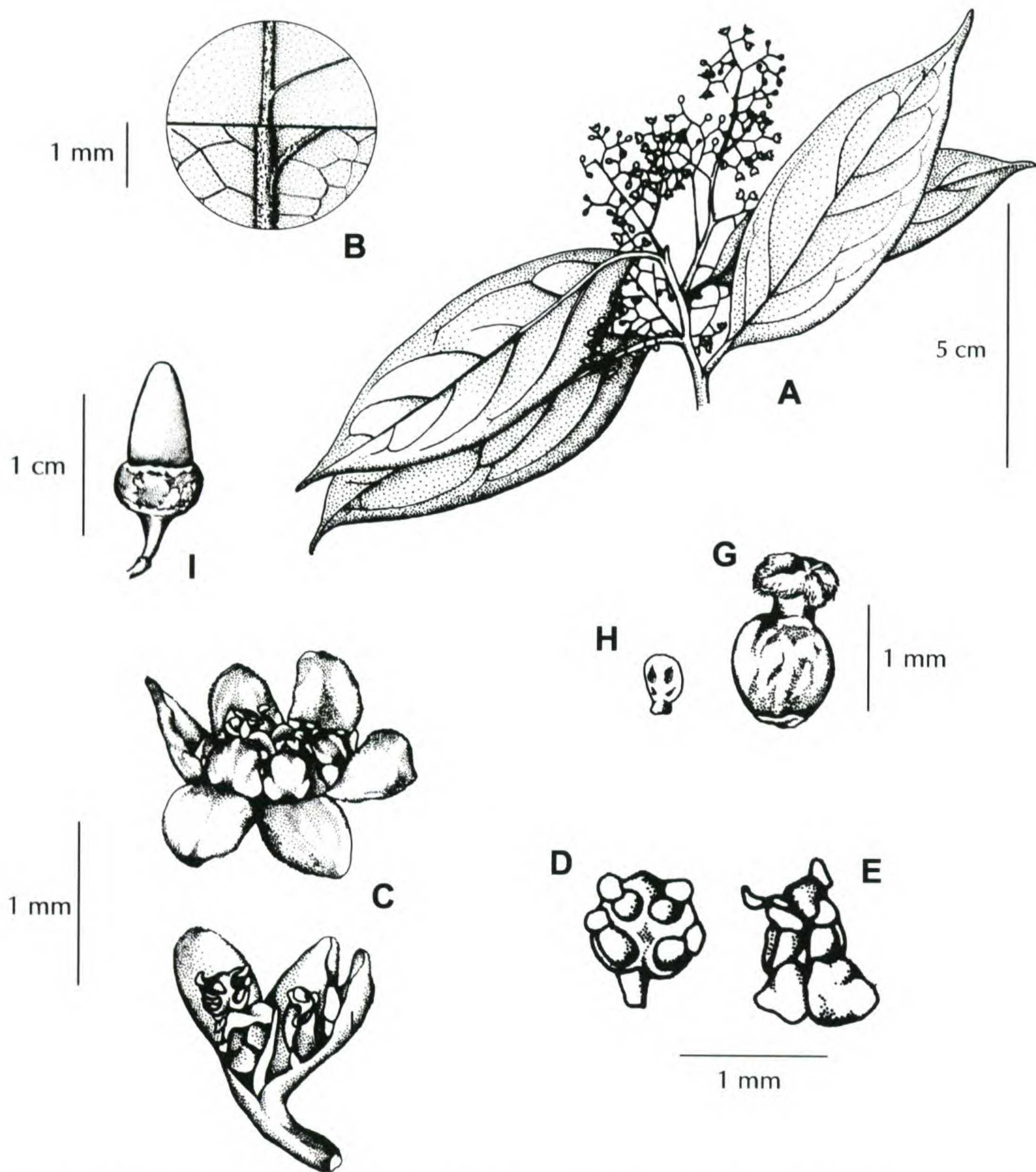


Figure 8. *Ocotea nigrescens* Vicentini. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Staminate flowers. —D. Stamen of whorl I. —E. Stamen of whorl III. —G. Pistil. —H. Staminode of a pistillate flower. —I. Fruit. (A, B, and G, H from *Assunção* 418; C–E from *Aluíso* 237; I from *Assunção* 520.) Drawn by Angelic Katz Nara.

neath, but more conspicuous above; domatia consisting of tufts of whitish hairs, present in the axils of most secondary veins, rarely absent; petiole 0.6–1 cm long, deeply canaliculate to infolded, with the same minute indument as twigs, sparser and soon glabrous. Inflorescences 1.5–7 cm long, borne in the axils of normal leaves, 2 to 3 orders of branching; peduncles and branches with minute erect (or crisped) whitish to yellowish hairs, indument dense

but leaving surface visible; bracts and bracteoles caducous at anthesis. Flowers unisexual, ca. 2–3 mm diam.; pedicels as long as or shorter than flowers, ca. 1–1.5 mm long, with sparse minute erect hairs; tepals equal, white, erect at anthesis, ca. 1.2 mm long, glabrous or nearly so on both surfaces. Staminate flowers with 9, 4-celled stamens; the outer 6 ca. 0.8 mm long, filament ca. 0.2 mm long, glabrous, narrower and shorter than anthers, these

glabrous and with introrse cells in two rows, the connective not extended, flat or shortly apiculate; the inner 3 stamens ca. 0.8 mm long, filaments glabrous, narrower and shorter (ca. 1/2) than anthers, these rectangular, upper cells latrorse, lower ones extrorse-latorse, connectives not extended, flat or emarginate, glands reniform as high as filaments; staminodes of whorl IV not seen; pistillode glabrous, without a stigma or only with a discolored style apex (rarely enlarged), shorter than inner stamens and in a shallow receptacle, which is glabrous or nearly so inside. Pistillate flowers with 9 staminodes, these ca. 0.5 mm long, filaments glabrous, narrower and shorter than anthers, glands of inner three stamens larger than filaments; pistil glabrous, ca. 1.5 mm long, style less than 1/2 the length of ovary, the ovary almost entirely enclosed in the receptacle, which is glabrous inside, stigma large, discoid, at anthesis included in the flower. Fruits ovoid, ca. 10 × 5 mm; the cupule deeply cup-shaped, warty (not lenticellate), with a single margin, ca. 5 mm high × 8 mm wide.

*Vernacular.* Brazil: "Louro-preto."

*Phenology.* Flowers: September, October, November, and December. Fruits: April and June.

*Habitat.* Terra firme forest on clay soil.

*Ocotea nigrescens* is easy to recognize by its leaves that are blackish when dry (hence the epithet) and have conspicuous whitish reticulation and veins on the upper surface, and by the secondary veins acutely arching, strongly prominent and distinctly loop-connected beneath, with the basal pairs closer together than the rest, and usually with domatia on their axils. *Ocotea bofo* HBK and *Ocotea rubrinervis* Mez, the latter probably a synonym of the former (H. van der Werff, pers. comm.), have very similar leaves, which also present domatia. However, both are shrubs or treelets that have leaves clearly gland-dotted on the upper surface, with short erect hairs on the lower one, and the fruits present a shallow cupule and persistent tepals. While *Ocotea nigrescens* occurs toward the east of Manaus, apparently limited on the west by the Rio Negro and Rio Madeira, *O. bofo* (including *O. rubrinervis*) is known only from the western Amazon (Peru, Colombia, Ecuador), Venezuela (Orinoco basin), and Panama. *Ocotea nigrescens* is known from eastern Pará, Mato Grosso, Rondônia, and Amazonas states in Brazil.

*Paratypes.* BRAZIL. **Amazonas:** Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W (fl), *Aluísio* 237 (INPA), (fl), *Aluísio* 240 (INPA, MO), (fl), tree 1731-06, *Assunção et al.* 418 (INPA, MO, SP), (fr), tree 1731-06, *Assunção et al.* 520 (INPA, MO, SP), (buds), *Prance et al.* 2622 (A306) (INPA), (young fr), *Vicentini et al.* 823

(INPA, MO, SP); Distrito Agropecuário, Reserva 1501 (km 41) of the WWF/INPA MCS Project, 02°24'S, 59°43'W (fl), *Boom et al.* 8698 (MO, NY), (buds), *Boom et al.* 8528 (INPA, MO, NY), (fl), *Mori et al.* 20203 (INPA, MO, NY); Distrito Agropecuário, Fazenda Porto Alegre, Reserva 3304 of the WWF/INPA MCS Project, 02°22'S, 59°57'W (young fr), tree 159, *Mars et al. s.n.* (MO, NY), Reserva 1302 of the INPA/WWF MCS Project (buds), tree 2430, *sine coll. s.n.*, INPA 191109 (INPA); Novo Airão, Área Indígena Waimiri-Atroari, Aldeia Maré, 01°45'S, 61°15'W (young fr), tree 1699, *Miller et al.* 666 (INPA, MO); Rio Negro, 120 km above Barcelos (fl), *Madison et al.* 6173 (MO). **Mato Grosso:** Rio Juruena (fr), *Rosa & Santos* 2195 (MG, MO, NY). **Pará:** Santarém, km 70 da estrada do Palhão, ramal do Caetetu (fl), *Silva & Souza* 2546 (MG, MO, NY); km 1131, Cuiabá-Santarém Highway, Igarapé Natal (fl), *Prance et al.* P25445 (MG, MO, NY); km 1115, Cuiabá-Santarém Highway, 6°50'S, 55°30'W (fr), *Amaral et al.* 792 (MO). **Rondônia:** Porto Velho, estrada Belmonte (fl), *Mota & Coêlho* 92 (INPA); Porto Velho, hwy. BR 364, 20 km ENE of junction with hwy. BR 325, 9°43'S, 65°10'W (st), *Nee* 34940 (MO, NY).

***Ocotea obliqua*** Vicentini, sp. nov. TYPE: Brazil.

Amazonas: Manaus, Manaus-Itacoatiara road, km 135, 5 Dec. 1966 (fl), *W. Rodrigues & Osmarino* 8284 (holotype, INPA; isotypes, MO, NY). Figure 9.

A ceteris speciebus Amazoniae ramulis dense ferrugineo-puberulis, foliis majoribus, subtus secus nerviis dense puberulis et cupula parva disciforme recedit.

