Three new species of *Coffea* L. (Rubiaceae) from NE Madagascar

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KEY WORDS
Rubiaceae,
Coffea,
coffee,
Madagascar,
IUCN Red List Categories.

ABSTRACT
Three new species of *Coffea* are described from the Antsiranana Province, in NE Madagascar: *C. littoralis*, *C. mcphersonii* and *C. ratsimamangae*. The three new species are compared with *C. pervilleana*. The conservation status of each species is given, using IUCN Red List Categories.

MOTS CLÉS
Rubiaceae,
Coffea,
café,
Madagascar,
Catégories de l'UICN,
Listes Rouges.

RÉSUMÉ
Trois nouvelles espèces de Coffea L. (Rubiaceae) du NE de Madagascar.
Trois nouvelles espèces de *Coffea* sont décrites de la province d'Antsiranana, au Nord-Est de Madagascar : *C. littoralis*, *C. mcphersonii* et *C. ratsimamangae*. Les trois nouvelles espèces sont comparées au *C. pervilleana*. Le statut de conservation est donné pour chaque espèce, en utilisant les catégories de l'UICN pour les Listes Rouges.

INTRODUCTION

There are approximately 92 species of *Coffea* of which 45 species occur in Madagascar, 44 in Africa, and three in the Mascarenes. Of the *Coffea* species occurring in Madagascar 26 were described by LEROY (e.g., 1961, 1962a, 1962b, 1972a, 1972b), and he also gave provisional names to several other species. Recently, two of these provisional names were described (DAVIS & RAKOTONASOLO 2000), and in this paper we are describing two more: *C. ratsimamangae* and *C. littoralis*. A third new species (*C. mcphersonii*) identified during herbarium studies, and confirmed by fieldwork (F. RAKOTONASOLO), is also described.

Examination of the herbarium material held at Paris (P) clearly shows that LEROY made compar-

isons between *C. ratsimamangae*, *C. littoralis* (= *C. vohemarensis* J.-F. Leroy ined.), and *C. pervilleana* (Baill.) Drake. It is likely that this association was made on the basis of three shared morphological features: small leaves, hairy domatia, and the presence of an apiculum at the apex of each inter-petiolar stipule. The key to species, diagnoses, and descriptions presented in this paper describe how these three species (and *C. mcphersonii*) differ from each other.

In Madagascar the genus *Coffea* occurs in humid and sub-humid evergreen forests, and in seasonally dry deciduous forests. The highest diversity of species occurs in the humid and sub-humid forests, which are found in eastern Madagascar. The three new species described here are endemic to the NE part of the Antsiranana Province, in NE Madagascar.

MATERIALS AND METHODS

Herbarium material of *Coffea* was consulted at the Département de Botanique, Parc de Tsimbazaza, Antananarivo (TAN), the Muséum National d'Histoire Naturelle, Paris (P), Recherches Forestières et Piscicoles, Antananarivo (TEF), and the Royal Botanic Gardens, Kew (K). Material was loaned from Missouri Botanical Garden (MO). The measurements, colours and other details given in the descriptions are mostly based on herbarium specimens, or data derived from field notes. Field observations were made for *C. ratsimamangae* and *C. mcphersonii*.

The conservation status of each species was assessed by calculating the extent of occurrence using GIS (J. MOAT pers. comm.), and applying the IUCN Red List Category criteria (IUCN 1994 — after MACE & STUART 1994). The three species assessed in this article only occur in reasonable to good quality primary forest, which is very limited in NE Madagascar. Study of species distribution and remaining primary vegetation shows that the IUCN ratings for *C. littoralis* and *C. mcphersonii* are likely to remain unchanged. Furthermore, the distribution of most *Coffea* species in Madagascar is very restricted, apart from *C. perrieri* Drake ex Jum. & H. Perrier (a widespread species occurring in riverine forest), *C. resinosa* (Hook. f.) Radlk. (a species of eastern littoral forests), and perhaps *C. grevei* (in seasonally dry forests of eastern Madagascar, roughly from Toliara to Mahajanga). Further field studies may enlarge the area of extent and area of occupancy for *C. ratsimamangae*, and therefore the conservation status of this species is given as provisional.

Key to three new species of *Coffea* and *C. pervilleana*

1. Leaf venation on abaxial surface manifest to prominent 2
1'. Leaf venation on abaxial surface obscure 3
2. Leaf apex shortly caudate to caudate; pedicel ± absent, or 0.1-0.5 mm long, bractlets absent; calyx limb shallowly 5-crenate to undulate, NW Madagascar (Island of Nosy Be) ..... **C. pervilleana**
2'. Leaf apex acute to ± rounded, rarely very shortly caudate; pedicel always present, 3-5 mm long, bractlets present; calyx limb truncate to slightly undulate; NE Madagascar ..... **C. littoralis**
3. Leaves broadly obovate, broadly elliptic, or ± orbicular; calyx limb with colleters; calyx and disc prominent on fruit (at apex) ..... **C. mcphersonii**
3'. Leaves obovate or elliptic; calyx limb without colleters; calyx and disc not prominent on fruit (at apex) ..... **C. ratsimamangae**

1. **Coffea littoralis** A.P. Davis & Rakotonas., **sp. nov.**

Coffea vohemarensis J.-F. Leroy ined., in sched. herb. P.

Coffeae pervilleanae (Baill.) Drake *affinis sed foliis subcoriaceis (haud chartaceis usque subcoriaceis), apicibus rotundis usque rarissime abrupte breviterque caudatis (haud abrupte caudatis usque caudatis), pedicello 3-5 mm longo (non 0.1-0.5 mm longo), calycis limbo truncato usque leviter undulato (haud debilibus crenulato usque undulato) distinguenda.*

TYPUS. — *Capuron 27302-SF*, Madagascar, Est (Nord), forêt littorale au S de Vohemar, 11-19 Dec. 1966, fl. (holo-, P!; iso-, K!, P!, TEF!).

