A revision of *Weinmannia* (Cunoniaceae) in Malesia and the Pacific. 3. New Guinea, Solomon Islands, Vanuatu and Fiji, with notes on the species of Samoa, Rarotonga, New Caledonia and New Zealand

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ABSTRACT
Species of *Weinmannia* belonging to two sections occur in eastern Malesia and the western Pacific: sect. *Fasciculata* is largely Malesian, extending as far east as Fiji, and sect. *Leiospermum* is largely Pacific and occurs as far west as Papua New Guinea. In total, about 20 species occur in the region from New Guinea to the Cook Islands. *Weinmannia fraxinea*, which is widespread in Malesia, also occurs in New Guinea and the Solomon Islands. *Weinmannia croftii* from Papua New Guinea (Bismarck Archipelago and Karkar Island) is described as new, and the new combination *W. ouaiemensis* is published for a species in New Caledonia. There is a high level of endemism within the various island groups of this region, although the status of species from Samoa and the Cook Islands has not been resolved. Regional keys, illustrations and distribution maps are provided.

KEY WORDS
Weinmannia,
Cunoniaceae,
New Guinea,
Solomon Islands,
Vanuatu,
Fiji,
New Caledonia.

RÉSUMÉ

Plusieurs espèces de *Weinmannia*, appartenant à deux sections, existent dans l'est de la Malésie et l'ouest du Pacifique. La sect. *Fasciculata*, en grande partie de Malésie, s'étend vers l'est jusqu'à Fidji ; la sect. *Leiospermum*, essentiellement du Pacifique se trouve vers l'ouest jusqu'à la Papouasie-Nouvelle-Guinée. Au total, environ 20 espèces se trouvent dans la région comprise entre la Nouvelle-Guinée et les Iles Cook. *Weinmannia fraxinea*, largement répandu en Malésie, existe aussi en Nouvelle-Guinée et aux Iles Salomons. *Weinmannia croftii* de Papouasie-Nouvelle-Guinée (Archipel Bismarck et Ile Karkar) est une nouvelle espèce décrite ici, et une nouvelle combinaison, *W. ouaiemensis*, est proposée pour une espèce de Nouvelle-Calédonie. Le taux d'endémisme au sein des divers groupes d'îles de cette région est très élevé, bien que le statut des espèces de Samoa et des Iles Cook n'ait pas encore été résolu. Des clés de détermination régionales, des illustrations et des cartes de distribution sont présentées.

MOTS CLÉS
Weinmannia,
Cunoniaceae,
Nouvelle-Guinée,
Iles Salomons,
Vanuatu,
Fidji,
Nouvelle-Calédonie.

INTRODUCTION

This is the third part of a revision of the Malesian-Pacific species of *Weinmannia*. Part 1 (HOPKINS 1998a) gives a general introduction, including definitions of the terms used for the structure of the inflorescence, and describes the species of western Malesia. Parts 2 and 4 (HOPKINS 1998b; HOPKINS & FLORENCE 1998) deal with the species of Sulawesi and the Philippines, and the central Pacific respectively.

The *Weinmannia* species dealt with here show considerable island or island-group endemism, although a number which occur on volcanic islands and belong to sect. *Leiospermum* appear to be closely related to one another, and the morphological differences between them are relatively small. In addition to the new species and new combination published here, incomplete material from Irian Jaya and the Solomon Islands (including Bougainville which is politically part of Papua New Guinea) appears to represent a handful of undescribed taxa.

I. WEINMANNIA IN NEW GUINEA AND THE BISMARCK ARCHIPELAGO

Four named species occur in this region, *Weinmannia fraxinea*, *W. urdanetensis*, *W. pullei* (all sect. *Fasciculata*) and *W. croftii* (sect. *Leiospermum*). *Weinmannia pullei* and *W. croftii* are endemic. Some small-leafleted collections from Irian Jaya may represent additional taxa but better collections are needed, and they are not included in the key.

Key to the species of New Guinea and the Bismarck Archipelago

1. Flowers inserted on inflorescence axes in fascicles, i.e. a group of pedicels subtended by each bract; inflorescence usually composed of 1-3 pairs of dyads or tetrads inserted in the axils of the most distal pair of leaves; apical bud of shoot, between central peduncles of the partial inflorescences, present and usually dormant 2
1'. Flowers inserted on inflorescence axes singly, i.e. each individual pedicel subtended by a bract; inflorescence usually a central triad or pentad, developing from the apical bud of the shoot ..... **4. W. croftii**
2. Lateral leaflets in 1-4(-6) pairs, 3-10 × 0.8-3 cm; mature seeds comose at each end; inflorescence usually of 1-3 pairs of dyads or tetrads ..... **1. W. fraxinea**
2'. Lateral leaflets in 1-19 pairs, 0.6-3.2 × 0.3-1.5 cm; mature seeds bearing hairs all over surface; inflorescence usually a pair of dyads 3

3. Lateral leaflets oblong or elliptical, 2-19 pairs; secondary veins oriented at 90° to main vein; leaflets inserted at 90° to leaf rachis, often strigose-velutinous on underside; calyx pubescent ..... **3. W. urdanetensis**
3'. Lateral leaflets obovate, 1-6 pairs; secondary veins oriented at an acute angle to main vein; leaflets inserted at an acute angle to the leaf rachis, usually glabrous on underside; calyx glabrous ..... **2. W. pullei**

1. Weinmannia fraxinea (D. Don) Miq.

For synonomy, description, illustration and distribution map, see part 1 (HOPKINS 1998a: 23).

BREEDING SYSTEM.—Flowers usually bisexual in New Guinea, rarely unisexual (male: *Ledermann 9922, 9784*, *Henty & Foreman NGF 42671*, all from West Sepik; female: *Stevens LAE 58123* and *Brass 22460*).

FIELD CHARACTERS.—Small treelet to emergent, 5-35 m, up to 70 cm dbh, trunk rarely with buttresses up to 8 m. Bark variable, pale to dark brown or grey, smooth, cracked, fissured, scaly or with pustules; inner bark brown or reddish brown; sap wood white, straw, pink-straw, sometimes turning purple, hard; heartwood pink or red; sometimes with sticky exudate. Buds and inflorescence axes pink. Flowers whitish, sometimes tinged with pink, red or green; smell fragrant or unpleasant.

DISTRIBUTION AND ECOLOGY.—Malesia (except Sulawesi and Philippines) to Solomon Islands. See HOPKINS 1998a, Fig. 8, p. 29. In New Guinea, from 10 m (Vogelkop) to 1450 m and rarely to 2250 m (Mt. Dayman, Milne Bay and Mt. Talawe, East New Britain). Found in a wide range of forest habitats including lowland rain forest, hill forest, lower montane and cloud forest up to the border of subalpine grassland on Mt. Dayman; frequently from steep slopes and ridge tops; in primary forest, disturbed forest and regrowth and described as characteristic of older second growth at 350 m; scattered to dominant. Juvenile plants common on road cuts and open areas (Morobe, 100-150 m).

At low altitude (< 200 m), associates include Linaceae and *Anisoptera*. At mid elevation (300-950 m) found in hill forest with *Castanopsis*, *Agathis*, *Freycinetia*, and *Pandanus*; also in hill forest on limestone karst (600 m, New Ireland), lower montane, moderately dry forest dominated by *Eucalyptopsis* (450 m, Normanby Island), and lower montane forest dominated by *Weinmannia* and *Alstonia spectabilis* (950 m, New Ireland). At higher elevations grows with *Podocarpus* and *Dacrydium*.

Weinmannia fraxinea is frequently recorded from lower elevation in New Guinea and the Solomons than for instance in Java, Sumatra and the Malay Peninsula though usually from the same types of habitat (e.g. road cuts and open areas, hill forest and lower montane forest).

SELECTED COLLECTIONS (from a total of 63 studied for this region).—**IRIAN JAYA**: *Aet & Idjan 806*, Memperawaja nr. Seroei, buds, 16 Sep. 1939 (A, BO, K, L, SING); *Dijk bb 30351*, Ond. afd. Seroei, Eil. Japen, 800 m, st., 3 Aug. 1939 (A, BO, L); *Kanehira & Hatusima 12797*, Boemi, 40 km inward of Nabire, 300 m, buds, fr., 11 May 1940 (BO, L, type of *W. hypoglauca*); *Koster BW 8112*, Div. Hollandia, Bodem R., 60 km SE from Sarmi, 70 m, buds, 10 Feb. 1959 (A, L); *Lam 1574*, R. Mamberamo, nr. Mt. Doorman, 1450 m, fl., 9 Oct. 1920 (BO, K); *Schram BW 6009*, Vogelkop, Beriat, ± 20 km S of Teminaboean, 10 m, st., 19 Apr. 1958 (L); *Sijde BW 4071*, Hollandia, Cycloop Mts., Bivouac 1, 500 m, yfr., 12 Sep. 1956 (A, K, KEP, L); *Soengeng Reksodihardjo 386*, SE West Irian, Ingembit to Opka, fr., 8 June 1967 (L); *Vink BW 8426*, Div. Hollandia, Sidoarsi Mts., ca. 200 km W of Hollandia, 200 m, st., juv., 20 May 1959 (L).—**PAPUA NEW GUINEA**: ***Western***: *Henty et al. NGF 31797*, nr. Ingembit village, 480 ft., fr., 8 June 1967 (BISH, K, L); *Ridsdale & Galore NGF 33436*, Kiunga, 200 ft., fl., 21 July 1967 (A, K, L). ***West Sepik***: *Darbyshire 258*, nr. Miwaute village, Torricelli Mts., Lumi subdistr., 2600 ft., fl., 23 Aug. 1961 (A, BISH, CANB, K, L); *Darbyshire & Hoogland 8374*, nr. Wantipi village on Bliri R., Aitape subdistr., 800 ft., fl., 3 Aug. 1961 (A, BISH, BM, CANB, K, L); *Henty & Foreman NGF 42671*, Kokomo Creek, trib. of Frieda R., Telefomin subdistr., 2300 ft., fl., 28 June 1969 (A, BISH, K, L); *Ledermann 10129*, Lordberg, 1000 m, fr., 6 Dec. 1912 (K, type *W. alta*). ***East Sepik***: *Ledermann 8172*, Hunstein Mts., 2-300 m, fr., 9 Aug. 1912 (B, type *W. tomentella*). ***Madang***: *Pullen 1040*, between Aiome Patrol Post and Togum village, 1000 ft., fl., 23 Aug. 1958 (A, BM, CANB, K, L). ***Morobe***: *Clemens 1407*, Wareo, 2000 ft., yfr., 28 Dec. 1935 (A, L); *Croft & Lelean LAE 68552*, Natter Bay logging area, 93 km SE of Lae, 100 m, 30 July 1976 (A, K, L); *Croft et al. LAE 68601*, track from Tigedu to Sambiang, E of

Mongi R., 25 km E of Finschhafen, 800 m, fr., 17 Sep. 1976 (A, BISH, BM, K, L); *Hartley 12829*, above Bakaia, ca. 15 miles SE Garaina, 3000 ft., fl., 26 Jan. 1964 (A, L, P); *Takeuchi 7135*, Markham village along margin of Labu swamp, 100-150 m, fr., 4 July 1991 (A, L); *Streimann NGF 26111*, Tiaura, Kipu, 2600 ft., fl., 7 Jan. 1966 (A, K, L); *Womersley NGF 19044*, Oomsis logging area, 1800 ft., buds, yfr., 29 Nov. 1963 (A, BISH, K, L). ***Oro***: *Pullen 5931*, N side of Sibium Range, S of Toma, Bariji-Managalasa, 3500 ft., st., 9 Sep. 1964 (L). ***Milne Bay***: *Brass 22460*, N slopes Mt. Dayman, Maneau Range, 2250 m, fr., 24 May 1953 (A, L); *Smith NGF 1355*, nr. Mapo, 1100 ft., fr., Mar. 1945 (A, BISH, K, L); *Stevens LAE 58123*, Mt. Duau, above Agaun, 1460 m, fl., 1 Feb. 1973 (A, K, L); *Croft LAE 71111*, Normanby Island, NE of Bwasiaiai, 450 m, fl., fr., 2 Dec. 1977 (A, BISH, K, L); *Croft et al. LAE 68620*, S Fergusson Island, track between Ailuluai and Agamoia, 720 m, fr., 3 Nov. 1976 (A, BISH, K, L); *Brass 27428*, Misima Island, Mt. Sisa, N slopes, 350 m, fl., fr., 20 July 1956 (A, K, L); *Gideon LAE 73267*, Tagula Island, Mt. Riu, 600 m, fr., 11 Mar. 1979 (BISH, K, L). ***New Britain***: *Frodin NGF 26807*, Mt. Talawe, Talasea, 6400 ft., fr., 25 May 1966 (A, BISH, BM, CANB); *Isles et al. NGF 34400*, 6 miles E of Fullerborn Harbour, 300 m, fr., 8 May 1973 (A, BISH, K, L); *Sayers NGF 21989*, Pirilongi village, Kandrian subdistr., 1300 ft., fr., 14 Mar. 1965 (L). ***New Ireland***: *Croft LAE 65576*, 5 km S of Logagon village, N Schleinitz Range, Logagon subdistr., 600 m, fr., 23 Oct. 1974 (A, BISH, BM, L); *Gideon LAE 77167*, Lelet farm, Lelet Plateau, Konos subprov., 950 m, fr., 29 Oct. 1984 (A, K, L).

LOCAL NAMES.—Mesjeforon (Tehid language, Vogelkop); Saboo (Tor language) and Hassip (Manikiong language) both from Sidoarsi Mts.; Tima (Orne language, Wantipi) and Yeh-peh (Wapi language, Miwaute) both W Sepik; Yibit(s) (Western Prov.); Suweti (middle Waria, Morobe); Gabisamina (Upper Waria, Milne Bay); Vani'Idaidalava (Fergusson Island).

VARIATION AND RELATIONSHIPS.—A complex and variable ochlospecies, and several names from New Guinea have been put into synonomy for the first time (see HOPKINS 1998a, p. 23). Relatively variable within New Guinea, showing almost the complete range of variation on this one island. There is no morphological overlap with *Weinmannia pullei* and *W. urdanetensis* even though the largest leaflets of *W. pullei* may approach the size of the smallest ones in *W. fraxinea*.

2. Weinmannia pullei Schltr.

Bot. Jahrb. Syst. 52: 164 (1914); Nova Guinea 12: 492, t. 192 (1917); Engl., Nat. Pflanzenfam., ed. 2, 18a: 255 (1930); Bernardi, Bot. Jahrb. Syst. 83: 176, t. 25 (1964); P. Royen, Alpine Fl. New Guinea 4: 2539, t. 739 (1983).—Type: *Pulle 470*, West New Guinea (Irian Jaya), on summit of Mt. Perameles, ca. 1100 m, 27 Nov. 1912 (holo-, B; iso-, BM!, BO!, K!, L!).

Weinmannia virgulata Schltr., Bot. Jahrb. Syst. 52: 164 (1914); Nova Guinea 12: 492 (1917); Engl., Nat. Pflanzenfam. ed. 2, 18a: 255 (1930).—Type: *Pulle 692*, West New Guinea (Irian Jaya), on Mt. Hellwig, ca. 1700 m, 15 Dec. 1912 (holo-, B; iso-, BO!, L!).

Weinmannia versteeghii L.M. Perry, J. Arnold. Arbor. 30: 162 (1949); Bernardi, Bot. Jahrb. Syst. 83: 183 (1964).—Type: *Brass & Versteegh 10469* (Irian Jaya), 9 km north-east of Lake Habbema, 2700 m, Oct. 1938 (holo-, A; iso-, BM!, BO!, K!, L!).

Shrub or tree (1.75-)4-27 m high, up to 30 cm dbh, rarely epiphytic. Young stems, buds and young leaves sericeous, older stems glabrescent, bearing numerous pale lenticels. Branching not usually dichotomous. Stipules usually caducous, ligulate to ± orbicular or reniform, up to 0.8 × 1 cm, narrowing at base, apex rounded, abaxial surface strigose especially towards the base, adaxial surface glabrous. Leaves imparipinnate with 1-6(-10) pairs of lateral leaflets, total length up to 10.5 cm long, including petiole 0.7-1 cm long; rachis segments ca. 0.8 cm long; petiole and rachis diverging from the stem at an acute acroscopic angle, terete or somewhat flattened on upper surface just below point of insertion of leaflets, sometimes winged, the wings extending to 0.8 mm on either side of mid line, petiole and rachis glabrous, or puberulous above, or tomentose, the hairs up to 0.5 mm long; lateral leaflets obovate or oblanceolate, 0.6-3.2 × 0.3-1.5 cm, inserted at an acute acroscopic angle to the leaf rachis, base equal, apex acute to obtuse; terminal leaflet narrowly elliptical to elliptical, 0.8-4.8 × 0.3-1.7 cm, base attenuate, apex acute; blade flat above, usually glabrous on both surfaces, sometimes sparsely strigose below especially on midrib, subcoriaceous, not punctate; margin crenulate or rarely dentate with 3-7 notches on each side in the lateral leaflets; on upper surface, midrib and secondary veins ± flat, secondary

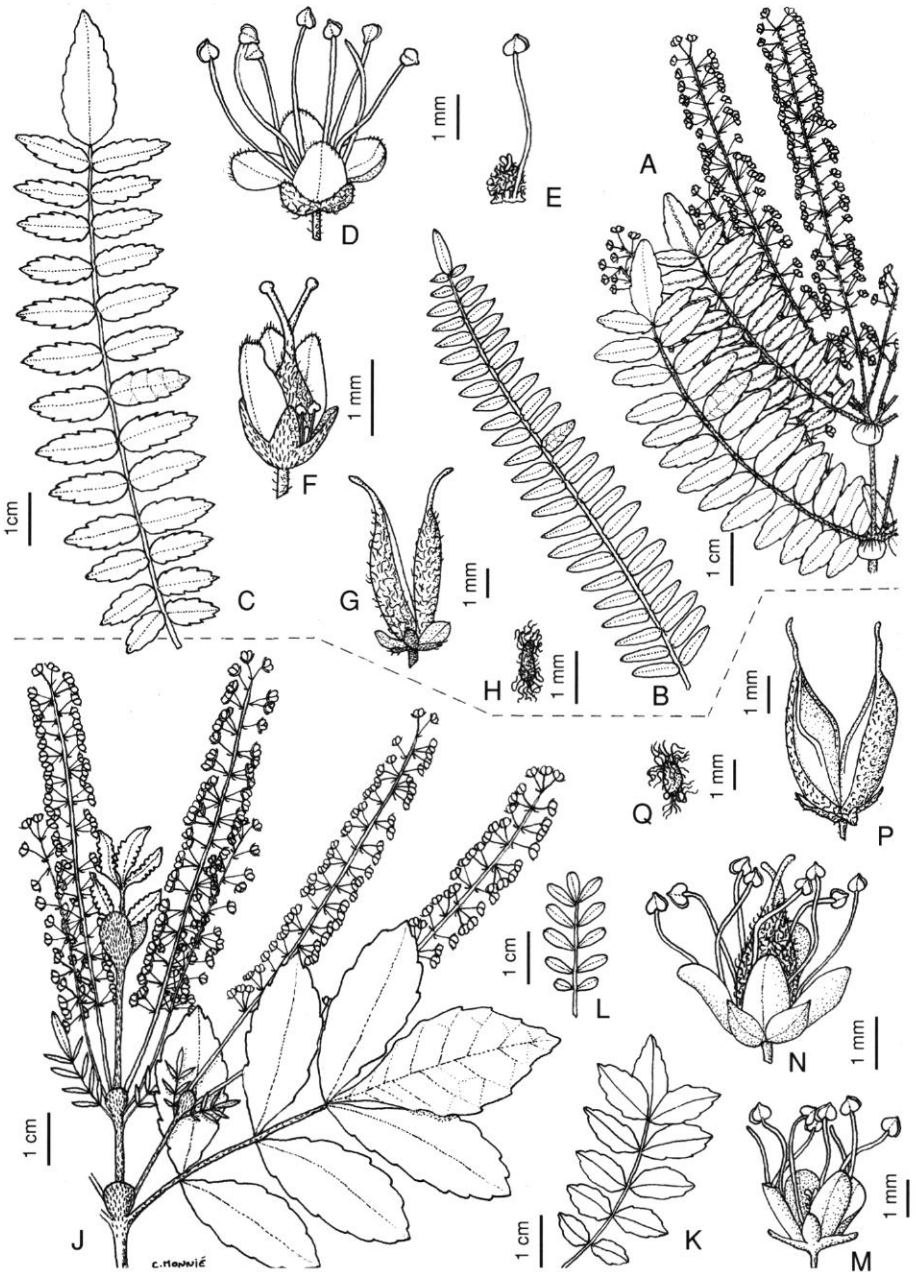

Fig. 1.—**A-H**, ***Weinmannia urdanetensis***: **A**, flowering shoot with inflorescence consisting of a dyad (base only) and a tetrad; **B**, **C**, leaves showing range in leaflet shape and number; **D**, male flower; **E**, detail of D with perianth removed to show pubescent gynoecium with short styles, minute disc lobes and a single stamen; **F**, female flower with one petal removed to show short filaments; **G**, capsule at dehiscence with persistent calyx and one petal remaining; **H**, seed. (A, *Bowers 401*; B, *Versteegh BW 10312*; C, *Robbins 2922*; D, E, *Hoogland & Pullen 5463*; F, *Wade ANU 7663*; G, H, *Paijmans 1315*).—**J-Q**, ***Weinmannia pullei***: **J**, flowering shoot with an inflorescence consisting of four racemes subtended by a pair of reduced leaves, the apical bud between the dyads continuing to grow vegetatively, and another pair of racemes borne on a lateral shoot, also subtended by reduced leaves; **K**, **L**, leaves showing range in leaflet size and shape; **M**, male flower; **N**, bisexual flower; **P**, capsule at dehiscence with persistent calyx; **Q**, seed. (J, *Hoogland & Schodde 6979*; K, M, *Vink 17098*; L, *Vinas & Wiakabu LAE 59405*; N, *Womersley NGF 24540*; P, Q, *Hoogland & Schodde 7685*).—Drawn by C. MONNIÉ.

veins at an acute acroscopic angle to the main vein; midrib prominent below.

