

ROSACEAE

(C. Kalkman, Leiden, The Netherlands)

Rosaceae Juss., Gen. Pl. (1789) 196, nom. cons.; Hutch., Gen. Flow. Pl. 1 (1964) 174–216; Vidal, Fl. Camb., Laos & Vietnam 6 (1968) 1–210 (excl. *Rubus*); Nguyen Van Thuan, ibid. 7 (1968) 1–83 (*Rubus*); Vidal, Fl. Thailand 2 (1970) 31–74 (*Rubus* by Nguyen Van Thuan); Tirvengadum, Fl. Ceylon 3 (1981) 328–378. — Type genus: *Rosa* L.

Woody or herbaceous plants. *Leaves* usually spirally arranged, sometimes distichous, rarely opposite (not in Malesia), simple or compound. *Stipules* on the twig or on the base of the petiole, free or adnate to petiole, rarely absent. *Inflorescences* various. *Flowers* usually bisexual and actinomorphic. *Hypanthium* ('calyx tube' of many authors) usually very distinct, from saucer-shaped to tubular or campanulate, the sepals, petals, and stamens inserted on its rim, its inside usually lined by a nectariferous disk. *Sepals* usually 5, free, in some tribes an *epicalyx* also present. *Petals* usually 5, free, from large and showy to small and not or hardly distinct from sepals, in some genera/species absent. *Stamens* usually numerous, but sometimes the number distinctly related to the number of perianth leaves, filaments free, anthers bilocular, dehiscing longitudinally. *Pistil(s)* 1 to many, free or variously connate with each other and/or with the hypanthium, ovary(ies) superior to inferior, style(s) present, ovule(s) 1 to several (often 2) per locule, anatropous, ascending or pendulous. *Fruits* various, fleshy or dry, dehiscent or not. *Seed(s)* 1 to several, without or with scanty endosperm, cotyledons fleshy or flat.

Distribution — A large family with worldwide distribution, including more than 3000 species in c. 100 genera. Almost all genera which are represented in Malesia have their actual centre of distribution in temperate to subtropical regions on the Northern Hemisphere. Some of those are large or medium large genera with only one or two species in Malesia (*Rosa*, *Alchemilla*, *Eriobotrya*), others have a more or less distinct sub-centre in the Malesian region (*Prunus*, *Rubus*, *Potentilla*). Exceptional is *Acaena*, a genus with a Southern Hemisphere distribution, of which one species also occurs in New Guinea.

Kalkman [Bot. J. Linn. Soc. 98 (1988) 37–59] postulated a Southern (Gondwanan) origin for the family and migration via three routes. Malesia in this view was reached mainly from the Asian continent (Laurasia), which in turn was reached by way of South, Central, and North America and via Beringia. Partly maybe the continent was also reached directly from Gondwana by transport on the Indian 'raft' (*Alchemilla*?). A third route was via Australia (*Acaena*). Most authors, however, favour a Laurasian origin for the family.

Habitat — The majority of Malesian *Rosaceae* belongs to the mountain flora and occurs only above 1000 à 1500 m altitude, in montane forest types, thickets or (sub)alpine grasslands. Only in the genus *Rubus* (a dozen species) and in *Prunus* (more than 20 species) an appreciable proportion of the species are (also) found in the lowlands.

Ecology — As is true for almost all Malesian higher plant families, no autecological research has been carried out for members of *Rosaceae*. From the habitats where the species have been collected, some superficial conclusions may be drawn about preferences or tolerances for light, temperature and soil conditions and wherever possible, the paragraphs on Habitat and Ecology contain this kind of information.

Pollination is undoubtedly normally by (unspecified) insects, as in the European relatives. Apart from the formation of a good quantity of pollen and the secretion of nectar by the disc, there are no specializations in the flowers related to pollination by specific kinds of insects. Only for *Acaena* wind-pollination might be inferred, but experimental or observational evidence is lacking in literature or on labels.

For **dispersal** most *Rosaceae* rely heavily on animals. Exceptions are found in genera with multi-seeded follicles with dry seeds (in Malesia only *Neillia*) where dispersal is by ballistochory. The same is true for most of the *Potentilla* species that have the dry achenes in the cups formed by the hypanthium, sepals and epicalyx. Some genera have dry achenes, imbedded in or surrounded by a fleshy spurious fruit (*Rosa* and also the not indigenous *Fragaria* and *Potentilla indica*). In these cases the hypanthium, resp. the torus functions as the attractant for endozoochory by snails, birds, or other animals. Many *Rosaceae* of different tribes have gone the way to fruits with a fleshy or juicy layer in their walls (drupes, either single or as collective, or pomes) and obviously these are also endozoochorous. Epizoochory is only exercised by *Acaena* and *Agrimonia* which possess spines on their hypanthium in which the fruit is included.

Taxonomy and Phylogeny — In modern systems the *Neuradaceae* and the *Chrysobalanaceae* [for the latter, see Flora Malesiana I, 10 (1989) 635–678] are mostly not included in *Rosaceae*, as in earlier classifications, but recognized as families in their own right.

In the family *Rosaceae* as implied in the previous paragraph usually four subfamilies are distinguished: *Spiraeoideae*, *Rosoideae*, *Maloideae* (*Pomoideae*), and *Prunoideae* (*Amygdaloideae*). The last-mentioned two groups are undoubtedly two end-branches in the phylogenetic tree, well recognizable, distinct, and natural (holophyletic) taxa. This cannot be said for the two other subfamilies. The group *Spiraeoideae* contains the genera with dry, dehiscent fruits. Dehiscent follicles is a plesiomorphic (primitive) character in the family and the genera possessing this character should better be included in a taxon with the genera that have been derived from them. Considering the likeness of the flowers of some *Spiraeoideae* and those of some *Maloideae* like *Cotoneaster* and *Pyracantha*, I would be inclined to enlarge the subfamily *Maloideae* with at least part of the Spiraeoid genera.

The *Rosoideae* are quite heterogeneous and they have probably to be united with other, 'Spiraeoid', genera to form another holophyletic branch, in which maybe some subdivision is possible.

A phylogenetic analysis, only considering morphological characters [Kalkman, Bot. J. Linn. Soc. 98 (1988) 37–59] was not successful and should be repeated with an augmented set of characters, also anatomical and chemical ones. Awaiting this, the recognition of the four classical subfamilies is hardly justified.

The next lower level of classification was used by Hutchinson, l.c., who divided the family in some twenty tribes. Some of these are heterogeneous, some others contain only one or two 'difficult' genera that have not yet found a good place with their nearest relatives in the phylogenetical sense.

The firm core of a tribal classification consists of the following tribes:

- S *Spiraeae* (see p. 244)
- S *Neillieae* (see p. 245)
- S *Gillenieae* (maybe to be split into two tribes) (not in Malesia)
- R *Rubeae* (see p. 247)
- R *Potentilleae* (see p. 285)
- R *Dryadeae* (probably to be divided into two tribes) (not in Malesia)
- R *Poterieae* (see p. 297)
- R *Alchemilleae* (usually included in *Potentilleae* or *Poterieae*) (see p. 301)
- R *Roseae* (see p. 303)
- M *Maleae* (*Pomeae*) (see p. 306)
- P *Pruneae* (including *Osmaronia*?) (see p. 319)

S = tribes belonging to *Spiraeoideae* in the classical sense; R = *Rosoideae*; M = *Maloideae*; P = *Prunoideae*.

— The following genera have not found a natural place in one of the eleven (or thirteen after dividing two of them) tribes mentioned above:

- the genera composing the tribe *Quillajeae* in Hutchinson's classification, a rather heterogeneous assemblage of Spiraeoid problem cases: *Quillaja*, *Kageneckia*, *Exochorda*, *Lindleya*, *Vauquelinia*, *Lyonothamnus*;
- a number of lone genera of uncertain disposition as to tribe and often also subfamily: *Holodiscus*, *Rhodotypos*, *Kerria*, *Neviusia*, *Cercocarpus*, *Coleogyne*, *Filipendula*, *Potaninia*, *Adenostoma*.

None of the genera mentioned above occur in Malesia.

Morphology — As apparent from the family description, there is variation in many characters of leaves, flowers, and fruits. The presence of a well-developed hypanthium, a probably axial outgrowth from the top of the pedicel surrounding the pistil(s), is about the only character that is common to all *Rosaceae*. The elaboration of this hypanthium causes much of the variation in flowers and fruits. The plesiomorphic (original) situation is still present in Spiraeoid genera that have a small number (up to 5) multi-ovulate ovaries on the bottom of a cupular hypanthium, the ovaries developing into ventrally dehiscent, dry-walled follicles containing several seeds.

Adnation of the ovaries to the inside of the hypanthium, accompanied by a more or less complete fusion of the ovaries with each other, creates the possibility for the evolution of the fleshy, (semi-)inferior fruits that are typical for *Maloideae*. In this group the exocarp of the inferior fruit is certainly hypanthial, the endocarp (membranous to woody) is certainly carpellary, the more or less fleshy mesocarp may be either or both. In the descriptions in this treatment the terms exocarp, mesocarp, and endocarp are used in

their topographical sense, for superior as well as inferior fruits and thus not implying a carpillary origin.

Another line of evolution is the change of dry, multi-seeded follicles into dry, 1-seeded achenes, that later may develop a fleshy fruitwall and become drupaceous. Examples are manifold in *Rosoideae* (e.g. *Rubus* with many pistils per flower) and all *Prunoideae* have drupes too, with one pistil per flower.

Vegetative Anatomy — Although many papers have been published on the leaf anatomy of the *Rosaceae*, little is known of the anatomy of the tropical representatives, especially of the Malesian species. The situation for wood anatomy is much better with recent comprehensive studies by Zhang (1992), Zhang & Baas (1992) and Zhang et al. (1992). The following is a concise summary for the Malesian representatives (wild and cultivated) of data surveyed more extensively in Metcalfe & Chalk (1950) and the above-mentioned wood anatomical studies, amplified with scattered data from the other papers cited below.

Leaf anatomy. Trichomes if present usually unicellular, but tufted or stellate hairs occur in *Potentilla* p.p. and *Rubus* p.p.; stalked capitate glands have been recorded in *Alchemilla*, *Fragaria*, *Potentilla*, *Prunus*, *Rosa*, *Rubus*, and *Sanguisorba*. Epidermal cells of lower epidermis sometimes papillate.

Extrafloral nectaries present on the petiole and various parts of the leaf blade of *Prunus* p.p.; leaf teeth glandular or hydathodal in species of *Alchemilla*, *Fragaria*, *Prunus*, *Pyrus*, *Rubus*, *Sanguisorba*, and *Spiraea*. Stomata almost always confined to the lower leaf surface, usually anomocytic, but cyclocytic, staurocytic, tetracytic, and actinocytic types may also occur (Lu et al. 1991). Upper epidermal cells often (partly) mucilaginous. A hypodermis is differentiated in some species of *Prunus* ('Pygeum') and *Rubus* (section *Micranthobatus*). Mesophyll dorsiventral. Vascular bundles of minor veins with or without sclerenchyma in bundle sheath, only rarely vertically transcurrent. Vascular system of midrib and petiole ranging from a single collateral bundle to more complex, open or closed systems. Nodes usually trilacunar, but 5-, 7-, and 9-lacunar nodes recorded in *Rubus* (Kato 1966, 1967). Crystals solitary and/or clustered. Tanniferous cells common. Mucilage idioblasts present in the mesophyll of some species.

Wood anatomy. Growth rings faint or absent. Vessels diffuse, typically mostly solitary, but radial vessel multiples common in *Prunus* s.l., and vessel clusters fairly common in *Rubus*. Vessel frequency and diameter very variable depending on plant habit and ecology. Intervessel pits, nonvestured, alternate, ranging from minute to large (2–12 µm); vessel-ray pits usually similar but half-bordered and slightly smaller (but conspicuously smaller in *Prunus* p.p.). Helical wall thickenings present in *Rosa*, all Old World *Maloideae*, and *Prunus*, but usually weakly developed or restricted to vessel element tails in the Malesian species (as far as studied). Gummy contents common in heartwood vessels. Ground tissue fibres typically fibre-tracheids with distinctly bordered pits common in radial and tangential walls, but in *Prunus* pits mainly confined to the radial walls, and in some species (belonging to the subgenera *Amygdalus* and *Laurocerasus*) also much reduced in size so that fibres tend to the libriform type. Parenchyma typically scarce, scanty paratracheal and apotracheal diffuse; in the *Maloideae* parenchyma more abundant and sometimes diffuse-in-aggregates. Irregularly zonate parenchyma bands restricted to *Prunus*.

p.p. ('*Pygeum*' and subg. *Laurocerasus* p.p.). Rays 1–3(–4)-seriate in all *Maloideae* and in *Alchemilla* (1-seriate) and *Potentilla* [1–2(–3)-seriate]; in the remaining genera (*Prunus* and most *Spiraeoideae* and *Rosoideae*) rays of two more or less distinct sizes, with the wide rays 3–8(–16)-seriate. Ray composition varying from homocellular in *Micromeles* and *Photinia* p.p.; heterocellular with one to several rows of square to upright marginal cells in *Prunus* and most Malesian *Maloideae* (Kribs' heterogeneous II & III); to largely composed of square to upright cells in all shrubby *Spiraeoideae* and *Rosoideae* (so-called 'juvenile rays'). Crystals absent, or present as rhomboidal crystals in ray cells (*Rosoideae* and *Spiraeoideae*) or in, usually enlarged, chambered axial parenchyma cells (*Maloideae*); in species of *Prunus* druses (subg. *Amygdalus*, *Laurocerasus* p.p., *Padus*, *Prunus*, and '*Pygeum*') may occur as well as, or instead of rhomboidal crystals (the latter are found in subg. *Laurocerasus* and *Padus*), in ray and/or axial parenchyma cells. Traumatic gum ducts sometimes present in species of *Prunus* (except species belonging to subg. *Prunus*).

The wood anatomical diversity of the *Rosaceae* lends itself well for microscopic wood identification and a contribution to phylogenetic classification of the family (Zhang 1992). The *Spiraeoideae* and *Rosoideae* are wood anatomically fairly heterogeneous but inseparable; the *Maloideae* are a very coherent group showing only very limited wood anatomical variation. *Prunus*, on the other hand is wood anatomically very diverse and several groups, largely coinciding with the present subgeneric boundaries, can be distinguished, lending some support to their treatment as separate genera: *Amygdalus*, *Laurocerasus*, *Padus*, *Prunus* s.s., and *Pygeum*. More detailed leaf and wood anatomical studies of the Malesian taxa will certainly yield much information of taxonomic significance.

References: Devadas, C & C.B. Beck, Amer. J. Bot. 59 (1972) 557–567 (nodal anatomy *Physocarpus*, *Prunus*, *Rubus*, *Potentilla*, *Geum*). — Kato, N., J. Jap. Bot. 41 (1966) 101–107 & ibid. 42 (1967) 161–168 (nodal anatomy). — Lersten, N.R. & J.D. Curtis, Can. J. Bot. 55 (1977) 128–132 (trichomes of *Rubus*, *Physocarpus*, *Fragaria*, *Potentilla*); ibid. 60 (1982) 850–855 (hydathodes and water pores). — Lu, L.T., Z.L. Wang & G. Li, Cathaya 3 (1991) 93–108 (leaf anatomy of *Eriobotrya*, *Photinia*, *Rhaphiolepis*, *Sorbus*, *Stranvaesia*). — Metcalfe, C.R. & L. Chalk, Anatomy of the Dicotyledons 1 (1950) 539–550. — Morvillez, M.F., Recherches sur l'appareil conducteur foliaire des Rosacées, des Chrysobalanacées et de Legumineuses. Thesis, Lille (1919). — Schnell, R., G. Cusset & M. Quenum, Rev. Gén. Bot. 70 (1963) 269–342 (extrafloral nectaries). — Simomura, T. & H. Kurokawa, J. Jap. Bot. 26 (1951) 339–343 (leaf anatomy *Prunus*). — Singh, V. & D.K. Jahn, Curr. Sci. 44 (1975) 63 (stomatal polymorphism in *Prunus*). — Zhang, S.-Y., Blumea 37 (1992) 81–158 (systematic wood anatomy of the *Rosaceae*). — Zhang, S.-Y. & P. Baas, IAWA Bull. n.s. 13 (1992) 21–91 (wood anatomy of Chinese *Rosaceae*). — Zhang, S.-Y., P. Baas & M. Zandee, IAWA Bull. n.s. 13 (1992) 307–349 (ecological wood anatomy).

P. Baas

Palynology — Pollen of representatives of some 80 genera of *Rosaceae* has been studied in greater or less detail (see Tissot 1990). A comprehensive family treatment is not available up to now. Detailed regional accounts are those by Reitsma (1966), Teppner (1966) and Eide (1981) for NW Europe, and those by Hebda et al. (1988a, b, 1990, 1991) for W Canada, and by Naruhashi & Toyoshima (1979) for Japan.

Rosaceae is a stenopalynous family. The pollen grains are isopolar, radially symmetric, subspheroidal monads. The polar axis (P) is 10–60 µm (mostly 20–35 µm), the equato-

rial diameter is 10–50 µm. The *Spiraeae*, *Gillenieae*, *Holodiscus*, *Filipendula* and *Adenostoma* have small pollen (P usually < 20 µm). The largest grains occur in *Agrimonia* and *Mespilus* (P up to 50–60 µm).

The apertural system is generally tricolporate, though di-, tetra-, syn- and pericolporate grains may be occasionally found in tricolporate samples. Small grains have often indistinct or ill-defined endoapertures (colpate, colporoidate). Pollen of *Woronowia*, a monotypic genus included in *Sieversia* by Hutchinson (1964), is 5- (or 6-)colporate (Li 1990). Usually the colpi are relatively long, but *Polyepis* and *Cliffortia* (*Poterieae*) have brevicolpate and porate ectoapertures respectively. All *Potentilleae* have operculate ectoapertures. Opercula occur also in several genera of *Poterieae* (e.g., *Acaena*, *Agrimonia*, *Sanguisorba*), and in a number of *Rosa* species. In *Sanguisorba* spp. the opercula are as wide as the mesocolpia, which often led to describing the grains as being 6-colporate. Many rosaceous pollen grains show 'pore flaps', i.e. more or less protruding sexinous extensions of the mesocolpia arching over an endoaperture, and that occasionally may form an equatorial bridge (Hebda & Chinappa 1990).

Exine stratification is usually distinct with light microscopy. The scarce electron micrographs published show a columellate infratectal layer. Ornamentation is mostly meridionally striate, but much variation is found in the length, height, width and pattern of the muri and lumina, and the size and number of the perforations within the lumina. *Agrimonia* and *Sorbaria* pollen is finely transversely striate. Other ornamentation types include rugulate, psilate (e.g. *Cotoneaster*), perforate-microreticulate (*Neillia*) and verrucate-scabrate (e.g., *Acaena*, *Alchemilla*, *Sanguisorba*). Many intermediate forms exist. The tribe *Poterieae* is most diverse with respect to ornamentation. The scabrate type of *Acaena* and *Polyepis* might be associated with wind-pollination. Pollen of these plants is recorded in many diagrams of lake sediments from Colombia and Venezuela (Smit 1978; Salgado-Labouriau 1979).

Obviously, *Rosaceae* pollen offers few possibilities for subdividing the family. The detailed studies of Canadian *Rosaceae* pollen allow the recognition of many pollen types (Hebda et al. l.c.), but future work must reveal whether these types have any systematic and phylogenetic significance. Very few fossil pollen has been reported, all from the Oligocene onwards (Muller 1981).

The pollen of *Chrysobalanaceae* and *Rosaceae* is readily distinguishable, but the differences are relatively small (Prance 1989). Pollen of the *Neuradaceae* is clearly different (see Erdtman 1952; Van Zinderen Bakker & Coetze 1959).

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Phytochemistry — *General remarks.* Chemistry and chemotaxonomy of *Rosaceae* were reviewed twice in recent time (Hegnauer 1973, 1990). In these treatises *Chrysobalanaceae* with their characteristic seed oils were included as a subfamily in *Rosaceae*. A series of papers treating the impact of secondary metabolites, predominantly phenolic compounds, on the classification and infrafamiliar evolution of *Rosaceae* was published by Challice (1973, 1974, 1981), and a short chemotaxonomic discussion of *Rosaceae* was included in an essay of Hegnauer (1976). For the present purpose references usually will only be given for papers not cited in one of the aforementioned publications.

Worldwide, many members of *Rosaceae* are highly esteemed in traditional medicine. Several recent investigations are concerned with rosaceous medicinal crude drugs, including some eastern Asiatic ones; they will be mentioned in the present phytochemical summary. Leaf phenolics are often heavily overrated in chemotaxonomic discussions (Hegnauer 1990: 373–375). They are doubtlessly valuable characters at generic and lower levels, but they should be used with extreme care only at higher hierachic levels; tannins and isoflavonoids are perhaps the taxonomically most promising phenol classes at suprageneric levels.

Cyanogenic glycosides. Since more than 160 years amygdalin, the gentiobioside of mandelonitrile, is known from seeds of bitter almonds, and prunasin, a glucoside of mandelonitrile, was prepared in 1895 from amygdalin by cleaving off one molecule of glucose. For a thorough discussion of cyanogenesis and its possible taxonomic meaning in *Rosaceae* see Fikenscher et al. (1981). Amygdalin has been detected in seeds of many species of *Prunus* and several genera of *Maloideae*. In vegetative parts of both taxa amygdalin is usually replaced by prunasin. For a long time these two cyanogenic glycosides, which release benzaldehyde on hydrolysis, were considered to be characteristic of the family. This is true, however, only of the genus *Prunus* with the basic chromosome number ($x = 8$) and of *Maloideae* ($x = 17$). True *Rosoideae* ($x = 7$) do not produce cyanogenic compounds. The genera *Exochorda*, *Oemleria* and *Prinsepia* (all with $x = 8$ and all considered to be *Prunoideae*) have weakly cyanogenic leaves and twigs with a still unidentified cyanogenic glycoside which is not prunasin.

The *Spiraeoideae* sensu Schulze-Menz 1964 (mostly $x = 9$) are rather heterogeneous with regard to cyanogenesis. Prunasin is present in leaves of *Gillenia trifoliata*, *Spiraea prunifolia* (release of HCN and benzaldehyde; not by other *Spiraea*-taxa) and *Aruncus silvester* (also in rootstocks), and *Sorbaria*-taxa (possibly also *Chamaebatia millefolium*) produce heterodendrin and aromatic esters of cardiospermin. *Kageneckia* with $x = 17$ produces prunasin and resembles *Maloideae* in this respect.

A third type of cyanogenic glycosides, the tyrosine-derived dhurrin, was demonstrated to be present in *Cercocarpus* and *Chamaebatia* (both with $x = 9$), whereas in other 'rosoid' taxa with $x = 9$ hitherto unidentified cyanogenic glycosides, which do not release benzaldehyde, occur in small amounts: *Kerrieae* with *Coleogyne ramosissima*, *Kerria japonica*, *Neviusia alabamensis* and *Rhodotypos scandens*, and *Adenostomeae* with *Adenostoma fasciculatum* and *sparsifolium*. Thus *Rosaceae* use at least three pathways, the phenylalanine-route, the tyrosine-route and the leucine-route, for the production of their cyanogenic glycosides. The leucine-pathway is also known from *Mimosaceae*, *Crassulaceae* and *Sapindaceae*.

Phenolic constituents. All rosaceous plants are accumulators of phenolic and polyphenolic constituents, but the profiles of phenolics vary widely with plant parts and with taxa. Simple phenolic glycosides like arbutin [*Pyrus*, *Sorbaria*, *Adenostoma*, but not *Exochorda* (Hegnauer 1990: 374)], picein (the glucoside of 4-hydroxyacetophenone; bark of *Amelanchier* p.p.), gein (vicianoside of eugenol; *Geum* s.l. p.p.), sweet-tasting dihydrochalcone glucosides phloridzin, sieboldin and trilobatin [*Pyrus* and according to Challice (1974) *Docynia* and *Sorbaria*, but not *Adenostoma*] and the glycosidic derivatives of salicylic acid monotropitin and spiraein (*Filipendula*) are taxonomic markers of the genera mentioned or at least of a number of their species.

The closely related species *Prunus laurocerasus* (prunasin) and *P. lusitanica* (lusitanicoside, the rutinoside of the monophenolic phenylpropanoid chavicol) can easily be discerned by their major leaf constituents mentioned, and the glucosidic phloracetophenone derivative domesticoside was hitherto only isolated from the bark of *Prunus domestica*. Mahaleboside is a 5-glucosyloxycoumarin of *Prunus mahaleb*; coumarin, herniarin and a number of 5-hydroxylated and O-methylated coumarins, such as tomentin and fraxinol, seem to be rather characteristic bark constituents of certain *Prunus* species. Biologically active acylphloroglucinol derivatives occur in flowers of *Hagenia abyssinica*, which were formerly used as taenifugum (kosotoxin, protokosin), and in the Chinese medicinal plant *Agrimonia pilosa* (agrimophol and the agrimols A-C).

Lignans (Ayres & Loike 1990) were isolated from *Maloideae* [9'-xyloside and 9'-rhamnoside of (+)-lyoniresinol: *Sorbus aucuparia*, *Cotoneaster depressus*] and from *Prunoideae* [prinsepiol, a furofuranoid lignan from *Prinsepia utilis* and pygeoside, the 9-xyloside of (-)-lyoniresinol from *Pygeum acuminatum*]. For aucuparin-like biphenyls see under phytoalexins.

Many more genus- or species-characteristic simple phenolic compounds and their glycosides could be listed without difficulties, but at higher taxonomic levels (tribes, subfamilies, family) hydroxybenzoic acids, hydroxycinnamic acids, flavonoids and tannins are the predominant classes of phenolic constituents.

Bate-Smith (1961, 1962, 1965) showed, that *p*-coumaric and caffeic acid (= 4-hydroxy- and 3,4-dihydroxycinnamic acid), the flavonols kaempferol and quercetin and cyanidin generated from procyanidins (condensed tannins) occur widely in rosaceous leaf hydrolysates, that trihydroxylation of the B-ring of flavanoid compounds (e.g. myricetin, prodelphinidins) is rare, and that ellagic acid indicating presence of ellagitannins is restricted to true *Rosoideae* ($x = 7$). Moreover, Bate-Smith already noted incidental presence of flavones (apigenin, luteolin) and 6-hydroxylated flavonoids (quercetagetin) in the family.

The screening for rosaceous leaf phenolics was much extended by Challice. He showed general occurrence of 3-caffeoquinic acid (chlorogenic acid) and restriction of mixtures of dicaffeoylquinic acids, known as isochlorogenic acid, to many genera of *Maloideae*, inclusive of sections *Aria* and *Aucuparia* of *Sorbus* and of *Lindleya*. At this point the non-phenolic cinnamic acid should be mentioned. It occurs in large amounts in hydrolysates of several species of *Spiraea*; originally it is present as cinnamoyl- β -glucopyranose and an acylated derivative, spirarin. Benzoylglucose was isolated from *Luetkea pectinata*. Challice

stressed the taxonomic importance of flavone-C-glycosides within *Maloideae*, including *Dichotomanthes*, and the rather sporadic occurrence of these metabolites elsewhere in the family.

As already mentioned, the presence of isoflavones in *Rosaceae* may be taxonomically rewarding, because they possibly indicate affinities with *Leguminosae* [see for isoflavones the treatment of *Mimosaceae* in Flora Malesiana 11 (1), p. 19]. The isoflavones genistein, prunetin, biochanin-A and their glucosides prunin (prunetin-4'-glucoside), prunetinoglycoside (prunetin-5-glucoside) and biochanin-A-7-glucoside have not yet been traced as leaf constituents; they were isolated from wood and bark of several species of *Prunus*, from fruit stalks of *Prunus avium* and *P. cerasus* and from flowers and fruits of *Cotoneaster pannosa* and *serotina*. Many more peculiar flavonoids including flavanones (e.g. Bilia et al. 1991), flavanonols (e.g. Yoshida et al. 1989a), the 8-methoxyflavanols sexangularetin and corniculatusin which occur in *Dryas octopetala*, *Cowania mexicana* and *Purshia glandulosa* (all *Dryadeae* with $x = 9$), many more O-methylated flavonoids, tricetin, a flavone with a 3',4',5-trihydroxylated B-ring (*Luetkea pectinata*), and even 2-phenoxychromones (Hashidoko et al. 1991a) are produced by *Rosaceae*. For more information about the multiformity of flavonoid metabolism in the family and its possible taxonomic meaning see Challice (1981) and Hegnauer (1973, 1990). The most conspicuous rosaceous hydroxybenzoic acid is gallic acid (3,4,5-trihydroxybenzoic acid); it will be mentioned under tannins.