Tree to 30 m. Branching presents sylleptic growth, i.e., initial growth without producing leaves, which are evenly distributed on upper half of flushes. Twigs cylindrical and strongly ridged, ca. 3–4 mm diam. 5 cm below terminal bud, the apices and terminal buds completely covered by short crisped ferruginous hairs, the indument becoming light brown and diminishing with age. Leaves alternate, 9–18 × 4–9 cm, coriaceous, broadly elliptic; the apex acuminate (acumen ca. 1.5 cm long); the base rounded to obtuse; the margins flat; lamina glabrous above, usually drying gray with reddish veins, finely gland-dotted, on the lower surface drying reddish brown, with short erect and crisped hairs, the indument dense but leaving surface visible, decreasing with age, but persisting on the veins (indument very hard to see, even with a microscope); midrib strongly prominent beneath, flat or slightly raised above; secondary veins 7 to 8 pairs, strongly prominent beneath, almost flat above, equally arching, essentially free, but most apical ones loop-connected; tertiary venation distinctly oblique (scalariform), slightly raised on the lower surface; domatia absent; petiole 1.5–2.5 cm long, flat above, with same indument as twigs, glabrescent with age. Inflorescences in the axils of normal leaves, 7–14 cm long, 4 orders of branching; peduncle and lateral



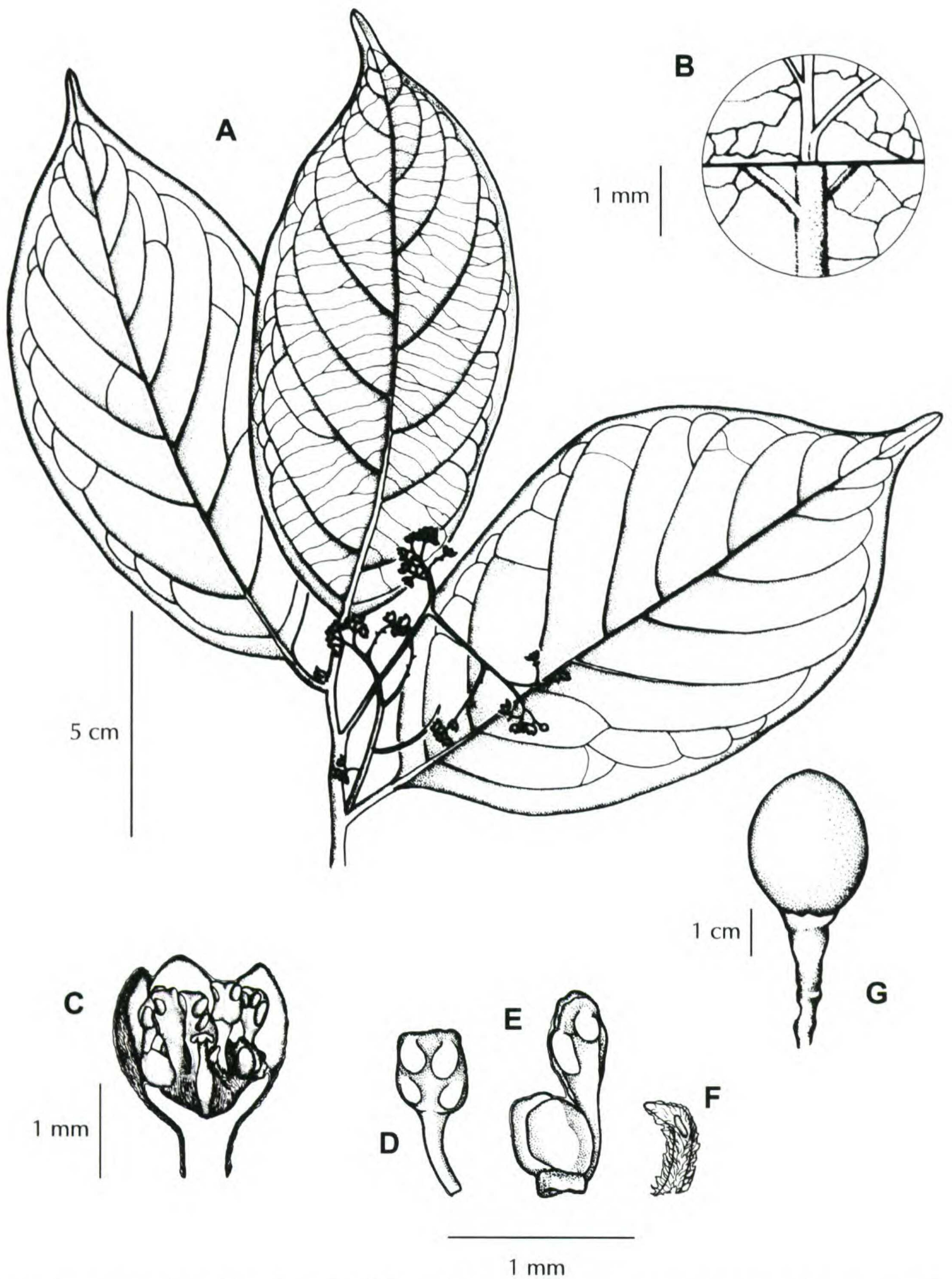


Figure 9. *Ocotea obliqua* Vicentini. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Staminate flower. —D. Stamen of whorl I. —E. Stamen of whorl III, lateral view. —F. Staminate whorl IV, lateral view. —G. Fruit. (A–F from *Rodrigues 8984*; G from *Rodrigues 7220*.) Drawn by Angelic Katz Nara.

branches covered by a dense indument of short and crisped ferrugineous hairs; bracts and bracteoles caducous at anthesis. Flowers unisexual, 1.5–2 mm diam.; pedicels shorter than flowers, < 1 mm long, pubescent, indument sparser than on inflorescence branches; tepals equal, white, erect at anthesis, ca. 1 mm long, glabrous or nearly so on both surfaces. Staminate flowers with 9, 4-celled stamens; the outer 6 ca. 1.5 mm long, filaments sparsely pubescent, longer and distinctly narrower than anthers, these rectangular, glabrous, upper cells introrse and smaller than the lower ones, which are introrse-latrorse; the inner 3 stamens ca. 1.5 mm long, filaments glabrous or nearly so, longer and distinctly narrower than anthers, lower cells extrorse-latrorse and upper ones introrse-latrorse, glands reniform and shorter than filaments; staminodes of whorl IV, ca. 0.5 mm long, stipitiform and pubescent or absent; pistillode without a stigma, glabrous or nearly so; receptacle shallow and densely pubescent inside. Pistillate flowers unknown. Fruits ellipsoid, ca. 3 × 2 cm; cupule plate-like, ca. 1.3 cm wide × 2 mm high; the pedicels swollen, 2–3 cm long.

*Vernacular.* “Louro-cedro.”

*Phenology.* Flowers: October and December. Fruits: October and May.

*Habitat.* Terra firme forest on clay soil.

*Ocotea obliqua* is easy to recognize vegetatively by its densely puberulous twigs, and the large elliptical leaves with distinct oblique tertiary venation (hence the epithet), that usually dry reddish, with short erect hairs below. The dense, reddish brown indument on the twigs is reminiscent of such species as *O. amazonica* (Meisner) Mez, *O. rhodophylla*, and *O. percurrens*, but these species have smaller leaves and the indument on their twigs is longer. The hairs on the twigs of *O. obliqua* are so short that one can scarcely see their orientation, in contrast to the other species where the hairs are erect. Relationships of *O. obliqua* are not known to me. The small, plate-like cupules are also found in the *O. minarum* group, but species of that group have different flowers and slender, long terminal buds, which are lacking in *O. obliqua*. For the time being the new species has to be considered an isolated species without obvious close relatives. *Ocotea obliqua* is known only from the type locality.

*Paratypes.* BRAZIL. Amazonas: Estrada Manaus–Itacoatiara, km 131 (fl), *Rodrigues 8984* (INPA, MO), (buds), *Rodrigues 9867* (MO), km 135 (fr), *Rodrigues 7220* (INPA), (fr), *Osmarino s.n.*, INPA 27370 (INPA).

***Ocotea percurrens*** Vicentini, sp. nov. TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 2°53'S, 59°58'W, 12 Jan. 1965 (fl), *W. Rodrigues & Osmarino 6835* (holotype, INPA). Figure 10.

*Ocoteae amazonicae* similis, sed foliis domatiis praeditis, receptaculo florum masculinorum intus pubescente recedit.

Trees to 35 m tall and up to 40 cm DBH. Branching presents sylleptic growth, i.e., branchlets initially grow without producing leaves, which are alternate and evenly distributed on the distal part of flushes. Twigs initially angular soon becoming cylindrical, 2.5–4 mm diam. 5 cm below the terminal bud, covered by a ferrugineous indument of erect and crisped hairs, these becoming grayish with age, and persisting so for at least two flushes; terminal buds covered by the same indument. Leaves 4.8–13.7 × 2.3–5.1 cm, ca. 2–3 times longer than wide, coriaceous, elliptic; the apex acuminate to attenuate (acumen 0.7–2.1 cm long); the base acute to oblique; the margin slightly recurved; lamina upper surface drying grayish, not clearly gland-dotted, with short erect hairs on veins, at least on midrib, lower surface brownish, with short erect or patent hairs, dense but leaving surface visible, indument decreasing with age, and eventually leaving upper surface glabrous, but at least persistent on the veins beneath; midrib raised on both surfaces; secondary veins 4 to 7 pairs, penninerved, evenly arching, the most basal pair longer and more acutely diverging from midrib than most apical, thus loop-connected at the distal part of leaves, slightly raised above, prominent beneath; tertiary venation scalariform, i.e., tertiaries parallel and perpendicular to midrib, flat above, slightly raised beneath; domatia consisting of whitish erect hairs, present in the axils of most secondary veins; petioles 0.5–1.2 cm long, flat above or with lateral ridges, but not canaliculate, with same pubescence as twigs, persisting dense on the petiole of old leaves. Inflorescences 4–7.2 cm long, borne in the axils of normal leaves, 1 to 2 orders of branching; peduncle and lateral branches completely covered by short and ferrugineous erect and crisped hairs, indument becoming shorter and sparser toward the flowers; bracts and bracteoles caducous at anthesis. Flowers unisexual, 2.5–3 mm diam.; pedicels shorter than flowers, ca. 1 mm long, minutely puberulous; tepals equal, cream, spreading at anthesis, ca. 1.5 cm long, outside minutely puberulous, inside glabrous or nearly so. Staminate flowers with 9, 4-celled stamens; outer 6 ca. 0.8 mm long, filaments glabrous, and narrower and shorter than anthers (ca. half their length), anthers ca. 0.5 mm long, cells in two rows, upper pair introrse, lower one latrorse-introrse, connectives not extended beyond them, flat to emarginate; inner 3 stamens ca. 0.5 mm long, filaments glabrous or hairy inside, narrower and shorter than anthers, upper anther cells latrorse-