Treelet or small tree, height not recorded, dbh not recorded. Bark not seen. Branches terete, 4.5-7 mm in diam., light brown or grey, smooth to slightly fissured. Branchlets ± terete, 1.7-4 mm in diam., ± the same colour and texture as the branches, the young parts puberulous (hairs erect to erecto-patent, c. 0.1 mm long). Stipules ± triangular to narrowly triangular, 0.5-1 × 0.7-1 mm, stipule body glabrous but margin sometimes minutely ciliate (hairs < 0.1 mm long); apex apiculate, apiculum 0.5-1.5 mm long. Leaves broadly elliptic to broadly ovate, (2.4-)3.2-3.5(-4.7) × (1.4-)1.9-2.8(-3.3) cm, subcoriaceous; petioles 2.5-3.5 mm long; base rounded to obtuse; margins flat to revolute; apex acute to ± rounded, rarely very shortly caudate; abaxial surface: midrib prominent; secondary veins ± prominent, 4-5 pairs, ascending at an angle of 45° to 60°; tertiary venation manifest to obscure, ± reticulate; higher order venation obscure to invisible, reticulate; adaxial surface: venation more clearly manifest than the venation on the abaxial surface; domatia crypt type, sometimes absent, the orifice 0.4-0.5 mm in diam., puberulous (hairs 0.1 mm long).

Inflorescences 1-flowered, unbranched, 1 per axil, 3-5 mm long, lightly covered with a clear exudate or not at all; inflorescence axis (bearing calyculi) 2-2.5 mm long. Calyculi 3, the basal calyculus often falling, ± sessile, subcoriaceous, glabrous to puberulous (hairs 0.1 mm long), margins minutely ciliate (hairs c. 0.1 mm long); basal [1st] calyculus 0.8-1.1 × 0.9-1.2 mm, lobes not seen; middle (2nd) calyculus 1-1.2 × 1.1-1.5 mm, stipular lobes shallowly triangular to deltate, c. 0.3 × 0.8 mm, foliar lobes ± triangular to elliptic, c. 0.3 × 0.2 mm; upper calyculus (3rd) 1.9-2 × 1.5-1.7 mm, stipular lobes deltate to triangular, c. 0.4-0.7 × 0.4-0.7 mm, foliar lobes ± triangular to elliptic, c. 0.3-0.4 × 0.2 mm; internal surfaces of calyculi sparsely covered with colleters; colleters white, narrowly conical, 0.1-0.2 mm long.

Flowers 5-merous; pedicel (0.7-)1-3 mm long, with 3-5 bractlets; bractlets alternate 0.2-0.4 × 0.4-0.5 mm, often splitting in fruit, margins coarsely fimbriate to irregularly denate. Calyx (hypanthium) ± obconical, 1.1-1.3 × 1.2 mm; calyx limb truncate to slightly undulate, margin glabrous or minutely ciliate (hairs c. 0.1 mm long); disc low domed, entire. Corolla 10-12 × 10-15 mm; corolla tube 8-9 mm long; corolla lobes 7-8.5 × 3.5-4 mm. Stamens: filaments 1.2-1.5 mm long; anthers 4.5-5 mm long. Style 11-13 mm long; stigma lobes 2-2.5 mm long.

Fruits ellipsoid to obovoid, entire or slightly bilobed, 10-12 × 6-8 mm; pedicel 3-5 mm long, calyx limb indistinct, disc prominent, apex rather corky, colour at maturity not known. Seeds elliptic to obovate in outline, 9.5-11 × 4.5-5.8 mm, whitish brown to pale brown (when dry). — Fig. 1.

DISTRIBUTION. — Endemic to Madagascar. Occurring in NE Madagascar, Antsiranana Province, only known from littoral forests in the vicinity of Iharana (Vohemar). — Fig. 4.

HABITAT AND ECOLOGY. — Evergreen, humid, littoral forest, including forest on stabilized dunes and swamp forest. On unconsolidated sands: sandy soils, marine sands. Altitude 0-50 m. Locally infrequent.

PHENOLOGY. — Flowering November to December, and fruiting in March, but relatively few specimens seen.

CONSERVATION STATUS. — IUCN Red List Category: **Critically Endangered** (CR B2 a-e). No populations (based on specimen collections) within current scheme of protected areas; total extent of occurrence less than 10 km^2.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana*: *Capuron 27432-SF*, Est (Nord), forêt d'Andaingo, sur vieilles dunes, au sud de la rivière d'Andripatra, au N de Vohemar, 16 Mar. 1967, fr. (K, P, TAN); *coll. ignot. A. 979 (herb. Leroy II-54),* forêt littorale d'Analabe derrière terrain d'aviation Vohemar, 19 Nov. 1970, ster. (P); *coll. ignot. A. 977 (herb. Leroy II-47),* forêt au N de Vohemar, au S rivière d'Andripatra, 17 Nov. 1970, ster. (P); *coll. ignot. A. 977 (herb. Leroy II-52),* N de Vohemar, 17 Nov. 1970, ster. (P).

J.-F. LEROY provided this species with the provisional name of *C. vohemarensis*, which he used on herbarium specimens in the Paris herbarium (P). We agree with LEROY's circumscription of this species but we have not used the epithet *vohemarensis* because there are a number of other *Coffea* species from Vohemar, including at least one other species with small leaves. We have used the name *C. littoralis* because this species is found in littoral forests, and in other types of vegetation near the sea shore.