Tannins (compare also *Mimosaceae* treatment). Proanthocyanidins (condensed tannins) seem to be more or less ubiquitous in leaves, flowers, fruits, stems and roots of *Rosaceae*; they are accompanied by their monomeric building stones (+)-catechin and (-)-epicatechin and many (4-8)- and (4-6)-linked catechin dimers and trimers with low tanning activity; the proanthocyanidins with strong tanning action are assumed to be usually tetramers and higher oligomers.

Double-linked A-type procyanidins are known from the bark of *Rhaphiolepis umbellata* and from *Prunus spinosa*. (+)-Gallocatechin and prodelphinidins which are rarely present in leaves seem to occur more often in 'tannin'-fractions of fruits (*Maloideae* p.p.) and roots (*Sanguisorba officinalis*, *Potentilla erecta*). *Purshia tridentata* and *Coleogyne ramosissima* yielded about 3% of true condensed tannins (average mol.wt. 13–1400, i.e. tetra- to pentamers) from winter dormant twigs of current season growth; the tannins of the two taxa differed in stereochemistry and biological activity (Clausen et al. 1990). The *Purshia* tannin was found to have a catechin/epicatechin-ratio of about 55 : 45 and to be preferred by snowshoe hares in a choice feeding bioassay to the *Coleogyne* tannin, which is predominantly based on epicatechin. This shows that the always highly complex condensed tannin-fractions may have an extremely diverse spectrum of biological activities which depend on hydroxylation patterns and stereochemistry of their building stones, on the nature and stereochemistry of interlinkages in the oligo- and polymers and on degrees of polymerisation.

In true *Rosoideae* ($x = 7$) the situation is even more complex, because in these plants condensed tannins are accompanied by gallo- and ellagitannins, and because catechins may also be linked with other aromatic metabolites; the pilosanols-A to -C are antimicrobial

compounds of *Agrimonia pilosa* in which C-8 of (-)-epicatechin is combined via a methylene group with acylphloroglucide residues (Kasai et al. 1992). In recent times hydrolysable tannins were thoroughly investigated for a number of medicinally used crude drugs. Examples from Rosaceae are roots of *Rosa davurica* (Yoshida et al. 1989a, 1991), hips and fresh leaves of *Rosa laevigata* (Yoshida et al. 1989b), petals of *Rosa rugosa* (Hatano et al. 1990), petals of 'apothecary's rose' (Eugster & Märki 1991), Alchemillae Folium (mainly *Alchemilla xanthochlora*), which seems to contain only hydrolysable tannins (Geiger 1991), and Tormentillae Radix which is rich in condensed tannins, but also contains ellagitannins (Geiger 1991) and which derives from *Potentilla erecta*.

Root cultures of *Sanguisorba officinalis* yielded gallic acid, (+)-catechin, (+)-gallocatechin, procyanidin-B3, three gallotannins (2,8%) and the ellagitannins pedunculagin, sanguin-H6 (up to 5,9%) and sanguin-H11 (up to 2,3%) and 4,6-hexahydroxydiphenoylglucose (Ishimaru et al. 1990). Strawberries (*Fragaria × ananassa* cv. Kent) and raspberries (*Rubus idaeus*) contain small amounts of ellagitannins, and casuarictin was isolated from strawberries (Daniel et al. 1991).

Lamaison et al. (1990) investigated 42 rosaceous taxa representing all four traditional subfamilies for tannin content and observed a range from 1,7 (flowers of *Kerria japonica*) to 25,1% (roots of *Potentilla erecta*); they demonstrated that biological activity measured by inhibition of the pancreatic endopeptidase enzyme elastase is not correlated with tannin concentration. Most active tannins were found in flowers and leaves of *Alchemilla xanthochlora*, flowers of *Filipendula ulmaria*, aerial parts of *Geum montanum* and *G. rivale* and leaves of *Sanguisorba minor*, all true Rosoideae with $x = 7$ and usually containing both condensed tannins and hydrolysable gallo- and ellagitannins. This is another indication for the pluriuniformity of biological activities of individual tannin components. Finally it should be mentioned that trimethylellagic acid was isolated from rhizomes of *Sanguisorba officinalis*, because ellagic acid methylethers are usually conceived as taxonomic markers of Myrtales; they also occur in Euphorbiaceae.

A most recent publication of Okuda et al. (1992) confirms confinement of ellagitannins to Rosoideae with $x = 7$, including *Filipendula* (!); moreover, oligomeric ellagitannins are assumed to show a genus-specific distribution: sanguin-H6 and -H11 in *Sanguisorba* and *Rubus*, gemin-A in *Geum* s.l., agrimonin in *Agrimonia*, *Fragaria* and *Potentilla* and rugosin-D in *Filipendula*; this publication considers leaf tannins only. For fruits, restriction of ellagitannins to Rosoideae was shown by Foo & Porter (1981).

Sugars and hexitols. Saccharose is present in all Rosaceae in appreciable amounts; it is an easily metabolised temporary carbohydrate reserve and is used for the transport of carbohydrates. In Prunoideae, Maloideae, most Spiraeoideae in traditional circumscription and in Kerrieae and Adenostomeae part of saccharose is replaced by the hexitol sorbitol (= glucitol) which got its name from *Sorbus aucuparia*, one of the first and best sources of this sugar alcohol. Lack of appreciable amounts of sorbitol is a character of the ellagitannin-producing true rosoids inclusive of Dryadeae-Geinae, all with $x = 7$. In this respect part of Dryadeae sensu Schulze-Menz (1964), i.e. Dryadinae and Cercocarpinae both with $x = 9$, seem to agree better with true Rosoideae ($x = 7$) than with Spiraeoideae and Kerrieae with $x = 9$.

Waxes and other lipids. Rosaceous cuticular waxes of leaves and fruits (Maloideae) usually are rich in free pentacyclic triterpenic acids. Ursolic and oleanolic acid and num-

ber of hydroxylated derivatives (e.g. maslinic and pomolic acid) were isolated from leaves and pomes of many taxa. Barks of *Rosaceae* often contain free and/or esterified pentacyclic triterpenic alcohols and ketones; lupeol, betulin, 23-hydroxybetulin (sorbicortol-B), taraxerol, alnusenol (= glutinol), friedelanol, alnusenone (= glutinone), friedelin and others were isolated from several taxa. Moreover, barks also contain free and esterified triterpenic acids; examples are pyracrenic acid (betulinic acid-3-coumarate) from *Pyracantha crenulata* and betulinic and 3-epibetulinic acid from *Spiraea cantoniensis*. Most non-glycosylated bark triterpenes are probably constituents of cork waxes. Besides triterpenes, lipid fractions of all plant parts contain alkanes, alkenes, alkanols, long-chain fatty acids and mixtures of phytosterins.

Saponins and pseudosaponins. Saponins are widespread in the family. The sapogenins are usually derivatives of pentacyclic triterpenes, mostly ursolic acid, but sometimes oleanolic or betulinic acids. Three types of sugar attachment to the sapogenins occur: 3-glycosides, esters of the 28-carboxyl group, and the bisdesmosidic saponins which have both linkages. Compounds which have only the ester-linkage were called pseudosaponins by French authors, because their properties are different from those of 3-glycosides (true saponins); tormentol or tormentoside (= rosamultin) is such a pseudosaponin which occurs in many true *Rosoideae* ($x = 7$) and in some *Maloideae*, but could not be detected neither in *Prunoideae* and *Spiraeoideae* nor in *Kerrieae*; it is the 28-COOH glucose ester of tormentillic (= tormentic) acid ($2\alpha,19\alpha$ -dihydroxyursolic acid) and seems to combine easily with condensed tannins to antibiotically active adducts.

As a rule saponins are complex mixtures of closely related compounds. Since a long time quillajasaponin is known; it occurs in the bark of *Quillaja saponaria* which is commercially available (Soap bark) and is (was) mainly used as a non-ionic detergent (soap substitute). Presently quillajasaponin is known to be a mixture of bisdesmosidic compounds of complex structure which have quillaic acid (= 16-hydroxy-23-oxo-oleanolic acid) as sapogenin and are acylated in the sugar part by two molecules of 3,5-dihydroxy-6-methyloctanoic acid (a normonoterpenoid compound).

The Japanese crude drug *Sanguisorba Radix* (= 'Ziyu') gathered from *Sanguisorba officinalis* yielded the 3-arabinoside of pomolic acid (ziyu-glycoside-II) and its bisdesmosidic derivative ziyu-glycoside-I which has its 28-carboxyl esterified with glucose. In recent time the pseudosaponins of leaves of Japanese *Rubus*-taxa were investigated thoroughly. The 28-COOH glucose esters of the ursolic acid derivatives acuminatic (= euscaphic) acid, 19-hydroxyasiatic (= 23-hydroxytormentillic) acid and the 3-epimer of 19-hydroxyasiatic acid could be isolated from *R. microphyllus* ('Niga-ichigo'; yielded the niga-ichigosides-F1 to -F3), *R. trifidus* ('Kaji-ichigo'; yielded the kaji-ichigosides-F1 and -F2), *R. koehneanus* (niga-ichigoside-F1 and -F2) and *R. × medius*, a *trifidus* hybride (niga-ichigoside-F2 and kaji-ichigoside-F1). Moreover, roots of the Chinese *R. suavissimus* contain niga-ichigoside-F1 and suavissimoside-R1, which is a 28-COOH glucose ester of a derivative of 19-hydroxyasiatic acid ($23\text{-CH}_2\text{OH}$ oxidized to 23-COOH). Niga-ichigoside-F1 was also isolated from *Geum japonicum* and from hips of *Rosa sterilis*. Russian *Sanguisorba minor* s.l., i.e. *Poterium lasiocarpum* and *P. polygamum*, yielded a pseudosaponin with caccigenin ($2\alpha,21\beta,23$ -trihydroxyoleanolic acid) as sapogenin.

Recent investigations of leaves of *Eriobotrya japonica* (Liang et al. 1990; De Tommasi et al. 1992), *Potentilla fruticosa* (Ganenko & Semenov 1989), hips of *Rosa davurica* (Kuang et al. 1989), fruits of *Rubus coreanus*, *crataegifolius* and *parvifolius* (Ohtani et al. 1990), whole plants of *Rubus ellipticus* (Pal et al. 1991) and root bark or roots and aerial parts of *Sarcopoterium spinosum*, *Sanguisorba minor* s.l. and *officinalis*, and species of the endemic Canary Island genera *Bencomia*, *Marcetella* and *Dendriopoterium* (Reher et al. 1991; Reher 1991) for pentacyclic triterpenes and their pseudosaponins and saponins yielded taxonomically remarkable results. For instance, *Sanguisorba officinalis* which only contains the ziyu-glycosides-I and -II and some recently detected other derivatives of pomolic acid (Cheng & Cao 1992) is distinct from all investigated members of subgenus *Poterium*, *Sarcopoterium spinosum* and the Canary Island endemics, which all produce 23-hydroxytormentilic acid and its 28-ester glucoside (= niga-ichigoside-F1).

Rubus coreanus is distinct from other eastern Asiatic species of *Rubus* by having 0.14–0.25% coreanoside-F1, a dimeric pseudosaponin, in leaves and fruits (Ohtani et al. 1990). Leaves and fruits of *Rubus foliolosus* do not contain pseudosaponins, but a mixture of goshonosides (see sub diterpenes; Ohtani et al. 1990). The triterpene (and sesquiterpene) glycoside profiles of leaves of *Eriobotrya japonica* growing in China are different from those of plants growing in Italy (Liang et al. 1990; De Tommasi et al. 1990, 1991, 1992). *Rosaceae* also produce tetracyclic dammarane- and cucurbitane-type triterpenes. They were detected in leaves and twigs of *Cowania mexicana* (dammarenediol-II) and *Cercocarpus intricatus* (isofouquierol) and in fruits of *Purshia tridentata* (bitterbrush; the intensely bitter cucurbitacins-D and -I; occur possibly also in other parts of the plant); all three taxa belong to *Dryadeae-Cercocarpinae* and *-Purshiinae* with $x = 9$.

Diterpenes. Isoprenoid C₂₀-compounds seem to be rather rare in the family. They occur in *Spiraea japonica* and *koreana* as atisane-type diterpene alkaloids (spirasines, spiramines, and others). In the genus *Rubus* several eastern Asiatic species were shown to produce large amounts of C₂₀-glycosides in leaves instead of the usual pseudosaponins. The Chinese *Rubus suavissimus* contains the intensely sweet-tasting kauranoid steviol-13,18-bisglucoside rubusoside. From *R. chingii*, a species also occurring in Japan, where it is called 'Gosho-igicho', non-sweet labdanoid mono- and bisglucosides, the goshonosides-F1 to -F5, were isolated; such diterpenes also occur in fruits of the respective species (Ohtani et al. 1990), whereas their roots contain pseudosaponins (e.g. *R. suavissimus*).

Seed reserves. *Rosaceae* store mainly proteins and fatty oils in their seeds; starch is absent. The seed oils belong to a 'normal' type with oleic and linoleic acids as main fatty acids; saturated acids (mostly palmitic) usually approximate 10–15%. Some species of temperate regions (*Filipendula ulmaria*, *Sanguisorba minor*, *Rosa* p.p.) have linolenic acid as a third main fatty acid. Reher (1991) found a 18:3/18:2-ratio of 1.4–2.4 in *Potentilleae* and of 0.4–1.0 in *Sanguisorbeae*. Some species of *Prunus*, notably *P. africana* (= *Pygeum africanum*), *P. mahaleb*, *spinulosa*, *undulata* and *yedoensis* and others, deviate from the patterns mentioned by having octadeca-9,11,13-trienoic (= elaeostearic) acid as a main fatty acid and resemble in this respect *Chrysobalanaceae*.

Miscellaneous. *Rosaceae* produce and store many more classes of metabolites. Examples are:

(a) Non-volatile organic acids, such as the ubiquitous malic, citric and succinic acids, and ascorbic acid (= vitamin C) which is present in large amounts in the hips of many species of *Rosa*. Isocitric acid which is seldom present in appreciable amounts in plants is stored in leaves of most investigated species of *Rubus*.

(b) Some species with glandular hairs produce essential oils containing mostly mono- and sesquiterpenoid constituents. Such essential oils are also deposited in the wood of certain species of *Prunus*. The best known 'volatile oils' of *Rosaceae* are rather products of hydrolysis of glycosides than true essential oils and usually consist for over 90% of one or two compounds, e.g. bitter almond oil (benzaldehyde from prunasin and amygdalin), methylsalicylate and salicylic aldehyde (from monotropitin and spiraein), eugenol (from gein), chavicol (from lusitanicoside) and *Sorbus aucuparia* fruit oil, which consists of antibiotically active parasorbic acid, the lactone of 5-hydroxy-2-hexenoic acid (= 2-hexene-5-oxide); parasorbic acid is not present as such in the bitter fruits and seeds of *Sorbus* species of section *Aucuparia*, but as the glucosidic bitter precursor parasorboside, which is 3-glucopyranosyloxy-5-hexanolide, and seems to be a chemical marker of *Sorbus* section *Aucuparia*. The very expensive true oil of rose is produced from fragrant flowers of several taxa of *Rosa* and contains predominantly the monoterpenic alcohols citronellol, geraniol and nerol and appreciable amounts of phenylethylalcohol; in fresh young petals these alcohols are present as glycosides. Glycosides of alcoholic mono- and sesquiterpenes seem to be rather common in the family; some recent examples are leaves of *Eriobotrya japonica* (De Tommasi et al. 1990, 1992) and leaves of *Spiraea cantoniensis* (Takeda et al. 1990).

(c) Characteristic constituents of fruit aromas, such as raspberry (*Rubus idaeus*), strawberry (*Fragaria*), quince (*Cydonia oblonga*), apples (*Malus*) and cherries (*Prunus*); in fresh fruits glycosidic precursors may be present.

(d) Nitrogen-containing constituents like the proline derivatives of *Malus* and other *Maloideae* and the amines present in the foetid flower smell of some rosaceous taxa (e.g. *Crataegus* p.p., *Sorbus* p.p.). According to Strack (1990) *Rosaceae* are characterized by the production of N,N,N-tricoumaroylspermidine in flowers, especially in their androecia.

From a taxonomic point of view metabolites mentioned sub (a) to (d) are unimportant at suprageneric levels, if the triacyl derivatives of spermidine are excluded. It seems therefore to be more rewarding to finish this short chemical survey with a few remarks on phytoalexins and recent publications on *Prunus* constituents.

Phytoalexins. Phytoalexins are antibiotically active compounds produced by plants after stimulation by infections or similar stresses. Phytoalexins became known from *Rosaceae* only recently. The chemical nature of phytoalexins produced by a taxon depends to some extent on the triggering agents and the plant parts. Nevertheless some taxonomically interesting trends can be discerned in *Rosaceae*. *Maloideae* tend to produce aromatic phytoalexins based on the biphenyl and benzofuran skeleton. The biphenyls aucuparin, 4'-methoxyaucuparin and rapholepin are produced in infected sapwood or bark of *Malus pumila*, *Eriobotrya japonica* and in stressed leaves of *Eriobotrya japonica* and *Rhaphiolepis umbellata*, and the biogenetically related benzofurans α-, β- and γ-pyrufurans, cotonefuran and eriobofuran were extracted from infected sapwood of *Pyrus communis* and

Cotoneaster lacteus and from diseased leaves of *Eriobotrya japonica* (Kemp & Burden 1986; Watanabe et al. 1982, 1990; Miyakado et al. 1985). Phenylpropanoid sapwood phytoalexins are the coumarin scopoletin of *Prunus domestica* and the lignan iso-olivil from *Prunus jamasakura* (Kemp & Burden 1986). Benzoic acid was shown to be the anti-fungal compound produced after infection by *Nectria galligena* in apples of cv. Bramley's Seedling; it can prevent or retard fruit rotting during storage (Swinburne 1973).

Usually the production of phytoalexins is connected with necrosis of attacked cells. Sapwood phytoalexins are comparable to compounds present in heartwoods which only contain dead wood parenchyma cells. Aucuparin, for instance, occurs in heartwood of all investigated species of *Sorbus* sect. *Aucuparia*. Moreover, what is known as a phytoalexin from one plant part may be a normal constituent of perfectly healthy tissues of another part of the same plant or of other plants, e.g. the coumarin scopoletin, the lignan iso-olivil and benzoic acid. Lastly, the definition of phytoalexin is rather vague; small amounts of a given phytoalexin of a given taxon may be present in its healthy tissues. Therefore triggering of intensified synthesis of a compound by stress is included by some authors in the phytoalexin concept. Scopoletin in bark of *Prunus domestica*, coumarin and biogenetically related compounds in leaves of *Prunus mahaleb* and glycosides of gentisic acid in wood and bark of *Prunus yedoensis* are examples of 'phytoalexins' which are already present in small amounts in healthy plant parts. *Chondrostereum purpureum* infection induced not only synthesis of aucuparin, but also of 2-dehydrotomentillic acid in sapwood of *Malus pumila* (Kemp et al. 1985).

Isoprenoid phytoalexin-like compounds were also isolated from damaged leaves of *Rosa rugosa* (Hashidoko et al. 1989); they were shown to be watersoluble sesquiterpenes with the carotane skeleton and named rugosal-A (strongly fungitoxic) and rugosic acid-A (scarcely fungitoxic); both are monohydroxy-endoperoxides which bear an aldehyde resp. carboxyl group. Later the same authors reported, that leaf tissues contain a labile precursor, carota-1,4-dienealdehyde which on autoxidation yields rugosal-A and rugosic acid-A (1990), and that leaves additionally produce many more carotane type sesquiterpenes together with acaranoid and bisabolanoid oxygenated C₁₅-compounds (1991b, c). Finally Hashidoko et al. (1992) observed that rugosal-A and rugosic acid-A are present in the exudate of the glandular trichomes of *Rosa rugosa* leaves. The last mentioned observations suggest that rugosal-A is not a true phytoalexin, but a compound generated by autoxidation from genuinely present precursors.

Recent phytochemical investigations with Prunus-taxa:

Subg. *Prunus* — *Prunus spinosa*: Phenolics of flowers (Kolodziej et al. 1991), fruits (Ramos & Macheix 1990) and branches (Crespo Ibizar et al. 1992; González et al. 1992).

Subg. *Amygdalus* — *Prunus davidiana*: (+)-Catechin and two flavanone glycosides, prunin and hesperetin-5-glucoside, from stems (Choi et al. 1991).

Subg. *Cerasus* — *Prunus avium* and *cerasus*: Comparative investigations of inner bark and seedlings for flavonoids, and detection of prunetin-5-glucoside and tectochrysin-5-glucoside as chemical markers of *P. cerasus* and of dihydrowogonin-7-glucoside and chrysin-7-glucoside as main flavonoids of *P. avium*; both species have genistein-5-glucoside (Geibel et al. 1990, 1991). *Prunus serrulata* Lindl., a cultigen, yielded 6-caffeoyleglucopyranoside and 1,6-dicaffeoylglucopyranoside (Ali et al. 1989). Its var. *spontanea*

(= *P. jamasakura*, the wild Japanese mountain cherry) has bitter fruits with prunasin as main bitter principle (Shimazaki et al. 1991); catechins, sakuranetin-5-glycosides, and the lignanoid compounds sakuraresinol, dihydrobuddlenol-B and racemic lyoniresinol were isolated from its bark (Yoshinari et al. 1990). Fruits of *P. maximowiczii* are also bitter; they contain bitter tetra- to hexaacetylsucroses (acyl = one paracoumaroyl + three to five acetyl residues), epicatechin and a little mandelic acid, but no prunasin (Shimazaki et al. 1991).

Subg. *Padus* — Fresh bark of *P. buergeri* yielded no flavonoids, but mono- and biacylated glucopyranoses (caffeic and paracoumaric acid), the 6-caffeoyleglucoside of mevalonolactone, and a little grayanin (Shimomura et al. 1988, 1989a). Bark of *P. grayana* is also free of flavonoids, but contains several caffeic, coumaric and 3,4,5-trimethoxybenzoic acid esters of glucopyranose, the grayanosides-A and -B and the strongly bitter grayanin which is prunasin with OH-6 of its glucose acylated by caffeic acid (Shimomura et al. 1987). Heartwood of *P. grayana* yielded taxifolin, dehydrodicatechin-A, the salicin derivatives populin, henryoside and pruyanaside-B and the complex salicylic acid derivatives virgaureoside and pruyanaside-A (Shimomura et al. 1989b). Leaf wax of *P. grayana* contains the antioxidative prunusols (Osawa et al. 1991). The bitter barks of *P. padus* and *P. ssiori* contain catechins, bitter prunasin and bitter lignanxylosides lyoniside and ssioriside, and schisandriside in *P. ssiori* and prupaside in *P. padus*; moreover, *P. ssiori* yielded syringin and glucosyringic acid, and *P. padus* melilotoside and bitter tetra- and pentaacetylated sucroses (Yoshinari et al. 1989, 1990).

Subg. *Laurocerasus* — From green fruits of *P. laurocerasus* Weinges et al. (1991) isolated the primveroside of benzylalcohol.

The *Prunus*-investigations just mentioned demonstrate clearly the enormous intrageneric variation of phenolic profiles and suggest once again that most phenolics are taxonomically useful above all at species, section and genus levels.

Summarizing it can be stated that secondary metabolites and seed oils can help a lot to arrive at a satisfying infrafamiliar classification, but procure only vague indications concerning family affinities [*Chrysobalanaceae*, *Crassulaceae* (phenolics, leucine-derived cyanogenic compounds), *Leguminosae*, *Sapindaceae*].

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R. Hegnauer

Uses — The usefulness of the Rosaceae is mainly to be found in the presence of many edible, and often delicious fruits. See: *Eriobotrya*, *Fragaria*, *Malus*, *Prunus*, *Rubus*, *Pyrus*.

Timber hardly enters the world market, but may well be useful on the local scale.

Medicinal uses appear to be scarce in the region judged from label data and Malesian literature. These sources may not give a complete picture considering the extensive use made of Rosaceous species in traditional medicine in East Asia (see also the chapter on phytochemistry, p. 233).

KEY TO THE GENERA

- 1a. Leaves simple, entire or lobed. 2
 b. Leaves compound, pinnate, palmate, or 3-foliate. 15
- 2a. Herbs. 3
 b. Woody plants, trees or shrubby. 4
- 3a. Flowers small, with epicalyx, without petals, with 1–5 stamens. Achenes enclosed in hard hypanthium *Alchemilla* (p. 301)
 b. Flowers usually showy, without epicalyx, petals only in few species absent, stamens numerous. Drupes cohering and forming a collective fruit *Rubus* (p. 247)
- 4a. Ovary or ovaries superior, not connate with the hypanthium 5
 b. Ovary inferior or semi-inferior, carpels connate with the hypanthium, either entirely or at least their lower half. 8
- 5a. Flower with 1 pistil (exceptionally 2). 6
 b. Flower with more than 2 pistils. 7
- 6a. Small shrubs. Leaves 3-lobed. Glands on the hypanthium outside, elongating after anthesis. Fruits dehiscent, with several seeds *Neillia* (p. 245)
 b. Trees or shrubs. Leaves not lobed. Hypanthium without long-stalked glands. Fruit a drupe with 1 stone *Prunus* (p. 319)
- 7a. Plants climbing, straggling, or creeping, rarely erect, usually armed. Stipules present. Fruits cohering as a collective, each of the juicy drupes with one stone
 Rubus (p. 247)
 b. Erect shrubs, not armed. Stipules absent. Fruit a dehiscent follicle with several seeds (cultivated) *Spiraea* (p. 244)
- 8a. Simple racemes. 9
 b. Racemes branched and compound. 10
- 9a. Styles free. Fruits with stone-cells in mesocarp (cultivated) *Pyrus* (p. 317)
 b. Styles connate at base. Fruits without stone-cells (cultivated) *Malus* (p. 310)
- 10a. Plants with thorns (cultivated) *Pyracantha* (p. 316)
 b. Plants without thorns 11
- 11a. Upper rim of hypanthium and sepals persistent on the fruit. Ovary semi-inferior 12
 b. Sepals and upper rim of hypanthium deciduous after flowering, leaving a scar on top of the fruit. Ovary inferior. 14
- 12a. Main nerves terminating in the margin *Eriobotrya* (p. 308)
 b. Main side-nerves not terminating in the margin 13
- 13a. Flower with 2 carpels, in their basal half adnate to the hypanthium, but free from each other (cultivated) *Cotoneaster* (p. 308)
 b. Flower with up to 5 carpels, connate with each other and with the hypanthium
 Photinia (p. 312)
- 14a. Evergreen. Ovary 2-celled. Fruits 1-, rarely 2-seeded, seeds thick, cotyledons thick
 Rhaphiolepis (p. 317)
 b. Deciduous. Ovary usually 3-celled (2–4). Fruits with usually 2 seeds per cell, seeds flat, cotyledons flat *Micromeles* (p. 310)

15a. Herbs	16
b. Plants with woody branches	20
16a. Flowers in globular heads, without petals	17
b. Flowers not in heads. Petals present	18
17a. Sepals imbricate. Male and bisexual flowers with 10–30 stamens (cultivated)	
	Sanguisorba (<i>p.</i> 301)
b. Sepals valvate. Flowers bisexual, with 2 or 3 stamens	Acaena (<i>p.</i> 297)
18a. Epicalyx absent. Pistils usually 2, remaining enclosed in the hypanthium which bears many erect spines under the calyx	Agrimonia (<i>p.</i> 299)
b. Epicalyx present. Pistils on a more or less elevated torus, not completely enclosed by the spineless hypanthium	19
19a. Petals yellow	Potentilla (<i>p.</i> 286)
b. Petals white (cultivated)	Fragaria (<i>p.</i> 285)
20a. Achenes hidden in the hollowed, fleshy hypanthium	Rosa (<i>p.</i> 303)
b. Drupes forming a collective fruit, on an elevated torus	Rubus (<i>p.</i> 247)

TRIBUS SPIRAEEAE

Mostly woody plants with simple leaves. Stipules absent. Epicalyx absent. Pistils mostly several, superior, free, not entirely enclosed in hypanthium. Ovules 2 or more, pendulous. Follicles. $x = 9$.

SPIRAEA

Spiraea L., Sp. Pl. (1753) 489. — Type species: *Spiraea salicifolia* L.

Unarmed shrubs. Leaves simple. Stipules absent. Flowers in terminal or axillary umbels, corymbs, or panicles. Hypanthium campanulate to turbinate, upper part of disc free, erect, fleshy. Sepals valvate or slightly imbricate. Petals white or pink. Stamens 15–many. Pistils 1–8, often 5; ovaries 1-locular; style (sub)terminal; ovules 2–several. Follicles dry, dehiscing ventrally and later at the top also dorsally. Seed with membranous testa, endosperm thin or absent.

Distribution — About 100 species, North temperate. Many species cultivated as ornamentals.

Spiraea cantoniensis Lour., Fl. Cochinchin.

1 (1790) 322; Backer & Bakh. f., Fl. Java 1 (1964) 511.