Inflorescence usually of 2 dyads, the apical bud of main stem sometimes aborting or continuing to grow vegetatively during flowering, or rarely of 2 or 4 individual racemes; sometimes a few successive nodes producing dyads simultaneously; a pair of reduced leaves and a pair of stipules usually present at base of the racemes in each dyad; peduncles 0.6-2 cm long; racemes up to 12 cm long; buds at apex of peduncles between bases of racemes minute, velutinous, sometimes starting to grow during reproduction; peduncles and rachises usually sparsely puberulent. Floral buds inserted in fascicles, floral bracts elliptical, often hairy, 1-1.2 × 0.5 mm, persistent; flowers mostly unisexual, sometimes bisexual; pedicel 1.5-3.5 mm long, puberulent or ± glabrous; calyx lobes ca. 0.5 × 0.4-1.4 × 1.1 mm, glabrous or with ciliate margin; petals elliptic, 1.1-2.3 × 0.7-1.5 mm, margin minutely ciliolate; disc lobes 0.3-0.6 mm long; in male flowers: filaments up to 4.1 mm long, ovary 0.5-1 mm, pubescent, styles 0.2 mm long, incurved; in female flowers: filaments up to ca. 0.8 mm long, ovary 0.5-1 mm long, pubescent, styles ca. 0.9 mm long, straight, puberulent at least at base, stigmas capitate, papillose; in bisexual flowers: filaments ca. 4 mm long, ovary ca. 1 mm long, styles ca. 1 mm long, straight.

Capsules 3-4.5 × 2.5-2.8 mm at dehiscence, the styles 0.7-1.2 mm long, the exocarp densely pubescent; calyx lobes persistent; central column about half length of valves. Seeds ca. 1 mm long, bearing hairs all over surface, longest at ends.—Fig. 1J-Q, 2.

BREEDING SYSTEM.—Polygamodioecious? Fruits develop from flowers with both long and short filaments.

FIELD CHARACTERS.—Outerbark brown, dark grey or cream, rather smooth with irregular

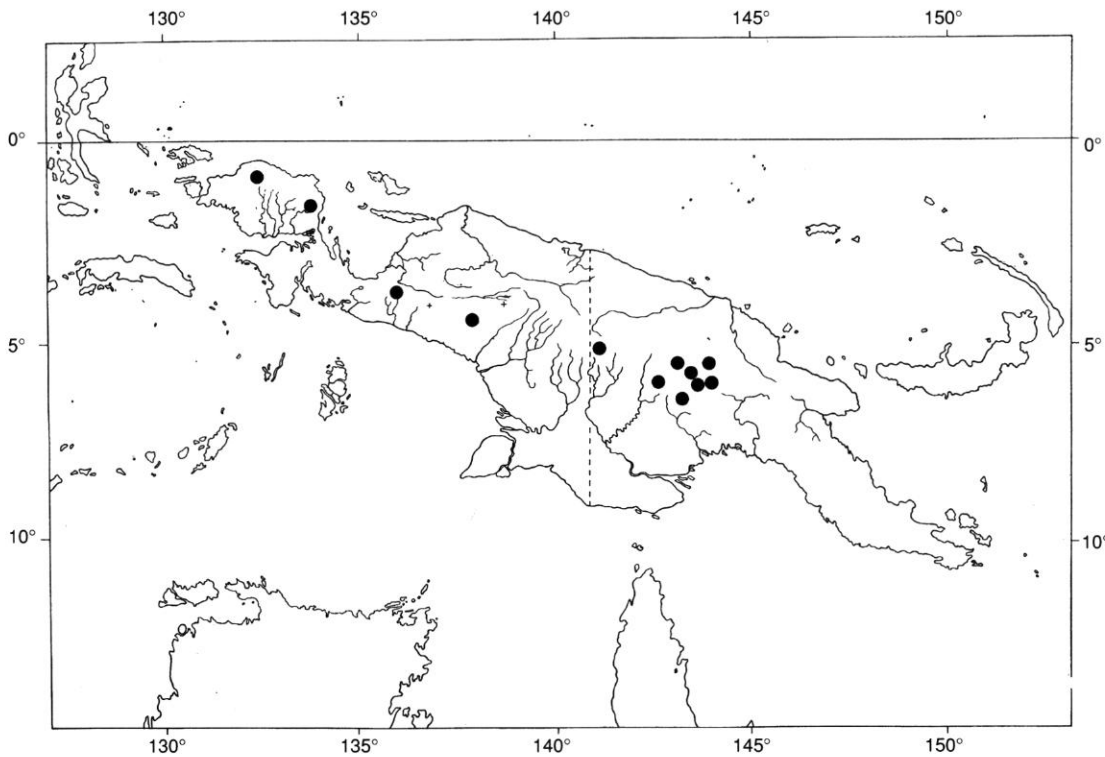

Fig. 2.—Distribution of ***Weinmannia pullei***.

cracks and lenticels; inner bark brownish, orange-brown or reddish brown. Wood cream to pink, of medium hardness, homogeneous. Flower buds light green; flowers creamy white, fragrant: sepals yellowish-green or red; corolla and filaments white; anthers pinkish-yellow; ovary light green turning pink, style pink at base and white at tip.

DISTRIBUTION AND ECOLOGY.—Endemic to New Guinea. Grows as a tree in montane forest with *Nothofagus*, *Podocarpus*, *Phyllocladus* and *Pandanus* and as a small tree or shrub in mountain top shrubbery; from 1100-2100 m in Irian Jaya and 2800-3200 m in Papua New Guinea (PNG). Common.

SELECTED COLLECTIONS (from a total of 28 studied).—**IRIAN JAYA**: *Eyma 5207*, Wissel Lakes region, Moetaro, fl., 9 Sep. 1939 (BO, L); *Eyma 5224*, ibid., Tarapadimi, S of Lake Tage Moetaro, buds, 1 Sep. 1939 (L, SING); *Pulle 488*, Mt. Perameles, 1100 m, fl., 28 Nov. 1912 (K, L).—**PAPUA NEW GUINEA**: ***West Sepik***: *Vinas & Wiakabu LAE 59405*, Telefomin subdistr., Silinmogu, ridge below Tamanagabip on track to Busilmin, 5°00'S-141°05'E, 2800 m, st., 1975 (A, BISH, K, L). ***Southern Highlands***: *Frodin NGF 26964*, N slope Mt. Ne, 9200 ft., 26 July 1966 (A, BISH, K, L); *Frodin NGF 28131*, nr. Lei camp on tack to Mt. Ambua, Tari, 8600 ft., fr., 29 July 1966 (A, L); *Gillison NGF 25132*, Ibiwara, Tari Gap, 8400 ft., 11 June 1966 (A, BISH, K, L); *Kalkman 4860*, Mt. Ne, Tari subdistr., 3140 m, 12 July 1966 (A, BISH, L); *Vink 17098*, Tari subdistr., N slope of Mt. Kerewa, 3015 m, 7 July 1966 (A, BISH, L, P). ***Enga***: *Hoogland & Schodde 6979*, nr. Poio village, SE ridge of Yaki valley, Wabag subdistr., 9000 ft., 8 July 1960 (A, BISH, BO, K, L); *Hoogland & Schodde 7685*, Yobobos grassland area, source of Lagaip R., Laiagam subdistr., 8500 ft., fr., 5 Sep. 1960 (A, BM, CANB, L); *Robbins 3056*, S slopes Ambum-Marimuni Divide nr. Londau village, Wabag area, 8000 ft., fl., fr., 24 July 1960 (CANB, L); *Womersley NGF 24540*, Kandep-Lagaip Divide, Laiagam subdistr., 9600 ft., 1 May 1965 (A, BISH, CANB, K). ***Western Highlands***: *Pullen 116*, E rim of Mt. Oga, 12 miles E of Mt. Hagen station, 8500 ft., 12 July 1957 (A, BM, K, L); *Robbins 1138*, Minj subdistr., Pinj R. valley nr. Banz R.C. sawmill, 8000 ft., st., 30 July 1957 (CANB); *Veldkamp & Stevens 5493*, Klangan Hill, S of Tomba, 2700 m, fl., 29 May 1972 (BISH, L); *Pullen 5173*, WHP/Simbu, Minj-Nona Divide, N side of Kubor Range S of Minj, 9540 ft., fl., fr., 20 Aug. 1963 (A, CANB, K, L, P).

LOCAL NAMES.—Enga language: Kain, Kaintaggan-taggan (Poio), Tagantagan and Tagar (Kepilam); Autiggli, Tewara no. 2 and Mabi (near Tari); Tandan (Mendi), Kwirap (Minj), Gubidigili (Margarima).

VARIATION.—Material of *Weinmannia* from montane New Guinea with small leaflets can be divided into two main groups, *W. pullei* (including *W. versteeghii* with a narrowly winged rachis) and *W. urdanetensis*. *Weinmannia pullei* has rather few, obovate leaflets and *W. urdanetensis* usually has more numerous elliptical or oblong ones and their leaflets also differ in their angle of insertion. These two species appear to be closely related and share the following characters: inflorescence primarily of dyads; floral bracts often persisting to fruiting stage; flowers usually unisexual but sometimes bisexual; fruits with the valves densely pubescent; seeds with hairs all over their surface and not confined only to the ends. Their distributions are largely sympatric but there is only a small minority of intermediate collections. The structure of the inflorescence is particularly variable in *W. pullei*.

Most collections of *W. pullei* are from Papua New Guinea and are relatively uniform in leaflet size, shape and vestiture, although *Vinas & Wiakabu NGF 59405* (Snow Mts., West Sepik Prov., Fig. 1L) has unusually small leaflets. Collections from Irian Jaya are more variable:

a) The three collections from near Lorentz River (Mts. Perameles and Hellwig) (*Pulle 488*, *470*, *692*) have 3-9 pairs of leaflets per leaf and the leaflets margins are dentate not crenate in two of them.

b) In the Wissel Lakes region, *Eyma 5207* is vegetatively quite close to many collections from PNG but *Eyma 5224* has trifoliolate leaves with small leaflets that are distinctly hairy on the lower surface, especially on the main vein.

c) In the Vogelkop, *van Royen & Sleumer 7224* and *Gjellerup 1159* both have largely trifoliolate leaves (the number of leaflets varies from 1-4). In the former, the leaflets are rather rounded at the apex and not very distinctly crenate; both collections are from small shrubs at 2080-2100 m.

Weinmannia versteeghii was distinguished by both PERRY (1949) and BERNARDI (1964) by its winged rachis and petiole. However, there is a continuum in the shape of the rachis and petiole within *W. pullei*.

3. Weinmannia urdanetensis Elmer

Leafl. Philipp. Bot. 7: 2608 (1915); Merr., Enum. Philipp. Fl. Pl. 2: 225 (1923); Engl., Nat. Pflanzenfam., ed. 2, 18a: 256 (1930); L.M. Perry, J. Arnold Arbor. 30: 160 (1949); Bernardi, Bot. Jahrb. Syst. 83: 181 (1964) excl. t. 29.—Type: *Elmer 13701*, Philippines, Mindanao, Prov. of Agusan, Cabadbaran (Mt. Urdaneta), Sep. 1912 (iso-, A, BM!, BO!, BISH!, K!, L! and others).

Weinmannia trichophora L.M. Perry, J. Arnold Arbor. 30: 161 (1949); Bernardi, Bot. Jahrb. Syst. 83: 181 (1964).—Type: *M.S. Clemens 9498*, NE New Guinea (Papua New Guinea), Morobe Distr., nr. Samanzing, 2100-2400 m, in mountain bush, 18 Jan. 1939 (holo-, A!; iso-, B).

Weinmannia novoguineensis L.M. Perry, J. Arnold Arbor. 30: 161 (1949).—Type: *M.S. Clemens 7517*, NE New Guinea (Papua New Guinea), Morobe Distr., Sarawaket, 1800-2400 m, in mountain forest, 9 Nov. 1937 (holo-, A!; iso-, B).

Shrub or tree, 3-26 m high, up to 43 cm dbh, variable in form from bushy to gnarled to slender. Young stems velutinous, axillary buds and young leaves sericeous, older stems glabrescent, bearing numerous pale lenticels. Branching not usually dichotomous. Stipules usually caducous, ± orbicular or reniform, up to 0.8 × 1.1 cm, narrowing at base, apex rounded, abaxial surface sparsely to densely strigose especially towards the base, adaxial surface glabrous or puberulent. Leaves imparipinnate with 2-19 pairs of lateral leaflets, total length up to 10.5 cm long, including petiole ca. 0.5 cm long; rachis segments 0.3-1 cm long; petiole and rachis diverging from the stem at an angle of almost 90° especially at growing tips; petiole and rachis segments terete, densely velutinous, the hairs erect, up to 0.5 mm long; lateral leaflets elliptical, oblong or somewhat ovate, the margins ± parallel, 0.6-2.6 × 0.3-1.1 cm, inserted ± at 90° to leaf rachis, base equal or unequal, cuneate to square to cordate, apex broadly acute; terminal leaflet narrowly elliptical to elliptical, 0.9-3 × 0.3-1.2 cm, base petiolulate, the petiolule ca. 0.3 cm long, apex acute; leaflets imbricate or not, flat or revolute, usually glabrous or puberulent on upper surface, the cuticle thick and shiny, sparsely to densely strigose-velutinous below, the midrib velutinous; blades coriaceous, not punctate; margin crenulate with 4-7 notches on each side in the lateral leaflets; on upper surface, midrib and secondary veins depressed into cuticle, secondary veins ± at 90° to main vein, tertiary venation obscure, midrib prominent below.

Inflorescence a pair of dyads (rarely a pair of tetrads or 4 dyads or 4 individual racemes), sometimes a few successive nodes producing dyads simultaneously; the apical bud of the main stem between the bases of the dyads densely velutinous and often continuing to grow vegetatively during flowering; bud at apex of peduncles between bases of racemes minute, velutinous; peduncles 0.3-0.4 cm long; racemes up to 9 cm long; peduncles and axes of the racemes densely velutinous. Flowers inserted in fascicles; floral bracts elliptical, often hairy, 1.1-2 mm long, persistent; flowers unisexual or rarely bisexual; pedicel 0.5-1 mm long, puberulent or ± glabrous; calyx lobes 0.7-1 × 0.6-0.9 mm, hirsute; petals elliptical, oblong or almost circular, 1-1.9 × 0.7-1.2 mm, rounded or notched at apex, margin minutely ciliolate; disc lobes 0.3-0.6 mm long; in male flowers: filaments 2.2-3.6 mm long, ovary ca. 0.6-1 mm, pubescent, styles 0.2-0.5 mm, incurved; in female flowers: filaments 0.8-1.7 mm long, ovary 1-1.5 mm long, pubescent, styles 0.5-1 mm long, straight, puberulent at least at base, stigmas capitate, papillose; in bisexual flowers: filaments 2.6+ mm long, ovary 1-1.5 mm long, styles 1-1.8 mm long, straight.

Capsules 2.5-4 × 1.5-2 mm at dehiscence, the styles ca. 1 mm long, the exocarp densely pubescent; calyx lobes persistent; central column about half length of valves. Seeds ca. 1 mm long, bearing hairs all over surface, longest at ends.—Fig. 1A-H, 3.

BREEDING SYSTEM.—Largely dioecious but some exceptions. *Wade ANU 7663* has both male and female flowers on the same sheet (though not the same stem) and *Womersley NGF 15240* has male, female and bisexual flowers. *Robbins*

191 has male and bisexual flowers in the same inflorescence.

FIELD CHARACTERS.—Outer bark grey-brown, silver-grey or rarely black; inner bark pinkish brown with fine red streaks or dark straw brown; sap wood white to pink, pale brown or orange, very hard; heart wood pink or dark red. Floral buds green, pink or red; flowers white or cream, rarely light green.

DISTRIBUTION AND ECOLOGY.—Philippines and New Guinea. In lower montane and montane forest; also secondary forest and open scrub on limestone; often recorded from ridges or on steep slopes; abundant and gregarious. Associates include *Litsea*, *Pandanus*, *Cinnamomum* and *Nothofagus*. In the Central Highlands of Papua New Guinea, recorded from 2500-3250 m but at lower elevations elsewhere (e.g. 1000-1900 m in Irian Jaya, 1200 m in Torricelli Mts., 1500 m in Hunstein Mts. and 1770 m on Mt. Simpson, Milne Bay Prov.).

SELECTED COLLECTIONS (from a total of 47 studied for this region).—**IRIAN JAYA**: *Kostermans 2304*, Vogelkop, Arfak Mts., Angi gita lake, Manokwari subdistr., 1900 m, fl., fr., 9-22 Oct. 1948 (BO, L); *Versteegh BW 10312*, Kebar valley, Watjetoni Mt., 1200 m, 23 Nov. 1960 (L); *Sijde BW 5588*, ibid., Tobi Mts., 1000 m, fl., 18 June 1958 (L); *Brass & Versteegh 11908*, 15 km SW of Bernhard Camp, Idenburg R., 1750 m, fr., 11 Jan. 1939 (A, BM, BO, K, L).—**PAPUA NEW GUINEA**: ***West Sepik***: *Frodin UPNG 4233*, Aitape subdistr., ridge on Aitape side of Mt. Somero, Torricelli Range, 1200 m, st., 2 Feb. 1974 (K, L). ***East Sepik***: *Hoogland & Craven 10952*, E ridge of Sumset (Mt. Hunstein), Ambunti subdistr., 4500 ft., st., 12 Aug. 1966 (CANB, L); *Takeuchi 6340*, Hunstein Range, Mt. Samsai, 1000+ m, fr., 24 July 1990 (A). ***Madang***: *Pullen 6131*, S slopes Finisterre Range to S of Mt. Abilala, 8100 ft., fr., 17 Nov. 1964 (BM, CANB). ***Southern Highlands***: *Croft et al. LAE 61048*, 2 miles N Iaro R., S slope Mt. Giluwe, Mendi subdistr., 2340 m, fr., 21 Jan. 1974 (A, K, L). ***Enga***: *Flenley ANU 2391*, 4 miles NW of Kupalis, nr. Wabag, 8400 ft., buds, 16 Jan. 1965 (A, K, L); *Hoogland & Schodde 7254*, nr. Kepilan village, Lagaip valley, Laiagam subdistr., 8000 ft., fl., 30 July

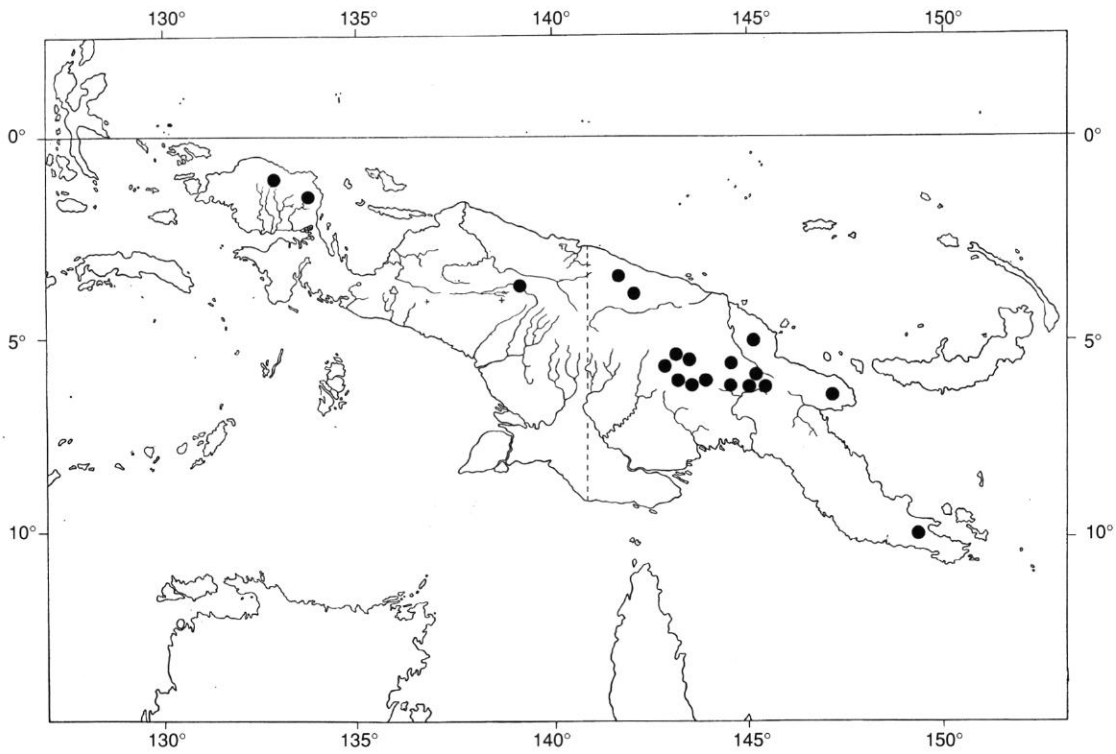

Fig. 3.—Distribution of ***Weinmannia urdanetensis*** in New Guinea (see also HOPKINS 1998b, Fig. 7).

1960 (A, BISH, BM, L); *Saunders 1008*, R.C. Mission Timber lease, Wabag-Komiam rd., Wabag subdistr., 7900 ft., st., juv., 15 July 1960 (CANB, L); *Womersley NGF 15240*, Wabag-Laiagam rd., 24 miles, margin L. Iviva, 1 mile SE Sirunke, 9000 ft., fl., 22 July 1962 (A, K, L). ***Western Highlands***: *Bowers 401*, Hagen subdistr., Pokaripuku, Kopaka, upper Kaugel, 7600 ft., fl., fr., 24 Nov. 1968 (L); *van Royen NGF 18168*, confluence of Warapuri & Kori rivers, Wahgi-Jimmi divide, N of Nondugl, Minj subdistr., 7200 ft., buds, 4 Sep. 1963 (A, BISH, K, L); *Saunders 627*, lower slopes of Mt. Hagen, 2 miles NW of Tomba, 8000 ft., fl., fr., 28 June 1957 (A, L); *Saunders 675*, top Mt. Oga, 8500 ft., st., 12 July 1957 (A, L); *Vinas UPNG 4988*, Mt. Ambrangaba, NE of Milep village, Minj distr., 2350 m, fl., 21 Feb. 1981 (L); *Womersley NGF 5352*, Al R., Nondugl, st., 7 July 1953 (A, BO, K, L, SING). ***Simbu***: *Brass 30306*, Mt. Wilhelm, E slopes, 2770 m, fr., 3 July 1959 (A, K, L); *Sterly 80-40*, Chimbu valley, Gurugaro Ongo, 2500 m, fl., 14 July 1980 (A, L); *Wade ANU 7663*, Keglsugl area, Upper Chimbu valley, 9000 ft., fl., 20 June 1967 (A, CANB, K, L). ***Eastern Highlands***: *Grubb & Edwards 391*, W of Fatima R., Marafunga sawmill, Goroka subdistr., 2600 m, yfr., 25 July 1971 (L); *Hoogland & Pullen 5463*, nr. Daulo camp, Asaro-Mairi divide, Goroka subdistr., 2500 m, fl., 26 June 1956 (A, BISH, BM, CANB, K, L); *Hartley 13274*, Marafunga, 20 miles NW of Goroka, 9500 ft., st., 13 Oct. 1964 (A, CANB, K). ***Morobe***: *Hoogland 9668*, Mannasat, Cromwell Mts., Huon Peninsula, 7900 ft., st., juv., 22 Aug. 1964 (CANB); *Schodde & Craven 4976*, E slope of Spreader Divide, 8 miles NW of Aseki, 7400 ft., st., 18 Apr. 1966 (L). ***Milne Bay***: *Pullen 7857*, Mt. Wadimana ridge, NE from Mt. Simpson, 1770 m, st., 22 July 1969 (L).