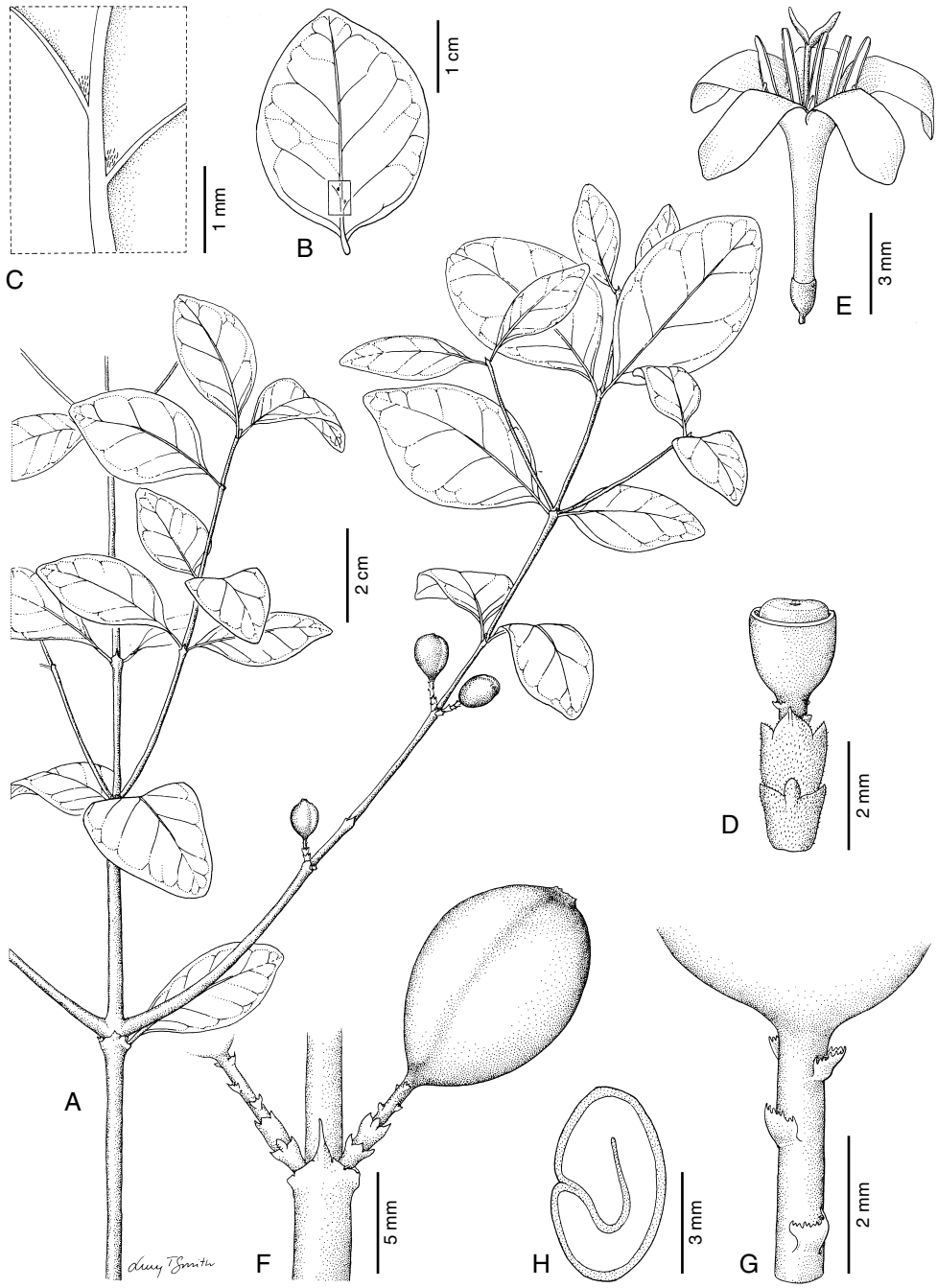

Fig. 1. — ***Coffea littoralis*** A.P. Davis & Rakotonas.: **A**, habit; **B**, leaf, showing position of domatia; **C**, domatia; **D**, inflorescence (showing middle and upper calyculi, and calyx); **E**, flower; **F**, infructescence; **G**, transverse section of seed; **H**, detail of pedicel, with bractlets (fruiting stage). A, *Capuron 27432-SF*; B-E, *Capuron 27302-SF*; F-H, *Capuron 27432-SF*.

2. Coffea mcphersonii A.P. Davis & Rakotonas., **sp. nov.**

Coffeae pervilleanae (Baill.) Drake *affinis sed foliis late obovatis late ellipticis vel fere orbicularibus (haud ellipticis usque late ellipticis vel elliptico-obovatis vel elliptico-lanceolatis), subcoriaceis (haud chartaceis usque subcoriaceis), apicibus obtusis usque rotundis vel usque rarissime abrupte breviterque caudatis (haud abruptis caudatis usque caudatis), venis obscuris usque invisibilibus (haud manifestis usque prominentibus), calycis limbo colleteribus obsito (haud colleteribus absentibus) distinguenda.*

TYPUS. — *McPherson 14734*, Madagascar, Diego Suarez region, SE of town (due E) and SE of Ambilobe, near Daraina on road to Vohemar (Iharana), D. Meyer's Lemur study site, 200 m, 20 Dec. 1989, fl. (holo-, MO!; iso-, K!, P!, TAN!).