Shrub with thin, flexuous, glabrous branches. Petiole 0.5–1 cm. Leaves oblong, (bi)serrate, 3–7 by 1–3 cm, glabrous, ± glaucous underneath. Corymbs axillary, shortly peduncled, with c. 10–20 flowers, pedicels 7–15 mm. Margin of disc lobed. Stamens in normal flowers 20–24. Pistils (3–)5.

Distribution — Southeast China (Guangdong to Zhejiang). The species is widely cultivated, often with double flowers. In Malesia cultivated, among others in Java (see also Backer & Bakh. f., l.c., where also two other species of *Spiraea* are mentioned).

Run wild from cultivation near Edie Creek, Morobe Prov., Papua New Guinea (Hartley 11673, collected in 1963).

TRIBUS NEILLIEAE

Woody plants with simple leaves. Stipules free, on twig. Epicalyx absent. Usually 1 pistil, superior, enclosed by hypanthium. Ovules 2 or more, mostly pendulous. Follicles. $x = 9$.

NEILLIA

Neillia D. Don, Prod. Fl. Nepal. (Febr. 1825) 228; DC., Prod. 2 (Nov. 1825) 546. — Type species: *Neillia thrysiflora* D. Don.

Adenilema Blume, Bijdr. (1826) 1120; Hassk., Cat. Hort. Bog. (1844) 170 ('*Adenilema*' —). — Type species: *Aadenilema fallax* Blume.

Unarmed shrubs, erect, scandent, or creeping. Leaves simple, lobed and dentate. Stipules free. Flowers in terminal racemes or panicles, 5-merous, bisexual. Hypanthium campanulate to tubular, often with stalked glands outside. Sepals imbricate, acuminate. Petals (sub)orbicular, white. Stamens 6–40. Pistil 1, rarely 2, free; ovary superior, included in hypanthium, 1-locular; style terminal, with peltate stigma; ovules 2–13, biserrately placed on the ventral placenta. Fruit a dry follicle, protruding from the enlarged hypanthium. Seeds several, with hard and shining testa; endosperm rather plentiful.

Distribution — About 12 species, from the Himalayan region through China to Korea and to Vietnam, one species also in Malesia: Sumatra and Java. — Fig. 1.

Neillia thrysiflora D. Don, Prod. Fl. Nepal. (1825) 228; Miq., Fl. Ind. Bat. I, 1 (1855) 391; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 241; Backer & Bakh. f., Fl. Java 1 (1964) 510; Steenis, Mount Fl. Java (1972) pl. 44-4. — Types: Wallich 698, Hamilton s.n.

Adenilema fallax Blume, Bijdr. (1826) 1121. — *Neillia fallax* (Blume) Blume, Mél. Bot. 1 (1855) 6 (see Taxon 35, 1986, 272). — Type: Blume 477, Mt Gede.

Rubus schefferi Focke, Abh. Naturw. Ver. Bremen 8 (1884) 472. — Type: Scheffer s.n., Mt Pangarango.

Neillia tunkinensis Vidal, Not. Syst. 13 (1948) 292. — *Neillia thrysiflora* D. Don var. *tunkinensis* (Vidal) Vidal, Adansonia 3 (1963) 153. — Type: Poilane 26671.

Small shrubs, erect, scandent, or creeping. Branches glabrous, ultimate ones often zigzag. Leaves ovate, 3-lobed, 4–12 by 2.5–7.5(–11) cm, base cordate to subtruncate, serrate, 3 main nerves, the middle one with 5–7 side-nerves, nerves and veins terminating in marginal teeth, glabrous to sparsely hairy. Petiole 0.5–2 cm. Stipules membranous, up to 12 by 6.5 mm, ± serrate. Inflorescence a bracteate compound raceme, the lower of

the up to 8 side-branches in the axils of the upper leaves, up to 12(–20) cm long, pedicels up to 2 mm. Flowers erect. Hypanthium widely campanulate, 1.5–3 mm high, growing after anthesis, hairy to glabrous outside, always with scattered stalked glands, the stalks growing to 6 mm after anthesis. Sepals ± spreading in anthesis, 3–5 by 1–2 mm including the up to 2(–3) mm long acumen, persistent, indumentum outside as hypanthium and often with occasional glands. Petals suborbicular to ovate, 1.5–3.5 by 1.5–3 mm, not or shortly clawed, with ciliate margin, early caducous. Stamens 7–21, filaments up to 1.2 mm, anthers c. 0.5 mm long. Pistil usually 1, ovary ovoid, 1.5–2.5 mm long, style up to 2 mm, ovules 7–10. Follicle 6–9 by 2.5–3.5 mm, not including the persistent style remnant. Seeds several, up to 2 mm long. — Fig. 1.

Notes — *Neillia fallax* has usually been considered as conspecific with *N. thrysiflora*, but Vidal (1963) separated the two on a specific level mentioning as distinguishing characters: shape of inflorescence, number of stamens and ovules, indumentum on leaves, inflorescences, and pistils. In all but one of these characters, however, there is an unbroken continuity and the only possible way to break up the complex into recognizable and defin-

able sub-units is to make use of the indumentum on raceme axis and pedicels. There is no correlation with other characters and the groups are not geographically separated. In view of this the two groups do not seem worthy of specific rank.

Neillia rubiflora, a continental-Asian species, is very closely related but may remain separated, i.a. because of the larger number of stamens (20–40).

a. var. *fallax* (Blume) Kalkman, Blumea 37 (1993) 377. — *Adenilema fallax* Blume, l.c. — *Neillia fallax* (Blume) Blume, l.c. — ? *Rubus schefferi* Focke, l.c.

Inflorescences glabrous, the pedicels sometimes with few short hairs. *Ovary* glabrous or with few long hairs only.

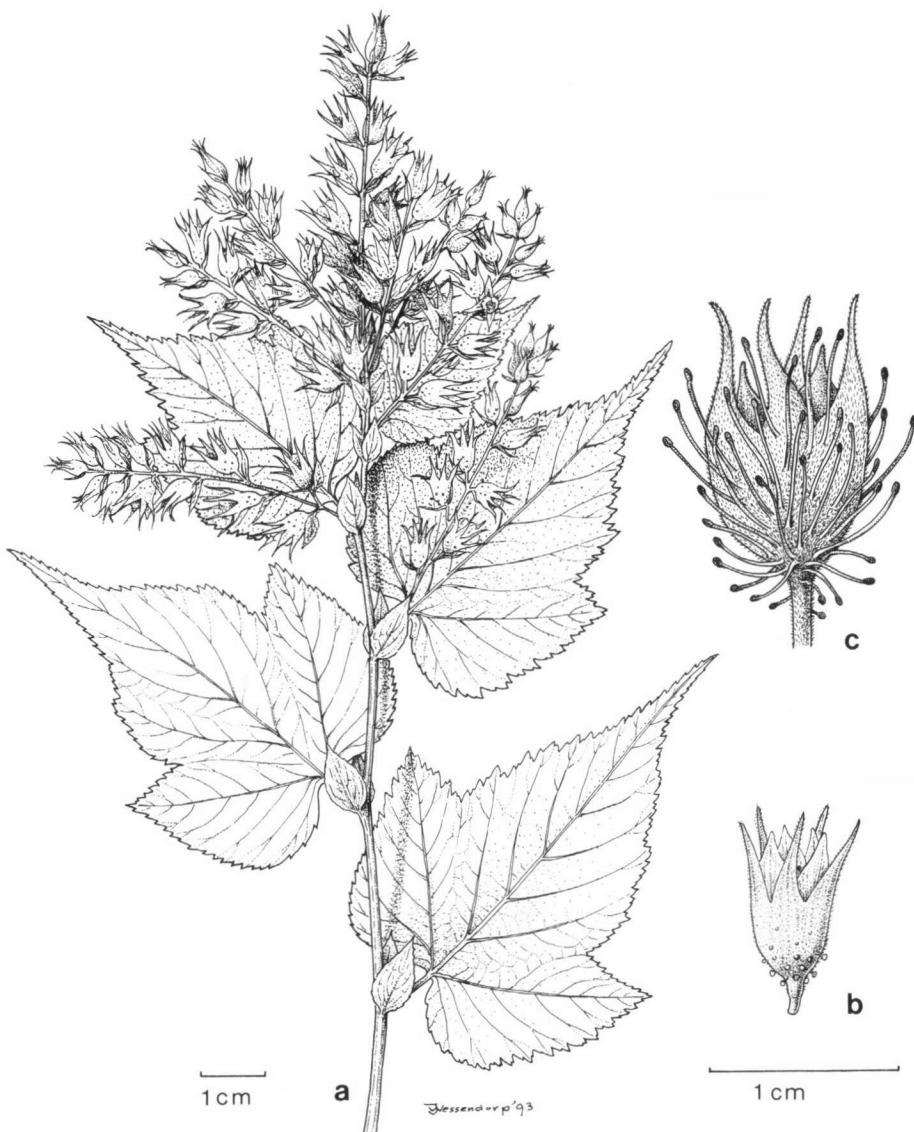


Fig. 1. *Neillia thrysiflora* D. Don. a. Flowering branch; b. flower; c. hypanthium with fruits (Schiffner 2014).

Distribution — *Malesia*: N & W Sumatra, W Java.
Habitat — Forest margins and similar open places, c. 2100–3000 m altitude.

Note — The Sumatran specimens differ from the Javanese ones in having less hairy leaves and flowers and more stamens (10–21, in Java 7–10).

b. var. *thyrsiflora* — *Neillia tunkinensis* Vidal,
 l.c.

Inflorescences, incl. pedicels, hairy. **Ovary** long-hairy all over or at least with long hairs near suture and base, rarely (in part of the Sumatra specimens) glabrous.

Distribution — Continental Asia (Himalayan region, Assam, China, Vietnam); in *Malesia*: W Sumatra and W Java.

Habitat — Montane thickets and forest-edges, between c. 1500 and c. 2500 m altitude.

TRIBUS RUBEAE

Woody or herbaceous plants, with simple, pinnate or palmate leaves. Stipules free, on petiole or twig. Epicalyx absent. Petals rarely reduced in number, flowers rarely unisexual. Pistils many, free, superior, on elevated torus. Ovules 2, pendulous. Drupes. $x = 7$. Only genus: *Rubus*.

RUBUS

Rubus L., Sp. Pl. (1753) 492; Focke, Bibl. Bot. 72 (1910–11) 1–223; ibid. 83 (1914) 1–274; Zandee & Kalkman, Blumea 27 (1981) 75; Kalkman, Blumea 29 (1984) 319; ibid. 32 (1987) 323. — Type species: *Rubus fruticosus* L. See Taxon 41 (1992) 573.

Shrubs (see under Morphology), usually climbing, straggling or creeping, rarely erect, only few species herbaceous. Twigs and other parts nearly always with prickles. Leaves compound (pinnately or palmately structured) or simple, then usually incised. Stipules free, on the base of the petiole or at the junction of twig and petiole, persistent or fugacious, rarely absent. Inflorescences terminal, elaborately branched with the lowermost branches often in the axils of the upper leaves, or little or not branched and in axillary bundles, or (rarely) strongly reduced and flowers (sub)solitary. Flowers 5-merous, mostly bisexual, rarely unisexual and the plants ± dioecious. Sepals imbricate, often unequal, outer margins often lobed. Petals normally longer than sepals, rarely partly or entirely absent, white, less commonly cream-coloured, pink, purplish, or red. Stamens many. Pistils many, rarely few, free, on a mostly elevated torus; ovaries 1-locular; style terminal, stigma capitate or bifid; ovules 2, only 1 developing. Fruits cohering and falling as a collective fruit with or without the torus, or (rarely) coming loose individually, drupes with usually a juicy or fleshy mesocarp and a hard and rugose endocarp. Seed with thin testa.

— Figs. 2–7.

Distribution — Genus with some hundreds of species, apart from the microspecies in the apogamous *R. fruticosus*/*R. caesius* complex (according to Weber, Phan. Mon. 7, 1972, there are at least 5000 of those in Europe; see also under Taxonomy). Subcosmopolitan. In *Malesia* c. 50 species, New Guinea (17) and the Philippines (c. 17) being richest in species, followed by Java and Sumatra. In the area New Guinea is the only (small) centre of endemism with 12 endemic species, the other islands have very few endemics or none at all.

Habitat — Mainly montane with an altitudinal range between 1000 and 3000 m, about a dozen species normally (also) under 1000 m, only three going down to sea-level, also a dozen species up into the alpine zone above 3000 m. Highest record is 4340 m for *R. archboldianus* (Mt Wilhelm, Papua New Guinea).

Ecology — Most species are light-loving and are restricted to more or less open places, either natural or anthropogenic. There does not seem to be evidence for suspecting apogamy in any of the Malesian species.

Taxonomy — Focke (1910–11) recognized twelve subgenera but made clear in his text (p. 6) that he considered the smaller subgenera to be offshoots from the three larger ones, that represent the main subdivision of the genus: subgenus *Malachobatus* (centred in SE Asia), *Idaeobatus* (centred in E Asia), and *Rubus* (centred in S America). Nevertheless he put the large groups and the small offshoots on the same taxonomical level what from a phylogenetical point of view would not be the most acceptable classification. In the present survey also the subgenus *Micranthobatus* is recognized although it may not be a holophyletic group (see Kalkman, 1987). The subgenus *Chamaebatus* has been maintained with the same misgivings.

The genus *Rubus* has a bad reputation among taxonomists, undeserved since the problems are only caused by one Northern Hemisphere offshoot of the subgenus *Rubus*, the so-called '*Moriferi*' or *R. fruticosus*/*R. caesius* complex. The complex is taxonomically unsolvable, like others of its kind, because of the facultative apogamy and easy hybridization with stable progeny. It is possible to find the same 'taxa' year after year, to describe them, and to recognize differences with other, neighbouring 'taxa'. Over a large area, however, it is impossible to reach a hierachic classification with more or less equivalent taxa. Although 'batologists' admit that their taxa are not comparable, they nevertheless try to classify them in the common scientific classification, and with predictably poor results. As one recent example, H.E. Weber (Die Gattung *Rubus* in NW. Europa, Phan. Monogr. 7, 1972) subdivides the subgenus *Rubus* in three sections (restricted to the NW European species). Of the three sections the *Eufruticosi* is the most important one, the two others accommodate, respectively, the dewberry (*R. caesius*) and the hybrids of the latter with *Eufruticosi* species. In the section *Eufruticosi* one of the two subsections contains the species that some authors consider to be hybrids with *R. idaeus* (belonging to subgenus *Idaeobatus*), the raspberry. The other subsection is divided into eleven series that are poorly recognizable and definable. As Weber himself says, in placing individual species in the series there is much room for the individual discretion of different authors.

The rest of the genus, however, behaves perfectly normally: there is a majority of well-recognizable, clear-cut species, several difficult cases of specific delimitation, and a small number of complexes like *R. moluccanus* that are obviously engaged in active speciation, possibly linked to an enlargement of their habitats by human interference.

Morphology — European blackberry plants (*R. fruticosus* complex) usually make long vegetative shoots, called primocanes or turios, during the summer season. After their first winter a number of shorter mixed shoots appear in the leaf-axils of the primocanes. These mixed shoots, floricanes, are of determinate growth and terminate in an inflorescence. After fruiting, in autumn and winter, the floricanes die back and so does a larger or smaller part of the primocanes. New primocanes will, next spring, appear axillary on the lower

nodes of still living parts of the old primocanes, from the subterranean parts, and from places where overhanging primocanes have rooted. These plants are not really shrubs, therefore. See Weber, l.c. (1972: fig.2).

Part of the tropical *Rubus* species may have the same kind of differentiation and periodicity in the branches but from herbarium specimens reconstruction is impossible. Field observations in the wild and in tropical botanic gardens are needed. In some cases it is obvious from the herbarium that there are two kinds of branches: long and stout ones with large leaves in whose axils shorter branches develop, terminating in an inflorescence. Continuation of growth of these shorter branches, if it occurs, must be sympodial.

Uses — The plants contain tannins, which may be responsible for their use in cases of diarrhoea and throat-troubles. These uses are reported for tea made from leaves of the European *Rubus fruticosus* and also for *R. moluccanus* and some other Malesian species.

The fruits of all species are edible, but not all are as juicy and tasty as the well-known American and European blackberries (*R. fruticosus/caesius* complex), the raspberry (*R. idaeus*), loganberry (*R. × loganobaccus*), or Japanese wine-berry (*R. phoenicolasius*). The fruits of these and other species can be eaten raw as table-fruit or made into preserves, jams, jellies and fruit juices. A few Malesian species could be promising for these purposes, see Kalkman in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 277–278 & 355.

KEY TO THE SPECIES

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| 1a. Leaves simple | 2 |
| b. Leaves compound | 24 |
| 2a. Underside of leaves with a closed felt of thin, curly hairs, apart from straight, stouter hairs on nerves and veins | 3 |
| b. Not a closed felt on underside of the leaves, leaf surface visible between the hairs | 12 |
| 3a. Stipules and bracts entire or with few minute teeth | 4 |
| b. Stipules and bracts distinctly toothed to deeply incised | 5 |
| 4a. Inflorescence richly and widely branched. Sepals at anthesis 5–6 mm long | |
| | 35. <i>R. luzoniensis</i> |
| b. Inflorescence a compact, few-flowered raceme. Sepals c. 12 mm long | |
| | 39. <i>R. perfulvus</i> |
| 5a. Flowerbuds globular | 6 |
| b. Flowerbuds ovoid, pointed | 7 |
| 6a. Leaves ± ovate, at least 1.4 times as long as wide, not or very shallowly lobed. Dioecious | 31. <i>R. elongatus</i> |
| b. Leaves suborbicular to broadly ovate in outline, ± as long as wide, deeply 5- to 7-lobed. Flowers bisexual | 26. <i>R. alceifolius</i> |
| 7a. Inflorescence a simple, compact raceme | 41. <i>R. rolfei</i> |
| b. Inflorescence elaborately branched | 8 |
| 8a. Leaves bullate above, surface distinctly raised between the veins | 9 |
| b. Leaves flat above, nerves (and veins) sometimes slightly impressed but leaf surface between the veins not distinctly raised | 11 |

- 9a. Outer sepals shortly toothed, teeth up to 1.5 mm long. Anthers glabrous
29. R. chrysophyllum
- b. Outer sepals with longer lobes or teeth. Anthers hairy on top 10
- 10a. Outer sepals with 5 or more lobes on each side, lobes up to 7 mm long
33. R. heterosepalus
- b. Outer sepals with 1–3 teeth on each side, teeth up to 3 mm long **36. R. malvaceus**
- 11a. Leaves (broadly) ovate, length/width up to 2(–2.5), not or shallowly lobed, if distinctly lobed (var. *angulosus*), the basal lobes overlapping. Stipules early falling, 4–12 mm wide, on each side with 4–10 lobes. Ovaries and fruits glabrous
38. R. moluccanus
- b. Leaves broadly ovate, length/width less than 1.5, distinctly 3-lobed, base cordate but lobes not touching. Stipules rather persistent, up to 2 mm wide, with 2 or 3 lobes on each side. Ovaries and fruits glabrous or hairy **34. R. keleterios**
- 12a. Creeping plants with solitary, terminal flowers, rarely 1 or 2 axillary flowers under the terminal one. Leaves reniform, often wider than long. Hypanthium and outside of sepals with needle-shaped prickles 13
- b. Erect, climbing, or straggling shrubs with flowers in inflorescences. Leaves usually distinctly longer than wide. Hypanthium and sepals unarmed 14
- 13a. Stipules serrate to dentate **45. R. calycinus**
- b. Stipules deeply digitately divided **46. R. pectinellus**
- 14a. Anthers basifixed 15
- b. Anthers dorsifixed or dorso-versatile 16
- 15a. Underside of leaves with scattered hairs only **42. R. smithii**
- b. Underside of leaves densely hairy **27. R. beccarii**
- 16a. Ovaries hairy 17
- b. Ovaries glabrous, on hairy or glabrous torus 19
- 17a. Leaves distinctly cordate at base **44. R. sundaicus**
- b. Leaves with rounded, subtruncate or very shallowly cordate base 18
- 18a. Leaves less than 1.5 times as long as wide, petiole 1.5 cm or longer, nerves terminating in the margin. Flowers unisexual (?) **30. R. cumingii**
- b. Leaves normally more than 1.5 times as long as wide, petiole rarely longer than 1 cm, nerves not reaching the margin. Flowers bisexual **40. R. pyrifolius**
- 19a. Petals 5 20
- b. Petals 0 or 1 22
- 20a. Leaves suborbicular to broadly ovate in outline, about as long as wide, deeply 5–7-lobed. Stipules and bracts divided into thin thread-like lobes **26. R. alceifolius**
- b. Leaves longer than wide, not or hardly lobed. Stipules and bracts toothed or dissected but not with thin, thread-like lobes 21
- 21a. Inflorescences laxly paniculate, up to 35 cm long, compound racemes with up to 20 racemes of each up to 30 flowers **28. R. benguetensis**
- b. Inflorescences rarely longer than 10 cm, racemes of 3- to 1-flowered cymes, the upper ones often congested **32. R. glomeratus**
- 22a. Flowers large, sepals 10–12 mm long **43. R. sorsogonensis**
- b. Flowers smaller, sepals 6–8 mm long 23

- 23a. Leaves 1–1.3 times as long as wide. Glandular hairs on outside of hypanthium and sepals, outer sepals on each margin with 3–6 distinct teeth of up to 1 mm long
37. *R. mearnsii*
- b. Leaves 1.4 or more times as long as wide. Outside of hypanthium and sepals without glandular hairs, outer sepals entire or with 1 or 2 minute teeth on each margin
28. *R. benguetensis*
- 24a. Leaves pinnate with more than 3 leaflets, or bipinnate 25
 b. Leaves 3-foliolate or pedately/palmately 5-foliolate 32
- 25a. Needle-shaped spines on stems, leaves and also on hypanthium 1 to 5 spines alternating with the sepals 26
 b. Prickles not needle-shaped 28
- 26a. Leaves bipinnate, 3-pinnate at base, simply pinnate at apex
20. *R. montis-wilhelmi*
- b. Leaves simply pinnate 27
- 27a. Leaflets 1–4 by 0.5–2 cm, with 7–12(–18) teeth on each side, upper surface glabrous or hairy between the nerves, lower surface glabrous or hairy on midrib and veins 14. *R. ferdinandi-muelleri*
 b. Leaflets 0.5–1.5 by 0.5–1 cm, with 4–6(–7) teeth on each side, both surfaces glabrous or almost so 23. *R. papuanus*
- 28a. Stems and leaves with up to 5 mm long gland-tipped hairs 25. *R. sumatranus*
 b. No long gland-tipped hairs present 29
- 29a. Leaves almost glabrous 30
 b. Leaves hairy, at least on underside 31
- 30a. Leaflets biserrate, with long-tapering apex. Pistils down to the base of the torus, ovaries with shortly stalked glands 11. *R. chrysogaeus*
 b. Leaflets serrate, apex acute to long-pointed. Base of torus without pistils. Ovaries without glands 15. *R. fraxinifolius*
- 31a. Leaflets below with a dense, woolly, silvery-white felt all over and with straight hairs on the nerves. Flowers small: sepals 4–7 mm long, petals 3.5–5 mm long, pink. Ovaries and fruits densely hairy 22. *R. niveus*
 b. Leaflets below long-hairy but without woolly felt. Flowers large: sepals 7–15 mm or longer, petals 8–17 mm long, white. Ovaries with stalked glands and apically with some hairs 24. *R. rosifolius*
- 32a. Leaves 5-foliolate, the uppermost ones and/or the first leaves on a branch sometimes only 3-foliolate 33
 b. Leaves 3-foliolate, the upper ones sometimes unifoliolate 37
- 33a. Leaflets with 18 or (many) more pairs of nerves. Unarmed or prickles very rare 34
 b. Leaflets with 6–17 pairs of nerves. Armed 35
- 34a. Normally 30–40 pairs of nerves. Stipules 2–4 cm long. Sepals sericeous outside, the covered parts woolly. Petals 4–5 mm long, distinctly shorter than sepals
16. *R. lineatus*
 b. Normally 16–26 pairs of nerves. Stipules 0.5–1 cm long. Sepals with few hairs outside, covered parts woolly. Petals 9–12 mm long, ± as long as sepals
21. *R. neo-ebudicus*

- 35a. Prickles rather few. Stipules long persistent, 4–12 mm long. Inflorescences monochasial or dichasial 8. *R. alpestris*
 b. Prickles rather many. Stipules absent or fugacious, 3–7 mm long. Inflorescences racemose, racemes solitary or in bundles 36
- 36a. Terminal leaflets 4.5–12 by 2–7 cm, with 9–14 pairs of nerves. Racemes with 10–25 flowers, solitary or in bundles. Filaments glabrous. Ovaries glabrous or hairy, not glandular 5. *R. royenii*
 b. Terminal leaflets 3–5 by 2–3 cm, with 6–8 pairs of nerves. Racemes with 2–7 flowers, solitary. Filaments long-hairy. Ovaries hairy and dorsally with many yellow glands 4. *R. novoguineensis*
- 37a. Stems unarmed or almost so 38
 b. Stems armed 40
- 38a. Leaflets with more than 16 pairs of nerves 21. *R. neo-ebudicus*
 b. Leaflets with fewer than 10 pairs of nerves 39
- 39a. Inflorescence a large, terminal thyrsse with up to 20 rich-flowered laterals under the terminal flower 1. *R. clementis*
 b. Inflorescence much poorer, with under the terminal flower only 1–4 axillary cymes of up to 4 flowers 18. *R. lowii*
- 40a. Hypanthium outside with up to 5 mm long bristles or spine-like hairs, otherwise hairy or not 41
 b. Hypanthium outside without bristles or spines, with or without short hairs and/or few short prickles 44
- 41a. Stipules deeply divided. Petals red. Ovaries hairy 9. *R. archboldianus*
 b. Stipules entire, serrate, or with some short teeth. Petals white 42
- 42a. Hypanthium outside with straight prickles and with capitate spines, otherwise glabrous. Ovaries glabrous. Fruits red 12. *R. copelandii*
 b. Hypanthium outside hairy and with straight bristles 43
- 43a. Stipules 10–18 by 3–15 mm. Inflorescences poor, usually less than 8 flowers. Ovaries glabrous. Fruits orange to red 17. *R. lorentzianus*
 b. Stipules up to 10 by 0.5 mm. Inflorescences rich, up to 150 flowers or more. Ovaries hairy. Fruits yellow to orange 13. *R. ellipticus*
- 44a. Flowers solitary and terminal or in poor racemes of 2–5 flowers 45
 b. Inflorescences richer, thyrsoid or racemose 47
- 45a. Underside of leaflets woolly all over 3. *R. megacarpus*
 b. Underside of leaflets glabrous or with hairs on midrib and larger nerves only 47
- 46a. Ovaries long-hairy 19. *R. macgregorii*
 b. Ovaries glabrous 18. *R. lowii*
- 47a. Under the terminal flower up to 6 lateral cymes or dichasias in the axils of bracts or leaves. Flowers bisexual 48
 b. Axillary racemes, almost always simple, rarely partly with cymes instead of flowers, racemes solitary or in bundles of up to 4. Flowers (always?) unisexual 50
- 48a. Stipules deeply divided 10. *R. banghamii*
 b. Stipules entire or with 1 or 2 small teeth 49

- 49a. Petals longer than sepals, early falling. Stamens and pistils both more than 150
 7. *R. acuminatissimus*
- b. Petals shorter than sepals, long-persistent. Stamens up to 45, pistils up to 25
 18. *R. lowii*
- 50a. Terminal leaflets 3–10 by 2–7 cm. Flowers small: sepals 2.5–4 mm, petals 4–8 mm long 2. *R. dictinis*
- b. Terminal leaflets 10–15 by 8–12 cm. Flowers larger: sepals 6–7 mm, petals 10–17 mm long 6. *R. trigonus*

Subgenus *Micranthobatus*

Rubus subg. *Micranthobatus* (Fritsch) Kalkman, Blumea 32 (1987) 324. — *Rubus* sect. *Micranthobatus* Fritsch, Österr. Bot. Zeitschr. 36 (1886) 259.

Leaves palmate, rarely unifoliolate. *Leaflets* pinninerved, nerves terminating in the margin. *Stipules* absent or 1 or 2 on the base of the petiole. *Inflorescences* terminal thyrses or axillary bundles of (1–)2–5 racemes. *Flowers* uni- or bisexual. *Hypanthium* saucer-shaped, sometimes with prickles outside. *Sepals* (sub)equal, entire. *Fruits* falling as a coherent collective from the torus, rarely falling separately (?).

Distribution — Twelve species with an East Gondwanan type area: Australia, New Guinea, New Zealand, Celebes, Borneo, Philippines, NE India, Madagascar. In Malesia 6 species.