LOCAL NAMES.—Asro (Kebar language, Vogelkop); Ain, Jine, Kain (Wahgi language, Minj); Dekiso (Naho language, Finisterre Mts.); Kain-tachai (Enga); Kumare (Chimbu) Kumare yaundo kembre (Kuman language, Chimbu); Kumai (Hagen, Togoba); Dzahamehgehtalalawa (Dunantina); Duasegeh (Chimbu, Masul); Tagantagan (Enga language, Kepilam); Pone-Kuni (Western Highlands?); Q-anak (nr. Wabag, Merimanta); Yambabengo (Chimbu); Uspa (Waskuku, Mt. Hunstein).

GEOGRAPHICAL VARIATION.—Specimens from the western part of the distribution tend to have more numerous pairs of longer, narrower leaflets (Philippines and Irian Jaya; also Torricellis and Mt. Hunstein but the latter are sterile). In the Central Highlands of PNG, leaflets on fertile specimens tend to be shorter and broader, often more densely pubescent ("*W. trichophora*") and there are fewer pairs per leaf. A number of specimens from the Central Highlands have comparatively large leaflets, approaching *W. pullei*; most of these collections are sterile and some show a range in variation in leaflet size on one sheet. Fertile collections with large leaflets include: *Robbins 191*, *Hoogland & Schodde 7254* and *Womersley NGF 11280*.

RELATIONSHIPS.—Apparently closely related to *W. pullei* from New Guinea and *W. clemensiae* from Mt. Kinabalu in Borneo, which it resembles in its branching pattern and somewhat bullate leaflets.

4. **Weinmannia croftii** H.C. Hopkins, **sp. nov.**

Weinmannia denhamii Seem. *et* W. vitiensis Seem. *affinis sed ab illa foliolis lateralibus uno usque tribus (non uno usque duodecimis) paribus dispositis, maximis per folio 2.9-6.7 × 0.9-1.7 cm (non 1.1 × 3(-4.8) × 0.3-1.1(-1.5) cm) differt, et ab hac quae folia trifoliolata foliolis latioribus et magnis coriaceis possedet.*

TYPE.—*C.E. Ridsdale NGF 36706*, Papua New Guinea, Madang Prov., Karkar Island, 4°40'S-145°57'E, 3000 ft., fl., yfr., 22 Jan. 1968 (holo-, L!; iso-, A!, BISH!, K!).

Shrub or tree, 2-20 m high. Young twigs shortly hairy, finely ridged with narrow longitudinal fissures and round or elliptical lenticels; branching sometimes dichotomous. Stipules usually caducous on reproductive branches, sometimes persistent on vegetative ones, usually elliptical, ligulate or rhomboidal, ca. 0.7 × 0.4 cm, obtuse to broadly acute at apex, ± glabrous on adaxial surface, strigose on abaxial surface, densely so towards the base. Leaves trifoliolate or imparipinnate with 1-3 pairs of leaflets, up to 14 cm long including petiole of 1.3-2.5 cm; rachis segments 0.8-1.7 cm long; petiole and rachis segments semiterete, flattened above with a narrow central ridge and winged, the wings extending ca. 1 mm on either side, in each rachis segment the wings broader distally towards point of insertion of opposite leaflets; petiole and rachis usually bearded above, glabrous or bearing a few hairs on underside; lateral leaflets lanceolate to narrowly elliptical, the proximal ones often shorter than

the more distal ones when in several pairs, 2.9-6.7 × 0.9-1.7 cm, apex acute, base asymmetrical, the distal side acute to attenuate, proximal side obtuse; terminal leaflet narrowly elliptical to narrowly obovate (2.8-)4.3-11 × (0.9-)1.2-2.3 cm, apex acute, base attenuate; blade glabrous on both surfaces, usually punctate below, subcoriaceous to coriaceous; margin somewhat thickened and minutely revolute, crenate especially towards the apex with 14-17 crenations on each side; midrib narrowly prominent above and slightly prominent below, sometimes hirsute.

Inflorescence a central triad or usually pentad, the lower racemes in the axils of leaves or not; peduncles and rachis segments 0.9-1.6 cm long; racemes 5-9 cm long; inflorescences axes puberulent. Floral buds inserted singly; floral bracts lanceolate or somewhat carinate, up to 2 mm long, somewhat strigose, caducous. Flowers unisexual; pedicel 1-2 mm long, puberulent; calyx lobes triangular, 0.7-1.1 × 0.6-0.9 mm, ± glabrous; petals elliptical, 1.1-1.7 × 0.7-1 mm; disc lobes 0.4-0.8 mm long; in male flowers: filaments 2.4-3 mm long, ovary 0.6-1 mm long ± glabrous, styles minute, 0.2 mm long and curved inwards; in female flowers: filaments 0.9-2 mm long, ovary 1-1.8 mm long, almost glabrous, styles 0.9-1.5 mm long, stigmas capitate and papillose.

Capsules distinctly supported by receptacle, valves 2-4 × 1.3-1.8 mm at dehiscence, the styles 0.8-1.3 mm long; exocarp minutely ridged, almost glabrous (few minute strigose hairs); calyx lobes not persistent; central column present and often persistent on receptacle after valves have fallen. Seeds 0.8-1 mm long, 16 per capsule, comose at both ends, the hairs ca. 0.5 mm long.—Fig. 4A-E, 5.

BREEDING SYSTEM.—Dioecious.

FIELD CHARACTERS.—Shrub in open areas such as scoria slopes, or a tree in forest. Flowers white or cream: calyx pale green, corolla and filaments

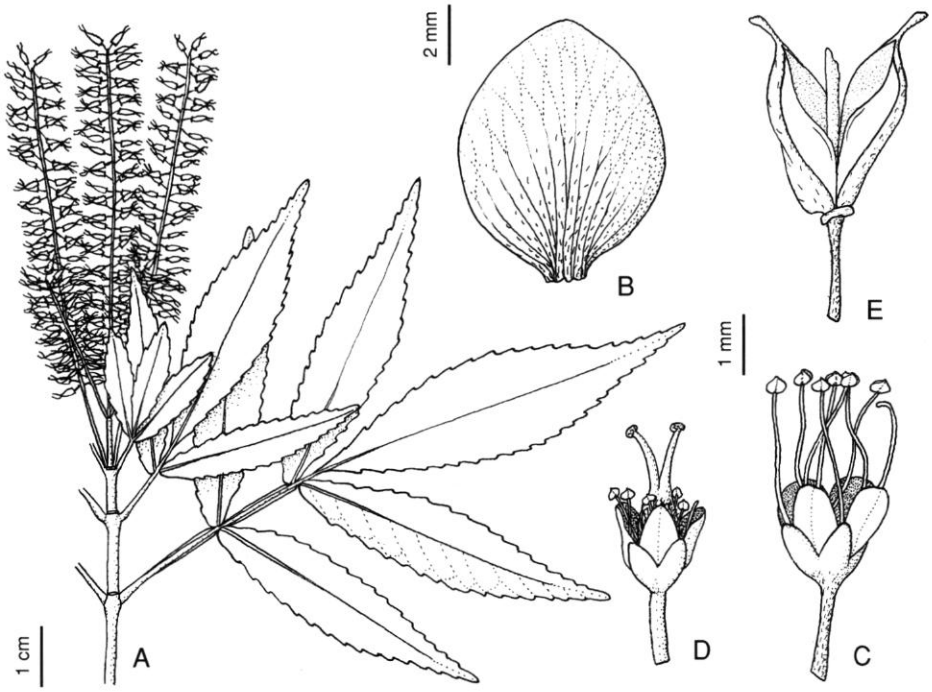

Fig. 4.—***Weinmannia croftii***: **A**, stem showing infructescence (pentad) with reduced leaf at node; **B**, stipule; **C**, male flower; **D**, female flower; **E**, dehisced capsule. (A, *Foreman & Katik LAE 59132*; B, *Frodin NGF 26810*; C, *Ridsdale NGF 36706*; D, *Croft & Katik NGF 14957*; E, *Vandenberg & Mann NGF 42302*).—Drawn by C. MONNIÉ.

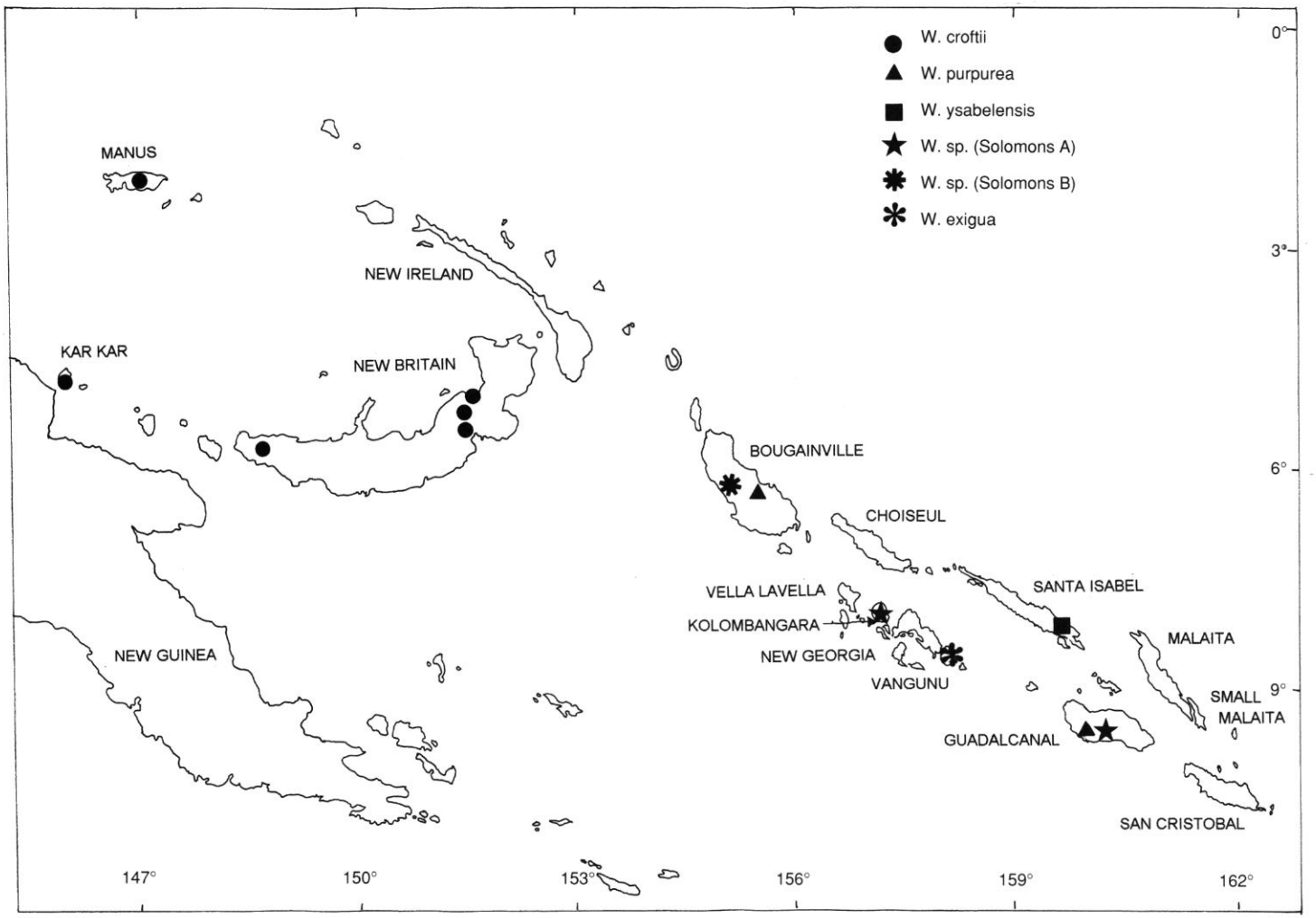

Fig. 5.—Distribution of ***Weinmannia*** in the Bismarck Archipelago and Solomon Islands (except *W. fraxinea*).

white, anthers yellow or straw, disc yellow-orange, ovary light green, stigmas white to brown.

DISTRIBUTION AND ECOLOGY.—Papua New Guinea: Karkar Island, Manus and New Britain. In New Britain, collected from 1200-2100 m, where it is an early coloniser on volcanic substrates as they become stable after an eruption, and sometimes very abundant e.g. on Mt. Ulawon (D. FRODIN pers. comm.). Also found on non-volcanic substrate in mossy montane *Nothofagus* forest where its associates include *Nastus* and *Gleichenia*; soils include clay over limestone. On Manus, collected from 530-720 m and on Karkar, from 820-1050 m in lower montane ridge forest with *Eugenia*, *Pandanus*, *Dillenia*, and *Elaeocarpus*, and a colonist on lava flows where it was co-dominant with *Dodonaea* and *Eurya*. Not yet recorded from New Ireland, where *Weinmannia fraxinea* is found. *Weinmannia croftii* and *W. fraxinea* are sympatric only in New Britain.

PARATYPES.—**PAPUA NEW GUINEA: Bismarck Archipelago**: ***East New Britain***: *Clunie LAE 63017*, nr. lake, central Nakanai plateau, Pomio subdistr., 5°32'S-151°18'E, 1200 m, fl., 28 Nov. 1974 (A, BISH, K, L); *Croft & Katik NGF 14957*, Mt. Sule, ca. 25 miles NNE of Fullerborn Harbour, Pomio subdistr., 5°50'S-150°50'E, 1500 m, fr., 8 May 1973 (A, K, L); *Isles et al. NGF 34406*, Mt. Lululua, ca. 30 miles NE of Fullerborn Harbour, Pomio subdistr., 5°45'S-150°50'E, 2000 m, fl., 11 May 1973 (A, BISH,K, L). ***West New Britain***: *Frodin NGF 26810*, Mt. Talawe, summit, Talasea, 5°32'S-148°18'E, 6400 ft., fl., 25 May 1966 (A, L); *Stevens LAE 51252*, NNE slope Mt. Ulawon, Hoskins subdistr., 5°2'S-151°22'E, 3600 ft., buds, 20 Feb. 1971 (A, K, L); *Vinas LAE 59724*, Lake in Nakanai Plateau, E Nakanai, 5°29'S-151°16'E, 1610 m, fl., fr., 11 Nov. 1975 (A, BISH, BM, K, L). ***Manus***: *Foreman & Katik LAE 59132*, Mt. Dremsel, Lorengau subprovr., 2°15'S-149°50'E, 600 m, fl., 25 Oct. 1974 (A, L); *Kerenga et al. LAE 77543*, ibid., 2°09'S-146°56'30"E, 530 m, fl., 26 Mar. 1981 (A, K, L); *Stone & Streimann LAE 53681*, ibid., 2°10'S-146°55'E, 1800-2000 ft., yfr., 21 June 1971 (A, BISH, L); *Sands et al. 2903*, Mt. Dremsel, 2°08'S-146°57'E, ca. 6 km inland from Pelekawa, fr., 29 Nov. 1975 (K). **NE New Guinea**: ***Madang, Karkar Island***: *Ridsdale NGF 33981*, 4°40'S-145°57'E, 2500 ft., fr., 16 Jan. 1968 (A, BISH, K, L); *Vandenberg & Mann NGF 42302*, 4°40'S-146°00'E, 3200 ft., 12 June 1969 (L).

LOCAL NAMES.—Naligugu (*Frodin NGF 26810*, New Britain), Sirikat (*Ridsdale NGF 36706*, Karkar).

RELATIONSHIPS.—Appears to be closely related to *Weinmannia denhamii* from Vanuatu and *W. vitiensis* from Fiji and possibly conspecific with *Weinmannia sp. A* from the Solomons. All have imparipinnate, coriaceous leaves with a winged petiole and predominantly unisexual flowers. *Weinmannia denhamii* usually has more numerous, shorter leaflets than *W. croftii*, and *W. vitiensis* has trifoliolate leaves with rather broader leaflets than those of *W. croftii*. The three are kept separate for the present since the populations are disjunct and the mean values of the foliage characters are different for each species, even though the ranges overlap.

This species is named after Jim CROFT, formerly at LAE.

Insufficiently known species

Weinmannia sp. (New Guinea A)

Lam 1869 (Irian Jaya, Doormantop, 3100 m, fl., 30 Oct. 1920 [BO, L!]) is from a shrub 0.5 m high: leaves trifoliolate; leaflets orbicular, rounded at apex, coriaceous; margins minutely notched; leaflets, petioles and stems densely hairy.

This collection appears to be a *Weinmannia* but it does not match any described taxon, and fertile material is needed before it can be named. It is most similar to *van Royen & Sleumer 7224* from the Vogelkop (which is placed here in *W. pullei*) but that specimen is almost glabrous and its leaflets are more obovate.

II. WEINMANNIA IN THE SOLOMON ISLANDS (INCLUDING BOUGAINVILLE)

Six species occur in this region: *Weinmannia purpurea*, *W. sp. A* and *W. sp. B* in sect. *Leiospermum*; and *W. fraxinea*, *W. ysabelensis* and *W. exigua* in sect. *Fasciculata*. Except for *W. fraxinea*, most species are known from few collections. Bougainville in particular appears to be

undercollected and *W. fraxinea* has not yet been reported from there. *Weinmannia exigua* also occurs in Fiji (see p. 94 for description) whereas the other four species are endemic.

Key to the species of the Solomon Islands

1. Flowers inserted singly in the axils of bracts on the axes of the racemes; inflorescence usually a triad or pentad; if leaves compound, then rachis winged, the wings extending > 0.7 mm on either side of midline of petiole and rachis 2
1'. Flowers inserted in small fascicles in the axils of bracts on axes of the racemes; inflorescence of 1 or 2 pairs of dyads or tetrads inserted in series at most distal leaf-bearing node; leaves compound and if rachis winged, then wings extending < 0.4 mm on either side of midline of petiole and rachis 4
2. Leaves usually simple (rarely trifoliolate) and relatively large ([3-] 4.2-18 × 1.3-5 cm) .... **4. W. purpurea**
2'. Leaves trifoliolate or imparipinnate, leaflets < 5.5 × 2 cm 3
3. Lateral leaflets 1-2 pairs, 2.5-3.8 × 1-1.5 cm ..... **5. W. sp. A**
3'. Lateral leaflets 3-5 pairs, 0.7-1.3 × 0.4-0.5 cm ..... **6. W. sp. B**
4. Lateral leaflets (1-)2-4 pairs, 3.5-9 × 1-2.7 cm; rachis terete to semiterete, not winged ..... **1. W. fraxinea**
4'. Lateral leaflets 1-5 pairs, 1.3-2 × 0.7-0.8 cm; rachis minutely winged (wings extending < 0.2 mm on either side of midline) ..... **2. W. ysabelensis**
4". Lateral leaflets 6-9 pairs, 0.9-1.3 × 0.4-0.5 cm, rachis narrowly winged (wings extending < 0.4 mm on either side of midline) ..... **3. W. exigua**

1. Weinmannia fraxinea (D. Don) Miq.

For synonomy, description, illustration and distribution map see HOPKINS (1998a, p. 23).

BREEDING SYSTEM.—Flowers bisexual in the Solomons, though the anthers are unusually small (ca. 0.25 mm diameter).

FIELD CHARACTERS.—Tree up to 40 m high, often with plank-like buttresses up to 2 m high. Bark variable: reddish brown and flaking, light brown and fissured, dark brown and scaly, or smooth. Slash also variable: slash wood reported as reddish brown, light brown, pink, white, whitish brown or red, the texture hard, soft, or coarsely fibrous; a detailed description is given on *Walker & White BSIP 150* (A). Buds reddish; flowers white (rarely cream, yellow, light brown), scented or not.

DISTRIBUTION AND ECOLOGY.—Malesia (except Sulawesi and Philippines) to Solomon Islands. See HOPKINS 1998a, Fig. 8, p. 29. Not yet recorded from Bougainville or Makira. From 10-620 m, in well drained primary and secondary forest, often on ridge tops; also in forest over coral limestone, including disturbed forest, flat plain, and forest-grassland boundary.