Treelet or small tree, c. 3.5 m high, dbh not recorded. Bark not seen. Branches terete, 4-6 mm in diam., light brown to whitish, smooth to fissured, often slightly peeling. Branchlets terete, 1.5-3 mm in diam., ± the same colour and texture as the branches, the young parts puberulous (hairs erect, < 0.1 mm long). Stipules ± triangular to narrowly triangular, 0.8-1.7 × 0.8-1.5 mm, stipule body glabrous but margin minutely ciliate (hairs < 0.1 mm long); apex apiculate, apiculum 0.5-1.2 mm long. Leaves broadly obovate, broadly elliptic, or ± orbicular, (2.4-)3.2-4.5(-5) × (1.4-)1.8-2.6(-3.1) cm, subcoriaceous; petioles 1-2 mm long; base cuneate; margins flat to subrevolute; apex obtuse to rounded, rarely very shortly caudate; abaxial surface: midrib not prominent; secondary veins ± obscure to invisible, 4-5 pairs, ascending at an angle of c. 45° to 60°, tertiary and higher order venation invisible; adaxial surface: venation more clearly manifest than the venation on the abaxial surface; domatia crypt type, prominent, the orifice 0.4-0.5 mm in diam., pubescent (hairs 0.1-0.2 mm long).

Inflorescences 1-flowered, unbranched, 1-2(-3) per axil, 3.8-6.5 mm long, lightly covered in exudate or not at all; inflorescence axis (bearing calyculi) 3.5-5.5 mm long. Calyculi 4, the basal calyculus often falling, ± sessile, subcoriaceous to chartaceous, glabrous to puberulous (hairs < 0.1 mm long), margins minutely ciliate (hairs < 0.1 mm long) or glabrous; basal [1st] calyculus 1.2 × 1.3 mm, lobes not seen; middle (2nd) calyculus 1.5-2 × 1-1.5 mm, stipular lobes very shallowly triangular to deltate, 0.3-0.5 × 0.9-1.5 mm, foliar lobes elliptic to narrowly elliptic, 0.7-1 × 0.2-0.4 mm; middle (3rd) 1.9-2.5 × 1.5-1.9 mm, stipular lobes shallowly triangular to triangular, 0.4-0.5 × 0.9-1.1 mm, foliar lobes elliptic to ± triangular, 1-1.5 × 0.6-0.8 mm; upper (4th) calyculus mostly concealed by the upper calyculus, truncate to ± 4-lobed, 1.4-1.6 × 1.4-1.6 mm, chartaceous, lobes, if present, shallowly triangular, 0.3-0.4 × 0.9-1 mm; internal surfaces of calyculi sparsely covered with colleters; colleters white, narrowly conical, 0.1-0.2 mm long.

Flowers 5-merous; pedicel 0.6-1 mm long, with 2-3 bractlets; bractlets alternate semi-sheathing, 0.2-0.5 × 0.4-0.5 mm, often splitting in fruit, margins coarsely fimbriate to irregularly denate. Calyx (hypanthium) ± obconical, 1.3-1.5 × 1.4-1.7 mm; calyx limb truncate to 5-lobed, margin with 5-6(-7) colleters or single at the apex of each lobe, colleters white, narrowly ellipsoid to narrowly conical, 0.1 mm long, glabrous or minutely ciliate (hairs 0.1 mm long); disc domed, entire to slightly 5-lobed. Corolla 9-10 × 8-10 mm; corolla tube 4-6 mm long; corolla lobes 5-6 × 3.5-4 mm. Stamens: filaments c. 1.3 mm long; anthers c. 4.5 mm long. Style c. 9 mm long; stigma lobes c. 2 mm long.

Fruits ellipsoid to oblong-ellipsoid, bilobed, 10-12 × 7-8 mm, pedicel 2.5-3 mm long; calyx-limb prominent, disc prominent, apex slightly corky; colour at maturity not known. Seeds elliptic to obovate in outline, 10-11.5 × 4.5-5 mm, pale brown (when dry). — Fig. 2.

DISTRIBUTION. — Endemic to Madagascar. Occurring in NE Madagascar, Antsiranana Province, in the vicinity of Iharana (Vohemar). — Fig. 4.

HABITAT AND ECOLOGY. — Evergreen humid forest. On basement rocks, including laterites. Altitude 100-450 m. Locally infrequent.

PHENOLOGY. — Flowering in December, and fruiting in February, but relatively few specimens seen.

CONSERVATION STATUS. — IUCN Red List Category: **Critically Endangered** (CR B2 a-e). No populations (based on specimen collections) within current scheme of protected areas; total extent of occurrence less than 100 km^2.