1. *Rubus clementis* Merr., Philipp. J. Sc., Bot. 3 (1908) 139; Elmer, Leafl. Philipp. Bot. 2 (1908) 458. — *Rubus lucens* Focke var. *clementis* (Merr.) Focke, Bibl. Bot. 72 (1911) 213; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 228.
 — Type: *Clemens* 740, Mindanao.

Climbing or scrambling shrubs. *Stems* up to 20 m long, unarmed or with few, short, curved prickles, short-hairy and with minute, stalked glands. *Leaves* 3-foliate, petiole 5–9 cm long. *Stipules* on the petiole, up to 5 mm above its base, linear, up to 7 by 1 mm, rather persistent. *Leaflets* ovate to elliptic, terminal ones 8–13.5 by 4.5–9 cm, lateral ones usually slightly smaller, base rounded, margin shallowly serrate in upper part, apex acuminate, nervation pinnate with 7–9 pairs of nerves, often near the end with one strong acropetalous tertiary vein, venation transverse, sparsely short-hairy and with minute glands. *Inflorescence* terminal, up to 55 cm long, a hanging thyrsus with up to 20 laterals in the axils of bracts or leaves, the lower laterals up to 25 cm long. *Bracts* linear, up to 5 mm long. *Pedicels* up to 5 mm long, growing to 10 mm, densely short-hairy

as are the rachises. *Flowers* uni- or bisexual, plants probably polygamodioecious. *Hypanthium* saucer-shaped, 3.5–5 mm across, woolly outside. *Sepals* triangular to ovate, 3.5–5 by 3–4.5 mm, obtuse, apiculate to acuminate, densely short-woolly outside. *Petals* obovate to elliptic, 5.5–9 by 4–6 mm, white. *Stamens* 70–160, filaments up to 2.5 mm, anthers 1–1.5 mm long, staminodes in female flowers 1–2 mm, including minute anther rudiment. *Pistils* 30–70, ovaries glabrous or with long hairs dorsally near apex, on elevated, hairy torus, style 2–3 mm long, sometimes hairs at base, pistillodes in male flowers 2 mm including style. *Collective fruits* globular, 1–1.5 cm, sepals closing and enlarging after anthesis. *Fruits* densely packed, 2.5–3.5 mm by 1.5–2 mm when dry, exocarp sometimes still hairy, red to orange-red, mesocarp juicy.

Distribution — Northern part of Sumatra, Borneo, Mindanao, Celebes.

Habitat — In forest along rivers and brooks, also in open places in forest and shrubland, altitude 150–1300(–1800) m.

Note — The disposition of uni- and bisexual flowers is incompletely known, see Kalkman (1987).

2. Rubus diclinis F. Muell., Trans. Roy. Soc. Vict. 1 (1889) 5; P. van Royen, Phan. Mon. 2 (1969) 69, only var. *diclinis*; Alpine Fl. New Guinea 4 (1983) 2481, idem. — Types: *MacGregor s.n.*, Mt Knutsford, Mt Musgrave.

Rubus tsiri P. van Royen, Phan. Mon. 2 (1969) 77, excl. most specimens cited; Alpine Fl. New Guinea 4 (1983) 2486, idem. — *Rubus paradoxus* Ridley, Trans. Linn. Soc. Lond. II, Bot. 9 (1916) 36, nom. illeg., non S. Moore (1878). — Types: *Kloss* specimens, Mt Jaya (Carstensz).

Climbing or scrambling shrubs. *Stems* up to 5(–18?) m long, densely patently hairy, sometimes with shortly stalked glands, prickles rather many, curved, small. *Leaves* 3-foliolate, petiole 1.5–5.5 cm long. *Stipules* very rarely present, on the petiole, up to 4 by 0.5 mm. *Leaflets* elliptic to ovate, terminal ones 3–10 by 2–7 cm, lateral ones smaller, base rounded to shallowly cordate, margin serrate, apex acute, hard-chartaceous, nervation pinnate with (6–)8–12 pairs of nerves, venation transverse, scattered hairy above, sparsely to densely golden to brownish hairy below. *Inflorescences* simple racemes, solitary or in bundles of up to 4 in the leaf axils, up to 8 cm long, peduncle 0–2 mm, some empty bracts at base, up to 15 flowers. *Bracts* up to 7 by 4 mm. *Pedicels* 4–10 mm long, densely hairy and always with small curved prickles, as is the rachis. *Flowers* normally unisexual, sometimes bisexual (at least appearing so in the herbarium). *Hypanthium* saucer-shaped, 2.5–3 mm across, woolly and with patent hairs outside. *Sepals* elliptic to tongue-shaped, 2.5–4 by 1.5–3.5 mm, with straight hairs outside and woolly on the margins, pinkish or purplish inside. *Petals* elliptic to oblong, 4–8 by (1–)2.5–4.5 mm, obtuse or emarginate, patently hairy inside, white or pale pink. *Stamens* 18–40, filaments up to 4.5 mm, anthers 0.5–1 mm long, staminodes in female flowers small and ± petaloid. *Pistils* c. 150, ovaries densely hairy, on high, densely hairy torus, style up to 3 mm long, pistillodes in male flowers minute. *Collective fruits* up to 1.5 cm when living, 1 cm when dry, sepals spreading. *Fruits* well separated, up to 5(–7) by 4 mm when dry, exocarp hairy or glabrous, dark red to black, mesocarp rather thick and fleshy when living, rather thin when dry.

Distribution – New Guinea.

Habitat – Montane forest, clearings, forest edges, secondary forest, shrubland, altitude 1750–3470 m, rarely lower.

Uses – On one herbarium label the leaves are reported to be used "in smoking", i.e. as cigarette wrapper.

3. Rubus megacarpus P. van Royen, Phan. Mon. 2 (1969) 65; Alpine Fl. New Guinea 4 (1983) 2480. — Type: *Brass* 30099, Mt Wilhelm.

Climbing or scrambling shrubs. *Stems* up to 10 m long, densely hairy, prickles many, short, curved, some cataphylls at base of lateral shoots. *Leaves* 3-foliolate, petiole 1.5–5 cm long. *Stipules* not always present, on the petiole, filiform to linear, 4–6 by 0.1–0.5 mm, early falling. *Leaflets* obovate to elliptic, 3–6 by 2–3 cm, lateral ones usually relatively narrower than apical one, shallowly serrate in upper part only, apex rounded to truncate, with or without apiculus, stiff-coriaceous, nervation pinnate with 5–7 pairs of steeply ascending nerves, venation transverse, glabrous above, lower surface densely woolly all over and with appressed straight hairs on midrib and nerves. *Inflorescence* a simple raceme, axillary, up to 12 cm long, rachis stiff, with up to 5 flowers, often reduced to only the terminal flower. *Bracts* 5–9 by 1.5–3 mm, persistent, also empty ones under the flowers. *Pedicels* up to 4 cm long, densely hairy as is rachis. *Flowers* uni- or bisexual. *Hypanthium* saucer-shaped, 6–10 mm across, densely hairy outside. *Sepals* broadly ovate, 9–12 by 8–11 mm, inner ones slightly narrower than outer ones, obtuse and apiculate, shortly woolly and with appressed hairs outside, pale purplish. *Petals* obovate, 13–20 by 8–13 mm, densely long-hairy in basal half outside, (pinkish or greenish) white. *Stamens* 70–100, filaments up to 10 mm, with long hairs, anthers up to 2 mm long, staminodes in female flowers minute. *Pistils* c. 150, ovaries densely hairy, on high, densely hairy torus, style up to 3 mm long, pistillodes in male flowers minute. *Collective fruits* large, up to 5.5 by 4 cm when living, most of the pistils developing, sepals appressed to spreading after anthesis. *Fruits* closely packed, up to 9 by 7 mm when dry, exocarp densely whitish-hairy, purplish, mesocarp still thick when dry, stone up to 8 by 6 mm. – Fig. 2.

Distribution – New Guinea, only known from Mt Wilhelm.

Habitat – Alpine shrubland and mossy forest, altitude 3500–3750 m.

4. Rubus novoguineensis Merr. & Perry, J. Arnold Arbor. 21 (1940) 183; Kalkman, Blumea 32 (1987) 337. — *Rubus diclinis* F. Muell. var. *novoguineensis* (Merr. & Perry) P. van Royen, Phan. Mon. 2 (1969) 75; Alpine Fl. New Guinea 4 (1983) 2484. — Type: *Brass* 4337, Mt Albert Edward.



Fig. 2. *Rubus megacarpus* P. van Royen. Fruiting twig (Brass 30099). Photo P. van Royen.

Scrambling or trailing shrubs. *Stems* up to 2 m long, densely hairy and with few stalked glands, glabrescent, prickles rather many, curved, up to 2 mm, several cataphylls at base of laterals. *Leaves* palmately 5-foliolate, the first leaves on a branch sometimes 4- or 3-foliolate, petiole 2.5–5.5 cm long, petioles and petiolules hairy, with rather many strongly curved prickles. *Stipules* maybe not always present, on the petiole, 3–5 by less than 1 mm, hairy. *Leaflets* elliptic, terminal ones 3–5 by 2–3 cm, base rounded to slightly cordate, margin serrate, apex rounded, chartaceous, nervation pinnate with 6–8 pairs of nerves, venation transverse, densely (semi-)patently hairy below, glabrescent. *Inflorescence* a simple raceme, axillary, 5–7.5 cm long, with 2–7 flowers, peduncle up to 2 cm, with some to many prickles. *Bracts* up to 6 by 2 mm, also empty ones at base of peduncle. *Pedicels* 1.5–4 cm long, with prickles. *Flowers* unisexual and plants dioecious or polygamodioecious.

Hypanthium flat, 3–3.5 mm across, appressed-hairy and glandular outside, sometimes with a prickle. *Sepals* elliptic, 3.5–7 by 3–6 mm, obtuse, indumentum outside as hypanthium, purplish. *Petals* elliptic, 5–7 by 3.5–7 mm, rounded to slightly emarginate at apex, hairy, pale green to white. *Stamens* 14–20, filaments up to 2.5 mm, long-hairy, anthers c. 1 mm long, staminodes in female flowers minute. *Pistils* 17–25 in a compact globe, ovaries densely long-hairy and yellow-glandular on the backside, on a flat hairy torus, style 0.8–1 mm long. *Collective fruits* globular, 1–1.5 cm when dry, up to 2.5 cm when living, sepals spreading. *Fruits* well separated, 5–7 by 4–4.5 mm, exocarp hairy and dorsally also glandular, brown (?), mesocarp thick.

Distribution — New Guinea, only known from Central Prov. in Papua New Guinea.

Habitat — Open places in forest and in forest margins, altitude 2800–3680 m.

Note – Closely related is the Australian *Rubus moorei* F. Muell., under which name two species are hiding. See Kalkman, l.c.: 334, 338.

5. *Rubus royenii* Kalkman, Blumea 32 (1987)

333. — *Rubus tsiri* auct. non P. van Royen: P. van Royen, Phan. Mon. 2 (1969) 77, excl. type; Alpine Fl. New Guinea 4 (1983) 2486, excl. type. — Type: Brass 30919, Mt Otto.

Rubus diclinis F. Muell. var. *ikilimbu* P. van Royen, Phan. Mon. 2 (1969) 75; Alpine Fl. New Guinea 4 (1983) 2486. — *Rubus royenii* Kalkman var. *ikilimbu* (P. van Royen) Kalkman, l.c.: 336. — Type: see below.

Rubus moorei auct. non F. Muell.: Merr. & Perry, J. Arnold Arbor. 21 (1940) 184, in obs.

Climbing, scrambling, or trailing shrubs. Stems up to 6(–10) m long, variously hairy, prickles rather many, 1–2 mm long, straight to slightly curved, shoots with large cataphylls at base. Leaves palmately 5-foliolate, occasionally 4- or 3-foliolate, petiole 3–11 cm long, with many small, curved prickles. Stipules usually absent. Leaflets elliptic to ± ovate, terminal ones 4.5–12 by 2–7 cm, shallowly cordate to rounded at base, margin dentate-serrate, apex acute to acuminate, chartaceous, nervation pinnate with 9–14 pairs of nerves, rather often forking, venation transverse, indumentum various. Inflorescences simple racemes, 1–5 in the leaf axils, 6–15 cm long, peduncle 0–1 cm, with up to 25 flowers. Bracts 3–7 by 1–4 mm, also empty ones at base of peduncle. Pedicels 4–18 mm long, densely hairy and with small prickles, as is rachis. Flowers unisexual, plants probably dioecious. Hypanthium saucer-shaped, densely hairy outside, sometimes with prickles. Sepals ± elliptic, obtuse, densely hairy outside on the marginal parts, pinkish. Petals elliptic, obtuse to emarginate, long-hairy inside, white to pink. Stamens glabrous, staminodes in female flowers minute. Ovaries glabrous or with long hairs in upper part, on (slightly) elevated, hairy torus, pistillodes in male flowers minute. Collective fruits globular, up to 2 cm, probably late in attaining their final dimensions, sepals spreading. Fruits dark red to black, with thick mesocarp.

Distribution – New Guinea, New Britain.

Habitat – Open places and forest, up to 3400 m altitude, rarely collected below 1200 m.

Note – Related is the Australian *Rubus moorei* F. Muell., under which name two species are hiding. See Kalkman, l.c.: 334, 338.

KEY TO THE VARIETIES

1a. Long, non-glandular bristles of 3–4(–5) mm long on stems, petioles and petiolules

a. var. *hispidus*

b. Bristles absent 2

2a. Stalked glands absent. Leaves glabrous to sparsely hairy on both sides. Flowers small: sepals 3–4 mm, petals 5–7.5 mm long, stamens 20–40, pistils 10–30 c. var. *royenii*

b. Stalked glands on stems, petioles, inflorescences, and pedicels. Leaves hairy on upper surface, densely so on midrib and large nerves, lower surface densely soft-hairy on all nerves and veins. Flowers larger: sepals 3.5–5 mm, petals 8–10 mm long, stamens 45–60, pistils c. 50 b. var. *ikilimbu*

a. var. *hispidus* Kalkman, Blumea 32 (1987) 336. — Type: Sayers & Millar NGF 19884, Mt Wilhelm.

Stems with many, reddish to brown, 3–4(–5) mm long, straight, non-glandular bristles, otherwise sparsely hairy to glabrous. Stipules rarely present, on the petiole, linear, 3–7 mm long. Petioles and petiolules densely hairy and with bristles. Leaflets on upper surface glabrous, lower surface sparsely short-hairy on main nerves and sometimes minutely glandular. Hypanthium 1.5–2.5 mm across. Sepals 2–3 by 1.8–3 mm. Petals 4.5–6.5 by 2–3 mm, white. Stamens 14–20, filaments up to 1.5 mm. Pistils 10–20. Collective fruit up to 1.5 cm (living), fruits growing to 6 by 4.5 mm.

Distribution – Papua New Guinea, New Britain.

Habitat – Forest, forest edges, disturbed places, shrubland, altitude (1800–)2400–3400 m.

Note – One chromosome count $2n = 28$ was made by Borgmann, Zeitschr. f. Bot. 52 (1964) 124, as *Rubus spec.*, with Borgmann 203 as voucher.

b. var. *ikilimbu* (P. van Royen) Kalkman, Blumea 32 (1987) 336. — *Rubus diclinis* F. Muell. var. *ikilimbu* P. van Royen, Phan. Mon. 2 (1969) 75. — Type: Hoogland & Pullen 6179, Upper Wahgi Valley.

Stems, petioles, and petiolules densely soft-hairy and often with stalked glands, their stalks up to 1(–2.5) mm long. Leaflets on upper surface hairy all over, densely so on main nerves, ± glabrescent, on lower surface densely patently soft-hairy on all nerves and veins. Inflorescence rachis and pedicels with stalked glands. Hypanthium 3.5–

4.5 mm across, sometimes with stalked glands outside. *Sepals* 3.5–5 by 2.5–3.5(–5) mm. *Petals* 8–10 by 4–5 mm, pink. *Stamens* 45–60, filaments up to 2.5 mm. *Pistils* c. 50. *Collective fruit* up to 2 cm (dry), fruits up to 8 by 5.5 mm (dry).

Distribution — Papua New Guinea.

Habitat — Secondary forest and shrubland, altitude 1280–2560 m.

Uses — Stems used for making ropes, leaves are smoked (Note on Flenley ANU 2071 from Wabag).

c. var. *royenii*

Stems, petioles, and petiolules sparsely hairy to glabrous. *Leaflets* on both surfaces sparsely hairy on nerves to glabrous. *Hypanthium* 2.5–3 mm across. *Sepals* 3–4 by 2.5–3 mm. *Petals* 5–7.5 by 2.5–3.5 mm, (pinkish- or cream-)white. *Stamens* 20–40, filaments c. 2.5 mm. *Pistils* 10–30. *Collective fruit* c. 7 mm, fruits up to 4 by 3.5 mm when dry.

Distribution — New Guinea.

Habitat — Forest margins, secondary forest and shrubland, streambanks; alt. (670–)1900–3340 m.

6. *Rubus trigonus* Kalkman, Blumea 37 (1993)

378. — *Rubus cordiformis* Kalkman, Blumea 32 (1987) 331, non Weber & Martensen, Sonderb. Naturwiss. Ver. Hamburg 4 (1981) 100.
— Type: Brass 30932, Mt Wilhelm.

Climbing or scrambling shrubs. *Stems* up to 6 m long, densely patently hairy and with small, sessile glands, prickles rather many, 1–1.5 mm long, large cataphylls at base of shoots. *Leaves* 3-foliate, petiole 5–12 cm long. *Stipules* not seen. *Leaflets* ovate, terminal ones 10–15 by 8–12 cm,

lateral ones slightly smaller, basal part usually folded back in herbarium, base cordate, margins irregularly dentate, apex acuminate, nervation pinnate (pedate) with 6–9 pairs of nerves, the lowermost with some strong basiscopic side-nerves, veination transverse, patently hairy, nerves on underside with glands. *Inflorescence* very lax, usually a simple raceme, sometimes partly branched from the bracteoles, up to 20 cm long, peduncle 0–2 mm long, racemes solitary or 2 or 3 in the axils of leaves or cataphylls, with up to 10 flowers. *Bracts* 4–10 mm long. *Pedicels* 2–5.5 cm long, densely hairy as is the rachis. *Flowers* unisexual, plants probably dioecious. *Hypanthium* saucer-shaped, 4–5 mm across, densely hairy outside. *Sepals* elliptic, 6–7 by 4–7 mm, obtuse, with patent hairs and glands outside, the marginal parts woolly. *Petals* elliptic, 10–17 by 4–10 mm, long-hairy at base inside, white or cream-coloured. *Stamens* 40–60, filaments up to 7 mm, anthers 1–1.5 mm long, staminodes in female flowers minute. *Pistils* c. 60, ovaries densely hairy, on slightly elevated, hairy torus, style 1 mm long, pistillodes in male flowers c. 30, minute to small. *Collective fruits* ellipsoid, c. 1.2 by 1 cm, sepals spreading under the ripe fruits. *Fruits* 4 by 3 mm when dry, exocarp and mesocarp forming a thin layer when dry, hairy in upper part, colour unknown.

Distribution — New Guinea (only known from Papua New Guinea).

Habitat — Shrubland and forest (margins), altitude 1500–3200 m.

Notes — Dr. A. A. van de Beek drew my attention to the older homonym.

See also under Dubious names, *Rubus diclinis* F. Muell. var. *papuanus* Focke.

Subgenus Ideobatus

Rubus subg. *Idaeobatus* (Focke) Focke, Bibl. Bot. 72 (1911) 128; Zandee & Kalkman.

Blumea 27 (1981) 79–113. — *Rubus* sect. *Idaeobatus* Focke, Abh. Naturw. Ver. Bremen 4 (1874) 147.

Leaves 3-foliate, palmately 5-foliate, or imparipinnate, rarely bipinnate, rarely 1-foliate (not in Malesia). *Leaflets* pinninerved, nerves terminating in the margin. *Stipules* on the basis of the petiole, persistent. *Inflorescences* thyrsoid, ± elaborate, terminal or sometimes also lateral. *Flowers* bisexual. *Hypanthium* saucer-shaped. *Sepals* (sub)equal, usually entire. *Fruits* cohering, becoming loose from the torus as a whole, endocarp rugose.

Distribution — Many species, distributional centre in Asia, extending to Australia and the Pacific islands, Africa including Madagascar, islands in the Indian Ocean, few in N and C America, one species (*R. idaeus*) in Europe. In Malesia 19 species.

7. Rubus acuminatissimus Hassk., Tijd. Nat. Gesch. Phys. 10 (1843) 146, excl. syn. *Rubus moluccus parvifolius* Rumph.; Miq., Fl. Ind. Bat. I, 1 (1855) 377; Backer & Bakh. f., Fl. Java 1 (1964) 514. — Type: probably a living plant in the Bot. Gard. Buitenzorg (Bogor), not maintained in herbarium.

Rubus podocarpus Kuntze, Rev. Gen. Pl. 1 (1891) 223. — Type: Kuntze 5350, Java.

Climbing shrubs, sometimes erect? *Stems* up to 3 m long, glabrous, prickles rather many, curved, stout. *Leaves* 3-foliate, usually 1-foliate near and in the inflorescence, petiole 1.5–5 cm long. *Stipules* linear, 3–7 by up to 1 mm, with some long hairs. *Leaflets* elliptic to oblong or ovate-oblong, terminal one 4–11 by 2–6 cm, lateral ones 2–9 by 1–4 cm, base rounded, margin serrate, apex acuminate, thinly herbaceous, 6–13 pairs of nerves, upper surface with patent hairs on main nerves, sometimes appressed hairs between them, lower surface glabrous except some hairs on larger nerves. *Inflorescence* lax, up to 5 cymes below the terminal flower, the cymes 1- to 3-flowered. *Bracts* often leaf-like or 3-partite. *Pedicels* up to 5 cm long, glabrous, with prickles. *Hypanthium* 5–6 mm across, glabrous outside, unarmed or with few short prickles. *Sepals* triangular to narrowly ovate, 6–12 by 3–6 mm, growing to 17 mm after anthesis, pointed, entire, glabrous outside but woolly on the covered margins, thick and hard. *Petals* obovate, 12–15 by c. 8 mm, falling early, emarginate, with ciliate undulate margin, white. *Stamens* 150–180, filaments up to 5 mm, anthers c. 1 mm long. *Pistils* more than 150, ovaries glabrous, on elevated, glabrous torus, the lower part without pistils and stalk-like, style up to 2.5 mm. *Collective fruits* (depressed) globose, up to 1.5 cm, sepals ultimately recurved. *Fruits* c. 2 by 1 mm (dry), exocarp orange-red to red, mesocarp a thin membranous layer when dry.

Distribution – Sumatra, W Java.

Habitat – Forest edges and lighter places in forest, altitude 1450–2200 m, descending to 700 m along watercourses [Backer & Bakh. f., Fl. Java 1 (1964) 514].

8. Rubus alpestris Blume, Bijdr. (1826) 1108; Miq., Fl. Ind. Bat. I, 1 (1855) 378; Backer & Bakh. f., Fl. Java 1 (1964) 514; Steenis, Mount. Fl. Java (1972) pl. 45-1; Naruhashi & Sato, Tukar-Menukar 2 (1983) 11. — Type: Blume 407, Java.

Climbing or erect shrubs, up to 4 m. *Stems* sparsely hairy when young, with many to few

short glandular hairs, prickles rather few, up to 7 mm, curved to straight. *Leaves* palmately (sometimes ± pedately) 5-foliate, upper ones often 3-foliate, petiole (1–)2–5 cm long. *Stipules* linear to linear-lanceolate, 4–12 by 0.5–2 mm (larger and wider in Celebes and Moluccas), entire or with some small teeth, with some glandular hairs, otherwise ± glabrous. *Leaflets* oblong, rarely obovate-oblong, terminal ones (4–)6–14 by 2–4 cm, lateral ones smaller, base acute, margin serrate to biserrate, apex acuminate to caudate, papyraceous to parchmentaceous, 9–17 pairs of nerves, upper surface with few hairs, lower surface hairy. *Inflorescences* in the axils of the upper 1–3 leaves, apex of flowering twig usually (?) aborted, dichasial with 1–6 flowers, peduncle up to 5 cm. *Bracts* elliptic to lanceolate, up to 12 mm long. *Pedicels* up to 3 cm long, sparsely pubescent and with glandular hairs. *Hypanthium* 6–8 mm across, glabrous to sparsely hairy outside. *Sepals* ovate-triangular to narrowly triangular, 10–15(–17) by 2.5–6 mm, entire or outer ones with 1–2 marginal teeth, acuminate to long-caudate, acumen up to 6 mm, few hairs outside but covered margins shortly woolly. *Petals* orbicular to elliptic, 6–7 by 5–6 mm, falling early, with few hairs inside, light green to white or pink. *Stamens* c. 50–60, filaments up to 4 mm, anthers 1–1.5 mm long. *Pistils* 15–25, ovaries glabrous, on little elevated to flat, hairy torus, style up to 8 mm long. *Collective fruits* ovoid, c. 1 cm, sepals upright. *Fruits* up to 4 by 2.5 mm (dry), red, mesocarp moderately thin when dry.

Distribution – N Thailand, N Vietnam; Malesia: Sumatra, Borneo, Java, Celebes, Moluccas.

Habitat – Lighter places in forest and shrubland, altitude 1650–2850(–3000) m.

Uses – Fruits edible, the species even recommended for planting by Koorders (on Koorders 31658).

9. Rubus archboldianus Merr. & Perry, J. Arnold Arbor. 21 (1940) 180; P. van Royen, Phan. Mon. 2 (1969) 57; Alpine Fl. New Guinea 4 (1983) 2477. — Type: Brass 4565, Wharton Range.

Climbing or scrambling shrubs. *Stems* up to 5 m, with long hairs, glabrate, prickles up to 2 mm, curved, often purplish. *Leaves* 3-foliate, upper ones sometimes simple, petiole 1–4 cm long. *Stipules* deeply divided into up to 6 linear lobes, 4–15 mm long, hairy outside. *Leaflets* elliptic, ovate-elliptic, or obovate-elliptic, sometimes deltoid or rhomboid, terminal ones 1.5–12 by 2–6.5

cm, lateral ones up to 5.5 by 4 cm, base usually acute, margin serrate, apex obtuse to acute or acuminate, coriaceous, 5–10(–12) pairs of nerves, upper surface more or less densely long-hairy, lower surface with hairs mainly on the nerves. *Inflorescences* with 1 or 2 cymes under the terminal flower, the cymes 1- or 2-flowered. *Bracts* stipule-like. *Pedicels* up to 4 cm long, hairy and with some prickles. *Hypanthium* up to 15 mm across, long-hairy and with many straight prickles outside, prickles up to 5 mm. *Sepals* ovate to triangular, 12–18 by 6–10 mm, growing after anthesis, caudate, exposed margins with up to 15 long and slender teeth, indumentum outside as hypanthium, purplish or reddish. *Petals* obovate or spatulate, distinctly clawed, 11–18 by 7–10 mm, early falling, (orange or pinkish) red. *Stamens* 50–75, filaments up to 10 mm, anthers up to 1.5 mm long. *Pistils* 35–90, ovaries long-hairy in upper part, on elevated, glabrous torus, style up to 7 mm long, hairy at base. *Collective fruits* depressed ovoid, up to 3 cm. *Fruits* 4–5 by 2–2.5 mm, exocarp long-hairy and with a silky shine, dark red, mesocarp juicy, endocarp dorsally keeled.

Distribution — New Guinea, only known from the Eastern part.

Habitat — In and along edges of different kinds of mountain forest and in shrubland, altitude 1800–3600(–4300) m.

Uses — The fruits are edible and have a pleasant taste.

Note — According to Borgmann, Zs. f. Bot. 52 (1964) 144 (sub *R. spec.3*), the species is high-polyplid with $2n = c. 91$.

10. *Rubus banghamii* Merr., Contr. Arnold Arbor. 8 (1934) 68, pl. III. — Type: *Bangham 1163*, Tapanuli.

Semi-scendent shrubs. *Stems* glabrous, prickles rather few, curved, up to 5 mm. *Leaves* 3-foliate, upper ones simple and lobed, petiole 1.5–4 cm long. *Stipules* deeply 3- to 8-laciniate, lobes up to 12 mm long and up to 0.5 mm wide, glabrous. *Leaflets* elliptic, terminal ones 8–10 by 4–5 cm, lateral ones 6–8 by 2.5–4 cm, base acute, margin serrate, apex acuminate, herbaceous, 8–12 pairs of nerves, only short hairs on midrib above, otherwise glabrous. *Inflorescence* lax, up to 6 dichasia of up to 3(–6) flowers below the terminal flower. *Bracts* entire or like the stipules. *Pedicels* up to 6 cm long. *Hypanthium* c. 7 mm across (in fruit), glabrous and unarmed outside. *Sepals* triangular to triangular-ovate, 9–17 by 5–8 mm, entire, pointed, glabrous outside but woolly on the covered margins.