MATERIAL EXAMINED.—**SOLOMON ISLANDS**: ***Choiseul***: *Gafui BSIP 18977*, SE, W of Oaka River, 1800 ft., fr., 12 Mar. 1970 (L). ***Vella Lavella***: *Kotali BSIP 11173*, S, Oula R. area, 360 ft., fl., fr., 13 Aug. 68 (K, L). ***Kolombangara***: *Mauriasi et al. BSIP 8603*, NE, Kokove Area, 1300 ft., fl., yfr., 12 Jan. 1968 (K, L); *Mauriasi et al. BSIP 8687*, N, Shoulder Hill Area, 400 ft., fr., 19 Jan. 1968 (K, L); *Mauriasi et al. BSIP 11361*, SE, 2000 ft., buds, 6 June 68 (K, L); *Mauriasi et al. BSIP 11493*, SE, Shoulder Hill Area, 800 ft., fl., 17 June 68 (K, L); *Mauriasi et al. BSIP 11647*, NW, Rei Area, 900 ft., fr., 3 July 1968 (K, L); *Whitmore & Womersley BSIP 838*, SE, Bambari Harbour, fl., 24 Nov. 1962 (K, L); *Whitmore BSIP 1436*, W coast, Merusu Cove, 340 ft., fl., 14 Feb. 63 (K, L). ***New Georgia***: *Burn-Murdoch's collectors BSIP 6939*, SE, Mala, fl., 26 Oct. 1966 (K, L); *Cowmeadow BSIP 3690*, NW, Vaimbu R., 230 ft., fl., fr., 18 Mar. 1964 (K, L); *Whitmore's collectors BSIP 3737*, NW, nr. Hovoro, 565 ft., buds, 21 May 1964 (K, L). ***Vangunu***: *Maenu'u BSIP 6420*, Davala, 160 ft., fl., 22 July 1965 (K, L); *Whitmore BSIP 871*, SE coast between Vura village and Gevala R., fl., 29 Nov. 1962 (K, L); *Whitmore BSIP 946*, SE coast between Vura village and Gevala R., inland nr. Merusu Islet, 3 Dec. 1962 (K, L). ***Santa Isabel***: *Beer's collectors BSIP 5124*, NW, Kolokofa R., 20 ft., fr., 1 Apr. 1966 (K, L); *Susui BSIP 8319*, Allardyce Harbour, 30 ft., buds, 17 Nov. 1967 (K, L). ***Guadalcanal***: *Gafui et al. BSIP 9442*, E, ridge S of Makina Station, 120 ft., buds, fr., 14 May 1968 (K, L); *Kere BSIP 4909*, NW, Mt. Mambulu, 1500-1600 ft., fr., 17 Nov. 1964 (K, L); *Lipaqeto BSIP 3376*, NE, Rere R., ca. 3 miles inland, fr., 21 Nov. 1963 (K, L); *Mauriasi et al. BSIP 11823*, E, Makina Area, 180 ft., buds, yfr., 29 Sep. 1968 (K, L); *Mauriasi et al. BSIP 12221*, SW, Wanderer Bay Area, 800 ft., fl., 18 Oct. 1968 (K, L); *Nakisis & Mauriasi BSIP 8122*, NW, E of Mt. Mambulu, 1000

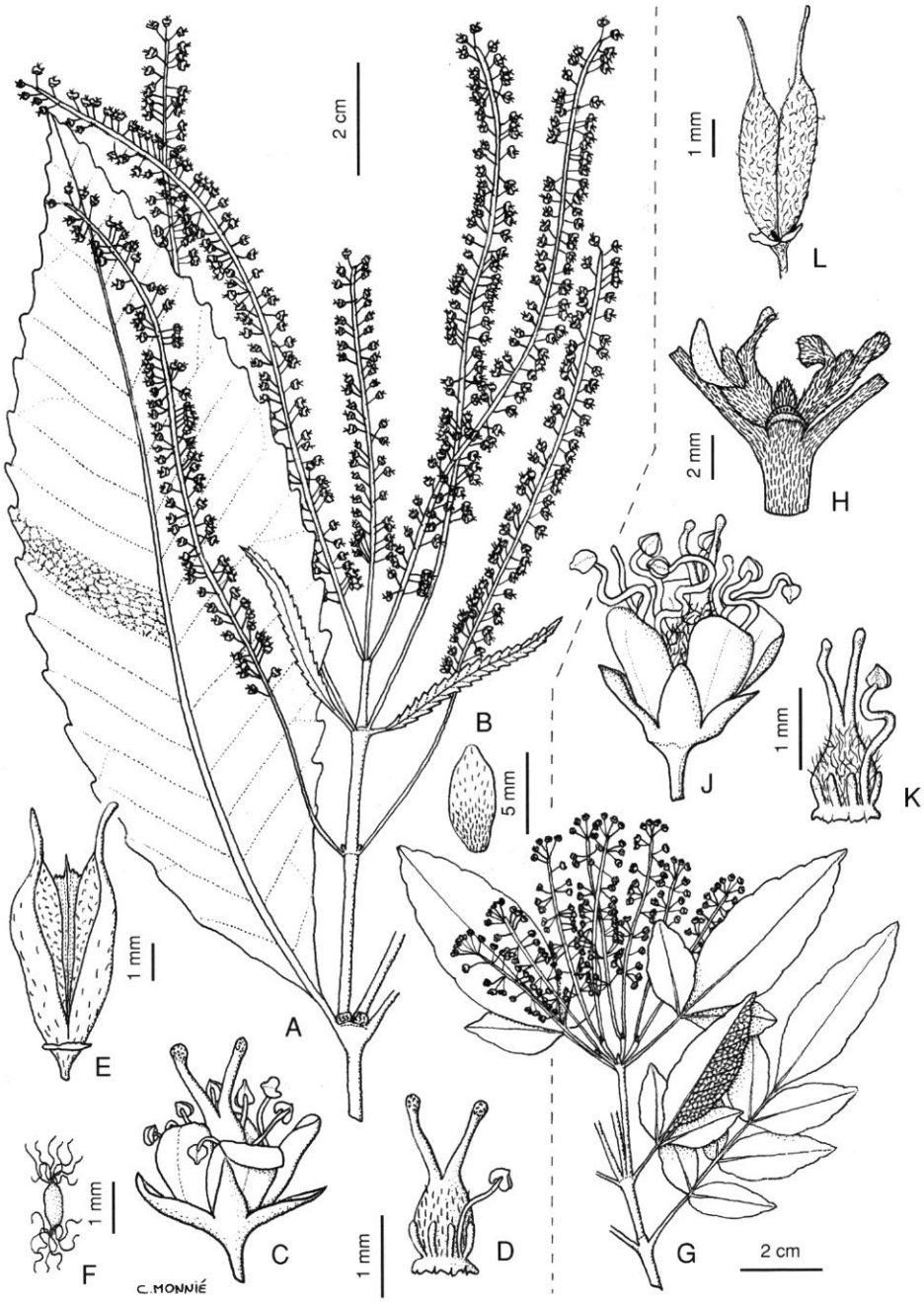

Fig. 6.—**A-F**, ***Weinmannia purpurea***: **A**, left side of a flowering shoot with opposite unifoliolate leaves and one of two partial inflorescences, (heptad) that has reduced leaves at one node; **B**, stipule; **C**, female flower; **D**, detail of C with perianth removed to show gynoecium, disc lobes and one stamen; **E**, capsule at dehiscence with central column; **F**, seed. (A, C, D, F, *Kajewski 1738*; B, E, *Mauriasi BSIP 12092*).—**G-L**, ***Weinmannia ysabelensis***: **G**, flowering shoot with inflorescence of four dyads; note apical bud between inner pair of dyads; **H**, detail of a node showing dormant apical bud and two axillary buds starting to develop, and the bases of two opposite petioles; note stipular scar beneath apical bud; **J**, bisexual flower; **K**, detail of J with perianth removed to show gynoecium, disc lobes and single stamen; **L**, fruit. (A-L, *Brass 3215*).—Drawn by C. MONNIÉ.

ft., fl., yfr., 14 Nov. 1967 (A, K, L); *Sirute'e et al. BSIP 9900*, SE, nr. Logu Village (Avu Avu), 1900 ft., fl., fr., 1 June 1968 (K, L); *Sirute'e et al. BSIP 10074*, W coast, Alidavata (Talise) Kiki Ridge, Duidui, 1000 ft., fl., 13 June 1968 (K, L); *Whitmore BSIP 1283*, Honiara, Mt. Austen, yfr., 31 Dec. 1962 (K, L). ***Malaita***: *Fa'arodo et al. BSIP 13492*, NE, 450 ft., fl., fr., 22 Nov. 1968 (K, L); *Whitmore BSIP 3874*, SW, Are Are district, W coast, Kiu, fl., 13 Dec. 1963 (K, L). ***Small Malaita***: *Gafui et al. BSIP 16322*, Waiusuusu Area, 170 ft., fl., 26 Aug. 1969 (K, L).

LOCAL NAMES.—Aitoto (Kwara'ae) commonly recorded; other names are Futankwai and Wangalu (both Kwara'ae names), Oliolimwani.

DISCUSSION.—Although this is the most commonly collected species from the Solomons Islands, most of the collections date from the 1960s and this species was not recorded from here by BERNARDI (1964). Material from the Solomons is rather uniform.

2. Weinmannia ysabelensis L.M. Perry

J. Arnold Arbor. 30: 162 (1949); Bernardi, Bot. Jahrb. Syst. 83: 183 (1964).—Type: *Brass 3215*, Solomon Islands, Ysabel, Tiratona, 600 m, mountain forest, Nov. 1932 (holo-, A!; iso-, BISH, BM!, BRI, BO!, G, L!, SING!).

Tree 25 m tall. Young twigs densely pubescent, the hairs to 0.4 mm long; older twigs sparsely pubescent; branching not dichotomous. Stipules caducous, ca. 3.5 mm long, sericeous, apex rounded. Leaves imparipinnate, with 1-5 pairs of lateral leaflets, up to 9 cm long, including petiole; petiole and rachis segments 0.5-1.3 cm long, semiterete, sparsely hairy along midline on adaxial side, hirsute on abaxial side, minutely winged, the wings extending 0.2 mm on either side; lateral leaflets ovate to oblong, 1.3-2 × 0.7-0.8 cm, the most proximal ones smaller than more distal ones, apex broadly acute, base somewhat unequal to dimidiatus; apical leaflets narrowly ovate-elliptical, 3-4.4 × 1-1.3 cm, larger than lateral leaflets, apex acute, base often abruptly constricted into decurrent petiolule; blades glabrous on both sides except for hairs ca. 0.5 mm long on midrib on adaxial surface, not punctate; margin somewhat thickened and crenate, 4-6 or 8-9 crenations on each side of lateral and apical leaflets respectively; midrib minutely indented above and prominent below.

Inflorescence of 2 or 4 pairs of dyads; apical bud of the main stem between the bases of the central peduncles sericeous; bud at apex of peduncles between bases of racemes minute, velutinous; peduncles 0.3-0.7 cm long, racemes up to 8 cm long; inflorescence axes puberulent. Flowers inserted in fascicles or singly, especially distally. Flowers bisexual; pedicel 1.5-2.3 mm long, sparsely puberulent; calyx ca. 0.5 × 0.4 mm, glabrous; petals obovate or oblong, 1.3 × 0.8 mm, apex rounded or emarginate; disc lobes up to ca. 0.3 mm long; filaments ca. 3.5 (-4.5) mm long; ovary ca. 0.9 mm long, pubescent; styles up to 1.7 mm long; stigmas papillose.

Immature capsules with ovary 2.8-3.5 × 1.5 mm, exocarp pubescent, the styles 0.8-2 mm long; calyx and disc lobes mostly persistent. Immature seeds ca. 20 per capsule, comose at both ends.—Fig. 5, 6G-L.

BREEDING SYSTEM.—Hermaphroditic.

FIELD CHARACTERS.—Large tree with a thick bole. Bark reddish brown and flaky, the wood hard and red. Flowers white, immature fruits pink.

DISTRIBUTION AND ECOLOGY.—Known only from the type from Ysabel Island where it is described as common.

This species appears closely related to *Weinmannia fraxinea* although the leaflets are much smaller. Further collections are needed to determine the precise relationship between these two species.

PERRY recorded that the seeds had hairs all over their surface (as in *W. pullei* and *W. urdanetensis*) and not only at the ends. The holotype from A has a packet attached with a mature fruit and a seed that matches PERRY's description. However, the fruit is much older than those attached to the twigs with leaves on the sheet, and the seeds the latter contains are immature and have hairs only at the ends. It seems doubtful therefore that the seed described by PERRY was actually from this specimen.

3. Weinmannia exigua A.C. Sm.

For typification, description, illustration and breeding system see under Fiji (p. 94).

FIELD NOTES.—Common tree up to 20 m high (BRADFORD pers. comm.), with dense rounded crown and flowers in off-white panicles (*Whitmore BSIP 995*).

DISTRIBUTION AND ECOLOGY.—Originally described from Fiji where it is known from two collections. Said to be common on crater rim on Van(g)unu Island at 2000 ft., on ridge with deep humus (*Whitmore BSIP 995*).—Fig. 5, 9A-C.

MATERIAL EXAMINED.—**SOLOMON ISLANDS**: ***New Georgia Group***: *Whitmore BSIP 995*, Van(g)unu Island, inland from Merusu Islet, on narrow parts of ridge with deep humus layer, crater rim, alt. 2000 ft., fl., 10 Dec. 1962 (L!, LAE).

LOCAL NAME.—Wangulu (Kwara'ae) (*Whitmore BSIP 995*).

Whitmore BSIP 995 was previously equated with *Weinmannia urdanetensis* (WHITMORE 1966) which occurs in New Guinea and the Philippines, but the leaflet shape is not a close match. It is similar to the material from Fiji in the size, shape and texture of the leaflets and the narrowly winged rachis, and agrees well with *Howard 89* in the number of pairs of leaflets. The leaflets are also similar in shape to those of *W. ysabelensis* although they are smaller and more numerous (ca. 8 pairs).

4. Weinmannia purpurea L.M. Perry

J. Arnold. Arbor. 30: 159 (1949); Bernardi, Bot. Jahrb. Syst. 83: 198, t. 34 (1964).—Type: *Kajewski 1738* (Papua New Guinea), Bougainville Island, Kupei Gold Field, 1000 m, rain forest, Apr. 1930 (holo-, A; iso-, BISH, BM!, BRI, G, GH, L!, LE, S, SING!, US).

Tree 20 m high. Twigs terete, scarcely flattened at nodes, branching frequently dichotomous. Internodes up to 8 cm long. Stipules caducous, elliptical, ca. 0.8 × 0.4 mm, apex rounded or obtuse, sparsely strigose on abaxial surface, glabrous on adaxial one. Leaves usually simple or unifoliolate, the petiole articulated at junction with blade or not, or rarely trifoliolate; simple leaves broadly lanceolate or narrowly ovate (3-) 4.2-18 × 1.3-5 cm, apex acute to caudate, base attenuate to decurrent; in unifoliolate and trifoliolate leaves, articulated petiole ca. 1.5 cm long, narrowly winged, sparsely puberulent; in trifoliolate leaves, lateral leaflets ca. 3.5 × 1.2 cm, unequal at base; leaf blade glabrous on both surfaces, punctate below, subcoriaceous; margin somewhat thickened and minutely revolute, strongly crenate (13-)18-25 crenations on each side of the blade; midrib narrowly ridged above and strongly prominent below, secondary and tertiary venation slightly raise on both surfaces.

Inflorescence usually a central pentad (sometimes a triad or heptad) or composed of 2 lateral partial inflorescences, the apical bud aborted; triads sometimes developing in subdistal nodes also; peduncle and rachis segments 1.4-4.5 cm long, racemes up to 17 cm long; inflorescence axes puberulent to almost glabrous. Floral buds inserted singly; floral bracts ± linear, 1.8 mm long, caducous. Flowers unisexual, only female flowers seen, the stamens shortly exserted from the flower and shorter than the styles; pedicel 1-2.1 mm long, puberulent; calyx lobes triangular, 0.8 × 0.5 mm, glabrous; petals ovate, 1.4 × 0.8 mm; disc lobes up to 0.7 mm long; filaments ca. 1.5 mm long, anther 0.3 × 0.3 mm, empty; ovary ca. 1.5 long, sparsely and minutely strigose or ± glabrous; styles 0.9-1.3 mm long; stigmas capitate and papillose.

Capsules 3.1-3.5 × 1.2-1.5 mm at dehiscence, the styles 1.1-1.3 mm; exocarp with minute longitudinal ridges, almost glabrous with a few minute strigose hairs, warty; calyx lobes not persistent; central column present. Seeds ca. 0.8 mm long, 16 per capsule, comose at both ends, the hairs ca. 1 mm long.—Fig. 5, 6A-F.

BREEDING SYSTEM.—Dioecious?

FIELD CHARACTERS.—Bole crooked, ca. 50 cm dbh, buttresses absent. Bark light brown smooth; slash: wood hard, reddish brown, bark soft. Flowers very pale purple on purple stems (*Kajewski 1738*) or white with a faint smell (*BSIP 12092*). Fruit purple (*Kajewski 1738*),

green when immature (*BSIP 12092*).

DISTRIBUTION AND ECOLOGY.—Known from only two collections, growing at 785-1000 m. Habitats described as rain forest and well drained primary forest on ridge top. Common according to KAJEWSKI.

MATERIAL EXAMINED.—**PAPUA NEW GUINEA**: ***Bougainville***: *Kajewski 1738* (BO, L, P, SING, type).—**SOLOMON ISLANDS**: ***SW Guadalcanal***: *Mauriasi BSIP 12092*, Duidui area, 2400 ft., fl., yfr., 9 Oct. 1968 (K, L).

LOCAL NAME.—Aitoto (Kwara'ae).

Uncertain and little known species

5. Weinmannia sp. (Solomons A)

Weinmannia sp., Corner, Philos. Trans. Ser. B 255: 577 (1969).

Tree up to ca. 8 m high. Stems glabrous, branching sometimes dichotomous. Stipules caducous, ligulate, ca. 4 × 2 mm, with short strigose hairs on the abaxial surface. Leaves trifoliolate or imparipinnate with 2 pairs of lateral leaflets, up to 7.5 cm long, including the petiole; petiole and rachis segments 1-2 cm long, glabrous, winged, the wings extending up to 1 mm on either side of midline; lateral leaflets elliptical, 2.5-3.8 × 1-1.5 cm, base ± unequal, apex acute; terminal leaflets elliptical, 4.5-5.5 × 1.7-2 cm, base attenuate, apex acute; blades glabrous on both surfaces, punctate below, coriaceous; margin crenate (but much chewed by insects).

Inflorescence composed of triads or pentads, sometimes a few successive nodes bearing partial inflorescences simultaneously, and reduced leaves at nodes within the inflorescence. Floral buds inserted singly; floral bracts ca. 2.7 mm long, exceeding buds, ligulate, minutely strigose. Pedicel puberulent; calyx lobes glabrous. Mature flowers and fruits unknown.—Fig. 5.

IMMATURE FOLIAGE.—In *Corner RSS 1188*, the leaves have up to 3 pairs of narrowly elliptical leaflets; young stems, leaf axes and underside of the midrib are puberulent. *Hill RSS 9011* has broadly ovate lateral leaflets and the axes and leaves are glabrous.

FIELD CHARACTERS.—Bark and wood red. Inflorescence in bud red; flowers pinkish (*Corner RSS 89*) or white and sweetly fragrant (J.C. BRADFORD pers. comm.).

DISTRIBUTION AND ECOLOGY.—Collected at 700-900 m on Vangunu (J.C. BRADFORD pers. comm.), 1100-1800 m on Kolombangara (BRADFORD pers. comm. and *Corner RSS 89*) and 2340 m on Guadalcanal (*Hill RSS 9011*). Habitats include forest on summit plateau and ridge of mountains. Common.

MATERIAL EXAMINED.—**SOLOMON ISLANDS**: ***Kolombangara***: *Corner RSS 1188*, 5500 ft., st., 2 Sep. 1965 (K); ***Guadalcanal***: *Corner RSS 89*, Popomanasiu, 7000 ft., fl., 23 Oct. 1965 (K, L); *Hill RSS 9011*, Mt. Popomanasiu, 7000 ft., st., 5 Nov. 1965 (K, L).

LOCAL NAME.—Huta-ana-kwai (*Corner RSS 89*).

The description is based on *Corner RSS 89*, the only fertile collection, because sterile material of *Weinmannia* is notoriously variable and often lacks the distinguishing characters seen in adult plants.

This species belongs to the same group as *Weinmannia croftii* from the Bismarck Archipelago and Karkar Island, *W. denhamii* from Vanuatu, and *W. vitiensis* from Fiji, since all four taxa have a winged petiole and rachis, and an inflorescence consisting of triads or pentads, as frequently see in sect. *Leiospermum*. It may in fact turn out to be conspecific with *W. croftii*, but more fertile collections are needed to determine whether the range in leaflet size and shape for this population is unique.

6. Weinmannia sp. (Solomons B)

Parker 6, from Mt. Bolbi, Bougainville Island, Papua New Guinea, in low forest 10-30 ft. high, 8000 ft., Oct. 1963 (CANB) is a specimen in bud only of an undescribed species belonging to sect. *Leiospermum*.

Young stems hirsute, branching sometimes dichotomous. Stipules not seen. Leaves imparipinnate, with 3-5 pairs of leaflets, up to ca. 5 cm long: petiole and rachis segments 0.4-0.7 cm, hirsute especially on upper surface, winged, the wings extending up to 0.7 mm on either side of the midline; lateral leaflets ± elliptical, 0.7-1.3 × 0.4-0.5 cm, base acute, apex broadly acute; terminal leaflets elliptical, 1.5-1.9 × 0.5-0.6 cm, base attenuate, apex acute; blades coriaceous, glabrous. Floral buds inserted singly on inflorescence axis.—Fig. 5.

III. WEINMANNIA IN VANUATU (with R.D. HOOGLAND†)

Two species occur in this region, both of them endemic: *Weinmannia denhamii* is widespread and more common than *W. macgillivrayi*. The first belongs to the group of species in sect. *Leiospermum* that have a narrowly winged leaf rachis and are often found on young volcanic soils, where as *W. macgillivrayi* is closely allied to *W. fraxinea* in sect. *Fasciculata*. Both species in Vanuatu have predominantly unisexual flowers and almost glabrous fruits.

Key to the species of Vanuatu

1. Leaf rachis and petiole terete, densely hairy on the upper surface, not winged; lateral leaflets often with small "ears" at point of attachment to leaf rachis; inflorescence of one or more pairs of lateral dyads, the apical bud of main stem persisting and dormant during flowering ..... **1. W. macgillivrayi**
1'. Leaf rachis and petiole semiterete, glabrous, winged; lateral leaflets without "ears" at point of attachment to leaf rachis; inflorescence a central triad or pentad sometimes also with lateral triads or additional racemes ..... **2. W. denhamii**

1. Weinmannia macgillivrayi Seem.

Fl. Vit.: 109 (1866); Engl., Nat. Pflanzenfam., ed. 2, 18a: 256 (1930); Bernardi, Bot. Jahrb. Syst. 83: 173, t. 22 (1964).—Type: *Milne 277* (Vanuatu), Aneiteum (= Anatom), H.M.S. Herald 1854 (lecto-, here designated, K!).

Small shrub to largish tree, 15-20 m tall. Branching not usually dichotomous. Nodes somewhat laterally flattened, the stipular scar arched on both sides, especially at distal nodes. Stems glabrescent, rarely not, with numerous lenticels and fine longitudinal grooves. Stipules usually caducous, ± orbicular or shortly spathulate, rounded at apex rounded and narrowing towards base, up to 1 × 1.1 cm, sometimes revolute, shortly strigose on abaxial surface, especially towards the base and glabrous on adaxial surface except at base. Leaves imparipinnate with 4-10 (-12) pairs of leaflets, up to 14 cm long including petiole of 10-35 mm; rachis segments 5-9 mm long; petiole and rachis terete or channelled, densely hairy on adaxial surface and in groove, the hairs up to 0.5 mm long, glabrous or with few scattered hairs below (rarely densely hairy all round, *Veillon 3992*); lateral leaflets sessile, narrowly ovate to lanceolate, the lower 1-3 pairs distinctly shorter than the upper pairs but of similar width, up to 2.2-4.6 × 0.6-1.3 cm, apex narrowly acuminate, base unequal, obtuse to rounded, not lying flat on pressing, often 1 or 2 small free auricles ca. 0.6 × 0.4 mm on rachis between bases of opposite leaflets; apical leaflets 2.7-5.5 × 0.9-1.4 cm, narrowly elliptical, the base attenuate, the apex narrowly acuminate to caudate; blades glabrous on both surfaces except for weak hairs ca. 1 mm long on midrib on abaxial surface, not punctate below, subcoriaceous; margin sometimes somewhat thickened or minutely revolute, crenate to serrate especially towards the apex with up to 10 teeth on each side of the largest leaflets; midrib indented above and prominent below, secondary veins ± flat on both surfaces.