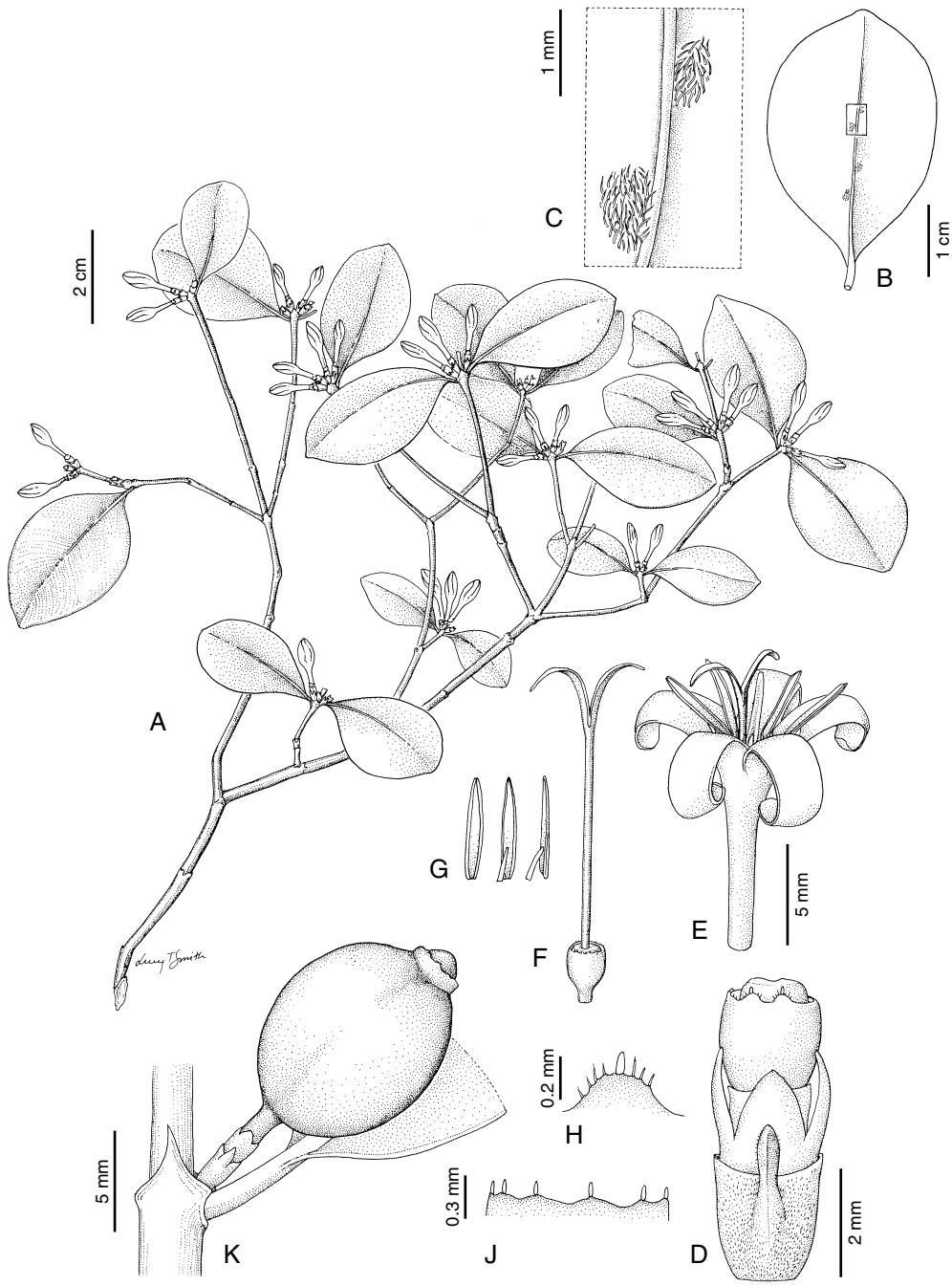

Fig. 2. — ***Coffea mcphersonii*** A.P. Davis & Rakotonas.: **A**, habit; **B**, leaf, showing position of domatia; **C**, domatia; **D**, inflorescence (showing calyculi and calyx); **E**, flower; **F**, calyx and style; **G**, anthers: adaxial, abaxial, and side view (from left to right); **H**, detail of one calyx lobe, with hairs and colleter; **J**, detail of calyx limb, showing colleters; **K**, infructescence. A-C, J, *McPherson 14734*; D-H, *Davis & Rakotonasolo APD 2343*; K, *Capuron 27416-SF*.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana*: *Capuron 27416-SF*, Ouest (Nord), versant Est massif de l'Ankarana, partie S du massif de Mafokovo, au N de Vohemar, 450 m, 12 Feb. 1967, fr. (P, TEF); *herb. Leroy II-40,* 10 km S de Vohemar, 18 Nov. 1970, ster. (P); *coll. ignot. A. 976 (herb. Leroy II-45),* S de Makofovo, N de Vohemar, 18 Nov. 1970, ster. (P); *Capuron 27364-SF,* Ouest (Nord), versant Est du massif de l'Ankarana, partie S du massif de Mafokovo, au N de Vohemar, 50-450 m, 17 Dec. 1966, fl. (P, TEF); *Davis & Rakotonasolo APD 2343*, Vohemar, recollected from the Coffee Research Centre at Kianjavato (*Kianjavato acc. no. A. 977*), date of recollection: 27 Nov. 1999, fl. (K, P, MO, TAN).

This species is named after Gordon MCPHERSON, who has collected widely in Madagascar, and made a large number of good quality specimens. A specimen collected by MCPHERSON (*McPherson 14734)* allowed us to make an adequate assessment of this species, and his collection is used here as the type.

The presence of colleters on the calyx limb is a rare feature for *Coffea* in Madagascar, and we have found only one other species with this character, namely *C. jumellei*, although this species is easily set apart from *C. mcphersonii*. *Coffea jumellei* has chartaceous leaves, a broadly acute stipule apex, paired bractlets on the pedicel, corolla lobes distinctly longer than corolla tube, and the calyx limb has more than 15 colleters on the margin. *Coffea mcphersonii* has subcoriaceous leaves, each stipule has an apiculum at the apex (0.5 to 1.2 mm long), alternate bractlets on the pedicel, corolla lobes about the same length as the tube or slightly longer, and the calyx limb has less than seven colleters on the margin.

3. **Coffea ratsimamangae** J.-F. Leroy ex A.P. Davis & Rakotonas., **sp. nov.**

Coffeae pervilleanae (Baill.) Drake *affinis sed foliis subcoriaceis (haud chartaceis usque subcoriaceis), apicibus rotundis usque obtusis vel acutis (haud abrupte breviterque caudatis usque caudatis), venis obscuris usque invisibilibus (haud manifestis usque prominentibus), corollae tubo longo lobis superanti (haud corollae lobis tubum superantibus).*

TYPUS. — *Capuron 23171-SF*, Madagascar, Plateau de l'Ankarana, massif d'Antsandoko, au Sud d'Ambondromifehy, 22 Dec. 1963, fl. (holo-, P!; iso-, K!, TEF!).