Petals not seen. *Stamens* c. 50, filaments up to 7 mm, anthers c. 1 mm long. *Pistils* c. 35, ovaries glabrous, on elevated, densely long-hairy torus, styles up to 5 mm long. *Collective fruits* ± ovoid, c. 1.5 cm, sepals spreading. *Fruits* up to 4 by 2.5 mm, red, mesocarp a thin membranous layer when dry.

Distribution — Sumatra.

Habitat — Primary forest, 1250–1400 m altitude.

Note — Insufficiently known species.

11. *Rubus chrysogaeus* P. van Royen, Phan. Mon. 2 (1969) 42, fig. 8. — Type: *Womersley & van Royen NGF 5919* = *van Royen 4334*, Edie Creek.

Sprawling to erect shrubs, up to 2 m. *Stems* glabrous, prickles up to 4 mm, slightly curved. *Glands* (sub)sessile, pale, on many parts of the plants. *Leaves* imparipinnate, with 2 or 3 opposite pairs of leaflets, often simple in the inflorescence, up to 17 cm long, petiole 0.8–5 cm long. *Stipules* linear, 6–9 by 0.5 mm, entire, ± glabrous. *Leaflets* ovate-lanceolate to lanceolate, 2–8 by 1–3 cm, base ± rounded, margin biserrate, apex long-tapering, papyraceous, 9–13 pairs of nerves, both sides sparsely hairy on main nerves only. *Inflorescences* with up to 4 monochasial or sometimes dichasial branches under the terminal flower, altogether up to 12 flowers. *Bracts* leaf-like to linear. *Pedicels* up to 4 cm long, glabrous, with some small prickles. *Hypanthium* up to c. 5 mm across, glabrous outside but with rather many sessile, yellow glands. *Sepals* narrowly triangular, 8–16 by 3–5 mm, incl. the long acumen, indumentum outside as hypanthium and woolly on the covered margins. *Petals* elliptic to obovate or spatulate, 8–12 by 3.5–5 mm, falling early, obtuse, shortly hairy outside, white. *Stamens* 70–80, filaments up to 5 mm, anthers 0.8 mm long. *Pistils* c. 500, ovaries (sub)glabrous and with pale glands, on elevated, hairy torus, style up to 1.5 mm long. *Collective fruits* globose to slightly ovoid, up to 1.5 cm, sepals spreading. *Fruits* up to 1 by 0.8 mm, red, mesocarp only a thin layer when dry.

Distribution — New Guinea, only known from the Eastern part of Papua New Guinea.

Habitat — Shrubland, forest borders, roadsides and similar rather open places, also recorded from grassland and forest, altitude 1200–2600 m.

12. *Rubus copelandii* Merr., Philipp. J. Sc. 1, Suppl. 3 (1906) 194 ('*copelandi*'); Elmer, Leafl. Philipp. Bot. 2 (1908) 457; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 227. — Type: *Merrill 4810*, Pauai.

Climbing or sprawling shrubs. *Stems* up to 4 m, with spine-like capitate hairs, otherwise glabrous, prickles many, up to 5 mm, straight to curved. *Leaves* 3-foliolate, in the inflorescence and at the base of laterals often simple and lobed, petiole 2.5–6.5 cm long. *Stipules* ovate to oblong, 7–15 by 2–7 mm, entire or with some teeth, with capitate hairs. *Leaflets* ovate, terminal ones 4–10 by 3–7 cm, lateral ones slightly smaller, base ± rounded, margin (bi)serrate, apex acute to acuminate, herbaceous, 9–12 pairs of nerves, upper surface shortly hairy on main nerves and with long appressed hairs between them, lower surface glabrous. *Inflorescences* lax, up to 3 dichasial of up to 5 flowers under the terminal flower. *Bracts* stipule-like or 3-partite. *Pedicels* up to 6 cm long, with curved prickles and capitate spines. *Hypanthium* c. 5 mm across, glabrous outside but with straight prickles and capitate spines. *Sepals* triangular to ovate, 7–11 by 3–5 mm, entire, acuminate, indumentum outside as hypanthium and the covered parts woolly. *Petals* broadly elliptic to obovate, 9–12 by 7–9 mm, early falling, rounded, sometimes ciliolate, white. *Stamens* 80–100, filaments up to 5 mm, anthers c. 1 mm long. *Pistils* over 100, ovaries glabrous, on elevated, glabrous torus, style up to 2 mm long. *Collective fruits* ovoid, up to 2 by 1 cm, sepals spreading. *Fruits* up to 2 by 1.5 mm, dark red, mesocarp a thin membranous layer when dry.

Distribution – Luzon.

Habitat – More or less open places in forest, forest borders, thickets, altitude 1700–2450 m.

13. Rubus ellipticus J.E. Sm. in Rees, Cyclop. 30 (1815) Rubus spec. 16; Elmer, Leafl. Philipp. Bot. 2 (1908) 456; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 227; Backer & Bakh. f., Fl. Java 1 (1964) 515. — Type: *Hamilton s.n.*, Nepal.

Climbing or scrawling shrubs. *Stems* up to 4 m, densely woolly when young, with many patent red bristles (up to 8 mm long and glandular when young), prickles rather few, straight to slightly curved, up to 8 mm. *Leaves* 3-foliolate, the upper ones sometimes simple, petiole 1–7.5 cm long. *Stipules* linear, up to 10 by 0.5 mm, entire, hairy. *Leaflets* elliptic to orbicular, sometimes slightly ovate or obovate, terminal ones 4–9 by 3.5–9 cm, lateral ones 2–6.5 by 2–6.5 cm, base ± rounded, margin (unequally) serrate, apex from acute to truncate, coriaceous, 7–10 pairs of nerves, patently hairy above, densely woolly and with longer straight hairs on the nerves below. *Inflorescences* rather lax, up to 30 cm long, with up to 12(–20)

much-branched laterals under the terminal flower, the whole inflorescence with up to 150 or more flowers. *Bracts* linear or 3-partite, hairy. *Pedicels* up to 1(–2) cm long, woolly, with bristles and curved prickles. *Hypanthium* 4–5 mm across, densely hairy and with bristles outside. *Sepals* ovate-triangular, 5–7.5 by 3–4.5 mm, entire, shortly acuminate, woolly and with longer hairs and at base also with bristles outside. *Petals* obovate to spatulate, up to 10 by 5 mm, early falling, rounded or acute, hairy, white. *Stamens* 30–40, filaments up to 2 mm, anthers c. 0.5 mm long. *Pistils* 100–150, ovaries on the back with many long straight hairs, especially near apex, on an elevated, densely hairy torus, style up to 2 mm long, hairy at base. *Collective fruits* ovoid to globose, up to 8 by 10 mm, sepals ultimately slightly spreading. *Fruits* up to 1.5 by 0.8 mm (dry), exocarp hairy, yellow to orange, mesocarp only a thin layer when dry.

Distribution – Continental Asia from India to China and Vietnam, Sri Lanka; *Malesia*: Philippines (Luzon). Introduced and naturalized in Java, Hawaii, Jamaica, Puerto Rico, Africa, Australia, and maybe elsewhere.

Habitat – In Luzon a species of oak and pine forest and in secondary growth, alt. 1000–2400 m.

Note – Root nodules from plants collected in Java showed nitrogenase activity and can be supposed to fix nitrogen under normal conditions. See J.H. Becking, Plant and Soil 53 (1979) 541–545.

14. Rubus ferdinandi-muelleri Focke, Abb.

Naturw. Ver. Bremen 13 (1895) 165; P. van Royen, Phan. Mon. 2 (1969) 21, f. 2, pl. 1; Alpine Fl. New Guinea 4 (1983) 2464. — *Rubus ferdinandi* Focke, Bibl. Bot. 72 (1911) 162, nom. superfl. — Type: *MacGregor s.n.*, Papua New Guinea, not seen.

Rubus laeteviridis P. van Royen, Phan. Mon. 2 (1969) 29, f. 5. — Type: *Womersley & van Royen NGF 5901* = *van Royen 4332*, Wau.

Rubus woitapensis P. van Royen, Phan. Mon. 2 (1969) 39, f. 7. — Type: *van Royen NGF 20287*, Woitape-Kosibi.

Usually erect shrublets, sometimes climbing or scrambling. *Stems* up to 1.5 m, densely hairy to glabrous, prickles usually rather many, slender and spine-like, up to 1.5 cm long, reddish to purple. *Glands* sessile, red or yellow, sometimes present on many parts of the plant. *Leaves* imparipinnate, with 3–8(–9), usually opposite pairs of leaflets, up to 13 cm long, petiole 1–3.5 cm long. *Stipules* linear to lanceolate, 3–10 by 0.2–3 mm, entire

or with small teeth, acute to acuminate, glabrous. *Leaflets* ovate to elliptic, 1–5 by 0.5–2 cm, terminal one larger than lateral ones, base rounded to cuneate, margin (bi)serrate, apex acute, papyraceous to parchmentaceous, 5–9 pairs of nerves, upper surface glabrous or with short appressed hairs between and parallel with the lateral nerves, lower surface glabrous or soft-hairy on main nerves, sometimes with spines on the midrib. *Inflorescence* loosely branched with one or two 3- to 1-flowered cymes under the terminal flower, up to 5 cm long. *Bracts* stipule-like or 3-partite. *Pedicels* up to 3 cm long, hairy to glabrous, with spines. *Flowers* usually erect. *Hypanthium* c. 4 mm across, sparsely hairy to glabrous outside and with 1–5 purple spines alternating with the sepals. *Sepals* narrowly triangular, 5–9 by 1.5–3 mm, entire, (gradually) acuminate, indumentum outside as hypanthium and woolly on the covered parts. *Petals* obovate or elliptic to suborbicular, up to 9(–10) by 7 mm, early falling, rounded, glabrous or with few hairs, white. *Stamens* 30–35, filaments up to 3 mm, anthers c. 0.5 mm long. *Pistils* 120–180, ovaries glabrous or dorsally with some hairs, on an elevated, glabrous torus, style up to 2 mm long. *Collective fruits* ovoid to sub-globose, up to 1 cm, sepals ultimately spreading. *Fruits* 1.5 by 1 mm, bright to dark red, mesocarp not very juicy and only a thin layer when dry.

Distribution — New Guinea, New Britain.

Habitat — Clearings in forest, forest edges, stream-banks, along tracks and roads, alt. (1550)–1800–3000(–3465) m.

Note — The complex formed by *R. montis-wilhelmi*, *R. papuanus*, and *R. ferdinandi-muelleri* must be studied with biosystematical methods. The present delimitation of these three species is admittedly provisional.

15. *Rubus fraxinifolius* Poiret in Lam., Encycl. Méth. 6 (1806) 242; Blume, Bijdr. (1826) 1107; Miq., Fl. Ind. Bat. I, 1 (1855) 376; Elmer, Leafl. Philipp. Bot. 2 (1908) 460; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 227; Backer & Bakh.f., Fl. Java 1 (1964) 514; P. van Royen, Phan. Mon. 2 (1969) 45; Steenis, Mount. Fl. Java (1972) pl. 45-3. — Type: *Commerson s.n.*, Java.

[*Rubus moluccus parvifolius* Rumph., Herb. Amboin. 5 (1747) 88, t. 47, 1.]

Rubus celebicus Blume, Bijdr. (1826) 1107. — *Rubus fraxinifolius* Poir. subsp. *celebicus* (Blume) Focke, Bibl. Bot. 72 (1911) 151. — Type: (?) *Reinwardt s.n.* in L.

Rubus fraxinifolius Poir. var. *haightii* Elmer, Leafl.

Philipp. Bot. 2 (1908) 461. — Type: (?) *Mearns BS* 4459, Pauai.

Rubus merrillii Focke, Bibl. Bot. 72 (1911) 153;

Merr., Enum. Philipp. Flow. Pl. 2 (1923) 228.

— Type: *Merrill BS* 862 or *BS* 6637, Pauai.

Erect, rarely semi-scandent shrubs, up to 3 m high. *Stems* glabrous, unarmed or prickles few, straight, up to 6 mm. *Glands* (sub)sessile, sometimes present on leaves and other parts up to the flowers. *Leaves* imparipinnate, up to 27 cm long, with up to 4 (or 5) opposite pairs of leaflets, petiole 2–6 cm long. *Stipules* linear, 5–13 by 0.5–1 (–2) mm, entire or sparsely toothed, glabrate. *Leaflets* elliptic to oblong or ovatish, 2–9(–12) by 1–4 (–6) cm, base usually rounded or cordate, margin serrate, apex acute or acuminate to long-pointed, papyraceous to parchmentaceous, (7–)10–15(–19) pairs of nerves, both sides sparsely hairy mainly on the nerves. *Inflorescence* lax and wide, up to c. 20 cm long and wide, with up to 7 branches under the terminal flower, the branches thyrsoid to cymes, the entire inflorescence with up to 60 flowers. *Bracts* lanceolate to 3-partite, up to c. 1 cm. *Pedicels* up to 5 cm long, glabrous, sometimes with small prickles. *Hypanthium* 5–6 mm across, glabrous and unarmed outside. *Sepals* triangular, 7–13 by 3–6 mm, including the 2–5 mm long acumen, entire, glabrous outside but woolly on covered margins. *Petals* orbicular to elliptic or obovate, 7–12 by 5–9 mm, falling early, glabrous, (greenish) white. *Stamens* up to more than 100, filaments up to 3 mm, anthers c. 1 mm long. *Pistils* up to more than 300, ovaries glabrous, torus elevated, basal part without pistils and long-hairy, upper part glabrous, style up to 1.5 mm long. *Collective fruits* ellipsoid to ovoid, up to 2.5 by 1.5 cm, sepals ultimately recurved. *Fruits* c. 1.5 by 0.8 mm (dry), (orange-)red, mesocarp a thin layer when dry.

Distribution — Taiwan; Malesia: Borneo, Java, Philippines, Celebes, Lesser Sunda Islands, Moluccas, New Guinea; Solomon Islands, Bismarck Archipelago.

Habitat — Forest borders and open places in forest, riverbanks, deserted gardens, roadsides, and other more or less open places, altitude 0–2500 m.

Uses — Although many collectors report on their labels that the fruits are tasteless or worse, they are at least in Java collected from the wild and sold for consumption. Heyne, Nutt. Pl. Indon. (1950) 693, mentions the use of the leaves in cases of slimy faeces (?dysentery, compare *Rubus moluccanus*).

Note – Erinea, as described under *R. rosifolius* (p. 266), also occur in the present species.

16. Rubus lineatus Reinw. ex Blume, Bijdr. (1826) 1108; Miq., Fl. Ind. Bat. I, 1 (1855) 378; Focke, Bibl. Bot. 72 (1910) 47, incl. var. *diengensis* Focke; Backer & Bakh. f., Fl. Java 1 (1964) 514; Steenis, Mount. Fl. Java (1972) pl. 45-4; Kalkman, Blumea 29 (1984) 322. — Type: *Reinwardt s.n.*, Java.

Rubus pulcherrimus Hook., Ic. Plant. 8 (1845) 729, 730. — Type: *Lobb s.n.*, Java.

Rubus lineatus Reinw. ex Blume forma *pulcherrimus* Focke in Hallier, Meded. Rijksher. 14 (1912) 39. — Types: *Elbert* 1087, 1681, Lombok, Gründler 2342, Sumbawa.

Shrubs, up to c. 3 m high, sometimes ± climbing and up to 10 m. *Stems* densely long-hairy, prickles very few or none, up to 3 mm. *Leaves* pedately 5-foliolate, in the inflorescence sometimes fewer leaflets, young leaflets folded lengthwise, petiole 2–10 cm long. *Stipules* on the junction of twig and petiole, oblong to lanceolate, 2–4 by 0.5–1 cm, entire, cuspidate, hairy outside, falling early. *Leaflets* oblong to lanceolate, terminal ones 7–18 by 2–7.5 cm, lateral ones smaller, base acute, margin caudately serrate, apex acuminate to caudate, parchmentaceous, (20–)30–40(–50) pairs of nerves, upper surface variously hairy, lower surface always densely sericeous on main nerves, either short-woolly and also long-sericeous or quite glabrous between the nerves, the indumentum silvery. *Inflorescences* terminal and lateral thyrsi, up to 5 cm long and with up to 15 flowers. *Bracts* stipule-like. *Pedicels* up to 2 cm, densely sericeous. *Hypanthium* 5–9 mm across, densely sericeous outside. *Sepals* (ovate-)triangular, 6–13 by 2–7 mm, entire, long-pointed to acuminate, indumentum outside as hypanthium. *Petals* obovate to ± rhomboid, 4–5 by 2–3.5 mm, early falling, rounded, (greenish) white. *Stamens* 50–150, filaments up to 4 mm, anthers 0.7–1 mm long. *Pistils* c. 80 to over 100, ovaries long-hairy in apical part, on elevated, hairy torus, style up to 5 mm long, long-hairy. *Collective fruits* globose-ovoid, c. 1 cm in diam., sepals upright to slightly spreading. *Fruits* up to 2.5 by 2 mm (dry), exocarp hairy, orange to red, mesocarp juicy but only a thin layer when dry.

Distribution – Himalayas (Nepal to Arunachal), S China, Burma, Vietnam; *Malesia*: Sumatra, Borneo, Java, Lesser Sunda Islands.

Habitat – Lighter places in different forest types and in places like streambanks, landslides, roadsides, and shrubland, altitude 1400–3000(–3800) m.

Notes – In this treatment *R. lineatus* has been transferred from subg. *Malachobatus* (as in Focke, l.c. 1910, and Kalkman, l.c.) to subg. *Idaeobatus*. It is true that its stipules are not placed on the base of the petiole, usual in the latter subgenus, but rather on the junction of twig and petiole. However, its inflorescence is rather out of line in *Malachobatus*, not being a compound raceme but a dichasium or thyrsse with di- to monochasial laterals.

The species seems to be most closely related to *R. alpestris* and *R. neo-ebudicus*. Its relationship to the former is also apparent from transitional specimens, probably hybrids, found in Borneo (*R. lineato-alpestris* Naruhashi & Sato, J. Phytogeogr. Taxon. 32, 1984, 102) and in Java (see Kalkman, l.c.).

Rubus satotakashii Naruhashi & Cheksum, J. Phytogeogr. Taxon. 32 (1984) 99, was interpreted by its authors as a hybrid with *R. lowii*, which – in view of the latter's relationship with *R. alpestris* – is certainly not improbable. Tawan, Sato & Naruhashi, J. Phytogeogr. Taxon. 39 (1991) 31, saw intermediate characters in the supposed hybrid, but also some unique ones.

17. Rubus lorentzianus Pulle, Nova Guinea 8 (1912) 647; P. van Royen, Phan. Mon. 2 (1969) 54; Alpine Fl. New Guinea 4 (1983) 2474. — Type: *von Römer* 1276, Hellwig Mts.

Climbing or scrambling shrubs, up to 4 m high. *Stems* long-hairy, glabrate, prickles many, straight, stout, up to 9 mm long, red. *Leaves* 3-foliolate, upper ones sometimes simple, petiole 1–5 cm long. *Stipules* ovate to lanceolate, usually oblique, 10–18 by 3–15 mm, entire to serrate, acute to caudate, hard, sometimes with prickles. *Leaflets* obovate, 2–7 by 1.5–3.5 cm, lateral ones shorter and relatively broader, margin serrate, apex rounded, rarely acute to acuminate, very stiff coriaceous, 4–8 pairs of nerves, both sides slightly hairy on main nerves when young, hairs often disappearing with age, leaflets often folded along the midrib. *Inflorescence* with up to 4 cymes below the terminal flower, cymes with 1–3 flowers, the whole inflorescence usually with less than 8 flowers. *Bracts* stipule-like. *Pedicels* up to 3 cm, hairy and with some prickles. *Hypanthium* up to 7 mm across, short-hairy and with many prickles outside. *Sepals* ovate to triangular, 9–14 by 5–8 mm, entire, caudate, rather sparsely hairy and with many long prickles outside, woolly on covered margins. *Petals* obovate to suborbicular, 8–11 by 6.5–9 mm, rounded, white. *Stamens* 30–45, filaments up to 5 mm, anthers c. 1 mm long. *Pistils* 15–45, ovaries gla-

brous, on elevated, hairy torus, style up to 4 mm long. *Collective fruits* ovoid, up to 1.5 cm across. *Fruits* up to 4.5 by 3 mm when dry, orange to red, mesocarp fleshy.

Distribution — New Guinea.

Habitat — Forest edges, openings in forest, shrubland, sometimes in grassland, altitude 2200–3650 (–3890) m.

Note — High-polyplloid with $2n = 126$, according to one count by Borgmann, Zs. f. Bot. 52 (1964) 144, sub *Rubus spec.*

18. Rubus lowii Stapf in Hook., Ic. Plant. 23 (1894) t. 2289; Trans. Linn. Soc. Bot. 4 (1894) 145; Naruhashi & Sato, Tukar-Menukar 2 (1983) 14, incl. var. *panalabanensis* Naruhashi & Sato, nom. nud.; Naruhashi et al., J. Phytogeogr. Taxon. 32 (1984) 102, f. 3, incl. var. *panalabanensis* Naruhashi & Sato, descr. — Type: Low s.n., Mt Kinabalu.

Climbing or scrambling shrubs. *Stems* up to 6 m, rather densely hairy, glabrate, prickles absent or few, stout. *Glands* sessile or stalked, sometimes present on all parts of the plants. *Leaves* 3-foliate, upper ones sometimes simple, petiole 0.7–2 cm long. *Stipules* lanceolate, 6–13 by 1.5–5 mm, long persistent, acute, entire or with small teeth, glabrous. *Leaflets* elliptic to elliptic-ovate, terminal ones 2–7 by 1–4 cm, lateral ones slightly smaller, base acute, margin serrate, apex acute to acuminate, coriaceous, 5–8 pairs of nerves, both surfaces with long hairs on main nerves, upper surface rarely also with hairs between nerves. *Inflorescence* with up to 4 few-flowered, axillary cymes below the terminal flower. *Bracts* stipule-like. *Pedicels* up to 3 cm long, hairy. *Hypanthium* c. 6 mm across, short-hairy outside. *Sepals* triangular to ovate, 8–11 by 4–6 mm, after anthesis slightly growing, ± entire, caudate, acuminate up to 3 mm long, sparsely hairy outside and with woolly covered margins. *Petals* obovate to suborbicular, 6–7 by 4–5.5 mm, rounded, white (to pinkish?). *Stamens* 30–45, filaments up to 5 mm, anthers c. 1 mm long. *Pistils* 15–25, ovaries glabrous, on slightly elevated, hairy torus, style up to 6 mm long. *Collective fruits* ovoid, c. 1.5 by 1 cm. *Fruits* up to 4 by 3 mm, red, mesocarp fleshy, tough when dry.

Distribution — Borneo, only seen from Mt Kinabalu.

Habitat — In open forest, forest edges, shrubland, altitude 3000–3960 m.

Note — Closely related to, maybe even conspecific with *R. macgregorii* from Celebes and New

Guinea. The latter species has distinctly armed stems and hairy ovaries. Both are also related to *R. alpestris* with 5-foliate leaves.

19. Rubus macgregorii F. Muell., Trans. Roy. Soc. Vict. 1, 2 (1889) 4; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 245; Merr. & Perry, J. Arnold Arbor. 21 (1940) 179; P. van Royen, Phan. Mon. 2 (1969) 52; Alpine Fl. New Guinea 4 (1983) 2472. — Type: *McGregor s.n.*, Mt Victoria, Papua New Guinea.

Creeping or scrambling small shrubs. *Stems* sparsely soft-hairy, glabrate, prickles rather few, curved, up to 2(–4) mm long. *Leaves* 3-foliate, upper ones sometimes simple, petiole 1–5 cm long. *Stipules* elliptic to elliptic-lanceolate, 5–12 by 1–5 mm, entire or toothed, acuminate to caudate, ± glabrous. *Leaflets* obovate to elliptic, terminal ones 1.5–3.5 by 1–2.5 cm, lateral ones smaller, base narrowed, margin serrate, apex rounded with or without a short acumens, stiff coriaceous, 4–7 pairs of nerves, both surfaces very sparsely hairy on main nerves. *Inflorescences* poor, often only the terminal flower, sometimes 1 or 2 flowers below it. *Bracts* stipule-like. *Pedicels* up to 2 cm long, hairy and with some curved prickles. *Hypanthium* 5–6 mm across, sparsely hairy outside and with some straight, short prickles. *Sepals* ovate to triangular, 8–12 by 5–7 mm, growing after anthesis, entire, acuminate to 4 mm caudate, long-hairy outside and woolly on the covered parts. *Petals* obovate to orbicular, 8–9 by 7–8.5 mm, rounded, white. *Stamens* 40–50, filaments up to 4 mm, anthers c. 1 mm long. *Pistils* 30–40, ovaries long hairy on the dorsal side and at the top, on an elevated, hairy torus, style up to 3.5 mm long, with hairs at base. *Collective fruits* ovoid, up to 2 cm across. *Fruits* up to 4 by 3 mm, purple (?), mesocarp fleshy, a thin layer when dry.

Distribution — Celebes, Papua New Guinea.

Habitat — Thickets in grassland, altitude 2600–3600 m.

Note — See note under the related *R. lowii*.

20. Rubus montis-wilhelmi P. van Royen, Phan. Mon. 2 (1969) 19, f. 1; Alpine Fl. New Guinea 4 (1983) 2462. — Type: Millar & van Royen NGF 14645, Mt Wilhelm.

Rubus keysseri Schltr. ex Diels, Bot. Jahrb. 62 (1929) 481. See note.

Erect shrublets, ± climbing or straggling when larger, up to 1(–1.5) m high. *Stems* sparsely hairy, glabrate, prickles spine-like, slender, up to 1(–1.5)

mm long, reddish. *Glands* (sub)sessile, red or yellow, usually scattered on many parts of the plant. *Leaves* up to 12 cm long, bipinnate to pinnate (to the apex) or sometimes tripinnate (at very base), primary pinnae 4–10, (sub)opposite, petiole 1–3 cm long. *Stipules* linear-lanceolate, 5–12 by 0.5–1.5 mm, (sub)glabrous. *Leaflets* 3–5 pairs on the primary pinnae, ovate to ovate-elliptic or elliptic-oblong, 2–10 by 1.5–6 mm, base acute, margin serrate to pinnatifid, apex usually acuminate, pergamaceous, with 3–5 pairs of nerves, both surfaces glabrous or with few hairs. *Inflorescence* loosely branched with one or two 1- to 3-flowered cymes under the terminal flower, up to 5 cm long. *Bracts* linear, up to 3 mm. *Pedicels* up to 2 cm long, sparsely hairy and with spines. *Flowers* usually (sub)pendulous. *Hypanthium* up to 4.5 mm across, sparsely hairy and with some spines outside, the largest ones almost as long as and alternating with the sepals. *Sepals* narrowly triangular, 5–9 by 2–3.5 mm, long-pointed, entire, indumentum outside as hypanthium and very shortly woolly on the covered parts. *Petals* obovate to elliptic, falling early, up to 12 by 10 mm, rounded, white. *Stamens* 25–35, filaments up to 3 mm, anthers 0.5–0.8 mm long. *Pistils* 100–150, ovaries glabrous, on elevated, glabrous torus, style up to 1.5 mm long. *Collective fruits* ovoid to ellipsoid, up to 1 cm across, compact, sepals ultimately spreading. *Fruits* 1.5 by 1 mm, (dark) red, mesocarp not very juicy.

Distribution – Papua New Guinea.

Habitat – In (the edges of) subalpine and alpine shrubland and forests, altitude 2660–3660 m.

Note – Probably easily hybridizing with *R. ferdinandi-muelleri* and *R. papuanus*, see there. *Rubus keysseri* Schltr. was based on what looks like a hybrid specimen with the first-mentioned species (isotype seen from BM).

21. Rubus neo-ebudicus Guillaumin, J. Arnold Arbor. 12 (1931) 249. — Type: Kajewski 249, Tanna I.

Rubus brassii Merr. & Perry, J. Arnold Arbor. 21 (1940) 182; Zandee & Kalkman, Blumea 27 (1981) 105. — Type: Brass 2891, San Christobal.