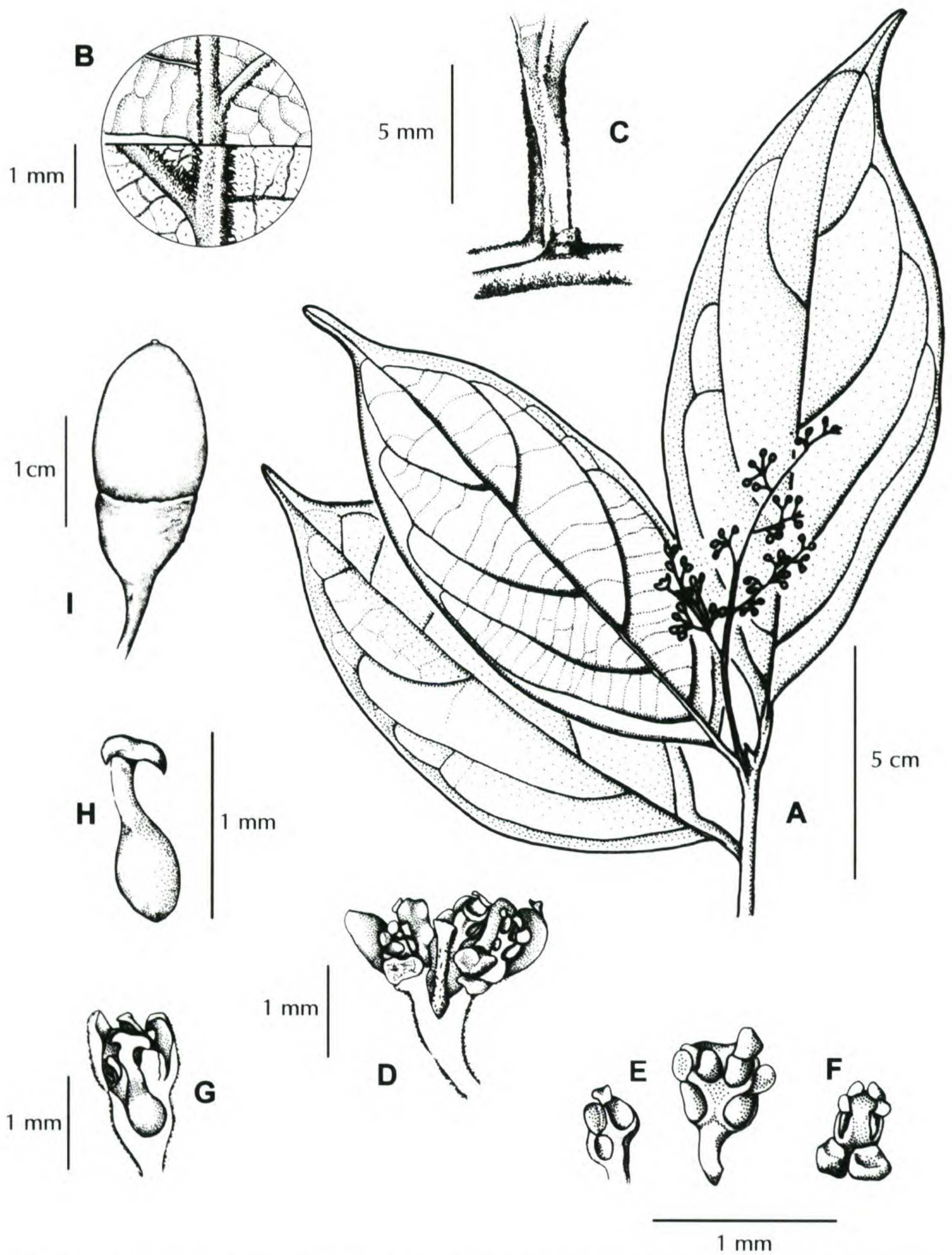


Figure 10. *Ocotea percurrens* Vicentini. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Detail of branch and petiole indument. —D. Staminate flower. —E. Stamens of whorl I (lateral and inner views). —F. Stamen of whorl III. —G. Pistillate flower. —H. Pistil. —I. Fruit. (A–F from *Prance et al.* 3846 except lower surface on B, from *Prance et al.* 3784; G, H from *Rodrigues & Rosmarino* 6826; I from *Rodrigues & Loureiro* 7091.) Drawn by Angelic Katz Nara.

apical, lower pair extrorse-latrorse, connectives not extended, usually emarginate, glands reniform and sessile, as long as filaments; staminodes of whorl IV stipitiform, pubescent or glabrous; pistillode with a stigma or sometimes with only a discolored and not enlarged apex, glabrous or nearly so, ovary almost entirely enclosed by the receptacle, which is pubescent inside. Pistillate flowers with 12 (rarely 9) staminodes, the outer 9 ca. 0.3 mm long, glabrous, those of whorl III with globose glands at the base, and those of whorl IV stipitiform and pubescent; pistil glabrous or nearly so, almost entirely enclosed by the receptacle, this glabrous inside, the stigma discoid. Fruit ellipsoid, 0.9–1.5 × 0.5–0.8 cm; cupule cup-shaped, smooth outside, with single margin, ca. 4 mm high × 6 mm wide, pedicel ca. 6 mm long.

*Vernacular.* Surinam: “witte pisi.”

*Phenology.* Flowers: December and January. Fruits: September, November, and December.

*Habitat.* Terra firme forest on clay or sandy-clay soils.

*Ocotea percurrans* is a conspicuous species, easily recognized by its ferruginous pubescent twigs and petiole, elliptical acuminate leaves with erect hairs beneath and showy tufts of hairs in the axils of most secondary veins (4 to 7 pairs only, acutely arching toward the apex), and the scalariform tertiary venation, perpendicular to the midrib. Three other Amazonian species have similar densely brown or ferruginous pubescent twigs: *O. amazonica*, *O. matogrossensis* Vattimo, and *O. rhodophylla*. *Ocotea matogrossensis* is the only species in this group with an appressed indument on twigs and leaves; the other species have an erect or crisped indument. *Ocotea percurrans* is the only species in this group with domatia and can thus be readily distinguished from the others. Additional differences between these species are presented in Table 1. Kostermans (1936) used the name *O. petalanthera* (Meisner) Mez for specimens of *O. percurrans* from Surinam. However, the type of *O. petalanthera* has sparsely to moderately pubescent twigs, with the surface largely or partially visible. The hairs are appressed and rather pale, and these pubescence characters clearly separate *O. petalanthera* from the group of *O. amazonica*, *O. percurrans*, and *O. rhodophylla*. *Ocotea percurrans* is distributed in the northeastern part of the Amazon Basin, not known to the west of Manaus and to the south of the Amazon River, occurring in Surinam and presenting a disjunct distribution in the Atlantic Forest in Bahia. The only known collection from this area, *Folli 882*, presents smaller leaves, which are waxy below

and with patent hairs, but I did not find any other differences that would lead me to treat it as a different species.

*Paratypes.* BRAZIL. **Amapá:** BR 156, 53 km WNW of Calçoene, 2°33'N, 51°16'W (fl), *Mori et al. 17328* (MG, MO, NY); BR 156, km 109 SSE of Oiapoque, 3°0'N, 51°30'W (fr), (MG, MO, NY); BR 156, 50 km SSE of Oiapoque, 3°21'N, 51°41'W (fl), *Rabelo et al. 2852* (MG, MO, NY). **Amazonas:** Distrito Agropecuário da Suframa, Reserva 1501 (“km 41”) of the PDBFF project, 2°24'N, 59°43'W (fr), *Kukle 21* (MO, NY), (young fr), *Lepsch da Cunha et al. 237* (MO, NY), (buds), *Pacheco et al. 98* (INPA, MO, NY), (fl), *Pacheco et al. 115* (MO, NY); Fazenda Porto Alegre, Reserva 3304 of the PDBFF project, 2°22'N, 59°57'W (young fr), tree 1334, *Mars et al. s.n.* (MO, NY), (fr), tree 4652, *Pereira et al. s.n.* (INPA, MO), Reserva 3402 of the PDBFF project (fr), tree 677.2, *Sothers et al. s.n.* (INPA, MO); hwy. Manaus–Itacoatiara, km 204 (buds), *Prance et al. 3784* (MO, NY); Manaus, Reserva Florestal Ducke, 02°53'S, 59°58'W (st), *Gentry & Nelson 69204* (INPA, MO), (fl), *Prance et al. 3846* (INPA, MO, NY), (buds), *Rodrigues & Osmarino 6815* (INPA, NY), (buds), *Rodrigues & Osmarino 6820* (NY), (fl), *Rodrigues & Osmarino 6826* (NY), (buds), tree 862–06, *Vicentini et al. 768* (INPA, MO, SP); Mun. de Novo Airão, Área Indígena Waimiri-Atroari, Aldeia Maré, 1°45'S, 61°15'W (fr), *Miller et al. 742* (INPA, MO). **Bahia:** Reserva Florestal de Porto Seguro da CVRD/BA (fl), *Folli 882* (MO). **Pará:** Itaituba, Jacareacanga, Parque Nacional do Tapajós (buds), *Silva & Rosário 3727* (MG, MO). FRENCH GUIANA. Dorlin, 3°45'N, 53°33'W (young fr), *Sabatier & Birnbaum 4450* (CAY, MO); Fleuve Approuague, Riv. Arataye, Sauts Parare (st), *Barrier 5079* (MO), (st), *Barrier 5072* (MO), (st), *Barrier 5156* (MO), 70 km SW Regina (st), *Villiers & Feuillet 2057* (MO). SURINAM. Jodensavanne-Mapane kreek area, (fl), *Schulz-LBB 8392* (MO, NY), (fl), *Lindeman 1961* (MO); Brownsberg (st), *Kanhai-LBB 13252* (MO, U), (fl), *Vreden-LBB 13707* (MO, U), (fl), tree 1284, *Boschwezen (BW) 6766* (MO); Brokopondo Lake, 20 km from Brownsweg (st), *van Donselaar 1880* (MO); Coesewijne (st), *Pinas-LBB 9529* (MO); Fallawatra (fr), *Jimenez-Saa 1617* (MO, U), (diseased fruit), *Jimenez-Saa 1695* (MO); Mapane Cr. Area (st), *Schulz-LBB 9332* (MO); Sectie O (st), *Stahel 67* (MO, U), (young fr), tree 574, U herb no. 2905 (MO, U), (fl), tree 574, U herb no. 2509 (MO, U).

***Ocotea rhodophylla* Vicentini, sp. nov. TYPE:** Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 2°53'S, 59°58'W, 23 Jan. 1995 (fl), *A. Vicentini et al. 888* (holotype, INPA; isotypes, MO, SP). Figure 11.

*Ocoteae amazonicae* similis, sed receptaculo intus pubescente, foliis ellipticis subtus ceraceis, pistillodio stipitiforme sine stigmatibus differt.

Trees to 20 m. Branching presents continuous growth, the leaves alternate and evenly distributed along twigs. Twigs initially angular soon becoming cylindrical, 3–4 mm diam. 5 cm below terminal bud, covered by ferruginous indument of erect and crisped hairs, these becoming grayish with age, and

Table 1. List of diagnostic character states of selected *Ocotea* species from the Manaus area and of *Ocotea* species with which they have been confused. (+) = present, (O) = absent, (-) = unknown; under receptacle indument (s) = staminate flower, (p) = pistillate flower.

Species	Twig indument			Leaf indument abaxially				Tepals		Pistillode		Cupule	
	Density	Type	Domatia	Hairs		Waxy below	Receptacle indument	Hairs outside	At anthesis	Hairs	Stigma	Tepals on	Form
				Density	Type								
<i>O. amazonica</i>	Dense	Erect	O	Sparse	Erect	O	O	Sparse	Reflexed	O	+/O	O	Shallow
<i>O. bofo</i>	Sparse	Erect or ascending	+	Sparse	Erect and minute			Sparse				+	Shallow
<i>O. cinerea</i>	Moderate to Sparse	Appressed	+/O	O		O	+(s) O(p)	O or Sparse	Spreading	O	O	O	Shallow, bowl-shaped
<i>O. delicata</i>	Dense	Erect	O	Sparse	Erect	O	+	Sparse	Erect	O	+	+	Shallow
<i>O. minor</i>	Moderate	Appressed	+	O		O	+	O	Erect	+	+/O	O	Shallow, cup-shaped
<i>O. nigrescens</i>	Moderate to sparse and glabrescent	Erect and minute	+/O	O	Erect	O	O	O	Erect	O	O	O	Deeply cup-shaped
<i>O. obliqua</i>	Dense	Erect or crisped	O	Dense	Erect	O	+	O	Erect	O	O	O	Plate-like
<i>O. percurrens</i>	Dense	Erect or crisped	+	Sparse	Erect	O	+(s) O (p)	Moderately dense, minute	Spreading	O	+/O	O	Cup-shaped
<i>O. petalanthera</i>	+	Appressed	+	+	Appressed	O	—	—	—	—	—	—	—
<i>O. rhodophylla</i>	Dense	Erect and Crisped	O	Moderate	Erect	+	+	O	Spreading	+	O	O	Plate-like