Inflorescence of 1 or 2 pairs of dyads, sometimes a few successive nodes producing partial inflorescences simultaneously; peduncles 0.2-0.6 cm long, shortly and sparsely pubescent; apical bud of main stem between central peduncles usually present, sericeous; buds at apex of

peduncles in angle between racemes sericeous, minute; racemes ca. 7-14 cm long, rachis sparsely puberulent. Floral buds inserted in fascicles; floral bracts ligulate or somewhat boat-shaped, 0.4-0.9 mm long, caducous with short, stiff hairs. Flowers unisexual or rarely bisexual; pedicel 1.6-2.8 mm long glabrous or minutely pubescent at base; calyx lobes triangular, 0.6-0.7 × 0.4 mm long, glabrous; petals elliptical-ovate or obovate, 1-1.6 × 0.7-0.8 mm; disc lobes 0.2-0.4 mm long; in male flowers: filaments 2.8-4.2 mm long, ovary small 0.3-0.9 mm, pubescent, the styles 0.4-1.2 mm long and not exserted beyond the anthers; in female flowers: stamens short and not exserted beyond the styles, the filaments up to ca. 1.1 mm long, ovary ca. 1 mm long, pubescent, styles ca. 1.3 mm long, ovules 8 per locule.

Capsules 2-3.5 × 2-2.2 mm at dehiscence, the styles 1.7-2 mm long, the exocarp smooth, almost glabrous with a few weak hairs; calyx lobes persistent; central column weakly developed or absent. Seeds ca. 0.8 mm long, persistent in capsule, usually comose at both ends, the hairs coarse and straw-like, ca. 2 mm long, twisted around seed in capsule.—Fig. 7A-E, 8.

BREEDING SYSTEM.—Polygamodioecious. Most specimens have only either male or female flowers but *Kajewski 735* has male and a few bisexual ones (though the ovary may not be functional as the ovules are minute). In *Schmid 3557* the flowers appear bisexual with a few males ones mixed in.

FIELD CHARACTERS.—Flowers white or cream, fruits reddish.

DISTRIBUTION AND ECOLOGY.—Several collections from Anatom (also known as Aneityum), the southern most of the main islands in the chain, and one from Santo, the largest island, towards the north. Recorded from 30-300 m from scrub, rain forest, open secondary forest and forest on ridge. Described as common (*Kajewski 735*).

MATERIAL EXAMINED.—**VANUATU**: ***Anatom*** (***Aneityum***): *Bernardi 12974*, nr. Anawounamalo, R. Inwa Lelgey (sic) (= Inwan Leleghei), 10-180 m, st., 5 May 1968 (K, P); *Bourdy 322*, autour d'Anelgahoat (sic), 30 m, fr., 1 Feb. 1986 (K, P); *Cabalion 1944*, W Inwooutié R., 300 m, fl., 18 Mar. 1983 (NOU, P); *Cabalion 1944b*, Anelgaohat, Inwooutié R., Res. Service Forestier, 80 m, fr., 18 Mar. 1983 (NOU, P); *Kajewski 735*, Anelgauhat Bay (sic), 100 ft., buds, 11 Feb. 1929 (A, BISH, K, P); *Roata 14*, fr., 1976 (NOU); *Schmid 3557*, fl., 1 Dec. 1970 (P); *Schmid 5083*, secteur de Anelghanal, fl., fr., Nov. 1974 (NOU); *s.coll., s.n.*, s.loc. (BM, type folder, no label). ***Espiritu Santo***: *Veillon 3992*, direction Voutmele, buds, Aug. 1979 (P).

LOCAL NAMES.—Nomropon (*Bourdy 322*) but see under *Weinmannia denhamii* in WHEATLEY (1992).

TYPIFICATION.—The material of both this species and of *Weinmannia denhamii* described by SEEMANN was collected during the voyage of the H.M.S. HERALD, under the command of Captain H.M. DENHAM. MACGILLIVRAY was the ship's naturalist and MILNE the assistant naturalist before they were dismissed and discharged respectively during the voyage, for dereliction of duty (DAVID 1995). According to DAVID, the Herald visited Aneiteum, where the collections of *Weinmannia* were made, between 7 November 1853 and 1 January 1854, and plant specimens were sent to W. HOOKER at Kew. However, MACGILLIVRAY may have passed some of MILNE's collections off as his own, and HOOKER criticised the poor labelling of the material he received (DAVID 1995). In the description of *W. macgillivrayi*, SEEMANN cited material collected by both MACGILLIVRAY and MILNE, which constitute syntypes; *Milne 277* (K) is designated here as the lectotype. A specimen in a type folder at BM has no label and may or may not belong to the same collection.

RELATIONSHIPS.—This species is a satellite of the widespread Malesian *W. fraxinea*, distinguished from it by more numerous and smaller leaflets and by the ears that are frequent on the leaf rachis at the point of insertion of the lateral leaflets. In both species, the upper surface of the leaf rachis is often densely hairy.

2. Weinmannia denhamii Seem.

Fl. Vit.: 109 (1866), as "denhami"; Engler, Nat. Pflanzenfam., ed. 2, 18a: 256 (1930); Bernardi, Bot.

Fig. 7.—**A-E**, ***Weinmannia macgillivrayi***: **A**, part of a flowering shoot with imparipinnate leaves (only one shown) at the most distal node subtending an inflorescence of 4 dyads; more proximal node has a lateral shoot with an inflorescence of two dyads; note minute buds in angle between racemes of each dyad; **B**, flower, probably bisexual; **C**, female flower, one petal removed; **D**, dehisced capsule with persistent calyx lobes; **E**, seed. (A, *Kajewski 735*; B, *Schmid 3557*; C, *Cabalion 1944*; D, E, *Roata 14*).—**F-N**, ***Weinmannia denhamii***: **F**, part of a flowering shoot with central and lateral triads (only one lateral triad shown); note reduced leaves at some nodes within inflorescence; **G**, single leaf with smaller, more numerous, leaflets (type of *W. tannaensis*); **H**, male flower; **J**, detail of H with perianth removed to show gynoecium with very reduced styles, disc lobes and a single stamen; **K**, female flower; **L**, detail of K with perianth removed to show gynoecium with long styles, disc lobes and a single stamen; **M**, capsule at dehiscence, note central column and enlarged receptacle; **N**, seed. (F, *MacGillivray 45*; G, *Kajewski 151*; H, J, M, N, *Aubert De La Rüe s.n.*, 2ème Voyage, Jan. 1936; K, *Schmid 5084*).—Drawn by C. MONNIÉ.

Jahrb. Syst. 83: 190, t. 32 (1964); Wheatley, Guide Common Trees Vanuatu: 76, t. 77 (1992).—Type: (*MacGillivray*) *45*, (Vanuatu), Aneiteum (= Anatom), in woods (lecto-, here designated, K!; isolecto-, BM!, G, P! 3 sheets).

Weinmannia kajewskii Guillaumin, J. Arnold Arbor. 12: 250 (1931).—Type: *Kajewski 317* (Vanuatu), Eromanga Island, Dillon Bay, 400 m, rain forest, common, 28 May 1928 (holo-, P!; iso-, A!, BISH!).

Weinmannia tannaensis Guillaumin, J. Arnold Arbor. 12: 251 (1931); Bernardi, Bot. Jahrb. Syst. 83: 178, t. 27 (1964).—Type: *Kajewski 151* (Vanuatu), Tanna Island, Mt. Tokosh Meru, 1000 m, rain forest, common, 15 Mar. 1928 (holo-, P!; iso-, BISH!).

Weinmannia kajewskii Guillaumin var. *ambrymensis* Guillaumin, Bull. Soc. Bot. France 82: 349 (1935), nom. illeg., no Latin description. Collection cited: *Aubert de la Rüe s.n.* (Vanuatu), Ile Ambrym, sur le grande plateau de scories à proximité du volcan actif, cote 600-700, Août 1934 (A!, L!, P!).

Shrub or tree, 2-20 m high, also sometimes an epiphyte or strangler; branching sometimes dichotomous; young twigs shortly hairy, finely ridged with narrow longitudinal fissures and round or elliptical lenticels; older twigs with stipular scars ± horizontal. Stipules usually caducous on reproductive branches, sometimes persistent on vegetative ones, variable in shape, usually ovate or ligulate, 6-10 × 2-4.5 mm, sometimes orbicular (juvenile foliage?), 8-12 × 10-14 mm, rounded or obtuse at apex, glabrous or minutely hairy on adaxial surface, with a few scattered hairs to 0.3 mm long on abaxial surface. Leaves imparipinnate with 1-12 pairs of leaflets, up to 14 cm long including petiole of 7-25 mm; rachis segments 6-13 mm long; petiole and rachis segments semiterete, flattened above with a narrow central ridge and winged, the wings extending 0.5-1.5 mm on either side of mid-line, on each segment the wings broader distally towards point of attachment of leaflets; petiole and rachis glabrous to puberulent above, glabrous or bearing a few hairs on underside especially at point of attachment of leaflets; lateral leaflets lanceolate, elliptical or ovate, the proximal ones often shorter than the more distal ones, 1.1-3(-4.8) × 0.3-1.1(-1.5) cm, apex acute, base asymmetrical, distal side acute to attenuate, proximal side obtuse to rounded; terminal leaflet narrowly elliptical to narrowly obovate 2.1-4.1 (-6.4) × 0.3-1(-1.7) cm, apex acute, base attenuate; in leaves with few pairs of pinnae, terminal leaflet often larger than lateral ones; in leaves with numerous pairs of pinnae, terminal leaflet ± equal length and narrower than lateral ones; blade glabrous on both surfaces, usually punctate below, subcoriaceous; margin somewhat thickened and minutely revolute, crenate especially towards the apex with 6-17 crenations on each side; midrib narrowly prominent above and slightly prominent below, when sometimes minutely hairy.

Inflorescence a central triad or usually pentad, the lower racemes either in the axils of leaves or not, rarely replaced by lateral triads; sometimes a few successive nodes on a shoot bearing partial inflorescences simultaneously; peduncles and rachis segments 0.8-3 cm long; racemes 5-11.5 cm long; inflorescences axes puberulent. Floral buds inserted singly; floral bracts lanceolate or somewhat carinate, up to 1.1 mm long, bearing a few hairs towards base on abaxial surface, caducous. Flowers unisexual; pedicel (1-)1.4-3 mm long, slender, puberulent; calyx lobes triangular, 0.9 × 0.6-0.7 mm, ± glabrous; petals ovate-elliptical, 1.3-1.6 × 0.7-0.9 mm; disc lobes 0.5-0.7 mm long; in male flowers: stamens long and anthers far exserted beyond stigmas, filaments (1.6-)2-3.5 mm long, ovary 0.9-1.1 mm long, styles minute, < 0.1 mm long and curved inwards; in female flowers: stamens short and stigmas exserted beyond anthers, filaments 1-1.7 mm long, ovary 1.3-1.5 mm long, almost glabrous, styles ca. 1 mm long.

Capsules distinctly supported by receptacle, valves 3-4 × 1.7-2 mm at dehiscence, the styles 0.8-1.3 mm long; exocarp with minute longitudinal ridges, almost glabrous with a few minute strigose hairs; calyx lobes not persistent; central column often persistent on receptacle after valves have fallen. Seeds ca. 0.6 mm long, 16 per capsule, tending to persist in capsule after dehiscence, comose at both ends, the hairs 0.8-1 mm long.—Fig. 7F-N, 8.

BREEDING SYSTEM.—Dioecious or polygamodioecious? Most specimens have unisexual flowers but two collections at P (*Aubert de la Rüe s.n.*, 19 Feb. 1936 and *Bernardi 12986*) have both

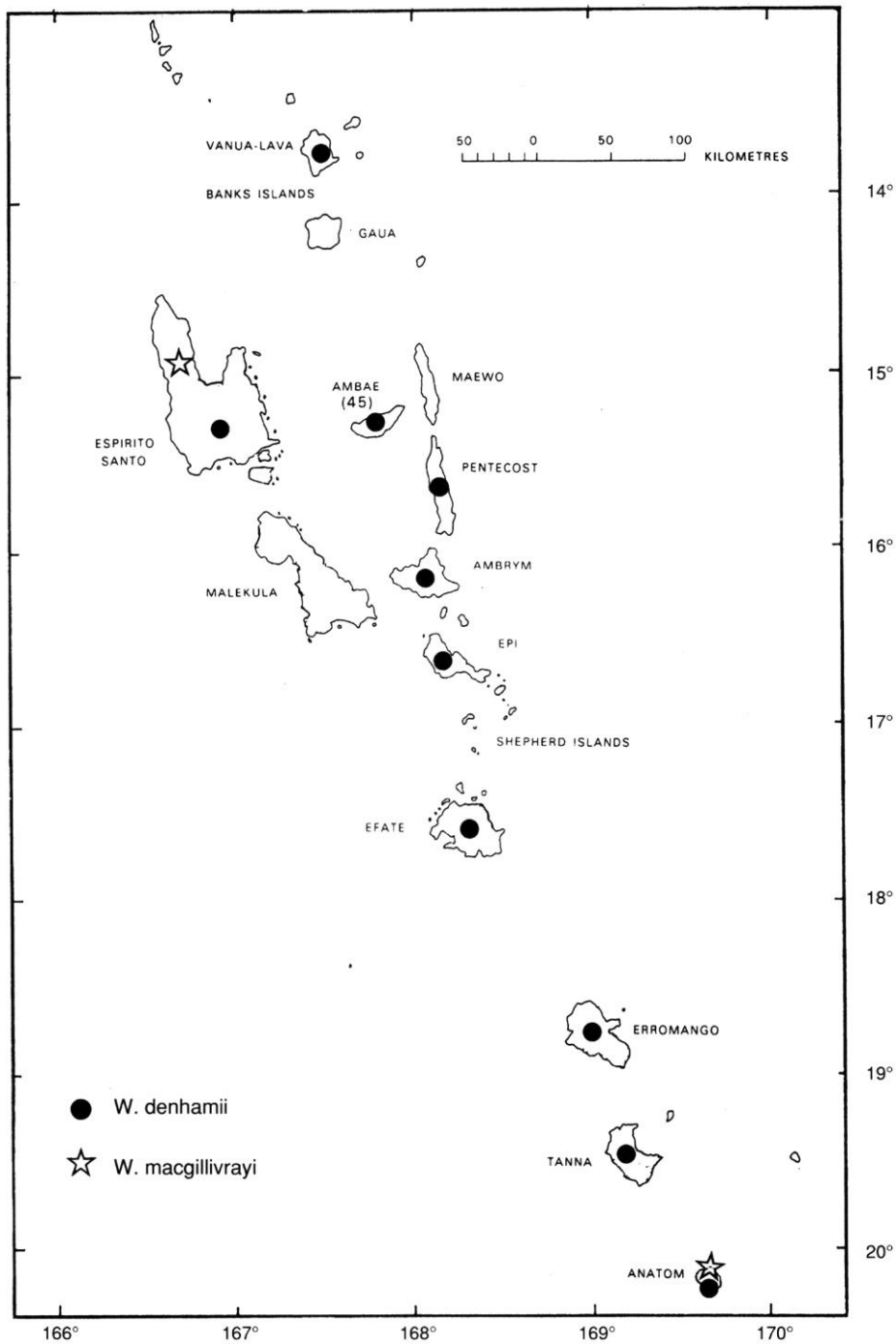

Fig. 8.—Distribution of ***Weinmannia*** in Vanuatu. One symbol per species per island.

male flowers and fruits on the same twig.

GROWTH FORM AND FIELD CHARACTERS.—As in other species whose distribution covers a wide range of elevation, size and growth habit are influenced by altitude and exposure. It is recorded as a tree 20 m high at 1300 m (on Ambae) and as a shrub 2 m high at 1800 m (on Santo). When a large tree, the crown may be open and spreading, flat-topped with the branches vertically ascending to form an inverted cone, or dome-shaped with divaricate branches, the foliage feathery (*Wheatley 207*), in distinct clumps on otherwise bare branches (*Wheatley 55*). The bole is sometimes twisted and leaning. Also described by *Wheatley 207* (and 1992) as a strangler that kills its host and then forms a bole by the fusion of the roots, with a diameter of nearly 70 cm.

Bark light grey or brown-grey, smooth with fine vertical fissures, blackish or reddish on old trunks. Inner bark red or orange, fibrous. Sap wood white, cream to yellowish. Heartwood pink-cream, sweet-smelling. Young leaves flush reddish or yellowish-red, mature leaves dark green and slightly shiny above, silver-green below (*Wheatley 207*). Flowers usually described as white, rarely yellowish-green or pink, and much visited by insects (*Bernardi 12986*). Fruit pink, red then brown.

DISTRIBUTION AND ECOLOGY.—Known from most of the larger islands of Vanuatu. Lowest recorded altitude varies by island but the overall elevation range is 120-1800 m.

According to WHEATLEY (1992), *W. denhamii* is a canopy species of upper middle and high elevation forest where it is co-dominant with *Metrosideros* over large areas. Other habitats include riverine forest on basalt, open woodland with tree ferns, bracken-covered ridge grazed by bullocks, open *Acacia spirorbis* scrub, open secondary forest, and deforested areas with *Pteridium* and *Gleichenia*. At higher elevations it occurs in montane, dwarf forest on exposed crests and ridges.

Soil types recorded from specimens include volcanic cinders and lava, and young brown andosol. Although *W. denhamii* belongs to the group of species (including *W. croftii*, *W. vitiensis* and *W. sp.* Solomons A) that are often found on relatively young volcanic soils, WHEATLEY says it is less frequent than *Metrosideros* on the juvenile ash soils of Tanna and the Ambrym caldera.

MATERIAL EXAMINED.—**VANUATU**: ***Vanua Lava***: *Wheatley 375*, s.loc., 550 m, fl. (K). (***Espiritu***) ***Santo***: *Cabalion 462*, Col sur le Custom rd., entre R. Pialapa et village Wunabaï, 850 m, fl., 21 Mar. 1978 (NOU); *Chew Wee-Lek RSNH 204*, Mt. Tabwemasana, 1520 m, st., 3-8 Sep. 1971 (K); *Cribb & Wheatley 82*, Saktouy to Tabwemasana, 1500-1550 m, fr., 24 Oct. 1988 (K); *Curry 1640B*, Fortsenale, nr. village, 700 m, fr., 10 Dec. 1994 (K); *Gillison & Beveridge RSNH 3531*, Nokowoula village area, 3500 ft., fr., 28 Aug. 1971 (P); *Raynal RSNH 16345*, Mt. Tabwemasana, 1800 m, fr., 2 Sep. 1971 (K, L); *Veillon 4026*, direction du Voutmele, 1000 m, fr., Aug. 1979 (P). ***Ambae*** (= ***Aoba***): *Quantin in Schmid 1941*, sommet du volcan, 1000 m, st., 18 Nov. 1966 (P); *Wheatley 55*, s.loc., 1300 m, st., 23 Nov. 1988 (K). ***Pentecost***: *Aubert de le Rüe s.n*, Kumre, 600 m, st., 19 Dec. 1935 (P); *Wheatley 207*, Tambok, 460 m, buds, 9 Feb. 1989 (K). ***Ambrym***: *Aubert de le Rüe s.n.*, Mt. Toüo, 1000 m, st., 5 Jan. 1936 (P); *Aubert de le Rüe s.n.*, 650-800 m, fl., fr., 8-11 Jan. 1936 (L, P); *Aubert de le Rüe s.n.*, Grand plateau autour du Mt. Marum, 700 m, fl., fr., 10 Jan. 1936 (P); *Bourdy 118*, au-dessus de Lalinda, 600 m, fr., 23 Sep. 1985 (K, P). ***Epi***: *Curry 1026*, Mt. Tainaruru, close to summit, S side above Filakara, 500 m, fr., 20 July 1993 (K). ***Efate***: *Schmid 248*, Vate, 450 m, fr., 26 Feb. 1965 (P); *Kajewski 236*, Undine Bay, 500 m, fr., 25 Apr. 1928 (K, P). ***Erromango***: *Aubert de le Rüe s.n.*, W du massif occupant le N de l'île, 400 m, fl., fr., 19 Feb. 1936 (P); *Bernardi 13258*, W, Dillon Bay, Oponhkor, Mt. Menel, R. Nevel, 250-350 m, fr., 3 June 1968 (K, L, P); *Cabalion 1388*, S, Fedmoghum, 300 m, fr., 21 Feb. 1982 (NOU); *Cheesman 34*, s.loc., 1600 ft., fr., 17 July 1930 (K); *Curry 550*, Logging trail from Dillons Bay to Port Narvin, 120 m, fr., 5 Aug. 1992 (K); *Johnson 12*, s.loc., 300 m, fl., s.dat. (K); *Schmid 4740*, Centre, 300 m, buds, fr., 25 June 1973 (NOU); *Schmid 5084*, N de Happy Land, 250 m, fl., 21 Nov. 1974 (NOU). ***Tanna***: *Aubert de le Rüe s.n.*, s.loc., st., Mar. 1934 (P); *Bernardi 12849*, nr. Lootopounga, 250-300 m, buds, 29-30 Apr. 1968 (K, L, P); *Bernardi 12909*, Lamwinaoura, fl., fr., 1-2 May 1968 (K, L, P); *Bernardi 13097*, Pagi Yanehoop, 300 m, fl., fr., 20 May 1968 (K, L, P); *Chew Wee-Lek RSNH 109*, Yerou, SW foot of Mt. Toukousmerou, 100-200 m, fl., fr., 27 July 1971 (K, P); *Morat 5897*, Flan E du Toukosmereu, 500 m, fl., 7 Feb. 1978 (NOU, P); *Morat 6043*, Mt. Toukosmereu, 500-600 m, fr., June 1978 (NOU, P); *Schmid 3176*, vers Côte Est, 500 m, fr., 7 May 1970 (K, NOU, P). ***Anatom*** (***Aneityum***): *Bernardi 12927*, nr. Anawounamalo to R. Inwa Lelgey, 10-180 m, fl., yfr., 5 May 1968 (K, L, P); *Bernardi 12986*, nr. Anowounamalo towards Anitchavo (= Port Patrick), Ougaphaérek, Inréro, Ounétchnytap, to R. Inwa

Anetcho, 430 m?, fl., fr., 7-8 May 1968 (K, L, P); *Bernardi 13018*, ibid., 700 m, buds, 7-8 May 1968 (K, L, P); *Morrison s.n.*, s.loc., fr., 26 June 1896 (K); *Schmid 3558*, Sud, buds, Dec. 1970 (NOU).