Straggling or climbing, unarmed shrubs, up to 4 m high. *Stems* shortly woolly to glabrous. *Leaves* pedately 5-foliate, the upper ones often 3–1-foliate, petiole 2–5 cm long. *Stipules* (linear-)lanceolate, 5–10 by 1–3 mm, entire, glabrous or with hairs. *Leaflets* (oblong-)lanceolate, rarely ovate-lanceolate, terminal leaflet 8–14 by

2–4.5 cm, on 2–8(–15) mm long petiolule, lateral leaflets smaller, sessile or to 2 mm petioluled, base acute, margin mostly serrate, apex acuminate, herbaceous, (16)–18–21(–26) pairs of nerves, sparsely hairy on both surfaces. *Inflorescence* lax, with up to 5 dichasial, up to 8-flowered branches under the terminal flower, up to 12 cm long. *Bracts* up to 1 cm, often toothed, those under the lateral dichasia usually 3-partite. *Pedicels* up to 2 cm long, all axes shortly woolly to glabrous. *Hypanthium* 5–6 mm across, sparsely hairy and sometimes with few short glandular hairs outside. *Sepals* narrowly triangular, 8–13 by 3–5 mm, acuminate to caudate (acumen up to 4 mm), entire, few hairs outside and covered margins woolly. *Petals* obovate to elliptic, 9–12 by 6–9 mm, falling early, obtuse, white. *Stamens* 45–100, filaments up to 4 mm, anthers c. 1 mm long. *Pistils* 80–100 or more, ovaries glabrous or with few hairs, on elevated, sparsely hairy torus, style up to 2.5 mm long. *Collective fruits* ovoid, up to 1 cm across, sepals upright. Fruits 2 by 1 mm when dry, orange to red, mesocarp only a thin layer when dry.

Distribution – New Ireland, New Britain, Solomon Islands, New Hebrides.

Habitat – Forest, altitude (180)–600–1700 m.

Uses – According to Woodley (ed.), Medicinal Plants of Papua New Guinea I. Morobe Prov. (1991) 120 (sub *R. brassii*) the extracted stem sap is drunk as a tonic by elderly people. Other species are, according to this source, used for the same purpose elsewhere.

Notes – Mr. P.S. Green (Kew) drew my attention to the conspecificity of the species reported from the New Hebrides with *R. brassii* from New Britain and the Solomon Islands.

The relationships of the present species seem to lie with *R. lineatus* and *R. alpestris*, which is peculiar since both species are absent from New Guinea and the Pacific.

22. Rubus niveus Thunb., Diss. Rubo (1813) 9, f. 3; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 229; Backer & Bakh. f., Fl. Java 1 (1964) 515; Lauener & Ferg., Not. Roy. Bot. Gard. Edinb. 30 (1970) 276; Steenis, Mount. Fl. Java (1972) pl. 45-5. — Non *Rubus niveus* Wall. ex Hook. f., Fl. Brit. India 2 (1878) 335 = *Rubus hypargyrus* Edgew. — Type: Thunberg s.n., Java.

Rubus horsfieldii Miq., Fl. Ind. Bat. I, 1 (1855) 375, t. 7; Koord., Nat. Tijd. Ned. Indië 60 (1901) 276. — *Rubus niveus* Thunb. subsp. *horsfieldii* (Miq.) Focke, Bibl. Bot. 72 (1911) 183. — Type: Horsfield s.n., Java.

Usually erect, sometimes climbing shrubs, up to 2 m high, the often drooping branches up to 3.5 m long. *Stems* sparsely hairy, glabrescent, prickles usually rather few, straight to curved, up to 7 mm. *Leaves* imparipinnate, up to 27 cm long, petiole 1.5–5 cm long. *Stipules* (linear-)lanceolate, 6–16 by 1–3(–5) mm, slightly hairy to glabrous. *Leaflets* 2–4(–5) opposite pairs, elliptic or rhombic to ovate, sometimes ovate-lanceolate, 2–8 by 1–4 cm, base usually acute, margin serrate to biserrate but the basal part often entire, apex acute to acuminate, papyraceous to parchmentaceous, 6–9 pairs of nerves, soft-hairy above but soon glabrate, lower surface with a woolly silvery-white felt of short curly hairs all over and with longer straight hairs on main nerves. *Inflorescence* usually rich and branched, a compound leafy thyrsus up to 20 cm long. *Bracts* stipule-like. *Pedicels* up to 1.5 cm, hairy. *Hypanthium* 2–3 mm across, hairy outside. *Sepals* triangular, 4–7 by 1.5–2.5 mm including the up to 2 mm long acumen, densely woolly outside, acumen mostly glabrous. *Petals* falling rather early, suborbicular, 3.5–5 by 3–3.5 mm, 1 mm clawed, pink. *Stamens* 25–35, filaments up to 4 mm, anthers c. 0.5 mm long. *Pistils* 50–75 or more, ovaries rather densely long-hairy, on elevated, hairy torus with pistils down to the base, style up to 3 mm long. *Collective fruits* globular to broadly ovoid, up to c. 1 cm across, compact, sepals spreading. *Fruits* c. 2.5 mm long, exocarp densely hairy, red but the colour masked by the dark (blue to blackish) hair-cover, mesocarp only a thin layer when dry.

Distribution — Continental Asia from Kashmir to Vietnam, Sri Lanka, Taiwan; *Malesia*: Sumatra, Java, Lesser Sunda Islands, Luzon, Celebes. Introduced and naturalized in Southern and Eastern Africa (Stirton, Bothalia 13, 1981, 346). Introduced and cultivated in peninsular Malaysia where it became naturalized on Fraser's Hill, Pahang. Introduced and (recently) cultivated near Kainantu, Eastern Highlands Prov., Papua New Guinea (R.H. Converse, in litt. 1986). Also cultivated for the fruits in Florida, USA ('Mysore raspberry'), maybe also elsewhere.

Habitat — Open and half-shaded places like hedges, shrubland, grassfields, abandoned gardens, roadsides, *Eucalyptus* savannas, rarely in forest, altitude (600–)1000–2900 m.

Uses — Fruits edible, see also under Distribution.

Notes — The species is on the Asian continent more variable than in Malesia where infraspecific taxa cannot be recognized. The synonymy given above is incomplete for the continent.

In some of the specimens from Timor the woolly indumentum on the underside of the leaflets is missing, but there are dots and patches of dense long hairs, possibly galls.

23. *Rubus papuanus* Schltr. ex Diels, Bot. Jahrb. 62 (1929) 481; Merr. & Perry, J. Arnold Arbor. 21 (1940) 182; P. van Royen, Phan. Mon. 2 (1969) 26, f. 4; Alpine Fl. New Guinea 4 (1983) 2470. —Type: Keysser 36, lost; neotype: Brass 4246, Mt Albert Edward.

Erect or scrambling small shrubs, up to 80 cm high. *Stems* soft-hairy, glabrescent, prickles straight, slender, spine-like, up to 1 cm, red. (Sub-)sessile red or yellow glands often present on many parts. *Leaves* imparipinnate, up to 10 cm long, petiole 0.5–1(–1.5) cm long. *Stipules* oblong to linear-lanceolate, 4–9 by 1–3 mm, glabrous. *Leaflets* 6–9(–10) (sub)opposite pairs, (broadly) ovate, 6–15 by 4–9 mm, base rounded to cuneate, margin rather deeply serrate, apex pointed to acuminate, parchmentaceous, 3–5 pairs of nerves, both surfaces glabrous or almost so. *Inflorescence* poor, at most 1 or 2 axillary flowers under the terminal one. *Pedicels* up to 2.5 cm long, soft-hairy. *Flowers* more or less pendulous. *Hypanthium* up to 6 mm across, soft-hairy to glabrous outside and with some spines, the largest of those up to c. 1 cm, alternating with the sepals. *Sepals* narrowly triangular, 6–11 by 2–4 mm including the up to 3 mm long acumen, indumentum outside as hypanthium and woolly on the covered parts. *Petals* falling early, broadly obovate to orbicular, 6–12(–18) mm long, rounded or retuse, white. *Stamens* 20–50, filaments up to 3 mm, anthers c. 0.8 mm long. *Pistils* 70–100, ovaries glabrous or dorsally with few hairs, on elevated, glabrous torus with pistils down to the base, style up to 1.5 mm long. *Collective fruits* ovoid, up to 2 by 1.5 cm, sepals ultimately spreading. *Fruits* up to 2.5 mm long, bright red, mesocarp fleshy but only a thin layer when dry.

Distribution — New Guinea, New Ireland. In 1965 introduced in England (Grasmere, Westmorland) and there it is hardy.

Habitat — Subalpine and alpine shrubland, grasslands, open places in forest, and forest edges, altitude (2100–)3000–3650 m.

Note — This may be a high altitude form of *R. ferdinandi-muelleri*. See the notes there and to *R. montis-wilhelmi*.

24. *Rubus rosifolius* J.E. Smith, Pl. Icon. Hact. Ined. 3 (1791), t. 60, 'rosaefolius' as in

- many other references; Blume, Bijdr. (1826) 1107; Hook., Ic. Plant. 4 (1840) t. 349; Miq., Fl. Ind. Bat. I, 1 (1855) 375; Elmer, Leafl. Philipp. Bot. 2 (1908) 462; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 230; Ochse, Fruits (1931) 107, pl. 42; Backer & Bakh. f., Fl. Java 1 (1964) 515, excl. subsp. *sumatratus* Focke; P. van Royen, Phan. Mon. 2 (1969) 34; Steenis, Mt. Fl. Java (1972) pl. 45-3; Kalkman in Steenis (ed.), Blumea 28 (1982) 168 (reduction of Gilli names). — Type: *Commerson s.n.*, Mauritius. *Rubus rosifolius* J.E. Smith var. *coronarius* Sims, Curt. Bot. Mag. (1816) t. 1783; Backer & Bakh. f., Fl. Java 1 (1964) 515. — Type: plate and description in Sims, l.c. *Rubus javanicus* Blume, Bijdr. (1826) 1108. — Type: *Blume 1571*, Java. *Rubus tagallus* Cham. & Schlechtend., Linnaea 2 (1827) 9; Elmer, Leafl. Philipp. Bot. 2 (1908) 461; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 230. — Type: *de Chamisso s.n.*, Luzon. *Rubus apoensis* Elmer, Leafl. Philipp. Bot. 5 (1913) 1618. — Type: *Elmer 10464*, Mindanao. *Rubus mingendensis* Gilli, Ann. Naturhist. Mus. Wien 83 (1980) 457, incl. var. *trichocarpa* Gilli, nom. nud., inval. — Type: *Gilli 111*, Papua New Guinea, Chimbu. *Rubus × dosediae* Gilli, l.c. 456. — Type: *Dosedia 45A*, Papua New Guinea, Mt Hagen.

Erect or scrambling, rarely climbing shrubs, up to 1(-3) m high. *Stems* soft-hairy, glabrescent, prickles usually rather few, curved to straight, 1-5 mm. Sessile, pale yellow glands usually present on many parts of the plants. *Leaves* imparipinnate, up to 18 cm long, petiole 1-5.5 cm long. *Stipules* linear, 4-9 by 0.5-1 mm, entire. *Leaflets* in (1-) 2-3(-4) opposite pairs, ovate to ovate-oblong, sometimes elliptic to oblong, 2-6 by 1-2.5 cm, terminal leaflets up to 8 by 4 cm, base acute to cordate, margin serrate, apex acute to long-tapering, papyraceous, (4-)7-9(-11) pairs of nerves, both surfaces soft-hairy. *Inflorescence* with up to 4 dichasia in the axils of the upper (reduced) leaves, rarely longer than 10 cm, with up to 10 flowers. *Pedicels* up to 4 cm long, hairy. *Hypanthium* 4-6.5 mm across, with scattered hairs and many glands outside. *Sepals* ovate to narrowly triangular, 7-15 (-22) by 2-5 mm, including the up to 5 mm acumen, entire, indumentum outside as hypanthium and shortly woolly on the covered margins. *Petals* falling early, broadly obovate to ovate, 8-17 by 6-12 mm, obtuse, white. *Stamens* 60-140, filaments up to 8 mm, anthers 0.5-0.8 mm long. *Pistils* up to c. 600, ovaries with some apical hairs

and usually many shortly stalked pale glands, on elevated, hairy torus with pistils down to the base, style up to 2 mm long. *Collective fruits* ovoid to globose or ellipsoid, up to 2.5 cm across, sepals recurved. *Fruits* c. 1.5 mm long when dry, red, mesocarp juicy, only a thin layer when dry.

Distribution – Continental Asia (Assam, Cambodia, Vietnam), Japan (?), Taiwan, New Britain, New Ireland, New Hebrides, New Caledonia, Australia (Queensland, New South Wales); in *Malesia*: Borneo, Java, Philippines, Celebes, Lesser Sunda Islands, New Guinea, Bougainville. Introduced and naturalized in many parts of the world: Africa, C & S America, island groups in the Pacific and Indian Ocean.

Habitat – In open (secondary, anthropogenic) places like clearings, forest-edges, roadsides, landslides, grassland, riverbanks, fallow gardens, also in shrubland and rarely in the undergrowth of lighter types of forest, altitude 0-2000(-2400) m, in Celebes also reported from 2800-2900 m.

Uses – Because of its easy growth, nice flowers and edible fruits often cultivated in sunny gardens, within and outside its natural area. Quisumbing, Medic. Pl. Philipp. (1951) 354, records the use of a decoction of roots as an expectorant.

Notes – Garden-forms exist with more than 5 petals in the flower, which resembles a small rose. They are usually called var. *coronarius* Sims. These plants may produce fruits and have sometimes escaped from cultivation.

Some specimens possess remarkable erinea, consisting of dots of a very dense indumentum on the leaves, probably caused by the gall-mite *Eriophyes rubierineus*. See Docters van Leeuwen, Zooecidida (1926) 220. The same kind of erinea is also found in some other species.

25. *Rubus sumatratus* Miq., Sumatra (1861) 307; Lauener & Ferg., Not. Roy. Bot. Gard. Edinb. 30 (1970) 280. — *Rubus rosifolius* J.E. Smith subsp. *sumatratus* (Miq.) Focke, Bibl. Bot. 72 (1911) 155; Backer & Bakh. f., Fl. Java 1 (1964) 515. — Type: *Teijsmann s.n.*, Sumatra. *Rubus asper* auct. non Wall. ex D. Don: Focke, Bibl. Bot. 72 (1911) 157, f. 67; Backer, Schoolfl. Java (1911) 454.

Erect or scrambling to semi-scandent shrubs, up to 2 m high. *Stems* with many up to 5 mm long gland-tipped, reddish, setose hairs and usually also with soft, curly hairs, prickles usually not many, curved, up to 5 mm. Sessile, pale or red globular glands often present on many parts of the plant, especially the leaves. *Leaves* imparipinnate, up to

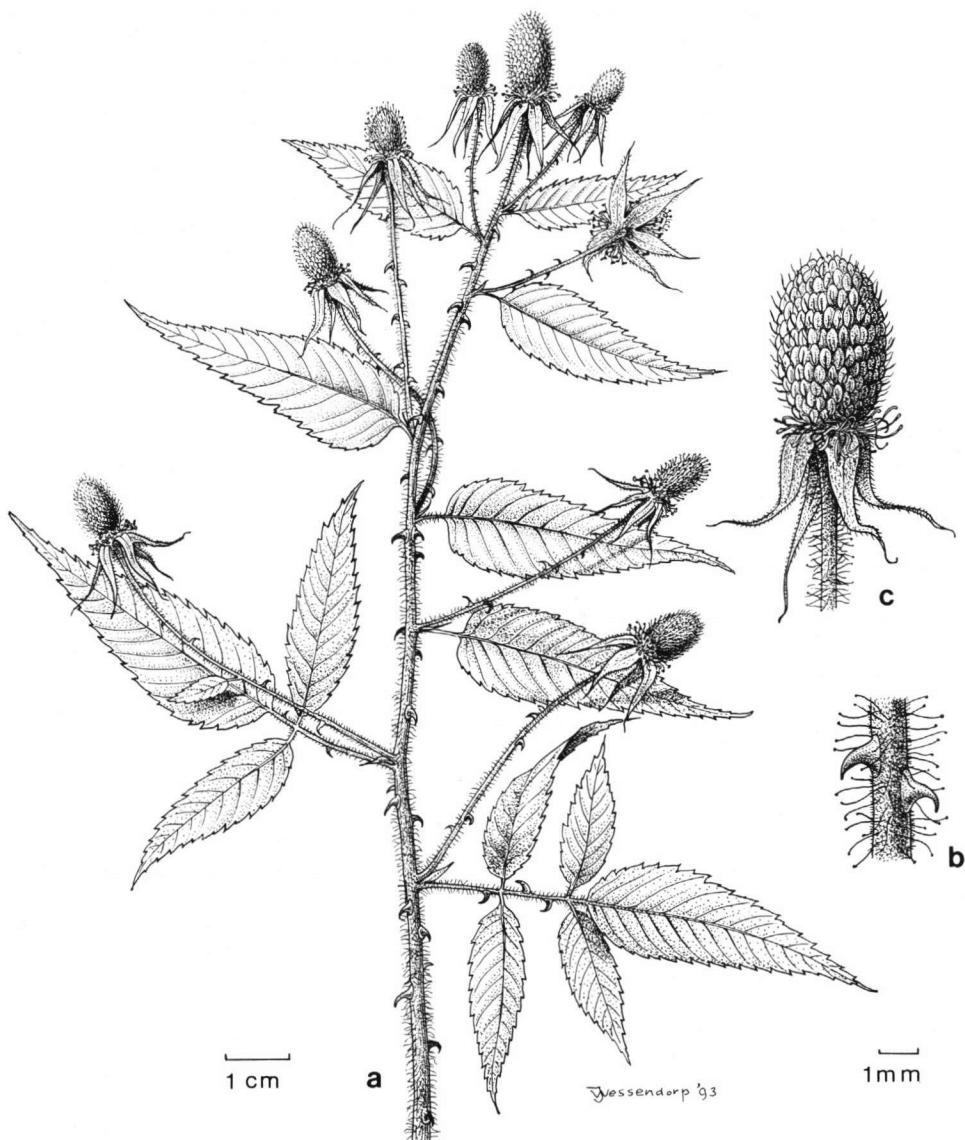


Fig. 3. *Rubus sumatranus* Miq. a. Branch with old flowers; b. stem with prickles and glandular hairs; c. collective fruit (a, b: Lörzing 4753; c: Kochummen FRI 16456).

21 cm long, petiole (1-)2–6 cm long. *Stipules* linear, 3–6 by up to 0.5 mm, entire. *Leaflets* in 2–3(–4) opposite pairs, oblong to oblong-ovate, 2.5–7 by 0.8–2 cm, base acute to rounded, margin serrate to biserrate, apex acute to long-tapering, herbaceous, 7–12 pairs of nerves, soft-hairy on both surfaces and with gland-tipped long hairs.

Inflorescence consisting of up to 5(–8) cymes in the axils of the upper leaves, up to 25 cm long, with up to 20 flowers. *Bracts* in the cymes often leaf-like. *Pedicels* up to 4 cm long. *Hypanthium* 4–5 mm across, with some soft hairs and with gland-tipped setose hairs outside. *Sepals* narrowly triangular, 7–14 by 2–3.5 mm, including the up

to 5 mm long acumen, indumentum outside as hypanthium and also woolly on the covered margins. *Petals* falling early, oblong to obovate, 8–10 by 2–4 mm, obtuse, slightly fimbriate at apex, white. *Stamens* up to c. 120, filaments up to 4 mm, anthers 0.5 mm long. *Pistils* up to c. 500, ovaries glabrous, on elevated, glabrous torus with pistils down to the base, style up to 2 mm long. *Collective fruits* ellipsoid, up to 1.5 by 0.8 cm when dry, sepals recurved. *Fruits* 1–1.5 mm long, orange-red to red, mesocarp only a very thin layer when dry. — **Fig. 3.**

Distribution — NE India, Thailand, Laos, Vietnam, S China, Taiwan, Japan; in *Malesia*: Sumatra, Peninsular Malaysia, Java.

Habitat — Clearings, roadsides, thickets, tea plantations, forest borders, and similar open places, very rarely reported from lighter types of forest, altitude (Sumatra and Malaya) 500–2000 m.

Uses — Fruits edible, pleasant of taste.

Note — Confused with *R. croceacanthus* Léveillé (*R. asper* Wall. ex D. Don 1825, nom. illeg., non Presl 1822) from continental Asia.

Subgenus Malachobatus

Rubus subg. *Malachobatus* (Focke) Focke, Bibl. Bot. 72 (1910) 41; Kalkman, Blumea 29 (1984) 319. — *Rubus* sect. *Malachobatus* Focke, Abh. Naturw. Ver. Bremen 4 (1874) 187, 201.

Leaves mostly simple (in *Malesia* always), entire or lobed, usually pedately nerved with on either side at the very base of the midrib 2 or 3 main side nerves, each with 2–5 basiscopic lateral nerves, above the base pinninerved, nerves usually terminating in the margin, nervation more rarely palmate with 3–7 main nerves, or pinnate. *Stipules* free, on the twig near the petiole-base, usually rather persistent. *Inflorescences* terminal, compound racemes or thyrses, side branches racemose or di- or monochasial, the lower branches axillary to leaves. *Flowers* usually bisexual, some species (gyno)dioecious. *Hypanthium* saucer- to cup-shaped. *Sepals* subequal or inner ones distinctly narrower, entire or (usually) with up to 5 teeth on the not-covered margins. *Petals* in some species wanting or only one left. *Fruits* cohering, falling as a whole together with the dried torus.

Distribution — Many species (c. 80?), centred in Continental Asia and *Malesia*, extending to Japan, Australia, and the W and SW part of the Pacific Ocean. In *Malesia* 19 species and some incompletely known ones (see Kalkman, l.c.). New Guinea is poor in species belonging to this subgenus, which contrasts with the two other subgenera.

26. *Rubus alceifolius* Poiret in Lam., Encycl. Méth. 6 (1806) 247, 'alcaefolius, alceaefolius', the latter orthography also in many other references; Blume, Bijdr. (1826) 1109; Miq., Fl. Ind. Bat. I, 1 (1855) 379; Suppl. 1 (1860/61) 116, 308; Kuntze, Meth. Speciesbeschr. (1879) 56; Ridley, Fl. Mal. Penins. 1 (1922) 677; Backer & Bakh. f., Fl. Java 1 (1964) 516. — *Rubus moluccanus* L. var. *alceifolius* (Poiret) Kuntze, Rev. Gen. Pl. 1 (1891) 222. — Type: *Commerçon* s.n., Java.

Shrubs with arching or climbing branches up to 5 m long. *Stems* rather densely covered with patent and straight hairs, mixed with shorter and thinner

hairs and with stalked glands, prickles usually rather many, stout. *Leaves* orbicular to broadly ovate in outline, (10–)12–26 by (9–)12–26 cm, 5–7-lobed with up to 4 cm deep incisions, lobes rounded and shallowly lobed, base deeply cordate, margins grossly and evenly serrate, apex obtuse to acute, herbaceous to slightly coriaceous, nervation pedate with 5–7 pairs of nerves, venation reticulate, sometimes the upper surface distinctly bullate between the veins, upper surface hairy, lower surface with a usually closed felt of short, curly hairs and with many long, patent hairs on the nerves. *Petiole* 3–11 cm long. *Stipules* often rather persistent, orbicular in outline, up to c. 2 cm, deeply digitately divided with the lobes pinnate, lobes



Fig. 4. *Rubus alceifolius* Poiret. Inflorescence and leaf. Mt Salak, Java. Photo J. H. Becking.

thread-like, at most 0.3 mm wide, hairy outside and on margins. *Inflorescence* a terminal compound raceme with 12 or more laterals, the lower of them in the axes of leaves, up to 50 cm long, the lateral racemes up to 12 cm long, all axes terminating in a flower. *Bracts* rather persistent, pinnatifid to -partite, with thin lobes. *Pedicels* 1–1.5 cm long, densely hairy as are all axes in the inflorescence. *Flowers* bisexual, flower buds ± globular. *Hypanthium* cup-shaped, 6–9 mm across, densely woolly and with long patent hairs outside. *Sepals* ovate, 6–10 by 4–7 mm, acute to acuminate, not-covered margins with 2–5 teeth up to 2(–4) mm long, indumentum outside as hypanthium. *Petals* early falling, orbicular, 5.5–9.5 by 4.5–9 mm, distinctly clawed, rounded or notched at apex, white. *Stamens* 160–230, filaments up to 5 mm, anthers 0.5–0.8 mm long, with long hairs. *Pistils* up to 150, ovaries glabrous, on elevated, glabrous torus, style up to 10 mm long. *Collective fruits* globular, c. 1 cm, sepals under ripe fruits spreading. *Fruits* 2–4 by 2–3 mm when dry, red, mesocarp juicy, a thin layer when dry. — Fig. 4.

Distribution — China, Taiwan, Burma, Thailand, Laos, Cambodia, Vietnam; *Malesia*: Sumatra, Malaya, Borneo, Java, Celebes, Lesser Sunda Islands. Introduced in Australia (Queensland), Madagascar, and Mascarenes.

Habitat — In light places like forest edges, roadsides, secondary forest, thickets, and riverbanks, altitude (0–)500–1400(–1600) m.

Uses — Shoots are eaten (Sumatra), a kind of use which is rarely mentioned for species of *Rubus*. Roots of the species are boiled and taken against dysentery (Malaya).

Note — *Rubus alceifolius* differs from all varieties and forms of the related *R. moluccanus* in the shape of the closed flowerbuds (globular, not ovoid-pointed) and in the stipules which have very thin, filiform lobes.

27. *Rubus beccarii* Focke, Bibl. Bot. 72 (1910) 62. — Type: Beccari 175, Sumatra.

Probably large, climbing shrubs. *Stems* densely hairy, prickles rather many, rather small. *Leaves* ovate, 9–11.5 by 6.5–7.5 cm, not lobed, base shallowly cordate, margin serrate, apex acute to shortly acuminate, rather thick and firm, nervation pinnate or pedate, with 7 or 8 pairs of nerves, those not always terminating in the margin, venation transverse, upper surface long-hairy, lower surface with many long, straight, patent hairs and with few short, curly hairs. *Petiole* c. 2 cm long, hairy.

Stipules c. 1 cm long, deeply divided, lobes thin. *Inflorescence* only fragmentarily known, axes densely hairy. *Flowers* possibly functionally unisexual, only males seen, flower buds globular. *Hypanthium* c. 5 mm across, densely hairy outside with woolly felt and long, straight hairs. *Sepals* broadly ovate, up to 6 by 6 mm, uncovered margins with c. 5 small teeth, covered margins entire, indumentum outside as hypanthium. *Petals* 7 by 6 mm (not full-grown), rounded apex. *Stamens* c. 115, glabrous, anthers 1 mm long. *Pistils* many, not developed in male flowers, pistillodes long-hairy on back and in basal part of style. *Collective fruits* not seen.

Distribution — Only known from the type specimen from Mt Singgalang in West Sumatra. Closely allied to, and maybe conspecific with *R. smithii*.

28. *Rubus benguetensis* Elmer, Leafl. Philipp. Bot. 1 (1908) 296; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 227. — Type: Elmer 8383, Luzon.

Climbing or scrambling shrubs. *Stems* up to 15 m long, young twigs (rather) densely covered with patent and with curly hairs mixed with glandular hairs, prickles few to rather many, small. *Leaves* ovate to elliptic, (6–)7.5–13 by (3.5–)5–8 cm, not lobed, in sterile shoots up to 17 by 9 cm and shallowly 3-lobed, base cordate to subtruncate, margin evenly serrate, apex acute to shortly acuminate, herbaceous to stiffly coriaceous, nervation pinnate with up to 6 pairs of nerves, sometimes ± pedate, venation transverse, both surfaces more or less densely hairy at least on nerves and veins. *Petiole* 0.5–1(–1.5) cm long. *Stipules* often rather persistent, pinnatisect to -partite with 2–4 pairs of lobes, up to 9 by 3 mm. *Inflorescence* laxly paniculate, a compound raceme with the ultimate branching sometimes cymose, up to c. 20 laterals with up to 30 flowers, the lowermost laterals in the axes of leaves, the entire inflorescence up to c. 35 cm long, the laterals up to 15 cm. *Bracts* usually tripartite, up to c. 8 mm long. *Pedicels* 0.7–1.5 cm long, densely hairy as are the branches of the inflorescence. *Flowers* bisexual, flower buds ovoid. *Hypanthium* saucer-shaped, 3.5–4 mm across, shortly woolly outside and also with long hairs. *Sepals* ovate, sharply pointed, 6–7 by 2.5–5 mm, inner ones narrower than outer ones, covered margins entire, outer margins with usually one minute tooth under the apex, indumentum outside as hypanthium, the outside pink to purple as are the pedicels. *Petals* none, rarely one or a semi-petaloid stamen. *Stamens* 50–80, glabrous, filaments up to 5 mm, anthers 0.5–0.8 mm long.

Pistils (13-)20-30, glabrous, ovaries on slightly elevated, hairy torus, style up to 5 mm long. *Collective fruits* globular, up to 8 mm diam., sepals closing after anthesis. *Fruits* 3.5-6 by 2-2.5 mm when dry, black, mesocarp probably fleshy and rather thick but when dry only a thin, tough layer.

Distribution — Borneo (seen from Sarawak, Sabah), Luzon, C and S Celebes.

Habitat — Primary forest on slopes, also on open cliffs, altitude (150-)600-2900 m.

Ecology — Several collections seen from limestone but also on other soil types.