Table 1. Continued

Species	Leaf indument abaxially										Cupule	
	Twig indument		Hairs		Waxy below	Receptacle indument	Tepals		Pistillode		Tepals on	Form
	Density	Type	Density	Type			Hairs outside	At anthesis	Hairs	Stigma		
<i>O. scabrel-la</i>	Dense	Erect	0	Erect	0	+(s) O(p)	Sparse	Spreading	0	+/0	+	Shallow
<i>O. schomburgkiana</i>	0		0	Moderate to sparse	0	+	0 or Sparse	Spreading	0	+	0	Deeply cup-shaped
<i>O. subterminalis</i>	Moderate to sparse	Erect and minute	+/0	0	0	Sparse (s) O (p)	Moderately dense, minute	Spreading	0	+	0	Deeply cup-shaped

persisting so for at least two flushes; terminal buds densely erect pubescent. Leaves 5.8–16 × 2.8–7.4 cm, ca. 1.7–3 times longer than wide, coriaceous, elliptic to ovate; the apex acuminate; the base obtuse or oblique; the margins flat or at the base recurved; lamina upper surface not gland-dotted, glabrous, midrib sometimes pubescent at the base, lower surface reddish, waxy, with erect and crisped hairs, the indument dense, but leaving surface visible and decreasing with age; midrib above prominent in an impression below the leaf surface, strongly prominent beneath; secondary veins 5 to 7 pairs, penninerved, veins essentially free, but most apical loop-connected, evenly arching, above flat, below prominent; tertiary venation reticulate, but with some well developed oblique tertiary veins, these not forming a uniform pattern, flat above, slightly prominent beneath; reticulation fine and usually more conspicuous on the upper surface; venation frequently with dark dots (resinous) on the lower surface; domatia absent; petioles 0.8–1.5 cm long, flat above, pubescent as twigs, indument decreasing with age, but rarely surfaces becoming completely glabrous. Inflorescences 1.5–5.8 cm long, borne in the axils of normal leaves, 1 to 2 orders of branching; peduncle and lateral branches covered by erect and crisped hairs, indument becoming sparser toward the flowers. Flowers unisexual, ca. 3 mm diam., pedicels shorter than flowers, 0.6–1.2 mm long, with short ascending hairs; tepals equal, white, spreading at anthesis, ca. 1.5 mm long, outside glabrous or nearly so. Staminate flowers with 9, 4-celled stamens; the outer 6 ca. 0.7 mm long, filament ca. 0.3 mm long, narrower than and as long as anthers, these with introrse cells in two rows, connective flat, not extended beyond cells; inner 3 stamens ca. 0.7 mm long, filaments narrower than and as long as anthers, introrsely pubescent, upper cells introrse-latorse, lower ones latorse to extrorse-latorse, glands reniform and as high as filaments; staminodes of whorl IV stipitiform and pubescent; pistillode absent or reduced without stigma and pubescent; receptacle pubescent inside. Pistillate flowers with 12 staminodes, outer 9 ca. 0.5 mm long, glabrous, those of whorl III with small reniform glands at the base; staminodes of whorl IV stipitiform and pubescent; pistil glabrous, ovary positioned almost half inside the receptacle, which is pubescent inside, stigma discoid. Fruit globose, ca. 1 cm diam., cupule plate-like, with single margin, ca. 1–2 mm high × 4–5 mm wide.

*Vernacular.* Venezuela: “laurel blanco,” “atudacani.”

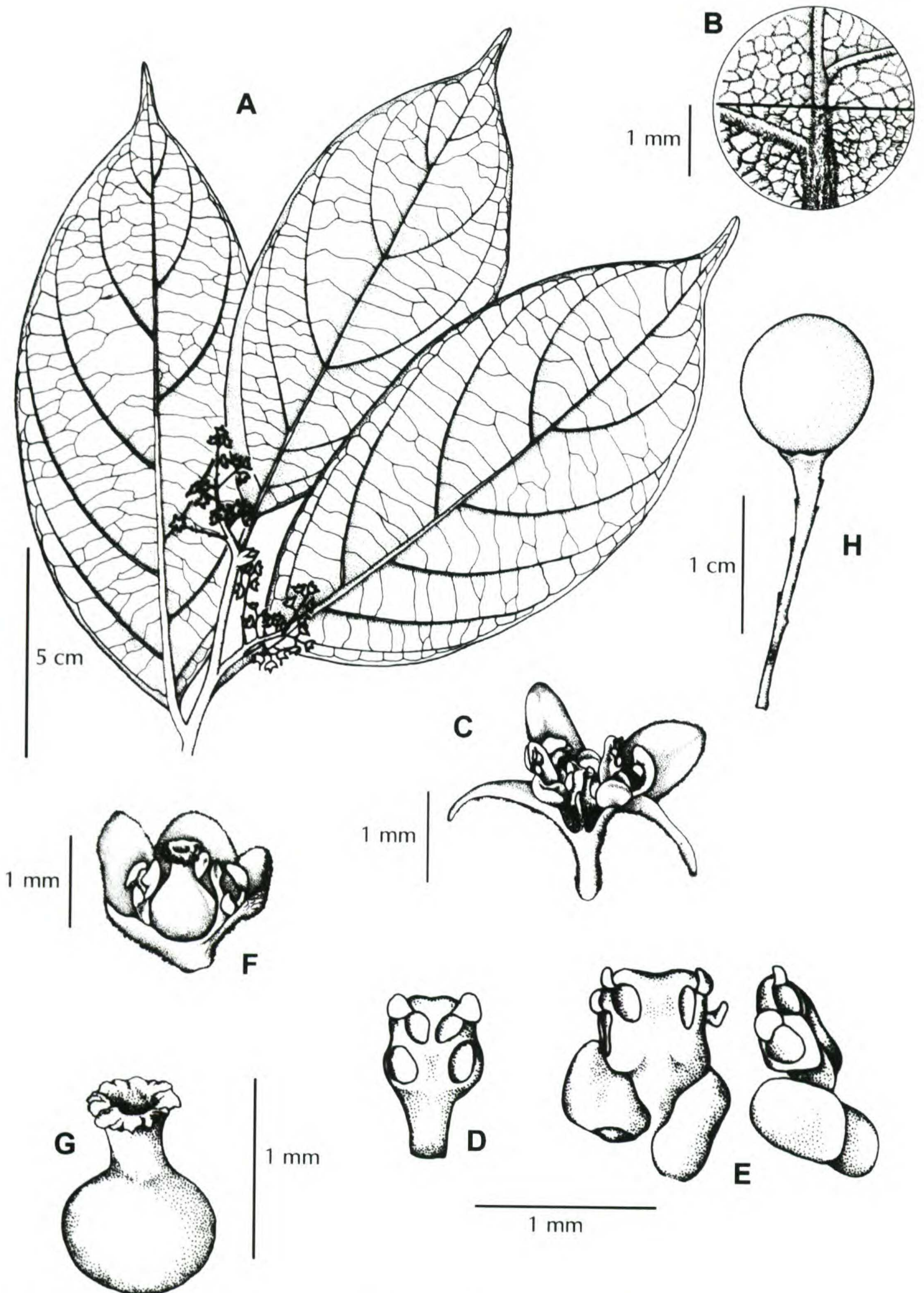


Figure 11. *Ocotea rhodophylla* Vicentini. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Staminate flower. —D. Stamen of whorl I. —E. Stamen of whorl III (outer and lateral views). —F. Pistillate flower. —G. Pistil. —H. Fruit. (A, B from Vicentini *et al.* 889; C–E from holotype, Vicentini *et al.* 888; F, G from Vicentini *et al.* 891; H from Rodrigues & Loureiro 5756.) Drawn by Angelic Katz Nara.

**Phenology.** Flowers: January, February, May, July, and September. Fruits: February, April, and May.

**Habitat.** Campinarana forest on white-sand soil.

Collections of *Ocotea rhodophylla* have been identified as *O. amazonica* or *O. rubrinervis* Mez, mainly because these three, possibly closely related species, present erect or crisped hairs on the lower leaf surface. However, it clearly differs from the types of both species: *Ocotea amazonica* is a small tree with usually obovate leaves, flowers with reflexed tepals at anthesis, the pistillode glabrous and usually with a well-developed stigma, the receptacle glabrous in both sexes, lacking staminodes of whorl IV, while *O. rhodophylla* is a canopy tree, with elliptical leaves, these waxy below, flowers with spreading tepals at anthesis, the pistillode is absent or reduced without a stigma and pubescent, the receptacle pubescent in both pistillate and staminate flowers, these bearing staminodes of whorl IV. The fruits of these two species are very similar (globose, ca. 1 cm diam. on a shallow cupule), suggesting that these are closely related taxa. *Ocotea rhodophylla* also resembles *O. rubrinervis*; the latter species has a sparse, erect indument on the lower leaf surface, domatia in the form of axillary tufts of hairs, a clearly gland-dotted upper leaf surface, persistent tepals on the cupule, and a sparser indument consisting of ascending, pale hairs on the twigs with the surface always partially visible. *Ocotea rubrinervis* does not have a waxy lower leaf surface. *Ocotea rhodophylla* is also similar to *O. matogrossensis*, both presenting a waxy lower leaf surface, but the indument on the latter is distinctly appressed and the leaves are obovate with an attenuate and decurrent base. *Ocotea rhodophylla* is distributed in the western portion of the Amazon Basin in Venezuela, Colombia, Peru, and Brazil; it is not found east of the Manaus area.

**Paratypes.** BRAZIL. **Amazonas:** Manaus, Reserva Florestal Ducke, 2°53'S, 59°58'W (fr), *Rodrigues & Loureiro* 5756 (NY), (fl), *Vicentini et al.* 889 (INPA, MO, SP), (fl), *Vicentini et al.* 891 (INPA, MO, SP), (fl), *Vicentini et al.* 892 (INPA, MO, SP); Mun. de Maués, basin of Rio Maués, Rio Urupadi, 3°43'S, 57°16'W (fl), *Zarucchi et al.* 3078 (INPA, MO, NY). **Roraima:** Estação Ecológica Ilha de Maracá, 3°19'N, 61°55'W (fl), *Milliken et al.* 624 (MO). COLOMBIA. **Amazonas:** Rio Caqueta, Araracuara (fl), *Vester* 261 (MO). PERU. **Madre de Dios:** Rio D'Orbigny near junction with Rio La Torre, 12°55'S, 69°20'W (buds), *Gentry & Jaramillo* 57801 (MO); Tambopata, 12°49'S, 69°18'W (fr), tree 3002, *Gentry et al.* 45914 (MO), (fr), tree 3093, *Gentry et al.* 46011 (MO). **Loreto:** Maynas, Distrito Fernando Lores, Caserio Serafin, 4°08'S, 72°55'W (fr), *Grández et al.* 2543 (MO), Iquitos, Rio Nanay, Puerto Almendras, 3°48'S, 73°25'W (fl), *Vásquez & Jaramillo* 10781 (MO), Rio Nanay halfway between Iquitos and San-

ta Maria de Nanay, 3°52'S, 73°30'W (fl), *Gentry et al.* 39458 (MO), along Rio Nanay, (fl), *van der Werff et al.* 10189 (MO); Requena, Sapuena, J. Herrera, 4°50'S, 73°45'W (fl), *Vásquez* 10439 (MO), Rio Ucayali, arboretum (fr), *Gentry et al.* 21168 (MO). VENEZUELA. **Amazonas:** San Carlos de Rio Negro, 3°56'N, 67°03'W (fl, young fr), *Clark & Maquirino* 7360 (MO), (fl), *Clark* 7282 (MO); Casiquiare, 12 km SE of San Fernando de Atabapo, 3°50'S, 67°47'W (fl), *Aymard et al.* 6420 (MO, PORT). **Bolívar:** basin of rio Caura, caño Maskani (fr), *Stergios & Delgado* 12814 (MO, PORT); Serranía de Maigualida, 6°9'S, 65°54'W (fr), *Stergios & Delgado* 13805 (MO, PORT).