LOCAL NAMES.—According to WHEATLEY (1992) names refer to the genus in general, e.g. Nomropom (Aneiteum), Nariop (Erromango), Aisensu (Paama), Kanumtep (Pentecost). Additional names from specimen labels include: Narurururu (Efate), Owara (Fortsenale language, Santo), Nivlewi (Sie language, Erromango, meaning: drinking medicine [*Curry 550*]), Sasatré (Santo).

LOCAL USES.—The bark gives a red dye used on clubs (*Aubert de la Rüe s.n.*, 19 Dec. 1935). The wood is hard and durable and used for "hot" firewood and house construction (e.g. house posts and rafters) (WHEATLEY 1992; *Wheatley 207*). It is also used as medicine for asthma or "short wind" (*Curry 550*): the bark is stripped off and ground to a powder which is then put into a curled *Heliconia* leaf and cold water added; the leaf is squeezed and the extract drunk.

TYPIFICATION.—SEEMANN gave the type as "-Aneiteum, in woods (*M'Gillivray!*)". Sheets at K and BM lack a collector's name but bear the number 45. According to STAFLEU & COWAN (1985), SEEMANN's study set for the botany of the H.M.S. HERALD is at BM, but he published the names *Weinmannia denhamii* and *W. macgillivrayi* in his "Flora Vitiensis", for which K, and not BM, is considered to have the first set. Since the situation is somewhat confused, a lectotype is designated at K. The isolectotypes at P give both MACGILLIVRAY's name and the number 45. The date "Feb. 1859" is after MACGILLIVRAY had left the H.M.S. HERALD (DAVID 1995), and may refer either to when the material was received in London or when it was collected on a later expedition (see DAVID 1995: 218).

TAXONOMY AND VARIATION.—The leaves of *W. denhamii* are variable in both the number of pairs of leaflets and their shape. When there are few leaflets, they are usually lanceolate and when they are numerous, they are shorter and relatively broader. However, there is no discontinuity in the number of pairs of leaflets per leaf (R.D. HOOGLAND, unpublished, based on analysis of 38 sheets). Specimens with fewest leaflets are from Efaté, Santo and Anatom, and those with the most are from Tanna and Ambae.

BERNARDI (1964) placed *Weinmannia tannaensis* in sect. *Fasiculata* but the flowers are inserted singly and the inflorescence architecture is that of sect. *Leiospermum*.

IV. WEINMANNIA IN FIJI (with J.C. BRADFORD)

We recognize four species occurring in Fiji. In sect. *Fasciculata*, *Weinmannia richii* is endemic and relatively abundant on the two largest islands while *W. exigua* is known from Vanua Levu and also occurs in the Solomon Islands. In sect. *Leiospermum*, *W. vitiensis* is endemic and known only from three of the smaller islands and *W. affinis* is relatively abundant on Viti Levu, Taveuni and Ovalau, and has also been reported from Samoa although its status there is uncertain.

Key to the species in Fiji

1. Inflorescence a series of dyads or tetrads, the apical bud of the main stem present between the peduncles of the inner most partial inflorescences; lateral, auxiliary buds absent 2
1'. Inflorescence of triads or pentads, the apical bud of the main stem either developed into a partial inflorescence or aborted; lateral auxiliary buds present 3
2. Leaves on reproductive shoots usually trifoliolate, the terminal leaflet often much larger than the laterals .. .. **1. W. richii**
2'. Leaves on reproductive shoots usually imparipinnate with (1-)3-7 pairs of leaflets, the terminal leaflet not or scarcely larger than the largest laterals ..... **2. W. exigua**
3. Leaves on reproductive shoots unifoliolate ..... **3. W. affinis**
3'. Leaves on reproductive shoots usually trifoliolate, the rachis narrowly winged ..... **4. W. vitiensis**

1. Weinmannia richii A. Gray

U.S. Expl. Exped., Phan. 1: 675, Atlas t. 85 (1854); Seem., Fl. Vit.: 110 (1865); Engl., Linnaea 36: 643 (1870), Nat. Pflanzenfam., ed. 2, 18a: 255 (1930); A.C. Sm., J. Arnold Arbor. 33: 133 (1952); Bernardi, Bot. Jahrb. Syst. 83: 177, t. 26 (1964); J. Parham, Pl. Fiji Islands: 124 (1972, rev. ed.); A.C. Sm., Fl. Vit. Nova 3: 20, fig. 5D (1985).—Type: *US 48071*, Fiji (Feejee) Islands, on mountains at Sandalwood Bay [= Mbua Bay *fide* Smith], Vanua Levu, 2000 ft., fr., 1840, US Expl. Exped. under the command of Capt. Wilkes (holo-, US 48071!; iso-, BM!, GH, K!, NY).

Weinmannia rhodogyne Gibbs, J. Linn. Soc. Bot. 39: 145 (1909); Engl., Nat. Pflanzenfam., ed. 2, 18a: 255 (1930).—Type: *Gibbs 594*, Fiji, Viti Levu, Nandarivatu, 2700 ft., fl., Aug. 1907 (holo-, BM!; iso-, K!).

Shrub or small tree 2-10(-20) m high. Branching not usually dichotomous. Nodes somewhat laterally flattened, the stipular scar arched on both sides, especially at distal nodes; internodes ca. 0.8-4.5(-8.5) cm. Young stems puberulent, older ones glabrous with numerous lenticels. Stipules caducous or not, suborbicular, up to 1.1 × 1.5 cm, rounded at apex, strigose to glabrous on abaxial surface. Leaves usually compound (1-)3(-7)-foliolate; total length up to 11 cm (for a trifoliolate leaf); petiole 0.9-1.5 cm long in trifoliolate leaves, to ca. 3 cm in imparipinnate ones; petiole and rachis segments where present subterete, slightly flattened or channelled on adaxial side, especially distally towards point of insertion of leaflets, scaly or puberulent; leaflets elliptical, rarely narrowly elliptical, lanceolate or ovate, often conduplicate when dry; in a trifoliolate leaf, lateral leaflets 2.1-5 × 0.7-3.9 cm, sessile, base ± equal to unequal, apex acute; apical leaflet often much larger than the laterals of the same leaf, 3.3-8.2(-9.5) × 1.1-3.2 (-4.4) cm, base attenuate, apex acute; in imparipinnate leaves, largest laterals about equal to terminal leaflet but not attenuate at base; blades subcoriaceous, glabrous, not punctate below; margin sometimes thickened, somewhat sinuate-crenate and undulate, ca. 8-12 crenations on each side of a leaflet; midrib slightly depressed above, prominent below and sparsely hairy, secondary and tertiary venation slightly raised on both surfaces.

Inflorescence usually (2-)4(-6) dyads or tetrads in a series at a node, sometimes a few successive nodes producing dyads or tetrads; peduncles 0.5-12 mm long, shortly strigose or with short erect hairs or almost glabrous; buds at most distal node of main stem and between the central pair of peduncles 1 or 3, sericeous; buds at apex of peduncle in angle between central pair of racemes sericeous, minute; rachises shortly pubescent, up to 10 cm long. Floral buds inserted in fascicles, tending to dissociate from the bract, the fascicles somewhat verticillate and the verticils somewhat separated so that sections of bare rachis visible between them; floral bracts about equal in length to buds, 1.5(-2) mm long, cymbiform, caducous, with short stiff hairs. Flowers unisexual or bisexual; pedicel 1-1.5 mm long, almost glabrous; calyx lobes 0.5-0.6 mm long, glabrous; petals obovate (not oblong) and often retuse at apex, 1-1.3 × 0.7-0.9 mm; disc lobes ca. 0.3 mm long; in female flowers: filaments 1-1.2 mm long, ovary pilose to densely pubescent, ca. 0.9 mm long, the styles ca. 0.9 mm long, ± straight or curved outwards; in male and bisexual flowers: filaments up to 2.2-3.8 mm, anthers ca. 0.4 mm long; in male flowers: ovary 0.4-0.5 mm long, the styles 0.4-0.5 mm long, curled inwards: in bisexual flowers (post anthesis): ovary ca. 1.1 mm long, the styles 1.1 mm long, straight or curved outwards.

Capsule 2-3.5 × 1.2-2 mm at dehiscence, the styles 0.5-1.5 mm, the exocarp almost smooth, softly pubescent; calyx lobes usually persistent; central column weakly developed, usually not persistent after valves have fallen. Seeds 0.8-1 mm long, 8 per capsule, comose at each end, the hairs to 1.5-2 mm long, much curled in capsule, later straight, sometimes with shorter hairs over the rest of the testa.—Fig. 9D-J, 10.

JUVENILE FOLIAGE.—*Hopkins & Bradford 5024*, sucker shoot in dense shade: leaves with up to 6 pairs of pinnae; leaflets chartaceous with serrate margins; stipules persistent, rounded and salverform, forming a horizontally flattened ring round the stem at nodes.

BREEDING SYSTEM.—Polygamodioecious.

FIELD CHARACTERS.—Shrub or small, compact tree with a dense, rounded or irregular crown.

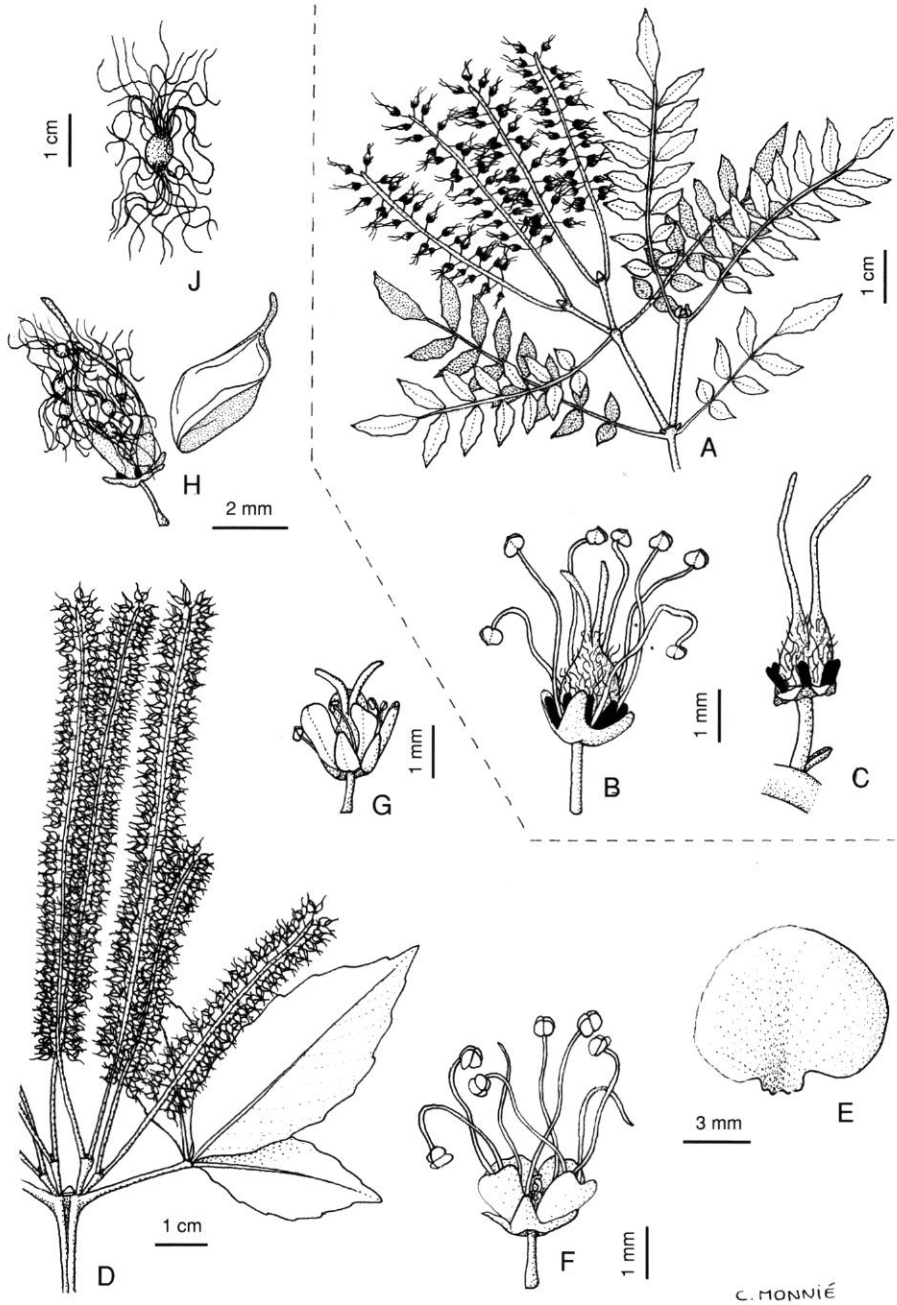

Fig. 9.—**A-C**, ***Weinmannia exigua***: **A**, shoot with infructescence of 2 dyads, the fruits immature; **B**, bisexual flower; **C**, immature fruit, note persistent bract at base of pedicel. (A-C, *Whitmore BSIP 995*).—**D-J**, ***Weinmannia richii***: **D**, shoot with infructescence of 4 dyads; **E**, stipule; **F**, male flower; **G**, female flower; **H**, dehisced capsule, one valve fallen and the other containing seeds; **J**, seed. (D, H, J, *Smith 6813*; E, *Gillespie 4333*; F, *Kuruvoli 16061*; G, *Gillespie 4233*).—Drawn by C. MONNIÉ.

Flowers white, greenish white, creamy or somewhat pink and the pedicel pinkish; also recorded as yellow orange (TURRILL 1915).

DISTRIBUTION AND ECOLOGY.—Known from Viti Levu and Vanua Levu. Reported by BERNARDI from Samoa on the basis of sterile collections which are unlikely to be this species.

Occurring from 100-200 up to 1400 m, with the majority of records from 800-1000 m. Habitats include various types of forest (montane forest, ridge forest, open and dense forest [with tall gingers and tree ferns]) on ridges, slopes and in rolling country; also scrub and thickets in grassland and on dry slopes. Sometimes locally common. Field observations in central Viti Levu in March 1996 found that adult trees were often clumped and most were in fruit. There was a high degree of phenological synchrony both within individual trees and within populations (pers. obs.).

SELECTED COLLECTIONS (from a total of 32 studied).—**FIJI**: ***Viti Levu***: *Damanu FD 991 D.177*, Serua, Naboutini, 1000 ft., buds, 21 Jan. 1964 (SUVA); *Degener 14379*, Tholo North, nr. Nandarivatu, Nandala fish hatchery, 750-900 m, fr., 4 Feb.-26 Mar. 1941 (A, BISH, K, L, P); *Gillespie 4233*, Tholo North prov., Nardarivatu, 2 miles along Nandran trail, 850 m, fl., 8 Dec. 1927 (BISH, GH); *Gillespie 4333*, Tholo North prov., slopes of Loma Langa Mt., 1100 m, fl., fr., 19 Dec. 1927 (BISH, GH); *Greenwood 384*, Lautoka, 600 ft., fr., 23 Oct. 1931 (A, K); nr. Monasavu Dam, 1 km N of FEA station, 840 m, fr., 28 Mar. 1996, *Hopkins & Bradford 5023* (MO, P, SUVA); *im Thurn 73*, Nandarivatu, fl., 1911 (BM, K, P); *Koroiveibau DA 11129*, Nailaga, Ba, buds, 19 Dec. 1957 (K, SUVA); *Kuruvoli DA 16061*, Macuata, Mt. Delainacau, fl., 9 Dec. 1968 (A, BISH, P, SUVA); *Parham DA 7121*, between Navai and Nadarivatu, Mba, Prov. Ba, 4340 ft., buds, fr., 15 Feb. 1951 (BISH, SUVA); *Qoro DA 12947*, Macuata, Tadradave, buds, 5 Nov. 1968 (SUVA); *Ranamu (DA) FD 1174*, Nadrao, Navosa, Nabosewale, Nadrau, 2700 ft., fl., 19 May 1967 (BISH, SUVA); *Smith 4710*, Nandronga, Navosa (formerly Tholo West), S slopes Nausori Highlands, Namosi Creek above Tumbenasolo, 300-450 m, fl., 29 May-5 June 1947 (A, BISH, L, P); *Smith 5739*, Mba, formerly Tholo North, W slopes of Mt. Nanggaranambuluta (Lomalangi), E of Nandarivatu, 850-1000 m, fr., 19 June-2 Oct. 1947 (A, BISH, K, L, P). ***Vanua Levu***: *Parham DA 1122*, Bua or Mbua, Wairiki, fl., 1 May 1938 (A, SUVA); *Parham & Sealolo DA 2277*, Bua or Mbua, Ndama, 90 m, fr., 7 Dec. 1939 (A, SUVA); *Parham s.n.*, Bua Prov., fl., Jan. 1937 (A, BM); *Smith 6813*, Mathuata, Seanggangga Plateau, Korovuli R., nr. Natua, 100-200 m, fr., 25 Nov.-8 Dec. 1947 (K, L, P).

LOCAL NAMES.—Qalo (PARHAM 1941, sub *W. rhodogyne*); Manaui (*Parham DA 1122*); Vota (*Smith 6813*).

2. Weinmannia exigua A.C. Sm.

J. Arnold Arbor. 33: 137 (1952); Bernardi, Bot. Jahrb. Syst. 83: 166 (1964); J. Parham, Pl. Fiji Islands: 122 (1972, rev. ed.); A.C. Sm., Fl. Vit. Nova 3: 25, Fig. 5C (1985).—Type: *Horne 632*, Fiji, Vanua Levu, between Waiwai and Lomaloma, May 1878, fl., yfr. (holo-, K!).

Shrub or small tree, ca. 3-13 m high. Branching not usually dichotomous. Stems woody, not thickened at nodes and annular scar faint, internodes 0.5-2.3 cm long. Young stems minutely hairy, axillary buds densely hirsute, older stems glabrescent, bearing numerous pale lenticels. Stipules mostly caducous even in vegetative material, rarely seen, ± orbicular in outline with a narrowed base, ca. 0.5 × 0.5 cm, strigose on abaxial surface especially towards the base and glabrous on adaxial surface, margin somewhat recurved. Leaves usually imparipinnate, (1-)2-9 pairs of lateral leaflets, rarely unifoliolate, total length up to 5 cm long; petiole and rachis segments semiterete and very narrowly winged, the wings sometimes curved upwards to give a laterally compressed U-shaped cross section, often densely pubescent on adaxial surface along midrib, more sparsely hairy elsewhere, petiole up to 1 cm long (0.3 cm in unifoliolate leaves), rachis segments 0.3-0.5 cm long; lateral leaflets elliptical or sometimes obovate, the distal ones larger than the proximal ones (0.5-)1-1.7 × (0.3-)0.4-0.6 cm, base acute and almost equal, apex acute; terminal leaflet narrowly elliptical, narrowly obovate to elliptical, 1.6-1 × 0.4-0.7 cm long, base attenuate, apex acute; blades glabrous except for midrib which is sparsely strigose below, coriaceous, not punctate; margin sometimes thickened, crenulate with 4-6 notches on each side in the lateral leaflets; midrib slightly depressed above and prominent below, secondary veins flat or very slightly raised above and below.

Inflorescence a pair of dyads or individual racemes, the apical bud of main stem densely velutinous, axillary buds at most distal leaf-bearing node often present and densely velutinous; bud at apex of peduncles between racemes minute, velutinous; peduncles 0.8-1 cm long, racemes up to 5 cm long; inflorescence axes sparsely hairy. Flowers inserted in fascicles; floral bracts caducous; female and bisexual flowers seen; pedicel ca. 1.5 mm long, minutely sparsely

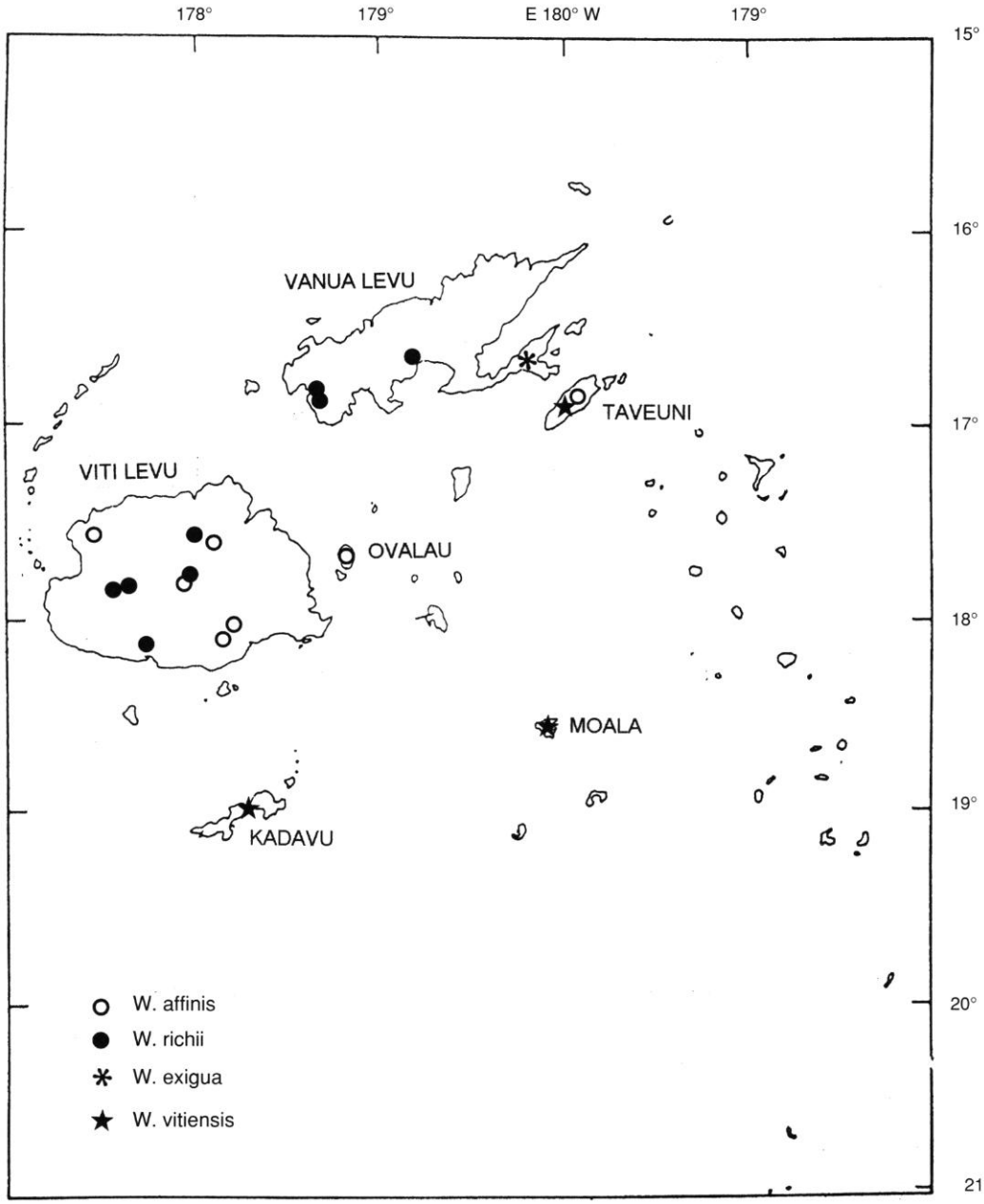

Fig. 10.—Distribution of ***Weinmannia*** in Fiji.

hairy; calyx lobes 0.6-0.7 mm long, glabrous; petals 1.1-1.4 × 0.6-0.7 mm, rounded or notched at apex; disc lobes 0.4-0.5 mm long; in female flowers: filaments ca. 1.3 mm and ovary ca. 1.3 mm long (but past anthesis), pubescent, with styles 1.2 mm long; in bisexual flowers: filaments ca. 4 mm long; ovary ca. 0.7 mm long at anthesis, densely velutinous, the styles 1.7-2 mm long. Immature fruit with ovary ca. 1.3 mm long, densely golden velutinous and styles ca. 2 mm long, glabrous, the calyx lobes mostly fallen, disc lobes persistent. Mature capsules and seeds not seen.—Fig. 5, 9A-C, 10.