**29. *Rubus chrysophyllus* Reinw. ex Miq., Fl. Ind. Bat. I, 1 (1855) 380; Kuntze, Meth. Species-beschr. (1879) 56, 76; Backer & Bakh. f., Fl. Java 1 (1964) 516; Steenis, Mount. Fl. Java (1972) pl. 45-2. — *Rubus moluccanus* L. var. *chrysophyllus* (Reinw. ex Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 222. — Types: *Reinwardt s.n.*, holo; *Junguhn s.n.*; both Java.
Rubus moluccanus L. var. *ochrascens* Blume, Bijdr. (1826) 1109. — Type: *Blume s.n.*, Java.**

Shrubs, up to 4 m high, overhanging branches up to 10 m long. *Stems* with a dense yellowish indumentum of short, curly hairs and long, (semi-)appressed, straight or wavy hairs, glabrate, prickles few, short, or twigs unarmed. *Leaves* ovate to broadly ovate, 7-22 by 7-18 cm, shallowly 3-7-lobed, base truncate to shallowly cordate, margins grossly and unevenly serrate, apex acute, stiff-coriaceous, nervation pedate with 6-9 pairs of nerves, venation reticulate, on upper surface the squarish interventional fields distinctly bullate raised, upper surface soon glabrous, lower surface with a dense, closed felt of short, curly hairs and on nerves and veins many straight, (semi-)appressed hairs, distinctly two-coloured when dry. *Petiole* 2-7 cm long. *Stipules* often persistent, orbicular in outline, digitately and deeply divided into 6-8 lobes, the largest of those pinnatifid, 1-1.5 cm long, hairy. *Inflorescence* panicle-like, a compound raceme with di- or monochasial last branches, up to 12 side-branches, the lower ones in the axils of leaves, the entire thyrsoid up to 35 cm long, side-branches up to 17 cm long. *Bracts* large, deeply dentate. *Pedicels* 1-2(-4) cm long, densely hairy as all axes in the inflorescence. *Flowers* bisexual, flower buds ovoid, pointed. *Hypanthium* cup-shaped, (4-)5-7 mm across, densely hairy outside with long, straight hairs hiding the smaller curly ones. *Sepals* triangular, pointed, outer ones (4-)6-8 by 3-6 mm, inner ones narrower, uncovered margins with (2-)3-5 teeth, up to 1.5 mm long,

indumentum outside as hypanthium. *Petals* orbicular to elliptic, 3.7-5 by 2.5-5.5 mm, apex notched, white. *Stamens* 50-100, glabrous, filaments up to 4 mm, anthers 0.5-0.8 mm long. *Pistils* 50-90, ovaries glabrous, on elevated, densely hairy torus, style up to 5.5 mm long. *Collective fruits* globular, up to 7 mm diam. when dry, sepals closing after anthesis. *Fruits* curved, c. 2.5 by 1.5 mm when dry, glabrous, yellow to orange, sometimes red, mesocarp juicy, a thin layer when dry.

Distribution — Sumatra, Java, Lombok.

Habitat — Light forest and more open places like thickets, forest edges, clearings, secondary bush, and near craters. Montane, altitude (900-)1200-2950 m.

Uses — The fruits seem to be delicious.

Notes — Some specimens from Java have only female flowers.

The bullate leaves, the rather stout and coarse habit, and the wide and lax inflorescences separate the species rather clearly from the related *R. moluccanus*.

30. *Rubus cumingii* Kuntze, Meth. Species-beschr. (1879) 72, 76; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 227. — Type: *Cuming s.n.*, Philippines.

Shrubs, dimensions unknown. *Stems* with some vestiges of thin, curly hairs and also with long and thicker hairs, prickles rather many, small. *Leaves* ovate, not lobed, 7-8 by 5-6 cm, base subtruncate, margin serrate, apex acute, herbaceous, nervation pedate with 7 pairs of nerves, venation transverse, both sides with long (semi-)appressed hairs on the nerves and fewer on and between the veins. *Petiole* 1.5 cm long. *Stipules* elliptic, entire. *Inflorescence* panicle-shaped, c. 15 cm long and wide, with 4 side branches, rich-flowered, densely patently hairy. *Bracts* persistent. *Pedicels* c. 3 mm. *Flowers* unisexual, flower buds ovoid. *Hypanthium* cupular, c. 5.5 mm across, densely hairy outside. *Sepals* broadly ovate, pointed, outer ones 5 by 4 mm, inner ones narrower, uncovered margins with one short tooth, indumentum outside as hypanthium. *Petals* persistent, elliptic, 3.5 by 2 mm. *Stamens* not seen, *staminodes* in female flowers c. 60, glabrous. *Pistils* 14, ovaries long-hairy on the back near the apex, on little elevated, hairy torus, style c. 2.5 mm long, hairy at base. *Collective fruits* not known. *Fruits* c. 2.5 by 1.5 mm.

Distribution — Known from one duplicate of the type, probably from Luzon, with female flowers.

Note – *Steiner* 2027 (Luzon) and *Beguin* 1546 (Ternate) may be conspecific but differ in details of the indumentum. Related to *R. luzoniensis*.

31. *Rubus elongatus* J.E. Smith, Pl. Icon. Hact. Ined. 3 (1791) t. 62; Blume, Bijdr. (1826) 1112; Miq., Fl. Ind. Bat. I, 1 (1855) 380, incl. varieties; Merr., Enum. Born. Flow. Pl. (1921) 288; Ridley, Fl. Mal. Penins. 1 (1922) 679; Backer & Bakh. f., Fl. Java 1 (1964) 516. — Type: *Commerçon s.n.*, Java.

Rubus lobbianus Hook., Icon. Pl. 8 (1848) pl. 741/742. — *Rubus moluccanus* L. var. *lobbianus* (Hook.) Kuntze, Rev. Gen. Pl. 1 (1891) 222. — Type: *Lobb* 62, Java.

Rubus blumei Focke, Bibl. Bot. 72 (1910) 60. — Type: *Korthals s.n.*, Java.

Rubus magnibracteatus Ridley, J. Fed. Malay St. Mus. 8 (1917) 32. — Type: *Robinson & Kloss s.n.*, Sumatra.

Rubus elongatus J.E. Smith var. *laevicalyx* Ridley, J. Fed. Malay St. Mus. 8 (1917) 31. — Type: *Robinson & Kloss* 143, Sumatra.

Climbing, scrambling, or creeping shrubs. *Stems* up to 25 m long, woody, thick, bark dark-brown to black, densely hairy to almost glabrous, prickles few to many, short, straight. *Leaves* ovate, entire or shallowly lobed, 7.5–15 by 5–9.5 cm, base deeply cordate to truncate (in smaller leaves), margins serrate to dentate, apex acute, firmly herbaceous, nervation pedate with 8–11 pairs of nerves, venation transverse, densely hairy on nerves and veins to almost glabrous above, with a dense mat of short, curly hairs below, especially on nerves and veins covered by longer, semi-appressed hairs, distinctly two-coloured in living as well as in dried state. *Petiole* 2.5–5.5 cm long. *Stipules* early deciduous, suborbicular to elliptic in outline, 6–9 by 6–10 mm, pinnatipartite with 5–9 pairs of lobes, hairy outside. *Inflorescence* a compound raceme, 12–35 cm long, with 6–18 side branches, the lower ones in axils of leaves, up to 10 cm long, laterals usually branched again, with up to 25 flowers. *Bracts* lobed. *Pedicels* up to 3 mm long, densely to slightly hairy as are all axes, with 2 bracteoles halfway. *Flowers* unisexual, plants dioecious, flower buds globular. *Hypanthium* cup- to saucer-shaped, 3.5–5 mm across, densely tomentellous and with longer, appressed hairs outside. *Sepals* triangular to (broadly) ovate, 3–6 by 2.2–3.5 mm, apex acute or rounded and shortly apiculate, margins entire, red to purple as are hypanthium, pedicels, and bracts, indumentum outside as hypanthium. *Petals* obcor-

date to obovate, 5–11 by 4–6 mm, apex rounded or emarginate, white to pink. *Stamens* 80–125, glabrous, filaments 2–2.5 mm, anthers 0.8–1.2 mm long, staminodes 60–90, minute. *Pistils* 45–70, ovaries glabrous, on elevated, hairy torus, style c. 2 mm long, pistillodes c. 1 mm. *Collective fruits* globose, 6–10 mm diam when dry, sepals closing after anthesis, spreading under ripe fruit. *Fruits* sickle-shaped, 2–3.5 mm long, black when ripe, mesocarp a rather thin layer when dry.

Distribution – Sumatra, Malaya, Borneo, W Java, N Celebes, ?Moluccas (Tidore).

Habitat – Forests, thickets, near rivers and roads, 300–2300 m altitude.

Note – Field observations on the sex ratio are wanting. Almost 80% of the existing herbarium collections has female flowers. This may, however, not reflect the real situation but the inclination of collectors to pick fruiting specimens. See also *P. luzoniensis*.

32. *Rubus glomeratus* Blume, Bijdr. (1826) 1111; Miq., Fl. Ind. Bat. I, 1 (1855) 381; Koord., Exk. Flora Java 2 (1912) 324. — *Rubus moluccanus* L. var. *glomeratus* (Blume) Backer, Schoolfl. Java (1911) 458; Backer & Bakh. f., Fl. Java 1 (1964) 517. — Non Hook. f., Fl. Brit. India 2 (1878) 328 et auctt. al. — Type: *Blume s.n.*, Java (L, sheet nr 905.130-133/134).

Rubus glabriusculus Hassk., Flora 27 (1844) 586; Miq., Fl. Ind. Bat. I, 1 (1855) 383. — *Rubus moluccanus* L. var. *glabriusculus* (Hassk.) Kuntze, Rev. Gen. Pl. 1 (1891) 222. — Type: not indicated.

Rubus sundaicus auct. non Blume: Kuntze, Meth. Speciesbeschr. (1879) 60, 76.

Rubus ledermannii Focke, Bot. Jahrb. 56 (1916) 79; P. van Royen, Phan. Mon. 2 (1969) 91, f. 23. — Type: *Ledermann* 11651 (lost), neo van Royen NGF 30159, New Guinea.

Rubus robinsonii Ridley, J. Fed. Mal. St. Mus. 8 (1917) 31. — Type: *Robinson & Kloss* 132 (?), Sumatra.

Rubus ledermannii Focke var. *beleensis* P. van Royen, Phan. Mon. 2 (1969) 93, f. 24. — Type: Brass 11035, New Guinea.

Climbing, trailing, or scrambling shrubs, up to 3 m high. *Stems* sparsely to densely hairy with curly hairs never forming a closed felt, and with longer, thicker, straight hairs, glabrate and then dark brown to blackish, prickles usually few, weak. *Stipular cataphylls* at the base of lateral branches. *Leaves* broadly ovate, 4–15 by 3.5–13

cm, shallowly 3(–5)-lobed or almost unlobed, base cordate to (upper leaves) truncate, margins serrate, apex acute, coriaceous, nervation pedate with 5–7 pairs of nerves, venation reticulate, upper surface sometimes slightly bullate between nerves and veins, hairy and glabrescent, lower surface with on nerves and veins short, curly hairs that never form a closed felt, and with longer and thicker, straight hairs. *Petiole* 1–5(–7) cm long. *Stipules* early deciduous, elliptic, 7–20 by 5–10 mm, dentate to pinnatipartite with up to 6 pairs of teeth or lobes, hairy outside. *Inflorescence* a terminal thyrsus with up to 6 lateral cymes of up to 3 flowers, up to 10 cm long, peduncle up to 5(–7) cm. *Bracts* pinnatipartite. *Pedicels* up to 5(–10) mm long, hairy as are the other axes. *Flowers* bisexual, flower buds ovoid, pointed. *Hypanthium* cupular, 4–7 mm across, densely woolly outside and with long, straight hairs, rarely with short, stalked glands. *Sepals* triangular, outer ones 6–9 by 4–7 mm, inner ones narrower, apex sharply pointed, not-covered margins with 2–6 teeth of 2–3 mm, covered margins entire, indumentum outside as hypanthium. *Petals* early deciduous, suborbicular to obovate or obcordate, 4.5–10 by 3–8 mm, apex rounded or emarginate, white, sometimes hairy outside. *Stamens* 24–120, in New Guinea up to 60, filaments up to 6 mm long, glabrous, rarely hairy, anthers 0.5–1 mm long, glabrous or with 1–5 hairs on the top. *Pistils* 30–60, ovaries glabrous, on elevated, hairy torus, style up to 6 mm long. *Collective fruits* globular, up to 8 mm diam., sepals closing after anthesis and staying erect around ripe fruits. *Fruits* curved, 2–4 mm long when dry, orange-red to red, mesocarp juicy, a thin membranous layer when dry.

Distribution — Sumatra, Malaya, Java, S Celebes, New Guinea, New Britain.

Habitat — Secondary and disturbed forests, and in open places like clearings, riverbanks, landslides, roadsides, forest edges, shrubland. Altitude (1200–) 1600–3000 m.

Notes — Specimens from Java and Sumatra differ slightly from the New Guinean specimens (*R. ledermannii*). Omitting overlapping measurements of flower parts, the differences are as follows. Java and Sumatra: stamens 75–120, anthers glabrous; New Guinea: stamens 24–60, anthers usually with 1–2(–5) hairs on top, rarely glabrous. The material from Celebes resembles the West Malesian specimens. To recognize a separate species for the New Guinean plants seems not to be justified.

The Malayan specimens are also slightly different and were earlier recognized as var. *gracilis* King, J. As. Soc. Beng. 66, ii (1897) 295.

Records from Moluccas and Philippines (*R. van-overberghii* Merr., var. *pileanus* Focke) could not be substantiated but are not necessarily incorrect. See Kalkman, Blumea 29 (1984) 380, note 5.

Rubus glomeratus has often been confused with *R. moluccanus* and the two were united by some authors. However, they can be separated without difficulty by means of the leaf indumentum: the felt of thin, short, curly hairs is in the former species never entirely closed and the leaf surface remains visible, which is not the case in *R. moluccanus*.

33. *Rubus heterosepalus* Merr., Philipp. J. Sc. 20 (1922) 387; Enum. Philipp. Flow. Pl. 2 (1923) 228. — Type: *Ramos & Edaño* BS 37609, Mt Polis.

Climbing or straggling shrubs. *Stems* densely hairy with many long, straight hairs and few short, thin, curly ones, prickles up to 2 mm. *Leaves* broadly ovate, 8.5–14 by 6.5–10 cm, shallowly 3–5-lobed, base cordate, margins rather grossly serrate, apex gradually acuminate, coriaceous, nervation pedate with 5–6 pairs of nerves, venation reticulate, upper surface bullate between the veins, both surfaces with long hairs on nerves and veins and lower surface also with a dense felt of thin curly hairs all over, two-coloured when dry. *Petiole* 3–5 cm long. *Stipules* pinnatipartite with 6–8 pairs of lobes, c. 15 by 11 mm, hairy outside. *Inflorescence* a compound raceme, large and rich, 10–25 cm long, only the lowermost of the 4–6 side branches in the axil of a leaf or all laterals in the axils of bracts. *Bracts* persistent, pinnatisect, large. *Pedicels* up to c. 8 mm long, densely hairy as are the other axes. *Flowers* bisexual, flower buds ovoid. *Hypanthium* cup-shaped, c. 8 mm across, densely hairy outside. *Sepals* distinctly dimorphous, outer ones 10–14(–18) by 10–13 mm, with 5 or more pairs of lobes, those up to 7 by 1.5 mm, inner sepals triangular and not lobed, 10–11 by c. 4 mm, indumentum outside as hypanthium. *Petals* falling early, c. 6 by 3–3.5 mm, apex deeply emarginate. *Stamens* 70–90, filaments up to 4 mm, glabrous, anthers c. 0.8 mm long. *Pistils* many, ovaries glabrous, on hairy torus, style up to 4.5 mm long. *Collective fruits* probably globular, c. 1 cm diam. (dry), sepals closing after anthesis, widely spreading under ripe fruits. *Fruits* 3 mm long, mesocarp rather thick.

Distribution — Luzon.

Habitat — Mossy forest at 1800 m, according to Merrill (l.c., 1922).

Note — Only few specimens known. Related to *R. chrysophyllus*, but sepals larger, with longer lobes.

34. Rubus keleterios P. van Royen, Phan. Monogr. 2 (1969) 87, f. 22. — Type: *Hoogland & Pullen* 6226, Mt Hagen.

Shrubs. *Stems* densely hairy, prickles few, short. *Leaves* broadly ovate in outline, 5–7.5 by 5–6.5 cm, distinctly 3-lobed, base cordate, margins unevenly serrate, apex acute, firmly herbaceous, nervation palmate with 5 main nerves, venation reticulate, rather densely hairy above, lower surface with a dense woolly felt of short, thin, curly hairs, and with many thicker, straight, long hairs, distinctly two-coloured. *Petiole* 1.5–2.5 cm long. *Stipules* rather persistent, linear, 14–17 by 2 mm, with 2–3 narrow lobes, hairy outside. *Inflorescence* a leafy thyrs, c. 15 cm long, with c. 8 dichasial to monochasial laterals of c. 4 cm long, with up to 5 flowers. *Bracts* c. 10 mm long, deeply incised, bracteoles 2, on the pedicel, persistent as are the bracts. *Pedicels* up to 1.5 cm long, densely hairy as are the other axes. *Flowers* bisexual, flower buds ovoid. *Hypanthium* cup-shaped, 7 mm across, short-woolly and with longer hairs outside. *Sepals* triangular, 6.5–8 by 2.5–4 mm, outer ones usually with up to 3 pairs of teeth (up to 1 mm long), inner ones entire, indumentum outside as hypanthium. *Petals* persistent, ± orbicular, distinctly clawed, 5.5–7 by 3–5 mm, white. *Stamens* 85–125, filaments up to 5 mm, glabrous, anthers c. 0.5 mm long. *Pistils* c. 60, ovaries glabrous or with few hairs on top, on elevated, densely hairy torus, style up to 6 mm long. *Collective fruits* globular, c. 1 cm diam., sepals closing after anthesis. *Fruits* c. 4 mm long (dry), exocarp glabrous or with long hairs on backside in the upper half, mesocarp thick and leathery when dry, probably thick and juicy when living.

Distribution – New Guinea (only known from two collections from Papua New Guinea); a collection from Cook Distr., Queensland, Australia (Clarkson 2742) seems to be conspecific.

Habitat – Once in shrubland, once in grass swamp, 1700–1950 m alt. The Queensland collection is from 780 m altitude.

Note – Closely related to *R. moluccanus* but distinct by its leafshape (very broad and short, end lobe about half of total leaf length) and its long pedicels with persistent bracteoles.

35. Rubus luzoniensis Merr., Philipp. J. Sc., Suppl. 1 (1906) 195; Elmer, Leafl. Philipp. Bot. 2 (1908) 452; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 228. — Type: *Merrill* 4596, Mt Data.

Climbing or sprawling shrubs, gynodioecious? *Stems* up to 10 m long, densely hairy when young, prickles rather few to many, short but strong. *Leaves* (broadly) ovate to suborbicular, 5–8.5 by 4–6.5 cm, not or very shallowly lobed, base shallowly cordate or truncate, margins serrate, apex obtuse to acute, stiff-coriaceous, nervation pedate with 5–7 pairs of nerves, venation transverse, (rather) densely hairy above, lower surface densely short-woolly all over and with long, straight hairs on nerves and veins, distinctly two-coloured. *Petiole* 1–3 cm long. *Stipules* often rather persistent, linear, 12–19 by 3–4 mm, entire or minutely toothed, hairy outside. *Inflorescence* a panicle-like compound raceme, richly and widely branched and many-flowered, up to 40 cm long, up to 15 side branches, up to 18 cm long. *Bracts* rather large, persistent. *Pedicels* up to 5 mm long, densely hairy as all axes in the inflorescence. *Flowers* bisexual or female. *Hypanthium* saucer-shaped, 3–4.5 mm across, densely hairy outside. *Sepals* ovate, 5–6 by 2.5–4 mm, after anthesis growing to 8 by 6 mm, apex apiculate, margins entire or with minute teeth, on the outside with a woolly felt and the not-covered parts also with long appressed hairs. *Petals* obovate to elliptic, 5–6.5 by 2.5–4 mm, apex obtuse to emarginate, white. *Stamens* 50–100, filaments up to 4.5 mm, glabrous, anthers 0.5 mm long, staminodes with shorter filament and minute anther. *Pistils* 15–25, ovaries long hairy at the top on the backside, on a slightly elevated, long-hairy torus, style 2–3 mm long, some hairs at the base. *Collective fruits* consisting of few fruits only, sepals closing after anthesis. *Fruits* c. 3 mm long when dry, still hairy at apex, bright red, mesocarp a rather thick, tough layer when dry.

Distribution – Luzon.

Habitat – Forest and clearings, altitude 2000–2500 m.

Notes – The sex distribution is incompletely known. The great majority of the rather few herbarium collections have female flowers. The species is most closely related to *R. elongatus* and replaces that species in the Philippines.

36. Rubus malvaceus Focke, Bibl. Bot. 72 (1910) 81, f. 30; Thuan, Fl. Camb., Laos & Vietnam 7 (1968) 51, excl. specimens from Asian continent; Fl. Thailand 2 (1970) 56, idem. — *Rubus moluccanus* L. var. *malvaceus* (Focke) Backer, Schoolfl. Java (1911) 458; Backer & Bakh.f., Fl. Java 1 (1964) 517. — Type: *Ploem* 19980, Sindanglaya, W Java.

Rubus wichurae Focke, Bibl. Bot. 72 (1910) 79.
— Type *Wichura* 2092, Mt Tangkubanperahu,
W Java.

Shrubs with overhanging branches. *Stems* with a dense, long persistent indumentum, prickles not many, curved, up to 3 mm. *Leaves* broadly ovate to suborbicular in outline, 7–15(–19) by 7–15(–17) cm, distinctly 5- to 7-lobed, base deeply and sharply cordate, margin rather evenly serrate, apex usually acute, coriaceous, nervation 5-palmate, the lowermost main nerves pedately nerved, venation reticulate, nerves and veins impressed above and surface distinctly bullate between them, densely hairy above, lower surface with a dense felt of long, curly hairs all over and with many long, patent hairs on nerves and veins, distinctly two-coloured. *Petiole* 1.5–6(–8) cm long. *Stipules* rather persistent, pinnatipartite to digitate-pinnate, 15–18 by 12–18 mm, the lobes 0.5–1.5 mm wide, hairy outside and on margins. *Inflorescence* a large thyrsse, 20–25 cm long, with up to 12 cymose laterals in the axils of normal or smaller leaves or bracts, the laterals up to 3 cm long, with 2–4(–10) flowers. *Bracts* pinnatifid, large. *Pedicels* up to 1 cm long, hairy. *Flowers* bisexual, the flower buds ovoid. *Hypanthium* cupular, 6–10 mm across, densely hairy outside. *Sepals* recurved at the top during anthesis, triangular, 7–10 mm long, outer ones 4–8 mm wide, the not-covered margins long-dentate, inner ones 3.5–6 mm wide, entire, indumentum outside as hypanthium. *Petals* suborbicular, 5–6 by 5–5.5 mm, clawed, the margin undulating, white. *Stamens* 100–200, filaments up to 5 mm, glabrous, anthers 0.5–0.8 mm long, with long hairs on top. *Pistils* 60–80, ovary glabrous, the style up to 7.5 mm long. *Collective fruits* not seen. *Fruits* 2–3 mm long, the colour unknown.

Distribution – W Java, Sumba.

Habitat – Hardly any data, one collection from 1300 m altitude.

Notes – Quite closely related to *R. rugosus* J.E. Smith, which is known from the Asian continent and Sri Lanka. It seems, however, premature, to combine the two.

The patchy distribution cannot be explained by supposing an escape from the botanical garden at Cibodas, Java.

37. *Rubus mearnsii* Elmer, Leafl. Philipp. Bot. 2 (1908) 448; Merr., Philipp. J. Sc., Bot. 5 (1910) 353; Enum. Philipp. Flow. Pl. 2 (1923) 228. — Type: *Mearns* BS 4304, Luzon.

Shrubs. *Stems* rather densely hairy when young and with many c. 1 mm long gland-bearing hairs, prickles (rather) many, curved, up to 1.5 mm. *Leaves* broadly ovate to suborbicular, 5–9 by 5–7 cm, not or faintly lobed, base cordate, margin rather coarsely serrate, apex obtuse to acute, coriaceous to herbaceous, nervation pedate with 6–7 pairs of nerves, venation transverse, both surfaces rather sparsely hairy, more densely on midrib and nerves below. *Petiole* 1–2 cm long. *Stipules* persistent, tongue-shaped, 7–9 by 3–4 mm, with 5–6 pairs of small teeth, hairy and glandular outside. *Inflorescence* a thyrsse, laxly paniculate in appearance, up to 52 cm long, with up to 18 lateral branches of up to 24 cm long and with up to 30 flowers. *Bracts* up to 9 mm long, hairy and glandular outside. *Pedicels* 0.5–1.5 cm long, long-hairy and with glandular hairs, as are the other axes. *Flowers* bisexual, flower buds ovoid, pointed. *Hypanthium* saucer-shaped, 6 mm across, hairy and glandular-hairy outside. *Sepals* ovate, 7–8 mm long, outer ones 5–6 mm wide, with 3–6 teeth on the uncovered margins, inner ones c. 4 mm wide, entire, indumentum outside as hypanthium. *Petals* none. *Stamens* 60–90, filaments up to 5 mm, glabrous, anthers 0.5–0.8 mm long. *Pistils* 12–18, ovaries glabrous, on flat, hairy torus, style up to 4 mm long. *Collective fruits* c. 6 mm diam., loose, often only some of the fruits developing, sepals closing and remaining closed after anthesis. *Fruits* 4 mm long when dry, mesocarp fleshy, a rather tough layer when dry.

Distribution – Luzon.

Habitat – Only six collections investigated, the majority without field data. According to Merrill (1923) in mossy forest, c. 2400 m altitude, one specimen collected along the road at c. 2260 m.

Note – Closely related to *R. benguetensis*.

38. *Rubus moluccanus* L., Spec. Pl. (1753) 1197; Blume, Bijdr. (1826) 1109; Miq., Fl. Ind. Bat. I, 1 (1855) 382; Backer & Bakh.f., Fl. Java 1 (1964) 516, excl. var. *glomeratus* (Blume) Backer and var. *malvaceus* (Focke) Backer; P. van Royen, Phan. Monogr. 2 (1969) 98, incl. var. *austropacificus* P. van Royen and var. *thespesiaephyllos* P. van Royen. — Type: Rumphius, Herb. Amboin. 5 (1747) 88, pl. 47, f. 2 [*Rubus moluccus latifolius*].

Rubus sundicus Blume var. *discolor* Blume, Bijdr. (1826) 1111. — *Rubus moluccanus* L. var. *discolor* (Blume) Kalkman, Blumea 29 (1984) 359. — Type: Kuhl & van Hasselt s.n., Java.

Rubus hasskarlii Miq., Fl. Ind. Bat. I, 1 (1855) 381. — *Rubus moluccanus* L. var. *hasskarlii* (Miq.) Kuntze, Rev. Gen. Pl. 1 (1891) 222. — Type: not identified, Java.

Rubus moluccanus L. var. *obtusangulus* Miq., Fl. Ind. Bat. I, 1 (1855) 383, 'obtusangula'; Kalkman, Blumea 29 (1984) 362. — Type: Junghuhn s. n., Java.

Rubus angulosus Focke, Bibl. Bot. 72 (1910) 90, f. 35, nom. illeg., non Gremli (1871); Koord., Exk. Fl. Java 2 (1912) 324; Ridley, Fl. Mal. Penins. 1 (1922) 678, f. 59. — *Rubus moluccanus* L. var. *angulosus* Kalkman, Blumea 29 (1984) 364 — Kurz (Amann) s. n., Bangka, lecto.

Rubus hasskarlii Miq. subsp. *dendrocharis* Focke, Bibl. Bot. 72 (1910) 99, f. 42. — *Rubus dendrocharis* (Focke) Focke, Bot. Jahrb. 54 (1916) 70. — *Rubus moluccanus* L. var. *dendrocharis* (Focke) P. van Royen, Phan. Monogr. 2 (1969) 106, f. 28. — Type: Rodatz & Klink 182, New Guinea, in SING.

Rubus glomeratus auct. non Blume: Ridley, Fl. Mal. Penins. 1 (1922) 679.

For a more complete synonymy, see Kalkman, Blumea 29 (1984) 346.