***Ocotea scabrella*** van der Werff, sp. nov. TYPE: Brazil. Pará: Município de Almerim, Rio Jari, reserva florestal da SEMA, 12 Oct. 1987 (fl), *A. S. Tavares* 194 (holotype, MO). Figure 12.

*Ocoteae bofo* affinis, sed indumento brevissimo ramulorum, tepalis per anthesin patentibus et domatiis absentibus differt.

Small tree or shrub, to 10 m. Twigs terete, solid, with a (rather) dense indument of short (up to 0.1 mm long), erect, brown or whitish hairs; terminal buds densely and minutely whitish pubescent. Leaves 11–24 × 4.5–11 cm, chartaceous, narrowly to broadly elliptic, alternate; the base acute to rarely obtuse; the apex acute or acuminate, the acumen to 2 cm long; the upper surface glabrous or with some minute, erect hairs along the midvein and lateral veins; the lower surface sparsely to moderately puberulous with minute, erect, whitish hairs, these denser along the major veins; the upper surface with the midrib and lateral veins slightly impressed or immersed, and the tertiary venation somewhat raised; the lower surface with midrib and lateral veins (prominently) raised and the tertiary venation (weakly) raised; domatia lacking; petioles 0.7–1.3 cm long, with the same indument as the twigs, flat on the upper side. Inflorescences in the axils of leaves, 5–12 cm long, paniculate-cymose, moderately puberulous with minute, erect, whitish hairs; the flowers almost sessile and arranged in dense glomerules. Flowers white, unisexual, 3–4 mm diam.; the tepals at anthesis spreading (pistillate flowers) to reflexed (staminate flowers). Staminate flowers with tepals ca. 2 mm long, sparsely pubescent on both surfaces; fertile stamens 9, all 4-celled; the outer 6 with the cells introrse, or the lower pair lateral, glabrous, the filaments slender, ca. 1 mm long, the anthers ca. 0.6 mm long; the inner 3 the same size, but with 2 large glands at the base of the filaments; staminodes not seen; pistillode glabrous, stipitiform, not surpassing and largely hidden by the glands, without a stigma or pistillode about twice as long as the glands and with a small stigma; receptacle shallow, pubescent



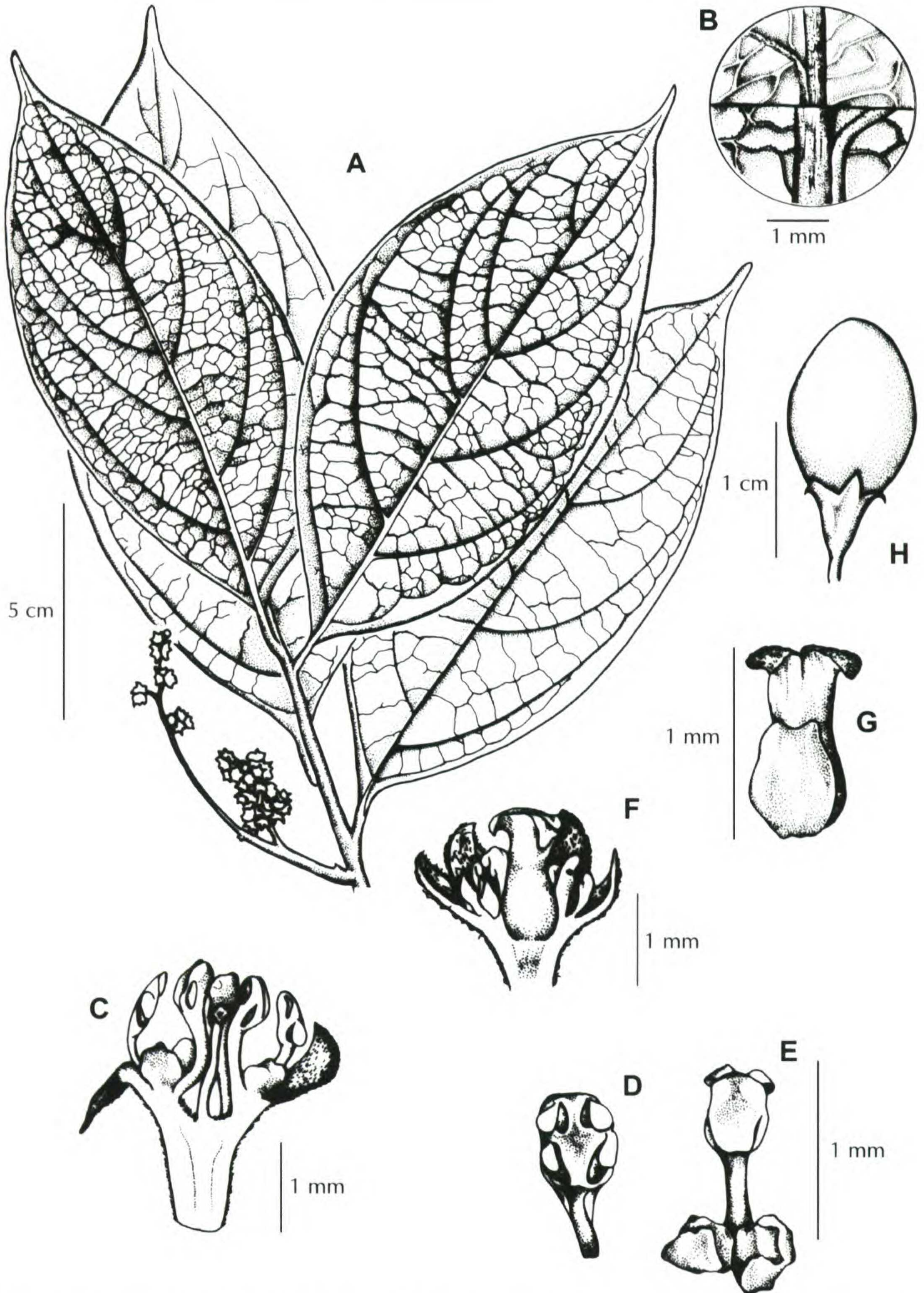


Figure 12. *Ocotea scabrella* van der Werff. —A. Habit. —B. Details of the upper (at top) and lower surfaces. —C. Staminate flower. —D. Stamen of whorl I and II. —E. Stamen of whorl III. —F. Pistillate flower. —G. Pistil. —H. Fruit. (A, B from *Rodrigues* 559; C–E from *Assunção* 574; F, G from *Vicentini* 606; H from *Sothers* 675.) Drawn by Angelic Katz Nara.

inside. Pistillate flowers with tepals as in staminate flowers; staminodia 9, glabrous, ca. 0.6 mm, the inner 3 with 2 glands at the base; staminodia of whorl IV threadlike, pubescent, 0.4 mm long; pistil 1.5–1.8 mm long, glabrous, stigma swollen; receptacle shallow, glabrous inside. Fruits ellipsoid, ca.  $13 \times 8$  mm; cupule shallowly cup-shaped to almost plate-like, with persistent tepals on the margin; the pedicel thickened.

*Phenology.* Flowers: January, June, July, August, September, and October. Fruits: September, November, and January.

*Habitat.* Terra firme forest on clay soil.

*Ocotea scabrella* resembles *O. bofo* and *O. rubrinervis* in having cupules with persistent tepals, but differs in the absence of domatia, in the very short, erect indument of the twigs, in the spreading tepals at anthesis, in the clustered flowers, and in the very small pistillode without a stigma in the staminate flowers. The pubescent receptacle of the staminate flowers is also a useful character. *Ocotea amazonica* differs from *O. scabrella* in the longer, reddish hairs on the twigs, in the cupule without persistent tepals, and in the less branched inflorescence. Although gland dots are visible on the upper leaf surface of *O. scabrella*, they are not as conspicuous and black as in *O. bofo* and *O. rubrinervis*. My concept of *O. rubrinervis* is based on the syntype (Poeppig 4580, B), that of *O. bofo* on a type photo, and of *O. amazonica* on a type (Poeppig 3037B, B). One of the characters used by Mez (1889) in the delimitation of these species is the relative length of the filaments of the stamens. I found that in young flowers the filaments can be shorter than the anthers, while in older flowers they are clearly longer than the anthers, and this character should therefore be used with care. *Ocotea commutata* (Nees) Mez, another shrubby species with persistent tepals on the shallow, almost plate-like cupules and known only from French Guiana, differs in its abruptly rounded leaf bases and in the absence of the very short, erect hairs on the twigs; no flowers of this species are known to me.

*Paratypes.* BRAZIL. **Amazonas:** Manaus, Reserva Florestal Ducke, 2°53'S, 59°58'W (fl), Assunção & Silva 574 (INPA, MO, SP), (fr), Assunção et al. 609A (INPA, MO, SP), (st), Gentry & Nelson 69037 (INPA, MO), (st), Gentry & Nelson 69053 (INPA, MO), (fl), Ribeiro et al. 962 (INPA, MO, SP), (fr), Ribeiro et al. 1719 (INPA, MO, SP), (fl), Rodrigues & Osmarino 7030 (INPA, NY), (fr), Rodrigues & Emygdio 8950 (INPA, MO), (fr), Sothers & Silva 675 (INPA, MO, SP), (fl), tree 1281-06, Vicentini & Assunção 606 (INPA, MO, SP), (buds), Vicentini et al. 1222 (INPA, MO, SP); Mun. de Novo Airão, Area Indígena Waimiri-Atroari, Rio Camanau, 1°45'S, 61°15'W (fl), Miller 685 (MO). **Rondônia:** Porto Velho, Represa Samuel,

Rio Jamari, 8°47'S, 63°25'W (fl), Thomas et al. 5185 (MO, NY). FRENCH GUIANA. **Gobaya Soula:** Bassin du Maroni, 3°37'N, 53°58'W (fr), de Granville et al. 10388 (B, CAY, MO, P, US). **Saül:** vicinity of Eaux Claires, Sentier Botanique, 3°37'S, 53°12'W (fr), Mori et al. 22821 (MO, NY), (young fr), Mori et al. 22822 (MO, NY), (st), Mori et al. 20985 (MO, NY).

***Ocotea subterminalis*** van der Werff, sp. nov.

TYPE: Brazil. Amapá: Mun. de Mazagão, 0°08'S, 51°48'W, 19 Dec. 1984 (fl), S. Mori & Cardoso 17453 (holotype, MO). Figure 13.

*Ocoteae schomburgkianae* affinis sed ramulis minute puberulis, cupulis foliisque majoribus recedit.