Treelet or small tree, 2-4 m high, dbh 1.5-2.2 cm. Bark grey-brown, smooth. Branches terete, 4-6 mm in diam., light brown to grey or whitish, smooth to slightly fissured. Branchlets terete, 1.5-2.5(-3) mm in diam, ± the same colour and texture as the branches, ± smooth, the young parts puberulous (hairs erect 0.1 mm long) or glabrous. Stipules ± deltate to triangular, (0.7-)0.9-1.5 × (0.9-)1-1.2 mm, stipule body glabrous but margin minutely ciliate (hairs 0.1 mm long); apex apiculate, apiculum (0.3-)0.5-1 mm long. Leaves obovate or elliptic, (2-)2.2-4.2 × (0.7-)0.9-2.2 cm, subcoriaceous; petioles 1.5-2 mm long; base cuneate, very slightly decurent or not; margins flat to subrevolute; apex rounded to obtuse, or acute; abaxial surface: midrib not prominent; secondary veins obscure to invisible, (3-)4-5 pairs, ascending at an angle of c. 60°; tertiary and higher order venation invisible, often turning pinkish to reddish when the leaves are folded or bruised; adaxial surface: venation usually more clearly manifest than the venation on the abaxial surface; domatia crypt type, obscure to prominent, the orifice 0.2-0.3 mm in diam., pubescent to puberulous (hairs 0.1-0.2 mm long).

Inflorescences 1-flowered, unbranched, 1(-2) per axil, 2.8-4.4 mm long, very lightly covered with a clear exudate or not at all; inflorescence axis (bearing calyculi) 2.5-3.5 mm long. Calyculi 3, the basal calyculus sometimes falling, ± sessile, subcoriaceous, ± glabrous, the margins minutely ciliate (hairs c. 0.1 mm long) or glabrous; (1st) calyculus 1-1.5 × 1.3-1.6 mm, stipular lobes deltate to triangular, 0.5-0.7 × 0.7-0.9 mm, the foliar lobes ± narrowly triangular or ± elliptic, 0.4-0.7 × 0.3-0.4 mm; middle calyculus (2nd) 1.5-2.5 × 1.4-2 mm, stipular lobes deltate to triangular, 0.6-1 × 0.8-1.1 mm, apiculate, apiculum c. 0.2 mm long, foliar lobes ± linear to elliptic, or oblanceolate to spathulate, 0.5-1.4(-2) × 0.3-0.5 mm; upper calyculus [3rd], 1.5-2 × 1.3-1.8 mm, stipular lobes deltate to triangular, 0.5-0.8 × 0.7-1 mm, foliar lobes delate to ± narrowly triangular, or ± elliptic, 0.4-0.7 × 0.4-0.5 mm; internal surfaces of calyculi very sparsely covered with colleters; colleters white, narrowly conical, 0.1-0.2 mm long.

Flowers 5-merous; pedicel 0.7-1.4 mm long, with 2-3 bractlets, bractlets alternate, semi-sheathing or not, 0.4-0.6(-1) × 0.4-0.5 mm, splitting in