BREEDING SYSTEM.—Polygamodioecious? *Horne 632* has female flowers and *Whitmore BSIP 995* (from the Solomon Islands) has bisexual ones.

FIELD CHARACTERS.—Habit appears to be variable as the type is described as a large shrub 10 ft. high, while in the Solomons it is a large tree.

DISTRIBUTION AND ECOLOGY.—Fiji (2 collections seen) and the Solomon Islands (1 collection seen). Habitats include high forest at 500-1000 ft. (*Howard 89*) and mountain top (*Horne 632*).

MATERIAL EXAMINED.—**FIJI**: ***Vanua Levu***: *Rangagone in Howard 89*, Thakaundrove, nr. tributary of Sovivi Creek, S of Karoko, Tunuloa District, Natewa Peninsula, st., May 1968 (BISH, K). Poorly collected but apparently common in montane forest.

Despite the wide disjunction, the leaves of the collections from the Solomons and Fiji are similar. *Weinmannia urdanetensis* also has numerous small leaflets and is the species which most resembles *W. exigua* but it differs in the details of the shape, texture and venation of the leaflets, and in the arrangement of the leaves. In the protologue, SMITH described the fruits and seeds but there are none on the type at K.

3. **Weinmannia affinis** A. Gray

U.S. Expl. Exped., Phan. 1: 674 (1854); Seem., Fl. Vit.: 110 (1865); Engl., Linnaea 36: 648 (1870), Nat. Pflanzenfam., ed. 2, 18a: 256 (1930); Reinecke, Bot. Jahrb. Syst. 25: 635 (1898); Gibbs, J. Linn. Soc. Bot. 39:145 (1909); Christoph., Bernice P. Bishop Mus. Bull. 154: 9 (1938), p.p.; A.C. Sm., J. Arnold Arbor. 33: 130 (1952); Bernardi, Bot. Jahrb. Syst. 83: 187, t. 30 (1964); J. Parham, Pl. Fiji Islands: 122 (1972, rev. ed.); A.C. Sm., Fl. Vit. Nova 3: 19, fig. 5A,B,E (1985).—Type: *US 48070*, Fiji (Feejee) Islands, on the mountains of Ovolau, 1200 ft., fr., U.S. Expl. Exped. under command of Capt. Wilkes (holo-, US 48070!; iso-, GH, K!, NY, P?).

Shrub or small compact tree 1-7 m high, rarely larger (20 m) or an epiphyte. Branching sometimes dichotomous (or into 4), the apical bud aborting, but not exclusively so; nodes somewhat thickened; glabrous except for young stems, inflorescence axes and pedicels shortly and sparsely strigose-pubescent, axillary buds sericeous, and ovary sometimes with short, sparse indumentum. Stipules variable in size, shape and persistence: either rhombic, obtrullate, ovate or broadly elliptical: either 0.5-1.1 × 0.35-0.6 cm and usually caducous when leaves small, or 1.1-1.9 × 0.6-1.6 cm, coriaceous and persistent, especially when leaves large; apex acute, almost round to cuspidate; margin sometimes toothed. Leaves simple, oblong, elliptical or broadly elliptical, the base decurrent into a short petiole 0.4-1.1(-1.6) cm long, the blade 1.8-9.8 × 1-4.8 cm, the apex acute to obtuse; punctate below; margin usually thickened, shallowly or markedly crenate or rarely sinuate, 9-14 notches down each margin of a leaf; midrib slightly raised above and prominent below, secondary and tertiary venation either flat, raised or obscure above and slightly raised below.

Inflorescence usually of 2 lateral triads or rarely 2 lateral pentads (central bud aborted), or sometimes 3 triads (central bud developed); further variants include four triads, developed from basal, lateral auxiliary buds, the central bud aborted; a few successive nodes of the main stem producing partial inflorescences simultaneously; peduncles 0.7-2.7 cm long; racemes usually short, 2.5-5 and not projecting beyond the foliage, rarely to 9 cm long; stipules at nodes within the inflorescence ligulate, sometimes persistent. Floral buds inserted singly; floral bracts not far exceeding length of buds, ligulate to cymbiform, ca. 0.7 cm long, not always fugaceous. Flowers unisexual or bisexual; pedicel 0.9-1.8 mm long;

calyx lobes 0.7-1.5 mm long; rarely pubescent; petals oblong or ovate, 1.2-1.8 × 0.9 mm; disc lobes 0.5-0.7 mm long; in male flowers: filaments up to 2.8-3 mm long, ovary ca. 1 mm long plus styles of 0.2 mm; in female flowers: filaments ca. 1 mm long; ovary (past anthesis) ca. 2 mm long plus styles 1.1 mm long.

Capsules 2.2-3.8 × 1.3-2.2 mm at dehiscence, the styles 1-1.3 mm long, the exocarp somewhat longitudinally ridged, glabrous or sparsely strigose-pubescent; calyx lobes caducous; free central column present. Seeds ca. 0.9 mm long, comose at both ends.—Fig. 10, 11A-F.

JUVENILE FOLIAGE.—*Hopkins & Bradford 5038*, 1 m high sapling: leaves 3-5 foliolate; leaflets chartaceous with serrate margin; stems, leaf rachis and underside of the midrib pubescent; stipules large, persistent, toothed. Small shrubs in open, disturbed areas had leaves relatively far down the stems, the lower ones usually trifoliolate and upper ones simple, sometimes with long internodes (ca. 10 cm).

BREEDING SYSTEM.—Polygamodioecious.

FIELD CHARACTERS.—Densely branched shrub or small compact tree 1-7(-20?) m high. Flowers white, the calyx and ovary pale green or white; petals and filaments white, stigmas tinged purple; disc lobes dark red and strongly contrasting with pale corolla; anthers pink or cream. Female inflorescences are comparatively small and inconspicuous, scarcely projecting beyond the foliage while male inflorescences are longer and exserted beyond the leaves (J.C. BRADFORD pers. obs.).

DISTRIBUTION AND ECOLOGY.—Highland regions of Viti Levu, Taveuni and Ovalau; also reported from Samoa. Recorded from dry open forest, dense ridge scrub and windswept thickets on mountain summit, escarpment edge and swamp, at (360-)700-1410 m on Viti Levu, 840-1100 m on Taveuni and 500-600 m on Ovalau. Common on summit of Mt. Victoria (Tomanivi). The form with large persistent stipules occurs in the Namosi District of Viti Levu and on Ovalau.

In March 1996 we found this species at three localities, always on the highest peaks and ridges in the vicinity and sometimes in boggy areas. Near Monasavu Dam, Viti Levu, in disturbed forest its associates included *Pullea glabra* and *Spiraeanthemum serratum* (Cunoniaceae), *Rubus*, *Vaccinium*, Melastomataceae, Zingiberaceae, *Lycopodium*, tree ferns and Gleicheniaceae (see *Hopkins & Bradford 5021*). On the summit of Des Voeux Peak, Taveuni, sterile shrubs 1-3 m high were one of the dominant components of disturbed areas near the telecom tower (*Hopkins & Bradford 5035*, *5039*) with *Scaevola floribunda*. It was also relatively common in undisturbed cloud forest with abundant *Freycinetia* along the ridge towards Lake Tagimaucia. *Weinmannia affinis* showed less synchrony in its reproductive behaviour than *W. richii*. Both within populations and within individuals we observed inflorescences at several stages of development including mature flowers.

Where *W. affinis* occurs at the same locality as other *Weinmannia* species, there appears to be some ecological separation between them. For instance, near Monasavu Dam, *W. affinis* was found as a small tree or shrub in fairly short forest near the road at its highest elevations (1070-1210 m) and *W. richii* was seen as a 20 m high tree in taller forest at lower elevation (ca. 840 m) in the same general area. On Des Voeux Peak, Tavenui, *W. affinis* was again found only near the summit and along ridges (ca. 1100 m) as a small tree, shrub or epiphyte while mature trees of *W. vitiensis* were only seen below 900 m in taller forest on the mountain slope.

SELECTED COLLECTIONS (from a total of 30 studied).—**FIJI**: ***Viti Levu***: *Bradford 591*, Tomanivi (Mt. Victoria), trail from Navai to ridge crest below summit, 17°38'S-178°01'E, fl., 30 Mar. 1996 (MO, P, SUVA); *Gibbs 642*, Nadarivatu, 2700 ft., fl., Sep. 1907 (BISH, BM, K); *Hopkins & Bradford 5022*, nr. Monasavu Dam, road S from dam, 1210 m, fl., 29 Mar. 1996 (MO, P, SUVA); *Koroiveibau DA 14184*, Ba, Mt. Evans Range, Natualevu, 3000 ft., fl., 8 Apr. 1965 (BISH, SUVA); *Koroiveibau & Qoro DA 14574*, Namosi, Mt. Nadobe, 2825 ft., fl., 16 Nov. 1965 (GH, L, SUVA); *Koroiveibau DA 14702*, Namosi, Mt. Vakarogosiu, summit, 3400 ft., fr., 23 Nov. 1965 (K, SUVA); *Kuruvoli DA 13890*, Nausori Highlands, 1900 ft., fr., 20 July 1964 (K, SUVA); *Parham DA 2201*, Namosi, Korobasabasaga, summit, 3950 ft., fl., 24 Mar. 1940 (A, BISH, SUVA); *Parham DA 2598 pro parte*, Namosi, Voma Peak, 2000 or 3000 ft., fl., 23 June 1939 (A, BISH, SUVA); *Smith 4905*, Mba

(formerly Tholo North), nr. Nandarivatu, 800-900 m, fr., 26 June-19 Oct. 1947 (A, BISH, K, L, P); *Thomerson DA 19527*, Nandronga-Navosa, Nausori Highlands, 850 m, fl., 29 Oct. 1985 (SUVA); *Webster & Hildreth 14204*, Mba, Tuvua, summit Mt. Victoria (Tomanivi), 4300 ft., fr., 13 July 1968 (GH, SUVA). ***Taveuni***: *J. & W. Ash DA 19957*, Lake Tagimaucia, Somosomo, 850 m, fr., 15 Sep. 1982 (SUVA); *Hopkins & Bradford 5036*, Des Voeux Peak, nr. telecom tower and ridge towards crater & lake, 1000-1100 m, buds, 2 Apr. 1996 (MO, P, SUVA); *Seemann 200*, Vuna (fide Smith), fr., 1860 (BM, GH, K, P); *Smith 878*, borders of Lake E of Somosomo, 700-900 m, fr., 29 Dec. 1933-8 Jan. 1934 (BISH, K). ***Ovalau***: *Smith 7608*, summit Mt. Ndelaiovalau, 575-626 m, fr., 11-25 May 1953 (BISH, GH, K, L, P, SUVA); *Smith 7704*, summit Mt. Tana Lailai, 500-550 m, fl., 1 June 1953 (BISH, GH, L, P, SUVA).

LOCAL NAMES.—Katakata (*Smith 4905*); Vure (*Gillespie 2736*).

VARIATION.—The size of the leaves and the size and persistence of the stipules are variable but the material cannot be readily divided into more than one taxon (see SMITH 1985). The majority of collections have small or medium sized, ± coriaceous leaves and small, caducous stipules (Fig. 11B). A few collections have larger leaves and some of these have large, persistent stipules that are rounded or pointed at the apex (Fig. 11A,C), e.g. *Smith 7608* from Ovalau, *Parham DA 2598 pro parte* and *Koroiveibau DA 14702* from Namosi region, Viti Levu.

4. **Weinmannia vitiensis** Seem.

Fl. Vit.: 110 (1866); Engl., Nat. Pflanzenfam., ed. 2, 18a: 256 (1930); A.C. Sm., J. Arnold Arbor. 33: 135 (1952); Bernardi, Bot. Jahrb. Syst. 83: 207, t. 38 (1964); J. Parham, Pl. Fiji Islands: 125 (1972, rev. ed.); A.C. Sm., Fl. Vit. Nova 3: 22 (1985).—Type: *Seemann 199*, Fiji, Kadavu (holo-, K!, photo US!; iso-, BM!, P!, also G, GH, MEL, NSW *fide* HOOGLAND).

Shrub or tree 3-20 m high. Branching often dichotomous. Stems woody, somewhat thickened at nodes, annular scar visible, internodes ca. 0.7-3 cm long. Young stems minutely or sparsely strigose, older stems glabrous with numerous prominent lenticels, axillary buds densely velutinous, acute at apex. Stipules fugaceous even in vegetative material, ligulate to shortly spathulate, apex rounded to acute, to 3 mm long, minutely hairy to ± glabrous. Leaves usually trifoliolate, rarely simple, total length up to 8 cm including petiole of 0.9-2 cm; petiole semiterete and narrowly winged, especially distally, midrib prominent above, glabrous; lateral leaflets elliptical (2.1-)3.3-4.7 × (0.8-)1-1.6 cm, unequal at base, acute at apex; terminal leaflet elliptical or sometimes narrowly obovate, often larger and broader than the laterals, 4.3-6.5 × 1.3-2 cm, base attenuate, apex acute; leaflet blades glabrous, coriaceous, punctate below; margin sometimes thickened, crenate, the crenations acroscopic, 11-13 on each side of a leaflet; midrib slightly raised above and prominent below, secondary and tertiary venation slightly raised on both surfaces, often drying paler than intervenium.

Inflorescence a central triad or pentad with the lower racemes either in axils of leaves or not, or in the axils of reduced leaves, sometimes also with a pair of lateral triads; sometimes a few successive nodes on a shoot producing partial inflorescences simultaneously; lateral auxiliary buds sometimes present at lower nodes of inflorescence; peduncle and rachis segments 0.7-1.3 cm long, sparsely pubescent, racemes 4-7 cm long. Floral buds inserted singly; floral bracts to 1 mm, cymbiform or dagger-shaped, almost glabrous, caducous. Flowers unisexual; pedicel 0.2-3 mm long, almost glabrous; calyx lobes 0.6-0.8 mm long, glabrous; petals 0.9-1.5 mm long; disc lobes 0.3-0.8 mm long; in male flowers: filaments 2-2.5 mm long, the anthers 0.5 mm long and ovary ca. 1 mm long, glabrous, the styles 0.2-0.3 mm long; in female flowers: the filaments to ca. 0.7 mm, ovary (post anthesis) 1.1-1.5 mm long, sparsely strigose, the styles ca. 0.5 mm long.

Capsules 1.8-2.5 × 0.9 mm at dehiscence, the styles 0.5 mm or less long, the exocarp sparsely strigose, with minute longitudinal ridges, calyx lobes not persistent, central column present. Seeds ca. 0.7 mm long, ca. 16 per capsule, comose at both ends.—Fig. 10, 11G-K.

JUVENILE FOLIAGE.—Differs markedly from adult: see *Hopkins & Bradford 5042*, from a sapling 3.5 m tall growing in shade, Taveuni:

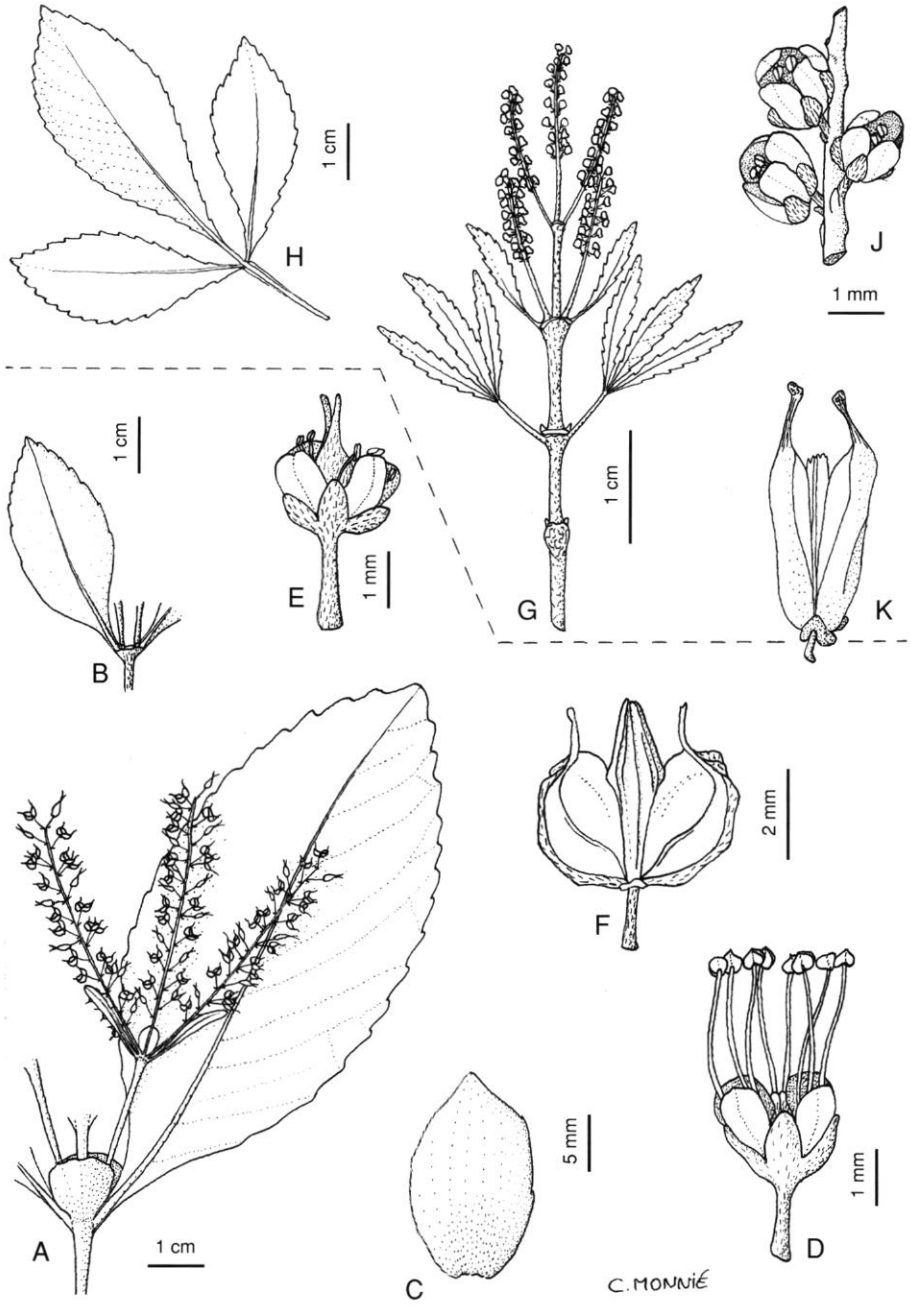

Fig. 11.—**A-F**, ***Weinmannia affinis***: **A**, shoot with large simple leaves and persistent stipules; infructescence a triad with reduced leaves at node; **B**, shoot with small simple leaves, the stipules caducous; **C**, stipule from A; **D**, male flower; **E**, female flower; **F**, dehisced capsule. (A, C, F, *Smith 7606*; B, *Seemann 200*; D, *Gibbs 642*; E, *Parham 2201*).—**G-K**, ***Weinmannia vitiensis***: **G**, shoot with an immature inflorescence (pentad) and reduced leaves at two nodes; **H**, leaf with slightly winged petiole; **J**, section of inflorescence axis showing flower buds inserted singly; **K**, dehisced capsule. (G-K, *Bryan 317*).—Drawn by C. Monnié.

leaves imparipinnate with 2-4 pairs of leaflets; leaflet margins crenate; petioles terete (not winged) with dense, erect hairs; stipules large, almost round, toothed.

BREEDING SYSTEM.—Dioecious. Flowers unisexual but little material is available.

FIELD CHARACTERS.—Dense shrub or tall, canopy tree, sometimes gnarled. Bark rough, scaly, light grey; sapwood orange-brown, coarse; heartwood yellow-brown, moderately hard. Flowers white with a slight fragrance; pedicel and calyx pale green, corolla and filaments white, anthers cream, disc lobes dark brown-red.

DISTRIBUTION AND ECOLOGY.—Known only from three of the smaller Fijian high islands at 300-900 m. Habitats include tall, dense forest on mountain slope (*Hopkins & Bradford 5041*), and forest on summit ridge (*Bryan 317*); also in open areas among bracken; locally frequent.

MATERIAL EXAMINED.—**FIJI**: ***Kadavu***: *Seemann 199*, buds, 1860 (BM, K, P), type. ***Taveuni***: *Hopkins & Bradford 5041*, Des Voeux Peak, W side, 900 m, fl., 2 Apr. 1996 (MO, P, SUVA); *Smith 8401*, hills E of Somosomo, W of old crater, 660-900 m, st., 18 Aug. 1953 (BISH, GH, K, L, P, SUVA). ***Moala***: *Bryan 317*, summit ridge, 300 m, buds, fr., 11 July 1924 (BISH, K); *Smith 1354*, Ndelaimoala, fr., 20-24 Mar. 1934 (BISH, K, P); *Harvey s.n.*, Feegee (sic) Islands, s.loc., Nov. 1855 (K).