Trees, to 20 m. Twigs roundish, moderately or sparsely minutely puberulous, the hairs straight and erect, glabrescent with age, solid; terminal buds densely white puberulous. Leaves 11–20 × 4.5–7 cm, alternate, firmly chartaceous, elliptic to ovate-elliptic; base acute; apex acuminate with the acumen to 2 cm long or acute; upper surface glabrous; lower surface glabrous or with some minute whitish hairs; margin frequently thickened, flat; midrib, lateral veins, and tertiary venation immersed on the upper surface, the midrib and lateral veins lighter in color than the leaf tissue; midrib and lateral veins raised, tertiary venation weakly raised or immersed on the lower surface; lateral veins 4 to 6 on each side; domatia consisting of axillary tufts of hairs present, small, or lacking; petioles 0.8–1.6 cm, flat to weakly canaliculate on the upper side, with the same indument as the twigs. Inflorescences 5–12 cm, paniculate-cymose, sparsely to moderately and minutely puberulous, in the axils of bracts near the tips of the branches and appearing terminal or, less frequently, in the axils of normal leaves. Flowers unisexual, 3–4 mm diam., the tepals somewhat spreading at anthesis. Staminate flowers with tepals broadly ovate, 1.5 mm long, sparsely puberulous outside, glabrous inside; outer 6 stamens ca. 1 mm long, glabrous, the cells arranged in 2 pairs, introrse, the filament half as long as the anther; the inner three stamens as long as the outer 6, the cells extrorse-lateral, the filaments with 2 globose glands at the base; staminodia not seen; pistillode ca. 2 mm long, stipitiform, glabrous, stigma small but present; receptacle deep, sparsely pubescent inside. Pistillate flowers with tepals as in staminate flowers; outer 6 staminodia 0.6 mm long, glabrous; inner 3 staminodes as long as outer 6, with 2 glands at the base; pistil ca. 2 mm long, glabrous, the stigma peltate; receptacle deeply cup-shaped, glabrous inside. Fruits 1.6 × 1.1 cm, ovoid, largely enclosed in the deeply cup-shaped cupule, this usually lenticellate, with a sin-

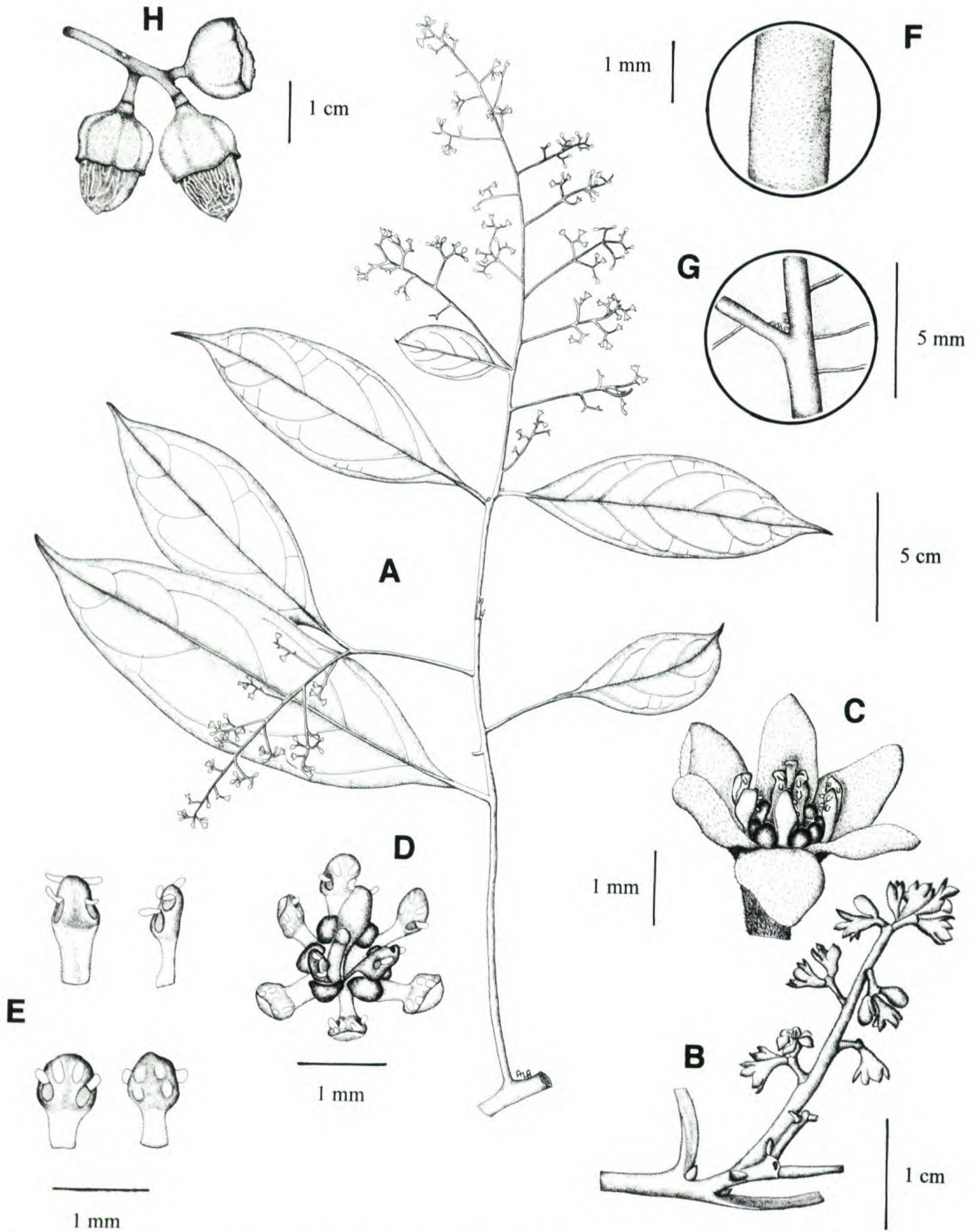


Figure 13. *Ocotea subterminalis* van der Werff. —A. Habit. —B. Inflorescence. —C. Flower. —D. Flower with tepals removed. —E. Stamens of whorl I and II (below) and whorl III (above). —F. Indument on twig. —G. Domatium in axil of lateral vein on lower leaf surface. —H. Cupule and fruits. (A–G from *Rabelo et al.* 3041; H from *Lepsch da Cunha & Assunção* 215a.) Drawn by Alba L. Arbelaez.

gle margin, 1.6 × 1.2 cm, the pedicel not or scarcely thickened.

**Phenology.** Flowers: September, November, December, and January. Fruits: June, August, September, and November.

**Habitat.** Terra firme forest on clay or sandy-clay soils.

The relatively large cupules, the ovoid fruits, the frequently terminal-appearing inflorescences, and the small domatia, which sometimes may be lacking, suggest a relationship of *O. subterminalis* with *O. schomburgkiana*. The latter species differs in having smaller cupules and fruits, smaller leaves and inflorescences, and in the lack of the very short, erect indument on the twigs. Various labels mention that the slash is orange and the wood fragrant.

**Paratypes.** BRAZIL. **Amapá:** Macapá, hwy. Cupixiri Vila Nova, 0°32'S, 51°52'W (fl), *Mori & Cardoso 17703* (MO); Mazagão, hwy. BR156 (fl), *Rabelo et al. 3041* (MO). **Amazonas:** Distr. Agropecuário da Suframa, Reserva 1501 ("km 41") of the PDBFF project, 2°24'S, 59°43'W (fr), *Lepsch da Cunha & Assunção 215a* (MO), (fl), *Boom et al. 8651* (MO), (fl), *Oliveira et al. 277* (MO), (st), *Nee 42630* (MO, NY), (fr), *Pessoal do PDBFF s.n.* (= *INPA 191123*) (INPA); Manaus, Reserva Florestal Ducke, 2°53'S, 59°58'W (fr), *Martins & Pereira 10* (INPA, MO, SP), (fr), *Loureiro s.n.* (= *INPA 16565*) (INPA, NY), (fl), *Rodrigues & Osmarino 8287* (INPA), (fl), tree 1353-06, *Sothers & Silva 182* (INPA, MO, SP). **Maranhão:** Monção, basin of rio Turiaçu, Ka'apor Indian Reserve (fr), *Balée 331* (MO, NY). **Pará:** Oriximiná, Rio Trombetas, estrada da Mineração do Norte, km 60 (fr), *Cid et al. 1968* (INPA, MO); Rio Trombetas, vicinity of Cachoeira Porteira (fr), *Prance et al. 22229* (MO, NY). FRENCH GUIANA. **Sinnamary River:** above Petit Saut, between Cr. Plomb and Cr. Tigre, 5°00'N, 53°01'W (buds), *Mori et al. 23562* (MO, NY), (buds), *Mori et al. 23394* (MO, NY), (st), *Mori et al. 23512* (MO, NY), (st), *Mori et al. 23667* (MO, NY), (st), *Mori et al. 23650* (MO, NY). **Saül:** 3°37'N, 53°12'W, vicinity of Eaux Claires, Sentier Botanique (fr), *Mori et al. 22777* (MO, NY), (fl), *Mori et al. 23312* (MO, NY). **Station des Nouragues:** basin de l'Arataye, 4°3'N, 52°42'W (fr), *Sabatier & Prevost 2980* (CAY, MO). Placed in *O. subterminalis* with some hesitation are the following three collections: FRENCH GUIANA. **Saül:** (fr), *Mori & Ishikawa 20838* (MO, NY), (fr), *Mori & Gracie 23932* (MO, NY), *Prance et al. 30652* (MO, NY). These specimens differ in having slightly recurved leaf bases and a dense indument on the young twigs.

**Rhodostemonodaphne recurva** van der Werff, sp. nov. TYPE: Brazil. Amazonas: Manaus, Reserva Florestal Ducke, 2°53'S, 59°58'W, 5 Aug. 1994 (fl), *A. Vicentini et al. 653* (holotype, INPA; isotypes, MO, SP). Figure 14.

*Rhodostemonodaphne peneiae* similis, sed 6 staminibus exterioribus 2-locellatis ramulisque indumento obtectis recedit.

Dioecious trees, to 20 m. Twigs ridged, the sur-

face completely covered by gray ascending to appressed hairs, these hairs turning darker with age; terminal buds densely pubescent. Leaves 5–10 × 2–4 cm, alternate, firmly chartaceous, obovate-elliptic to elliptic; the apex obtuse or bluntly acute; the base angustate, gradually narrowed into the petiole; the margin recurved over most of its length, but more strongly so toward the base; the upper surface appressed pubescent when young, becoming quickly glabrous with age; the lower surface moderately densely appressed pubescent, glaucous; midrib, lateral veins, and tertiary venation immersed on the upper surface; midrib raised, lateral veins and tertiary venation weakly raised on the lower surface; lateral veins 3–4; domatia lacking; petioles 1.7–2.5 cm, with the same indument as the twigs. Inflorescences axillary, 3–8 cm long (pistillate inflorescences shorter than staminate), densely pubescent, the hairs appressed or ascending, paniculate-cymose. Flowers unisexual, densely pubescent outside, 4–5 mm diam.; tepals spreading, greenish; stamens red. Staminate flowers with tepals pubescent on the inner surface, ca. 2 mm long, broadly ovate; stamens 9; the outer 6 sessile, 2-celled, ca. 1.5 mm broad, 1 mm high, the anther cells filling only a small part, introrse; stamens of whorl II narrower than those of whorl I, ca. 1 × 1 mm, 2-celled, introrse; the stamens of whorl I and II laminar; inner 3 stamens triangular-columnar, ca. 1 mm long, 4-celled, the cells in two pairs, the lower pair extrorse, the upper pair lateral-extrorse; glands present at the base of the inner 3 stamens, globose; staminodia not seen; pistillode ca. 1 mm long, glabrous; receptacle urceolate, pubescent inside. Pistillate flowers with tepals as in male flowers; staminodia 9; the outer 3 slightly broader than those of whorl II, but not as dissimilar as in male flowers, inner 3 columnar, all staminodes a little smaller than the stamens; remnants of anther cells same number as anther cells in stamens; glands small, globose; pistil glabrous, ca. 2 mm long; receptacle urceolate, pubescent inside. Young fruits fully enclosed in the receptacle. Fruit ellipsoid, ca. 3 cm long; cupules deeply cup-shaped, 2 × 1 cm; pedicels ca. 1 cm long, thickened, abruptly widened in the cupule.