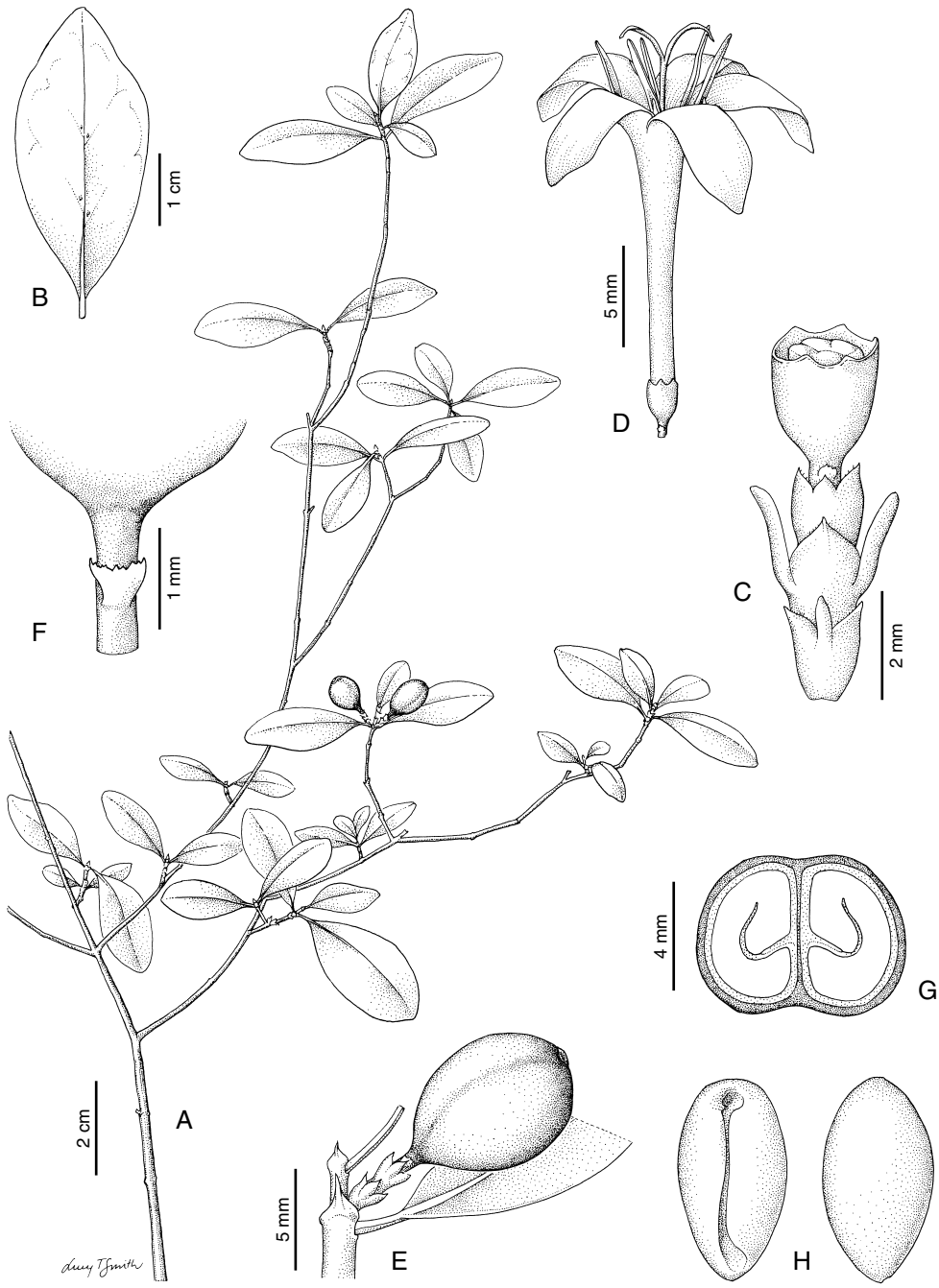

Fig. 3. — ***Coffea ratsimamangae*** J.-F. Leroy ex A.P. Davis & Rakotonas.: **A**, habit; **B**, leaf, showing position of domatia; **C**, inflorescence (showing basal, middle and upper calyculi, and calyx); **D**, flower; **E**, infructescence; **F**, detail of pedicel, with bractlets (fruiting stage); **G**, transverse section of fruit; **H**, seed, adaxial and abaxial view (left to right). A, E-H, *Capuron 23323-SF*; B-D, *Capuron 23171-SF*.

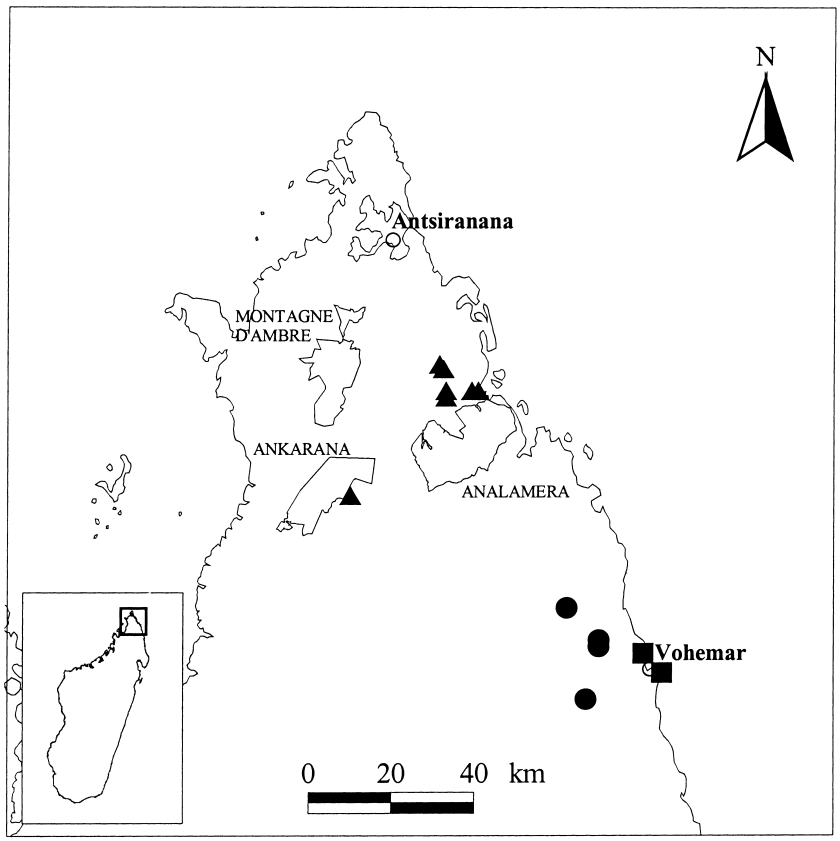

Fig. 4. — Distribution of ***Coffea littoralis*** (■), ***Coffea mcphersonii*** (●), ***Coffea ratsimamangae*** (▲).

fruit, margins coarsely fimbriate to irregularly denate. Calyx (hypanthium) obconical to ± campanulate, 1.5-1.8 × 1.2-1.5 mm; calyx limb 5-lobed, lobes 0.4 × 0.5-0.6 mm, margin glabrous; disc domed, ± 5-lobed. Corolla 11.5-13.5 × (8-)10-13 mm; corolla tube 8.3-11.5 mm long; corolla lobes (4.5-)5.5-6 × (2.5-)3.3-3.6 mm. Stamens: filaments 2-2.2 mm long; anthers 4.5-5 mm long. Style 13-15(-17) mm long; stigma lobes 1.2-1.4 mm long.

Fruits ellipsoid to oblong-ellipsoid, bilobed, 8-10 × 6-8 mm, pedicel 1.4-1.5 mm long; calyx-limb indistinct, disc indistinct, colour at maturity not known. Seeds elliptic to obovate in outline, 6.5-8 × 4-4.8 mm, light brown (when dry). — Fig. 3.

DISTRIBUTION. — Endemic to Madagascar. Occurring in NE Madagascar, Antsiranana Province, south of Antsiranana (Diego Suarez), near the Réserve d'Analamera, in the vicinity of Irodo, and near the Réserve d'Ankarana. — Fig. 4.

HABITAT AND ECOLOGY. — In seasonally dry transitional forest, composed of mainly evergreen species. A canopy tree in stunted forest, or as an understory component; sometimes on river banks. On alluvial and lake deposits, and sands. Altitude 0-400 m. Locally infrequent to locally frequent.

PHENOLOGY. — Flowering in December, and fruiting in February, but relatively few specimens seen.