LOCAL NAME.—Molau ndamu (*Smith 1354*).

RELATIONSHIPS.—Regarded by SMITH (1985) as not sharply distinct from *Weinmannia richii*, but the structure of the racemes and the inflorescences are quite different and these species belong to different sections of the genus. On present evidence there is no overlap in the distributions of *W. vitiensis* and *W. richii*.

Besides the differences in the leaves and habitat between *Weinmannia vitiensis* and *W. affinis*, in the former the apical buds of the shoots abort less often so that dichotomous branching is less frequent.

BERNARDI (1964) included *Weinmannia raiateensis* J.W. Moore (from Raiatea, Society Islands) in *W. vitiensis*. Both have trifoliolate leaves with a narrowly winged rachis; the leaves of *W. raiateensis*, however, tend to be smaller and less coriaceous than those of *W. vitiensis*.

Doubtful species

Weinmannia spiraeoides A. Gray

U.S. Expl. Exped., Phan. 1: 677 (1854); Seem., Fl. Vit.: 110 (1865), Engl., Linnaea 36: 644 (1870), Nat. Pflanzenfam., ed. 2, 18a: 256 (1930); A.C. Sm., J. Arnold Arbor. 33: 133 (1952); Bernardi, Bot. Jahrb. Syst. 83: 208 (1964); J. Parham, Pl. Fiji Islands: 125 (1972, rev. ed.); A.C. Sm., Fl. Vit. Nov. 3: 20 (1985).—Type: *US 48073*, Fiji (Feejee) Islands, Ovolau, U.S. Expl. Exped. under the command of Capt. Wilkes (holo-, US 48073!).

Known only from the sterile type which has chartaceous, 3-5-foliolate leaves with dentate margins and toothed stipules. It appears to be juvenile foliage of *Weinmannia* as suggested by SMITH (1985). However, immature foliage is so variable as to preclude identification in most cases (see HOPKINS 1998a). It is unlikely that this name represents a distinct taxon.

V. WEINMANNIA IN SAMOA AND THE COOK ISLANDS

Weinmannia has been collected from Savai'i and 'Upolu in Western Samoa and from Tutuila and the Manua group (Ta'u and Olosega) in American Samoa. It also occurs on Rarotonga in the Cook Islands to the SE but is not known from Tonga or Niue. Three species have been described fom this region: *W. samoensis* A. Gray, *W. manuana* Christoph., and *W. rarotongensis* Hemsl. in Cheeseman (HOPKINS & FLORENCE 1998, Fig. 7F-M); all belonging to sect. *Leiospermum*. *Weinmannia affinis* and *W. richii* from Fiji have also been reported (CHRISTOPHERSEN 1938; BERNARDI 1964).

Three treatments of *Weinmannia* have been published for this region, none of them satisfactory. CHRISTOPHERSEN (1938) recognised four species: *W. manuana*, *W. affinis*, *W. richii* and *W. samoensis* and did not discuss *W. rarotongensis*. SMITH (1952) considered all the species in Samoa to be endemic and recognised *W. samoensis*, *W. manuana* and *Weinmannia sp.* (based on *Christophersen 787*, *2561*, *2735*, all sterile); *Christophersen 534* (also sterile) was

unplaced; *W. rarotongensis* was separated from *W. samoensis* by implication. BERNARDI (1964) placed *W. manuana* into synonomy with *W. affinis*, included *W. rarotongensis* in *W. samoensis*, and recognised *W. richii*, based on *Christophersen 534*, *787* and *Rechinger 1647*. Thus none of his species was endemic to Samoa.

A. WHISTLER (pers. comm.) and J.C. BRADFORD (pers. comm.) have seen *Weinmannia* growing in Samoa, and both consider that there is only a single, variable species in this group of islands, whose leaves can therefore be unifoliolate, trifoliolate or imparipinnate. BRADFORD (pers. comm.) found that at lower elevations, trees usually had 3-7 leaflets per leaf and at higher elevations, 1-3 leaflets per leaf.

From studies of herbarium specimens, I have failed to reach a conclusion about the taxonomy of species from Samoa and the Cook Islands, and to avoid making matters worse, will comment only on the possible occurrence of the Fijian species. All the trifoliolate collections I have seen from Samoa referred by BERNARDI and CHRISTOPHERSEN to *Weinmannia richii* are sterile and likely to be juvenile specimens of other taxa. I have seen no fertile material from Samoa which could be equated with *W. richii*, which should therefore be considered endemic to Fiji. Several specimens with small, unifoliolate leaves from Samoa cannot be separated from *W. affinis* although many of the unifoliolate collections fall outside the range of the Fijian material. It is thus not clear at present whether *W. affinis* is endemic to Fiji or not.

The structure of the inflorescence of all collections seen from Samoa and Rarotonga is typical for sect. *Leiospermum*.

VI. WEINMANNIA IN NEW CALEDONIA (with R.D. HOOGLAND†)

Four endemic species of *Weinmannia* occur in New Caledonia (HOOGLAND, unpublished manuscript at P). Full synonomy, descriptions and citation of specimens will be published in the "Flore de la Nouvelle-Calédonie" and only a summary is given here. The taxonomic changes indicated here should be attributed to HOOGLAND, and in the citation of types below, ! shows that a specimen has been seen by him.

All the species in New Caledonia belong to sect. *Leiospermum* and appear more closely related to one another than to other members of the section. They have small, caducous, usually ligulate stipules in mature foliage; juvenile foliage may have more persistent, salverform stipules. The flowers are bisexual and white, and the calyx lobes usually fall in fruit. In *Weinmannia dichotoma*, *W. paitensis* and *W. ouaiemensis*, vegetative growth often involves dichotomous branching, and in the inflorescence, the apical bud is often aborted. When this is not so, the apical and axillary buds usually develop equally. Lateral auxiliary buds are especially prominent in the inflorescences of *W. dichotoma* (see HOPKINS 1998a, Fig. 3M).

Key to the species of New Caledonia

1. Leaves on reproductive branches always simple ..... **2. W. paitensis**
1'. Leaves on reproductive branches trifoliolate 2
2. Vegetative growth usually by development of both apical and axillary buds, i.e. branching not dichotomous; inflorescence usually a central, apical triad (or sometimes a pentad), often with two lateral triads .... **1. W. serrata**
2'. Vegetative growth almost exclusively by development of shoots from lateral, axillary buds, the apical bud aborted, i.e. branching dichotomous, though the branches sometimes unequal; inflorescence usually a pair of lateral dyads or triads, the apical bud aborted (rarely otherwise) 3
3. Young shoots sparsely hairy to glabrescent; upper surface of leaflets glabrous; pedicel 0.3-0.5 mm diameter, glabrous or briefly and sparsely hirsute; filaments 2.5-4.5 mm long; ovary sparsely strigose with 8-12 (-14) ovules per locule; styles 2-3 mm long ..... **3. W. dichotoma**
3'. Young shoots and inflorescence axes densely tomentose; upper surface of leaflets loosely histute, glabrescent; pedicel 0.5-0.7 mm diameter, moderately hirsute; filaments 5.5-6 mm long; ovary strigose-hirsute with 12-16 ovules per locule; styles 2-3 mm . ..... **4. W. ouaiemensis**

1. Weinmannia serrata Brongn. & Gris

Bull. Soc. Bot. France 9: 73 (1862).—Type: *Vieillard 572*, Hab. in montibus Novae Caledoniae, prope Balade (holo-, P!; iso-, NSW!).

Vegetative branching often dichotomous. Leaves subcoriaceous, not punctate below. Inflorescence usually a central triad or pentad, often with lateral triads developing from axillary buds (i.e. apical bud reproductive, rarely aborted); reduced leaves sometimes present at nodes within the inflorescence.

Tree up to 25 m, widespread on Grande Terre in humid forest and gallery forest between 150-800 m, on greywackes, schist and basalt.—Fig. 12A-E.

2. Weinmannia paitensis Schltr.

Bot. Jahrb. Syst. 39: 124 (1906).—Type: *Schlechter 14941*, New Caledonia, Sud-Bezirk: auf dem Gipfel des Mont Mou bei Paita, ca. 1250 m (holo-, B; iso-, BM, BR, E, G, K, L!, LAU, LE, M, NSW!, P!, W, Z! *fide* BERNARDI and HOOGLAND).

Weinmannia ?thornei Guillaumin in Guillaumin et al., Stud. Nat. Hist. Iowa Univ. 20: 31 (1965).—Type: *Thorne 28733*, New Caledonia, Mt. Mou, 1050 m, 8 Nov. 1959 (holo-, P!; iso-, L!, P!, RSA, Z); *syn. nov.* of HOOGLAND.

Vegetative branching usually dichotomous; dichotomous branching is fixed in juvenile plants while in adult foliage, branching can be dichotomous or not (J.C. BRADFORD pers. comm.). Leaves on reproductive shoots simple but foliage on lower branches within the crown trifoliolate. Leaves coriaceous, often punctate below. Inflorescence a pair of lateral dyads or triads, the apical bud aborted; dyads without buds between the racemes.—Fig. 12F-H.

A small tree known from Mt. l'Aoupiné and several mountains towards the south, including Mt. To, Mt. Kouakoué, Mt. Ouin and Mt. Mou, in dense humid forest from (500-)950-1300 m, on ultrabasic or schistose rocks.

3. Weinmannia dichotoma Brongn. & Gris

Bull. Soc. Bot. France 9: 73 (1862).—Type: *Vieillard 569*, Hab. in montibus Novae Caledoniae, prope Balade (lecto- of BERNARDI, P!; isolecto-, P!).

Weinmannia monticola Däniker, Vierteljahrsschr. Naturf. Ges. Zürich 76 = Mitt. Bot. Mus. Zürich 137: 165 (1931).—Type: *Däniker 1812*, New Caledonia, auf den flanchen Hohenrucken an der Westflanke des Ignambi, 6 June 1925 (holo-, Z!); *syn. nov.* of HOOGLAND.

Vegetative branching largely dichotomous. Leaves on reproductive shoots trifoliolate, those on lower leaves and immature foliage 3-7-foliolate. Leaves coriaceous, often punctate below. Inflorescence a pair of dyads or sometimes triads in larger-leafleted specimens, the apical bud aborted. Auxiliary buds at base of peduncle, in a plane perpendicular to that of the leaf-bases, large and conical.

Shrub or small tree up to 12 m. Widespread on Grande Terre in humid forest on mica-schist at 400-1550 m and ultrabasic substrate between 950 and 1300 m.

BERNARDI (1964) regarded *W. monticola*, with larger leaflets, as distinct from *W. dichotoma* but there are numerous intermediates. The possibility of any ecological differences correlated with leaflet size needs to be investigated in the field.

On Mt. Mou, the shape of the leaves approaches that of *W. serrata*, with a fairly sinuate margin. On both Mt. Ouin and Mt. Mou it grows in close proximity to *W. paitensis* in *Nothofagus* cloud forest on deep, peaty soil (BRADFORD & HOPKINS pers. obs.). The immature foliage of these two species can be difficult to separate although mature canopy foliage is clearly distinct.

4. Weinmannia ouaiemensis (Guillaumin & Virot) Hoogland, **comb. nov.**

Cunonia ouaiemensis Guillaumin & Virot, Mém. Mus. Natl. Hist. Nat., sér. B, Bot. 4: 28 (1953).—Type: *Virot 731*, New Caledonia, Arête rocheuse menant au Mt. Mi (versant W) point culminant du massif de la Roche Ouaième, 1050 m (holo-, P!; iso-, A, P! 2 sheets).

Vegetative branching dichotomous. Leaves trifoliolate, the petiole not winged; blade coriaceous, punctate below, the margin revolute; white

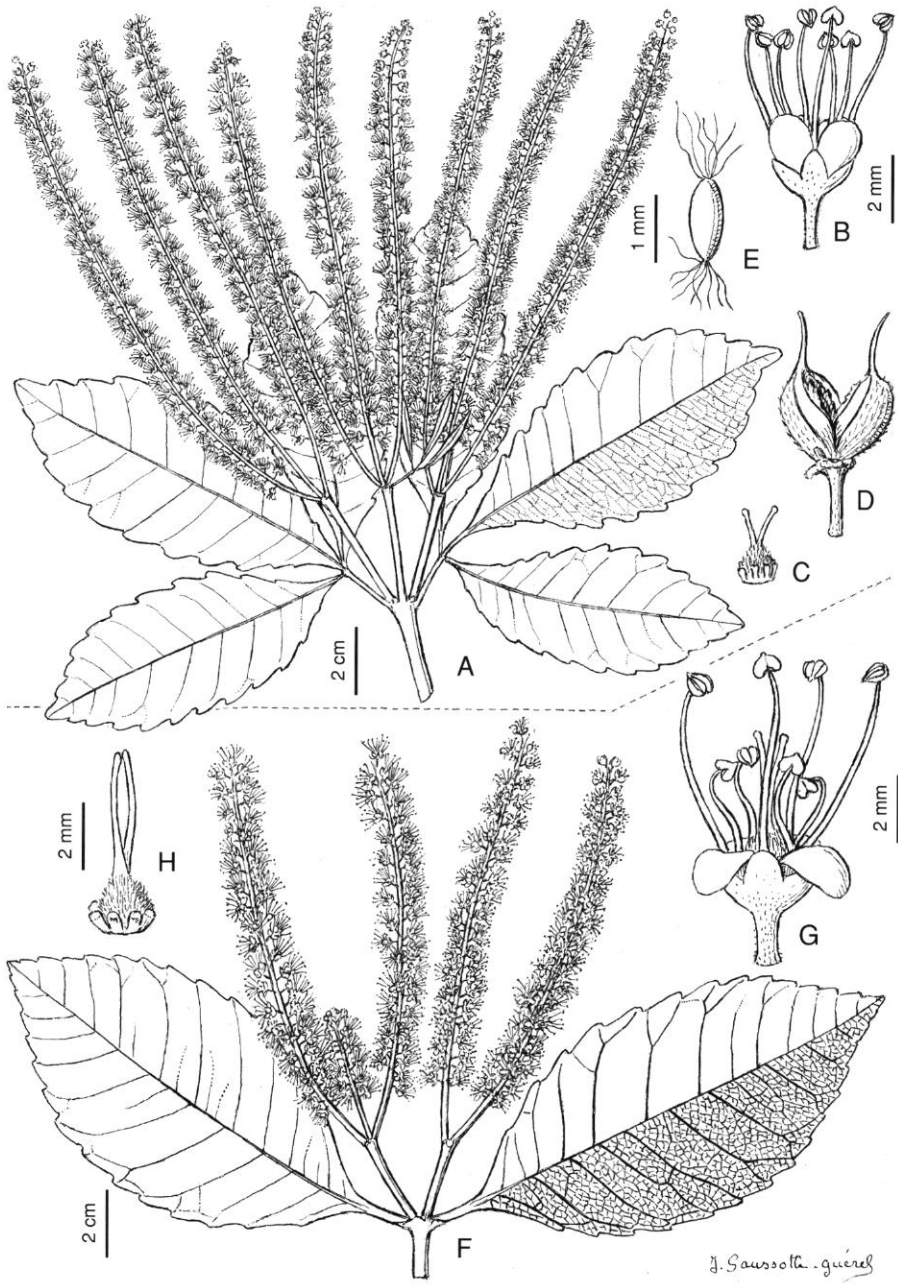

Fig. 12.—**A-E**, ***Weinmannia serrata***: **A**, flowering shoot with an inflorescence of three triads; one triad has an reduced leaf at the node where the racemes arise; note small auxiliary buds at base of lateral triads; **B**, bisexual flower at anthesis; **C**, gynoecium and disc lobes; **D**, dehisced fruit; **E**, seed. (A-C, *MacKee 25614*; D, E, *MacKee 18445*).—**F-H**, ***Weinmannia paitensis***: **F**, flowering shoot with an inflorescence of one triad and one dyad, the apical bud aborted; **G**, bisexual flower at anthesis; **H**, gynoecium and disc lobes. (F-H, *Thorne 28733*).—Drawn by J. SAUSSOTTE-GUÉREL.

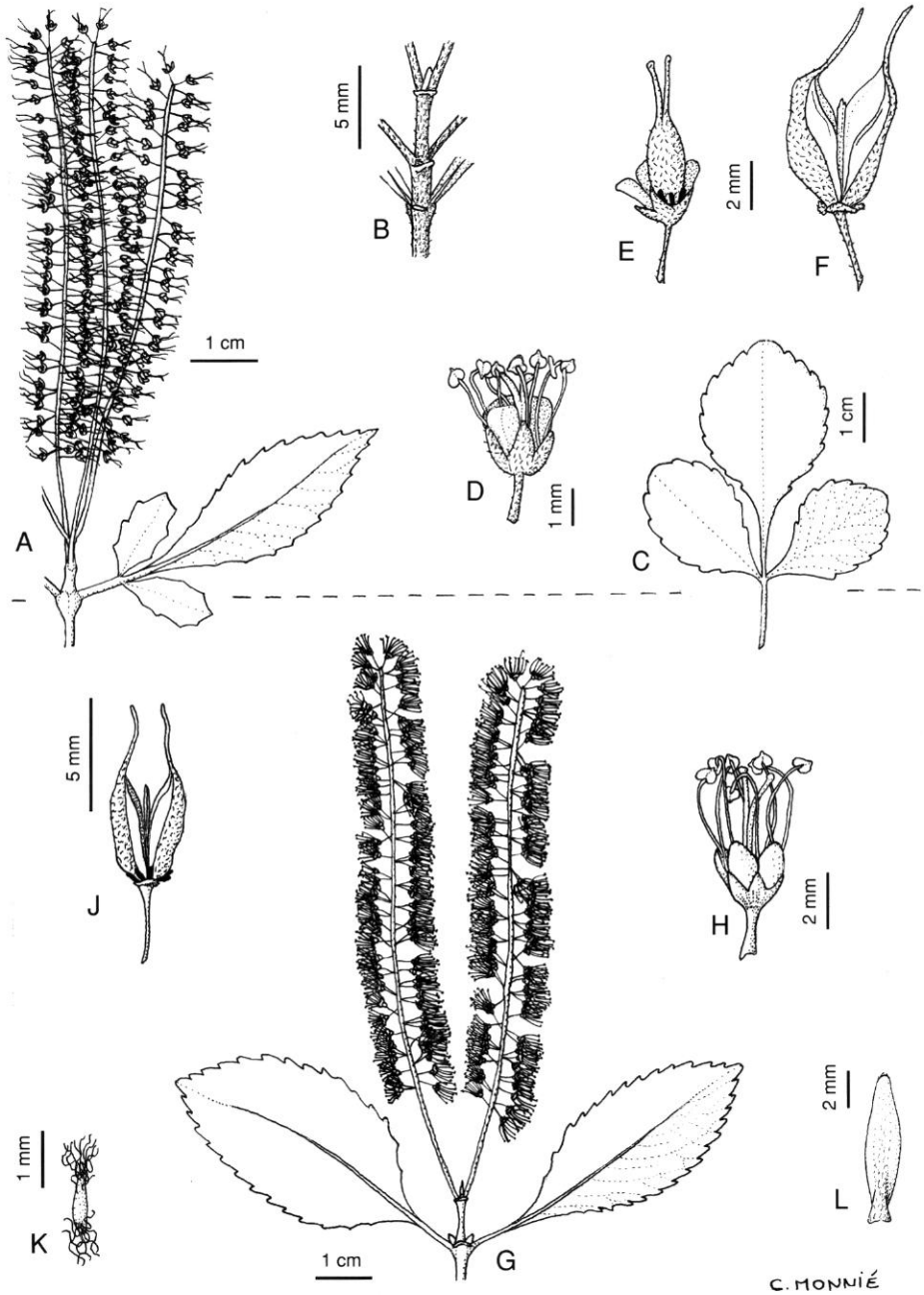

Fig. 13.—**A-F**, ***Weinmannia sylvicola***: **A**, shoot with infructescence of two sequential pairs of racemes; **B**, detail of A showing bases of opposite petioles at lowest node, bases of opposite and decussate racemes at subsequent nodes and dormant apical bud; **C**, trifoliolate leaf; **D**, bisexual flower; **E**, immature fruit; **F**, capsule at dehiscence. (A, B, D, E, *Hynes s.n.*, 10 Feb. 1952; C, *Colenso s.n.*; F, *van Steenis 22314*).—**G-K**, ***Weinmannia racemosa***: **G**, flowering shoot (inflorescence a median dyad with a dormant apical bud); **H**, bisexual flower; **J**, capsule at dehiscence; **K**, seed; **L**, stipule. (G, H, *Varekamp 97*; J, K, *Lam 7083*; L, *van Zaten 1331*).—Drawn by C. MONNIÉ.

deposit on upper surface of old leaves. Inflorescence a pair of lateral dyads (without a bud between the racemes) or triads, the apical bud usually aborted or rarely developed into a dyad.

Stunted shrubs endemic to Roche Ouaième, in exposed thicket and low humid forest on mica-schist, between 700-1150 m.

VII. WEINMANNIA IN NEW ZEALAND

There are two closely related allopatric species occurring in New Zealand: *Weinmannia racemosa* L. f. occurs on South and North Islands, as far north as Hamilton, and *W. sylvicola* Sol. ex A. Cunn. is found on North Island, to the north of Hamilton (BERNARDI 1964; WARDLE 1966). These two species appear to be closely related and are superficially similar to one another, but the adult leaves of *W. racemosa* are usually simple (Fig. 13G) while those of *W. sylvicola* are usually trifoliolate (Fig. 13A,C) (and see WARDLE for further differences).

In both species the flowers are inserted singly in the axils of bracts on the racemes, as in other species of sect. *Leiospermum*. Other characters that they share with most species of this section are: leaves often punctate below; leaf rachis slightly expanded; stipules caducous and where present, ligulate not orbicular (Fig. 13L); calyx lobes fallen in fruit (Fig. 13F,J) (a few exceptions); calyx lobes glabrous or sparsely strigose. These species also show a number of features which are not widespread within the section. The flowers are somewhat perigynous (Fig. 13E) (rather than hypogynous), and they may have a greater tendency to be 5-merous or to have a 3-merous ovary than other Pacific species. The flowers are bisexual (Fig. 13D,H), as in the New Caledonian species, where as in most Pacific species the majority of inflorescences have unisexual flowers. The inflorescences differ somewhat from those of other Pacific species and are described by HOPKINS & BRADFORD (HOPKINS 1998a).

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