**Phenology.** Flowers: August. Fruits: April.

**Habitat.** Terra firme forest on clay soil.

This new species straddles the fence between *Endlicheria* and *Rhodostemonodaphne*. These two genera differ only in their stamens, which are 2-celled in *Endlicheria* and 4-celled in *Rhodostemonodaphne*, a character of questionable validity in recognizing genera (Rohwer et al., 1991; van der

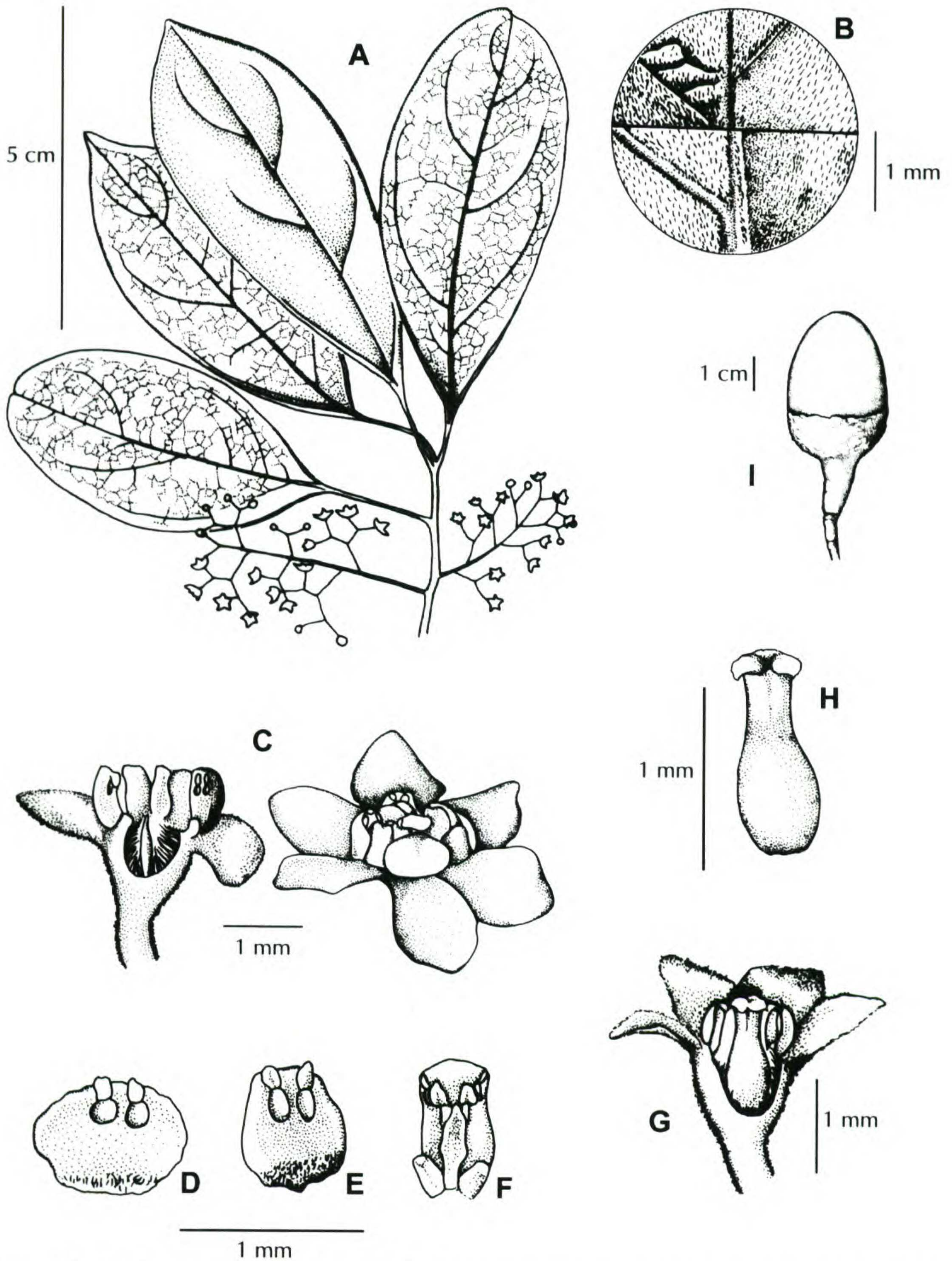


Figure 14. *Rhodostemonodaphne recurva* van der Werff. —A. Habit. —B. Details of the upper (at top) and lower leaf surfaces. —C. Staminate flowers. —D. Stamen of whorl I. —E. Stamen of whorl II. —F. Stamen of whorl III. —G. Pistillate flower. —H. Pistil. —I. Fruit. (A–F from holotype *Vicentini et al.* 653; G, H from *sine coll.*, PDBFF Reserva 3304, tree 3094; I from *Rodrigues* 6903.) Drawn by Angelic Katz Nara.

Werff & Richter, 1996). The 2-celled outer 6 stamens point to *Endlicheria*, while the 4-celled inner 3 stamens indicate *Rhodostemonodaphne*. Indeed, both *E. anomala* (Nees) Mez and *R. revolutifolia* Madriñan have six 2-celled and three 4-celled stamens. However, broad, sessile stamens occur frequently in *Rhodostemonodaphne* and not or rarely in *Endlicheria*; broad, sessile stamens are found in *E. rubriflora* Mez, a species only placed in *Endlicheria* because of its 2-celled stamens. The indument of twigs and leaves and the leaf venation of *R. recurva* resemble species of *Rhodostemonodaphne* such as *R. grandis* (Mez) Rohwer and related species and *R. capixabensis* Baitello & Coe Teixeira. This similarity led me to place the new species in *Rhodostemonodaphne*. Possibly the closest relationship is with *R. revolutifolia* Madriñan, which has the same stamen configuration, but which differs in having erect hairs on the lower leaf surface and larger leaves. Vegetatively, *R. recurva* is quite similar to *R. peneia* Madriñan, and both species occur near Manaus. They can be separated as follows: *R. recurva* has recurved leaf margins, densely pubescent twigs (with the surface completely covered by the indument), and 3 or 4 lateral veins, while *R. peneia* has flat leaf margins, sparsely pubescent twigs with the surface largely visible, and usually 5 to 7 lateral veins (rarely fewer).

*Paratypes.* BRAZIL. Amazonas: Manaus, Estrada AM-10, km 120 (fl), Rodrigues & Loureiro 7178 (INPA); Reserva Florestal Ducke, 2°53'S, 59°58'W (fr), Rodrigues & Osmarino 6903 (INPA); Distrito Agropecuário da Sufama, Fazenda Esteio, Reserva 1202 of the PDBFF project, 2°24'S, 59°52'W (fl), tree 5767, Santos et al. s.n. (INPA, MO), (fl), tree 5767, sine coll. s.n. (INPA, MO), Reserva 3304 (fl), tree 3094, sine coll. s.n. (INPA, MO); Fazenda Dimona, Reserva 2108 of the PDBFF, 2°19'S, 60°05'W (fl), tree 35, Mackenzie et al. s.n. (INPA, MO).

KEY TO THE SPECIES OF *OCOTEA* OF THE DUCKE RESERVE

The key to the *Ocotea* species presented here includes all species of *Ocotea* known from the Ducke Reserve for which flowering material was available, plus two new species, *O. ligulata* and *O. obliqua*, which occur in the surrounding area, but which have not been found in the Ducke Reserve. For a brief description and photographs (especially of vegetative characters) of all the species included in the key (plus additional *Ocotea* species), refer

to the field guide of the vascular plants of Ducke Reserve (Vicentini et al., 1999). Descriptions of the species not described in this article will be published in the Lauraceae treatment of the *Flórmula of the Reserva Ducke* (in prep.).

Identifying Lauraceae to species is very difficult without flowering specimens, except for a few striking species. The majority of the species of *Ocotea* in the area under study are dioecious, and the key is based on staminate flowers, although it may be possible to identify specimens with pistillate ones. For fruiting specimens refer to the above-mentioned field guide, which includes photographs of the fruits of some species and may narrow the decision-making process. To use the following key a good dissecting microscope is needed; some floral or pubescence characters (for instance, the indument on *O. scabrella*) are not visible to the unaided eye.

Vegetative characters, such as indument of twigs and leaves, as well as characters of the pistillode and cupule, can greatly help in the identification. Because these characters are not always mentioned in the key, we present them in Table 1 (pp. 284, 285) for nine of the new *Ocotea* species and four earlier described species with which the new species have been confused. Not included in Table 1 are *Ocotea ligulata* and *O. immersa*; these species are so distinct that confusion with other species seems unlikely. Type material of *O. amazonica* (Poeppig 3037B, B) and *O. petalanthera* (Poeppig 2426, B) has been used in making Table 1. While we found several collections matching the type of *O. amazonica* closely, we did not find other collections of *O. petalanthera*, and that species is to us only known from the type. Therefore, not all character states for this species could be entered in Table 1. Whether *O. bofo* and *O. rubrinervis* are distinct species is not clear. One of us (HW) assumes that the two are conspecific. Type material of *O. rubrinervis* (Poeppig 4580, B) has been studied in preparing Table 1, but the name *O. bofo*, the older name, has been used.

Two unidentified species were included in key as *Ocotea* sp. E and *O.* sp. G, following the names used in the field guide for the vascular plants of the Ducke Reserve (Vicentini et al., 1999). Both are probably new species, but good fertile material was not available. *Ocotea* sp. E (e.g., Assunção 576, 581 and Vicentini 1189, 950, 959, 960; INPA, MO, SP) is apparently related to the *Ocotea cernua* complex (Rohwer, 1986), because the filaments of the outer stamens are as in this complex partly fused with the tepals. The fruits are also very similar to those of the *O. cernua* group (cupule cup-shaped and enclosing the berry up to ca. 1/3 of its length; refer to Vicentini et al., 1999). However, terminal buds on *O.* sp. E are completely glabrous, which is not the case in the *Ocotea cernua* complex, or in the majority of Lauraceae. *Ocotea* sp. G (e.g., Assunção 528 and Ribeiro 905, 927; INPA, MO, SP) keys out to *O. schomburgkiana* in Rohwer's (1986) treatment, but *O.* sp. G is not, as the latter, a shrub or treelet with domatia in the axils of lateral veins.

- 1a. Lower leaf surface completely covered by a silvery or golden appressed indument, i.e., lamina surface not visible.
  - 2a. Leaves with a vernation line almost parallel to the midrib; secondary veins hidden by indument; leaves sessile or nearly so (petiole < 0.5 cm) . . . . . *O. guianensis* Aublet
  - 2b. Leaves without vernation line; secondary veins prominent and not hidden by indument; petiole ≥ 1 cm . . . . . *O. argyrophylla* Ducke
- 1b. Lower leaf surface glabrous, erect pubescent or with appressed hairs, but then surface of lamina still visible.
  - 3a. Domatia, i.e., cavities or tufts of hairs, in the axils of secondary veins (check carefully on several leaves).