PROVISIONAL CONSERVATION STATUS. — IUCN Red List Category: **Endangered** (EN B2 a-e). No populations (based on specimen collections) within current scheme of protected areas; total extent of occurrence is less than 5000 km^2 (c. 465 km^2

for *C. ratsimamangae*). Fieldwork in Réserve d'Analamera is necessary to see if this species occurs within the reserve, which could extend the areas of occupancy and extent.

PARATYPES. — MADAGASCAR, *Prov. Antsiranana*: *Davis & Rakotonasolo APD 2238,* forêt de Sahafary, between Andranomena and Irodo, c. 50 km SSE of Antsiranana (Diego-Suarez), 150 m, 5 Nov. 1998, ster. (K, P, MO, TEF); *Davis & Rakotonasolo APD 2240*, ibid., ster. (K, P, MO, TAN); *coll. ignot. A. 528*, origine forêt Antsandoko, Diego, (récolte Kianjavato [Coffee Research Station]), 26 Oct. 1971, fl. (P); envoi *Vianney-Liaud A. 532,* Analafondro, 4 Oct. 1968, ster. (P); envoi *Vianney-Liaud A. 528,* forêt d'Antsandoko, 9 Nov. 1966, ster. (K, P, TAN); *Davis & Rakotonasolo APD 2329*, forêt de Sahafary, recollected from the Coffee Research Centre at Kianjavato, date of recollection: 27 Nov. 1999, fl. (K, P, MO, TAN); *Capuron 23323-SF*, Ouest (Nord), forêt d'Analafondro, dans le bassin inférieur du Rodo [sic], 26 Feb. 1964, fr. (K, P, TEF); *coll. ignot. A. 536 (herb. Leroy 3-45),* forêt de Sahafary, versant baie d'Irodo, 10 Nov. 1966, ster. (P); *coll. ignot. A. 536 (herb. Leroy III-47),* forêt de Sahafary, versant baie d'Irodo, 10 Nov. 1966, ster. (P); envoi *Vianney-Liaud A. 536*, forêt de Sahafary, 1 Oct. 1968, ster. (P); *coll. ignot. A. 532*, forêt de Sahafary versant, baie d'Irodo, 10 Nov. 1966, ster. (P); *coll. ignot. A. 536 (herb. Leroy III-46),* forêt de Sahafary, versant baie d'Irodo, 10 Nov. 1966, ster. (P).

J.-F. LEROY determined several sheets in the Paris herbarium (P) using the unpublished name *C. ratsimamangae*. LEROY used the name *C. ratsimamangae* to honour Professor Albert RAKOTO-RATSIMAMANGA, an eminent figure in the study of Malagasy medicinal plants and traditional medicine.

Coffea ratsimamangae is easily recognised due to the combination of small obovate or elliptic leaves that bruise pink or beige after damage (e.g., after folding), obscure to invisible leaf venation, stipules with a single apical apiculum, and a corolla tube that is distinctly longer than the corolla lobes. — Fig. 3D.

Acknowledgments

We would like to thank the staff of the following herbaria for placing at our disposal herbarium material of *Coffea*: Muséum National d'Histoire Naturelle, Paris (P), Département Botanique, Parc de Tsimbazaza, Antananarivo (TAN), Recherches Forestières et Piscicoles, Antananarivo (TEF), and Missouri Botanical Garden, Missouri (MO). We are particularly grateful to the Director and staff at Paris (P) for providing research facilities during extended study visits. This work would not have been possible without the co-operation of the following organisations and ministries in Antananarivo, Madagascar: Association National pour la Gestion des Aires Protégées (ANGAP), Ministère des Eaux et Forêts (MEF), Ministère de la Recherche Scientifique Centre National de Recherche Appliquée au Développement Rural (FOFIFA). We also acknowledge the Director and staff at the Coffee Research Station (FOFIFA) at Kianjavato (Fianarantsoa), for their assistance during a study visit. At Kew, we would like to thank Diane BRIDSON for her comments on the manuscript, Mark COODE for checking the Latin diagnoses, and Lucy T. SMITH for her three drawings of *Coffea.* Justin MOAT prepared the distribution map and provided GIS support for the production of ecological summaries and IUCN Red List Categories. The work presented here was undertaken as part of a project on the Rubiaceae of Madagascar, funded by the LEVERHULME TRUST.

REFERENCES

DAVIS A.P. & RAKOTONASOLO F. 2000. — Three new species of *Coffea* L. (Rubiaceae) from Madagascar. *Kew Bull.* 55: 405-416.

IUCN 1994. — IUCN Red List Categories. Gland, Switzerland: IUCN.

LEROY J.-F. 1961. — Coffeae novae Madagascarienses. *J. Agric. Trop. Bot. Appl.* 8: 1-20.

LEROY J.-F. 1962a. — Prospection des Caféiers sauvages: rapport préliminaire sur une mission scientifique à Madagascar et aux Iles Mascareignes. *J. Agric. Trop. Bot. Appl.* 9: 211-244.

LEROY J.-F. 1962b. — Coffeae novae Madagascariensis et Mauritianae. *J. Agric. Trop. Bot. Appl.* 9: 525-530.

LEROY J.-F. 1972a. — Prospection des caféiers sauvages de Madagascar: deux espèces remarquables. *Adansonia*, sér. 2, 12: 317-328.

LEROY J.-F. 1972b. — Prospection des caféiers sauvages de Madagascar: sur deux espèces sympatriques du nord. *Adansonia,* sér. 2, 12: 345-358.

MACE G.M. & STUART S.N. 1994. — *Draft IUCN Red List Categories,* Version 2.2. Species 21-22.

Manuscript received 25 September 2000;
revised version accepted 22 March 2001.