- 4a. Domatia a glabrous cavity, prominent on the upper leaf surface, usually present only on the most basal pair of secondary veins . . . . . *O. douradensis* Vattimo-Gil
- 4b. Domatia hairy, or if glabrous inconspicuous on the upper surface.
- 5a. Twigs and petioles covered by a rusty dense indument of erect hairs, these also on the lower leaf surface, at least on the midrib . . . . . *O. percurrans* Vicentini
- 5b. Indument of twigs and petioles absent or consisting of sparse, appressed or very short hairs, but surface always visible.
- 6a. Flowers ca. 5 mm diam.; pistillode glabrous; receptacle pubescent in staminate and glabrous in pistillate flowers . . . . . *O. cinerea* van der Werff
- 6b. Flowers ca. 3 mm diam.; both pistillode and receptacle either glabrous or pubescent.
- 7a. Pistillode glabrous; receptacle glabrous or nearly so in both staminate and pistillate flowers.
- 8a. Reticulation coarse and (usually) white and very conspicuous due to the contrasting dull blackish lamina when dried . . . . . *O. nigrescens* Vicentini
- 8b. Reticulation fine, not white or differently colored from the lamina, the leaves usually drying green . . . . . *O. subterminalis* van der Werff
- 7b. Pistillode pubescent; receptacle pubescent in both staminate and pistillate flowers . . . . . *O. minor* Vicentini
- 3b. Domatia absent.
- 9a. Lower leaf surface with a moderate to dense indument of erect (or crisped) hairs, usually also on the petiole and branchlets.
- 10a. Leaves chartaceous; usually also pubescent on the veins above; the hairs long and conspicuous and soft to the touch.
- 11a. Shrub or treelet; petioles short (ca. 5 mm); leaf base cordate or rounded; branchlets slender (< 3 mm diam.) . . . . . *O. boissieriana* (Meisner) Mez
- 11b. Tree; petioles longer (> 10 mm); leaf base acute or obtuse; branchlets stout (ca. 5 mm diam.) . . . . . *O. tabacifolia* Rohwer
- 10b. Leaves coriaceous; glabrous on the veins above; indument short or very short.
- 12a. Leaves usually waxy beneath; pistillode absent or reduced to a tuft of hairs; receptacle pubescent inside; staminodes present, stipitiform and pubescent . . . . . *O. rhodophylla* Vicentini
- 12b. Leaves not waxy; pistillode present, glabrous, with or without a stigma; receptacle glabrous inside; staminodes absent . . . . . *O. amazonica* (Meisner) Mez
- 9b. Lower leaf surface glabrous, or with appressed hairs, or with sparse and extremely short erect hairs, these not visible to the naked eye.
- 13a. Terminal bud glabrous or hairy only on the inner surface of the bud scales (externally glabrous).
- 14a. Twigs angular or winged; receptacle glabrous in staminate flowers.
- 15a. Leaf apex attenuate to acuminate; lamina narrowly elliptic, usually > 15 cm long and 3–4.5 times longer than wide . . . . . *O. olivacea* A. C. Smith
- 15b. Leaf apex rounded to short acuminate; lamina broadly elliptic, usually < 15 cm long and ca. 2 times longer than wide . . . . . *O. neblinae* C. K. Allen
- 14b. Twigs cylindrical or soon becoming so; receptacle pubescent in staminate flowers.
- 16a. Bud scales free, revealing the pubescent inner surface (and margin), leaving clusters of scars on the twigs (at the end of each growth unit); filaments of outer stamens ca. half as long as anthers and free . . . . . *O. myriantha* (Meisner) Mez
- 16b. Buds completely glabrous (bud scales closed, not showing the inner surface and not leaving conspicuous scars on twigs); anthers of outer stamens sessile, the filaments partially fused to the tepals . . . . . *O. sp.* E
- 13b. Terminal buds pubescent, usually completely covered by indument.
- 17a. Flowers hermaphroditic, i.e., ovary well defined and distinct from style, bearing an ovule inside (some species present hermaphroditic and pistillate flowers).
- 18a. Tepals papillose on the inner surface; staminodes of whorl IV present.
- 19a. Connectives of outer stamens extended above thecae, forming sterile tips; leaves glabrous or nearly so.
- 20a. Stamens papillose, ca. 2 mm long . . . . . *O. ligulata* van der Werff
- 20b. Stamens glabrous, ca. 1 mm long . . . . . *O. rhynchophylla* (Meisner) Mez
- 19b. Connectives without sterile tips; leaves with appressed hairs beneath . . . . . *O. aciphylla* (Nees) Mez
- 18b. Tepals not papillose; staminodes of whorl IV absent.
- 21a. Leaf apex obtuse or rounded; base narrowed and decurrent on the petiole; leaves glabrous or nearly so . . . . . *O. immersa* van der Werff
- 21b. Leaf apex acuminate; base acute and not decurrent on the petiole; lower leaf surface with moderate to dense indument of appressed hairs . . . . . *O. oblonga* (Meisner) Mez

- 17b. Flowers unisexual, i.e., when pistillode evident with a conspicuous stigma, then ovary without an ovule inside.
- 22a. Whorl III of stamens close together forming a tube surrounding the pistillode; these filaments fused, at least at the base; pistillode as high as stamens and stigma positioned between the anther apices.
- 23a. Pistillode pubescent, at least on the style; twigs usually with persistent bracts and covered by an erect rusty indument . . . . .  
. . . . . *O. cujumari* Martius
- 23b. Pistillode glabrous; twigs without persistent bracts, glabrous or with appressed whitish hairs.
- 24a. Twigs strongly angular to winged, not lenticellate; leaves large (> 15 cm) with raised reticulation and appressed hairs; filaments ca. half as long as anthers . . . . . *O. longifolia* HBK
- 24b. Twigs angular, soon terete, densely lenticellate; leaves smaller with inconspicuous reticulation and glabrous; filaments as long as anthers . . . . . *O. nitida* (Meisner) Rohwer
- 22b. Whorl III of stamens not forming a tube surrounding the pistillode, or if so, then filaments free and pistillode shorter than stamens and included in the tube.
- 25a. Filaments of outer stamens ca. half as long as anthers or shorter, free or partly fused to the tepals.
- 26a. Leaf base cordate or rounded and petiole < 0.8 cm long; pistillode reduced without a stigma . . . . . *O. adenotrachelium* (Nees) Mez
- 26b. Leaf base not cordate or rounded, or if so, then petiole > 1.5 cm long or pistillode with a conspicuous stigma.
- 27a. Filaments of outer 6 stamens partly fused with the tepals; pistillode without or with a stigma.
- 28a. Pistillode present, stipitiform and pubescent; petiole < 1 cm long; leaves < 9 × 2.5 cm . . . . . *O. minor* Vicentini
- 28b. Pistillode absent or present but glabrous; petiole > 1.5 cm long; leaves > 6 × 2.8 cm.
- 29a. Lower thecae of outer stamens introrse . . . . .  
. . . . . *O. cernua* (Meisner) Mez
- 29b. Lower thecae of outer stamens latrorse to latrorse-introrse . . . . . *O. pauciflora* (Nees) Mez
- 27b. Filaments of outer 6 stamens free; pistillode well developed with a stigma.
- 30a. Staminodes of whorl IV present, stipitiform and pubescent . . . . . *O. cinerea* van der Werff
- 30b. Staminodes of whorl IV absent.
- 31a. Leaves, inflorescences, and twigs with appressed hairs; inflorescence branches densely appressed pubescent, obscuring surface; pistillode pubescent or glabrous.
- 32a. Pistillode pubescent . . . . .  
. . . . . *O. splendens* (Meisner) Baillon
- 32b. Pistillode glabrous or nearly so . . . . .  
. . . . . *O. leucoxyton* (Swartz) Mez s.l.
- 31b. Leaves, inflorescences, and twigs glabrous or with short erect hairs, the pubescence moderate to sparse; pistillode glabrous or nearly so.
- 33a. Reticulation coarse and (usually) white and very conspicuous due to contrasting dull blackish lamina when dried . . . . .  
. . . . . *O. nigrescens* Vicentini
- 33b. Reticulation fine, not white or differently colored than lamina (drying reddish, brown, or greenish).
- 34a. Leaves usually drying green; inflorescence branches and flowers externally moderately covered with short erect hairs . . . . .  
. . . . . *O. subterminalis* van der Werff
- 34b. Leaves usually drying red-brown; inflorescence branches and flowers glabrous or only with a few and extremely short, minute, erect hairs . . . . .  
. . . . . *O. sp. G*



- 25b. Filaments of outer stamens clearly longer than or as long as the anthers and completely free.
- 35a. Twigs with erect or crisped hairs, sometimes extremely short and sparse (use a microscope and look closely at the terminal bud).
- 36a. Indument on twigs ferruginous, grayish, or brownish, dense, the surface scarcely visible.
- 37a. Leaves sub-tripliveined; glands of inner stamens flat . . . . . *O. delicata* Vicentini
- 37b. Leaves pinnately veined; glands of inner stamens globose.
- 38a. Receptacle glabrous in both staminate and pistillate flowers . . . *O. amazonica* (Meisner) Mez
- 38b. Receptacle pubescent in both staminate and pistillate flowers.
- 39a. Pistillode reduced to a tuft of hairs or absent; staminodes of whorl IV present . . . . . *O. rhodophylla* Vicentini
- 39b. Pistillode present, glabrous, without stigma; staminodes usually absent . . . . . *O. obliqua* Vicentini
- 36b. Indument on twigs whitish or minute and leaving surface largely visible.
- 40a. Flowers externally glabrous or nearly so; tepals at anthesis erect . . . . . *O. puberula* (Richard) Nees
- 40b. Flowers externally pubescent; tepals at anthesis spreading to reflexed.
- 41a. Small tree or shrub, to 10 m. Inflorescences in the axils of leaves, flowers almost sessile and arranged in dense glomerules; tepals pubescent on both surfaces . . . . . *O. scabrella* van der Werff
- 41b. Tree to 20 m. Inflorescences in the axils of bracts near the tips of the branches and appearing terminal (rarely in the axil of normal leaves); flowers pedicellate and not arranged in dense glomerules; tepals pubescent only on outside . . . . . *O. subterminalis* van der Werff
- 35b. Twigs with appressed hairs, or completely glabrous.
- 42a. Leaf apex obtuse or rounded . . . *O. immersa* van der Werff
- 42b. Leaf apex acuminate or acute.
- 43a. Twigs completely covered by appressed hairs, indument usually dense to moderate on the lower surface of mature leaves, rarely sparse.
- 44a. Leaves strongly coriaceous, > 15 cm long, with fine reticulation; staminodes of whorl IV present . . . . . *O. matogrossensis* Vattimo
- 44b. Leaves chartaceous, usually < 10 cm long, with coarse reticulation; staminodes of whorl IV absent . . . . . *O. oblonga* (Meisner) Mez
- 43b. Twigs and the lower surface of mature leaves glabrous or nearly so.
- 45a. Flowers larger (> 4.5 mm diam. at anthesis); pistillode entirely pubescent . . . . . *O. floribunda* (Swartz) Mez
- 45b. Flowers smaller ( $\leq$  4 mm diam. at anthesis); pistillode glabrous or nearly so . . . . . *O. ceanothifolia* (Nees) Mez

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