Climbing or scrambling, rarely creeping shrubs. Stems up to 6(–10) m long, densely hairy when young, (tardily) glabrescent, prickles usually not many, small. Leaves ovate to broadly ovate in outline, 6–20 by 4–15 cm, variously lobed, base cordate to subtruncate, margins serrate, apex acute to acuminate, (firm)-herbaceous, nervation pedate with 5–9 pairs of nerves or palmate with 7 main nerves (var. *angulosus*), venation (widely) reticulate, the surface between the veins not or indistinctly raised above, upper surface hairy, especially on the nerves, lower surface with a densely woven felt of long, thin, curly hairs all over, and with on nerves and veins usually many long, thicker, straight, appressed to patent hairs, distinctly two-coloured. Petiole 2–6 cm long. Stipules early falling, 7–17 by 4–12 mm, pinnatilobed to pinnatifid with 4–10 pairs of lobes, sometimes digitate, lobes up to 8 by 1 mm, hairy outside. Inflorescence a terminal, leafy, compound raceme, up to 20(–50) cm long, with up to 12 laterals, those up to 5(–9) cm long and with up to 10(–30) flowers. Bracts up to 17 by 9 mm. Pedicels up to 1 cm long, hairy as are all axes. Flowers bisexual, flower buds ovoid, pointed. Hypanthium cupular, 4–7 mm across, densely woolly and with patent to appressed straight hairs outside. Sepals erect or apically recurved in anthesis, triangular to ovate, 4–9 by 2–6 mm,

apex acute to pointed, not-covered margins of the outer sepals with one or few, up to 3 mm long teeth, covered margins entire, indumentum outside as hypanthium. Petals long remaining, suborbicular to elliptic, 3–7 by 3–6 mm, apex rounded to emarginate, white, rarely reported to be pink, red, or yellow. Stamens 30–185, filaments up to c. 4 mm, anthers 0.2–0.7 mm long, mostly with few to several long hairs on top or on connective. Pistils 30–135, ovaries glabrous, on elevated, hairy or glabrous torus, styles up to 9 mm long. Collective fruits globular, 0.8–1 cm diam. when dry, sepals closing or apically slightly recurved after anthesis, spreading at ripeness. Fruits 2–3 by 1–2 mm when dry, red, mesocarp thick and fleshy, only a thin layer when dry. — Figs. 5, 6.

Distribution — All over Malesia, extending to the North to Sri Lanka (introduced?), Thailand, and Vietnam, to the South and East to Queensland, Carolines, New Hebrides, Fiji, and New Caledonia.

Habitat — Essentially at low and medium altitudes, up to 2000 m, occasionally higher.

Uses — Information from herbarium labels is reported under the varieties. According to literature [Burgess, Dict. Econ. Prod. Mal. Penins. (1966) 1952; Heyne, Nutt. Pl. Indon. (1950) 693; Quisumbing, Medic. Pl. Philipp. (1951) 354; Woodley (ed.), Medic. Pl. Papua New Guinea I, Morobe Prov. (1991) 120] the species has a number of widespread medicinal uses. The sap of shoots, the chewed leaves or decoctions of roots are obviously effective in relieving internal pains, in the treatment of dysentery or diarrhoea, sprue and angina, and for external afflictions like sores and boils. Several times the use as an emmenagogue (stimulating menstruation) or abortifacient is mentioned, but also applications to prevent miscarriage, which seems a strange combination. Use of the fruits as a remedy for children's bed-wetting was mentioned by Rumphius and later often repeated. It is possible that the medicinal uses recorded for this species also are valid for other species of the genus.

Notes — *Rubus moluccanus* L. is taken here in the narrowest possible sense. See Kalkman, Blumea 29 (1984) 349, for a discussion on the species limits as observed by Kuntze [Meth. Speciesbeschr. (1879) 33, and Rev. Gen. Pl. 1 (1891) 222] and Focke [Bibl. Bot. 72 (1910) 88]. *Rubus moluccanus* has been considered by Backer [Schoolfl. Java (1911) 457, and later] and by others as a taxonomical problem of the same order as presented by *R. fruticosus*, but incorrectly so. *Rubus moluccanus* is, if properly delimited from neighbouring but recognizable species, not much more variable than any other widely distributed species. There is no

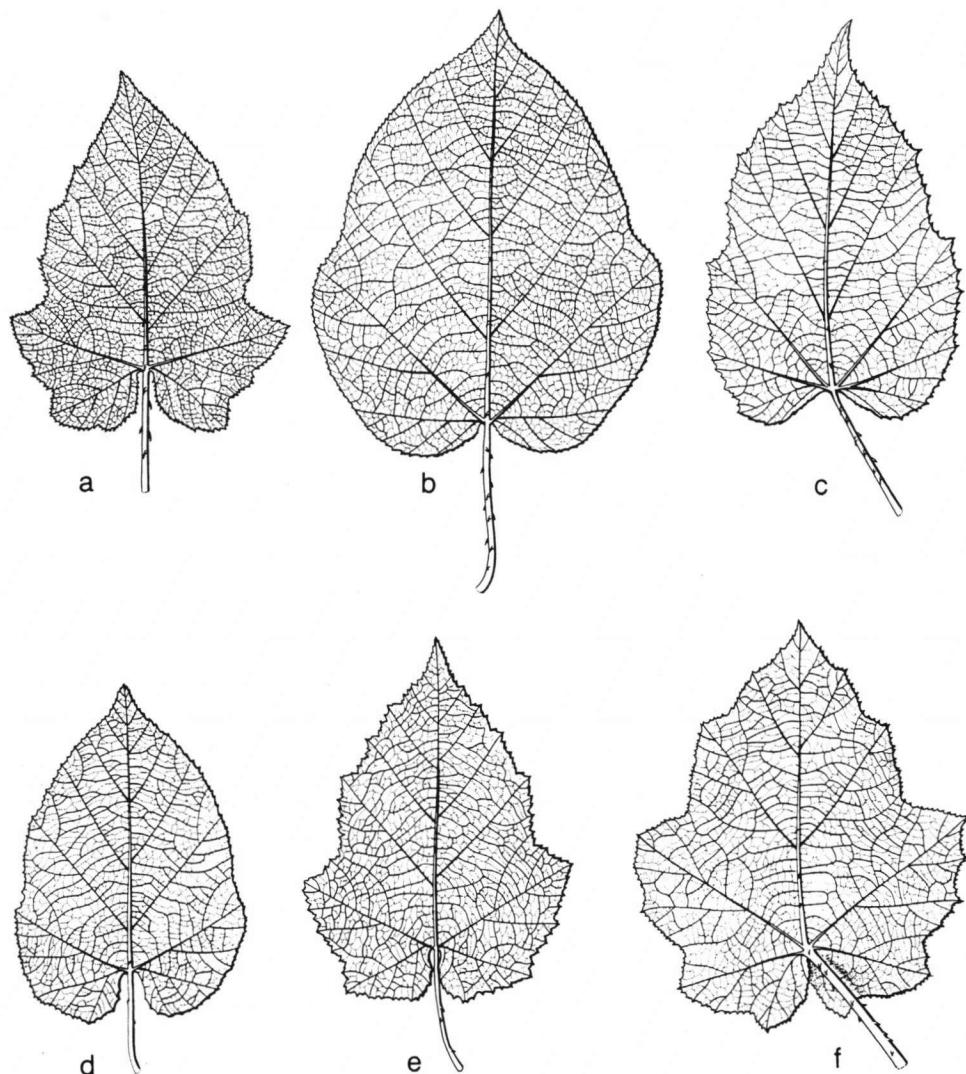


Fig. 5. *Rubus moluccanus* L. Leaf shapes of the varieties: a, b. var. *moluccanus*; c. var. *obtusangulus* Miq.; d, e. var. *discolor* (Blume) Kalkman; f. var. *angulosus* Kalkman.

evidence at present for supposing that the species is apogamous.

The species was divided by Kalkman into four varieties, based on leaf characters. Intermediates do occur and inadequately collected material showing – as too often is the case – only the upper leaves of lateral branches, cannot always be identified down to the variety.

KEY TO THE VARIETIES

- 1a. Leaf-base subtruncate to shallowly cordate, the basal lobes making an obtuse angle. The straight hairs on nerves and veins below appressed d. var. *obtusangulus*
- b. Leaf-base cordate, the angle between the margins of the basal lobes sharp 2

- 2a. The straight hairs on nerves and veins below appressed to semi-appressed
b. var. discolor
- b. The straight hairs on nerves and veins below patent 3
- 3a. The basal lobes of the leaves distinctly overlapping or at least touching each other. Leaves 3–5(–7)-lobed, the lateral incisions up to 2 cm deep, the nervation 7-palmate to -pedate
a. var. angulosus
- b. The basal lobes of the leaves not overlapping, their margins parallel or making a sharp angle. Leaves not lobed or shallowly 3–5-lobed, the lateral incisions 0.5–1 cm deep, the nervation 5- or 7-pedate **c. var. moluccanus**

a. var. angulosus Kalkman, Blumea 29 (1984) 364. See there for synonymy.

Young twigs and nerves and veins on the lower leaf surface with semi-appressed to patent, long, straight hairs over the woolly felt of thin, curly hairs. *Leaves* distinctly 3–5(–7)-lobed with the main lobes usually shallowly lobed again, apical lobe large (half of the total leaf length or slightly smaller), length/width index (1.1–)1.2–1.3(–1.4), base cordate, the margins of the basal lobes distinctly overlapping or at least touching each other. *Stamens* (85–)100–185, anthers hairy on apex. – **Fig. 5f.**

Distribution – Thailand, Vietnam, Andaman Is., Nicobar Is.; *Malesia*: Sumatra and islands near it, Malaya, Singapore, Java, Borneo, Palawan, Celebes, Lesser Sunda Islands.

Habitat – Forest edges, secondary forest, thickets, also near the beach and on riverbanks, altitude 0–500(–1000) m, the few specimens seen from Java from higher altitude (up to 1450 m).

Uses – Fruits edible. Boiled roots are a medicine against dysentery (Malaya, Alvins 375).

b. var. discolor (Blume) Kalkman, Blumea 29 (1984) 359. See there for synonymy.

Young twigs and nerves and veins on lower leaf-surface with appressed (rarely semi-appressed) straight hairs over the woolly cover of curly hairs. *Leaves* shallowly 3–5-lobed, sometimes hardly lobed, rarely more distinctly lobed, length/width index (1.0–)1.2–1.5(–2.5), basal incision narrow with subparallel margins or a sharp angle between them, the leaves in and close under the inflorescence often with a wider angle or base even subtruncate. *Stamens* 70–180, anthers hairy at apex or glabrous. – **Fig. 5d, e.**

Distribution – Malesia: Sumatra, Malaya (Penang, Penang I., and Tioman I.), Borneo, Java, Philippines, Celebes incl. Buton I., Lesser Sunda Islands, Moluccas, New Guinea, Bismarck Archipelago. Also in Solomon Islands, New Hebrides (Erromanga), and New Caledonia.

Habitat – Secondary and shrubby vegetation, in primary forest especially in clearings, along paths and in the forest margin, but possibly also in closed forest, further on hillsides, roadsides, riversides, from sea-level up to 2000 m altitude, highest records c. 2500 m and (once) 2900 m.

Uses – The fruits are edible but tasteless. The fluid from the stems is applied for eye diseases (Java, *Kuhl & van Hasselt*), fluid from the leaves is applied to the eyes of young mothers (Borneo, *Winckel 1013*). Young twig ends eaten raw as vegetable (Java, *Bakhuisen van den Brink 8168*).

Notes – The longer leaves with leaf index > 1.5 are found especially in Sumatra and Malaya (up to 2.0) and in New Guinea (up to 2.5).

Two specimens from Mt Panggrango on Java (*Schiffner 2019*, *van Steenis 17620*) have peculiar gland-bearing bristles on vegetative parts and on the hypanthium and sepals.

For distinction with var. *obtusangulus*, see there.

c. var. moluccanus — For synonymy, see Kalkman, Blumea 29 (1984) 346.

Young twigs and nerves and veins on the lower leaf-surface with (apart from the underlying woolly felt) patent to semi-patent, long, straight hairs. *Leaves* shallowly 3–5-lobed or not lobed at all, length/width index (1.0–)1.1–1.4(–1.8), basal incision narrow with parallel margins or a sharp angle between them. *Inflorescence* usually leafy but sometimes all lateral racemes in axils of bracts. *Stamens* 30–150(–200), anthers hairy at apex or glabrous. – **Fig. 5a, b.**

Distribution – Sri Lanka [introduced according to *Tirvengadum*, Fl. Ceyl. 3 (1981) 353], Thailand, Vietnam; *Malesia*: Sumatra, Malaya incl. Penang I. and Langkawi I., Singapore, Borneo, Java, Philippines, Celebes, Lesser Sunda Islands, Moluccas, New Guinea, New Britain. Also in the Solomon Islands, Carolines, Fiji Islands, and Australia (Queensland).

Habitat – Forest edges, secondary forest, lighter places in primary forest (e.g. riverbanks), open places like thickets, roadsides, lavastreams, heath vegetation, from sea-level up to c. 2000 m, very rarely higher.

Uses – The fruits are edible but have a poor flavour according to several collectors. Young, fresh



Fig. 6. *Rubus moluccanus* L. var. *obtusangulus* Miq. a. Flowering branch; b. old flower (a: Schodde 1493; b: Streimann NGF 34081).

leaves are a cure for diarrhoea (Borneo, *Mamit S* 33363). Twigs may be used for bundling firewood (Philippines, *Conklin & Buwaya PNH* 78635) and are used for catching bats (Philippines, *Britton* 434, how is not described).

d. var. obtusangulus Miq., Fl. Ind. Bat. I, 1 (1855) 383; Kalkman, Blumea 29 (1984) 362. See there for synonymy.

Young twigs and nerves and veins on the lower leaf surface with appressed (sometimes semi-appressed), long, straight hairs over the woolly layer of curly hairs, the straight hairs sometimes only sparsely present. Leaves shallowly 3–5-lobed to hardly lobed at all, length/width index (1.1–)1.3–1.7(–1.9), base subtruncate to shallowly cordate with an obtuse angle between the margins of the basal lobes. Stamens 30–140, anthers nearly always hairy on top, but in Sumatra always glabrous. — **Figs. 5c, 6.**

Distribution – Burma, Thailand, Vietnam; *Malesia*: Sumatra, Malaya, Borneo, Java, Philippines, New Guinea, New Britain.

Habitat – Forest edges, secondary forest, thickets, along roads, trails, and streams, altitude (150–)900–2000(–3000) m.

Uses – The fruits are edible. Stems are used as binding material (Philippines, *Conklin & Buwaya PNH* 80574). Men wash their bodies with the leaves before going to fight (Papua New Guinea, Maprik Subprov., *Wiakabu LAE* 73551).

Note – The recognition in the herbarium of the varieties *discolor* and *obtusangulus* does usually not present a problem, if the specimen possesses a number of leaves below the inflorescence. If only the flowering part of a twig is present, identification is not reliably possible since the raceme-bearing leaves of var. *discolor* are often subtruncate at the base.

39. Rubus perfulvus Merr., Philipp. J. Sc. 20 (1922) 386; Enum. Philipp. Flow. Pl. 2 (1923) 229. — Type: *Ramos & Edaño BS* 38566, Mindanao.

Climbing shrubs. Stems densely hairy when young, prickles few, short. Leaves ovate, 5–9 by 4–7 cm, not or hardly lobed, base truncate to rounded, margin grossly dentate, apex acuminate, stiff coriaceous, 3-nerved, the two lateral main nerves with c. 4 basiscopic side-nerves, the middle nerve with c. 4 pairs of lateral nerves, nerves and veins impressed above and leaf surface bullate, upper surface scattered long-hairy, glabrescent, lower

surface with a dense and thick woolly felt of curly hairs and with longer, straight, appressed hairs on nerves and veins, distinctly two-coloured. Petiole 1–1.5 cm long. Stipules persistent, up to 15 by 3 mm, entire. Inflorescence according to Merrill a terminal, 5-flowered, compact raceme and also some solitary flowers in the upper leaf axils. Flowers large. Sepals triangular, c. 12 by 3–4 mm, outer ones with few marginal teeth. Petals not seen. Stamens probably with glabrous anthers. Collective fruits c. 1.2 cm diameter. Fruits glabrous (Merrill), red, the mesocarp a thin membranous layer when dry, endocarp rugose, stone c. 3 mm long.

Distribution – Only known from the type specimen from Mt Lipa.

Habitat – Mossy forest, c. 2000 m altitude.

Note – Insufficiently known, complete inflorescences and flowers in anthesis not seen. Relationship is probably closest to *R. rolfei* Vidal.

40. Rubus pyrifolius J.E. Smith, Pl. Icon. Hact. Ined. 3 (1791) t. 61; Miq., Fl. Ind. Bat. I, 1 (1855) 384; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 229; Backer & Bakh. f., Fl. Java 1 (1964) 516; Steenis, Mount. Fl. Java (1972) pl. 45–6. — *Dalibarda pyrifolia* (J.E. Smith) Blume, Bijdr. (1826) 1112. — *Rubus moluccanus* L. var. *pyrifolius* (J.E. Smith) Kuntze, Rev. Gen. Pl. 1 (1891) 222. — Type: *Commerçon s.n.*, Java.

Dalibarda latifolia Blume, Bijdr. (1826) 1112. — Type: not found, from Cianjur, W Java.

Rubus philippensis Focke in Elmer & Focke, Leafl. Philipp. Bot. 5 (1913) 1617; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 229. — Type: *Elmer 13606*, Mindanao.

For a more complete synonymy, see Kalkman, Blumea 29 (1984) 333.

Climbing shrubs. Stems up to 8(–30) m long, usually with few hairs, prickles usually few, small, minute capitate brown hairs often present on vegetative parts and inflorescences. Leaves elliptic to ovate, 6.5–16 by (2.5–)3.5–8.5(–9.5) cm, not lobed, base rounded, margin serrate-crenate, apex acute or obtuse and then shortly or long acuminate, herbaceous, nervation pinnate with 5–8 pairs of nerves, the lowermost of these with up to 6 strong, basiscopic side nerves, rarely truly pedate, secondary nerves not reaching the margin, venation widely transverse, usually rather densely hairy on midrib and larger nerves above, lower surface with (semi-)appressed hairs on nerves and veins. Petiole 0.5–1(–3) cm long. Stipules early

falling, 6–9 by 0.5–1.2 mm, apically 3–6-lobed, lobes up to 6 mm, hairy. *Inflorescence* broadly paniculate, a leafy compound raceme, up to 30 (–40) cm, with 9–16 primary laterals, the latter up to 12(–15) cm, with up to 10 side branches, usually being dichasia with up to 7 flowers. *Bracts* up to 9 by 1.5–2 mm, lobed. *Pedicels* 6–8(–10) mm long, densely hairy as are the other axes in the inflorescence. *Flowers* bisexual, flower buds ovoid, pointed. *Hypanthium* saucer- to cup-shaped, 3–5 mm across, shortly woolly outside, sometimes also with appressed, straight hairs. *Sepals* triangular to ovate, reflexed to horizontal during anthesis, 4–7(–11) by 2–4 mm, outer margins with 1 or 2 teeth or lobes of up to 2 mm, inner margins entire, indumentum outside as hypanthium. *Petals* elliptic to obovate, 2–5(–7) by 0.5–2(–3.5) mm, apex (sub)truncate, usually sinuate or notched, white. *Stamens* (40)–50–80(–100), filaments up to 6.5 mm, anthers 0.5–0.8 mm long, usually wider than long, violet. *Pistils* (3)–5–10(–17), ovaries usually with many long hairs on the dorsal side, rarely glabrous, on a low, long-hairy torus, styles up to 5.5(–7) mm long, rarely with some hairs in basal part. *Collective fruits* loose, usually less than half of the ovaries developing, c. 0.5 cm diam., sepals closing after anthesis. *Fruits* 3.5–4.5 mm long when dry, with some hairs, red, mesocarp rather thick and fleshy.

Distribution — Laos, S Vietnam, Thailand, China; **Malesia**: Sumatra, Borneo, Java, Philippines (Negros, Leyte, Mindanao), Celebes, Lesser Sunda Islands (Bali, Lombok, Flores).

Habitat — Forest and forest edges, altitude 500–1700(–2200) m.

Ecology — Characteristic leaf galls, caused by a gall-mite, are found in specimens from Java and Sumatra. The galls are hollow bladders on the upper leaf surface, purple coloured according to Docters van Leeuwen & Docters Van Leeuwen-Reynvaan, Zoococcidia of Neth. Indies (1926) 219. On the underside of the leaf the bladders are densely hairy.

41. Rubus rolfei Vidal, Phan. Cuming. (1885) 171; Elmer, Leafl. Philipp. Bot. 2 (1908) 454; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 230.
— Types: *Cuming* 808, lecto; *Vidal* 294; both Luzon.

Rubus elmeri Focke, Bibl. Bot. 72 (1910) 112; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 227.
— Types: *Merrill* BS 4651, *Mearns* BS 4305, Luzon.

Rubus calycinoides Hayata, Icon. Pl. Form. 3 (1913) 88, non Kuntze (1879). — Type: *Mori* & *Kato* s.n., Taiwan.

Sprawling shrubs with prostrate long shoots up to 1 or more m, and with axillary, ascending, leafy shoots up to 25 cm long, terminating in an inflorescence, more rarely climbing shrubs. *Stems* densely hairy when young, prickles (very) few, small. *Leaves* orbicular to triangular in outline, 2–5.5 (–9) by 2–5(–9) cm, shallowly 3- to 5-lobed, base cordate, basal lobes rounded, margin unevenly crenate, apex rounded to acute, stiff-coriaceous, nervation pectinate, with 4–5 pairs of nerves, venation widely reticulate, upper surface bullate between nerves and veins, hairy but soon glabrous above, lower surface with a dense woolly felt of thin, curly hairs, and with on nerves and veins longer, patent, straight hairs, distinctly two-coloured. *Petiole* 0.5–3(–4.5) cm long. *Stipules* rather long persistent, 6–10(–13) by 2.5–4(–7) mm, incised. *Inflorescence* a terminal, simple raceme, usually very dense, up to 3 cm long, with up to 8 flowers. *Bracts* up to 13 by 10 mm, incised. *Pedicels* 0–5 mm long, densely hairy as is the rachis of the raceme. *Flowers* bisexual, flower buds ovoid. *Hypanthium* saucer-shaped, 4–6 mm across, densely woolly and with straight, longer hairs outside. *Sepals* triangular, outer ones 6–10 by 3–8 mm, inner ones narrower, growing after anthesis, apex acute to acuminate, uncovered margins with 1–3 small teeth, up to 3 mm, indumentum outside as hypanthium. *Petals* orbicular with rounded apex, up to 14 by 12 mm, white. *Stamens* 120–140, filaments up to 5 mm, anthers 0.5–1 mm long, glabrous or with few long hairs. *Pistils* 40–80, ovaries glabrous, on elevated, hairy torus, styles up to 5(–8) mm long. *Collective fruits* globular, c. 1 cm, sepals closing after anthesis, spreading at ripeness. *Fruits* 2–2.5 mm long when dry, yellow to orange (also reported as pink or red), mesocarp soft and thick, only a thin layer when dry.

Distribution — Taiwan; **Malesia**: Philippines (Luzon, Negros, Mindoro).

Habitat — Forest and more open places like clearings at higher altitudes, alt. (900)–1500–2700 m.

Uses — The fruits are edible and sweet.

Note — Most of the plants collected had prostrate, woody twigs with erect, determinate, short laterals terminating in an inflorescence [see Kalkman, Blumea 29 (1984) 371, f. 5]. The last-but-one order branches, however, are not always creeping but sometimes climbing and maybe there are even bushy plants with more or less erect branches. Possibly this will be largely determined by local conditions. Herbarium specimens of creeping plants may look rather different from collections from climbing shrubs, but in essential characters except habit they are alike.

42. Rubus smithii Backer, Schoolfl. Java (1911) 456. — *Rubus sundaicus* auct. non Blume; Backer & Bakh. f., Fl. Java 1 (1964) 516, p. p.
— Type: Backer 33873, Java, lecto.

Rubus maximus Kuntze, Meth. Speciesbeschr. (1879) 62, 76, nom. illeg., non Marsson (1869).
— *Rubus moluccanus* var. *maximus* Kuntze, Rev. Gen. Pl. (1891) 222. — Type: not identified.

Climbing shrubs. *Stems* up to 10 m long, hairy, prickles few to many, 1–2 mm long, reddish. *Leaves* ovate, 7–15 by 4.5–9 cm, not or shallowly lobed, base subtruncate to cordate, margin grossly serrate, apex acute to subacuminate, sometimes obtuse, rather stiffly herbaceous, nervation pedate with 6–10 pairs of nerves, venation widely transverse, upper surface only hairy on main nerves, lower surface with scattered semi-appressed to patent hairs on nerves and veins, two-coloured. *Petiole* 1–4 cm long. *Stipules* rather persistent, 5–9 by 3–5 mm, pinnatisect to -partite with 3–5 pairs of lobes, those 2–5 by 0.2–0.5 mm. *Inflorescence* an overhanging or pendant compound raceme, 15–35 cm long, with up to 12(–15) laterals of up to 9 cm, the laterals bearing up to 7 dichasial or cymes, each with up to 5 flowers. *Bracts* stipule-like to dentate, up to 6 mm long. *Pedicels* 6–10 mm long, densely woolly as are the other axes in the inflorescence. *Flowers* functionally unisexual, plants ?dioecious, flower buds broadly ovoid. *Hypanthium* cup-shaped, 4–5 mm across, densely woolly outside and also with appressed, straight hairs. *Sepals* (broadly) ovate, 3.5–5 by 3–5 mm, apiculate just under the obtuse apex outside, margins entire, indumentum outside as hypanthium. *Petals* obovate, 7–9 by 5–6 mm, apex rounded or emarginate, white. *Stamens* 70–140, glabrous, filaments up to 3 mm, anthers 1.5–2 mm long, staminodes in female flowers 60–100, up to 1.5 mm long, with minute anther rudiment. *Pistils* 30–100, ovaries densely long-hairy on the backside or glabrous, on slightly elevated, long-hairy torus, styles 1–3 mm long, pistillodes in supposedly male flowers as pistils but smaller. *Collective fruits* globose, up to 1 cm, compact, sepals spreading under ripe fruits. *Fruits* up to 3 mm long when dry, exocarp light red (to blackish?), still hairy to glabrous, mesocarp rather thick fleshy or juicy, endocarp with broad dorsal side.

Distribution — Sumatra, W Java.

Habitat — Forest and forest edges, from sea-level to 2000 m altitude.

Note — Female flowers have obviously non-functional, small stamens but in flowers with per-

fect stamens the ovaries are not always reduced in size. Herbarium study is, therefore, not conclusive on sex distribution in this species.

43. Rubus sorsogonensis Elmer, Leafl. Philipp. Bot. 10 (1939) 3777. — Type: Elmer 14607, Luzon.

Climbing shrubs. *Stems* slightly hairy, prickles few, short. *Leaves* ovate, 11–12 by 6–7 cm, not lobed, base cordate, margin grossly serrate, apex acute, herbaceous, nervation pedate with 6–7 pairs of nerves, venation widely parallel, sparsely hairy above and below. *Petiole* 1–1.5 cm long. *Stipules* lanceolate, up to 11 by 3.5 mm, margins with one minute tooth, with short hairs and short glandular hairs outside. *Inflorescence* a terminal panicle, many-flowered, branches up to 12 cm, the last branchings di- or monochasial. *Bracts* up to 15 by 1.5 mm, slightly lobed. *Pedicels* 1–1.5 cm long, sometimes with stalked glands between the hairs, like in the other axes of the inflorescence. *Flowers* bisexual, flower buds ovoid, pointed, no glands on the flowers. *Hypanthium* saucer-shaped, 4 mm across. *Sepals* triangular, 10–12 by 3–4 mm, long pointed, outer ones with a minute tooth on each uncovered margin. *Petals* none. *Stamens* c. 100, glabrous, filaments up to 8 mm, anthers 0.8 mm long. *Pistils* c. 30, ovaries glabrous, styles c. 6 mm long. *Fruits* not seen.

Distribution — Only known from the type, collected in the Philippines (Luzon, on Mt Bulusan), at 450 m altitude.

Note — Related to *Rubus benguetensis*.

44. Rubus sundaicus Blume, Bijdr. (1826) 1111; Miq., Fl. Ind. Bat. I, 1 (1855) 383. — Type: Reinwardt s.n., Tidore (see note).

Stems appressed-cobwebby, prickles very few, very small. *Leaves* ovate, 13–15 by 9.5–11 cm, shallowly 3-lobed, base cordate, margin rather coarsely serrate-crenate, apex gradually acuminate, herbaceous, nervation pedate with 9–10 pairs of nerves, venation widely transverse, upper surface only with hairs on midrib, lower surface with remnants of cobwebby felt on nerves and veins. *Petiole* 4–6 cm long. *Stipules* not seen, scar distinct. *Inflorescence* a terminal thyrsoid, c. 12 cm long, with 6–7 dichasial to monochasial laterals, up to 2.5 cm long, partly in the axils of leaves. *Bracts* incised from apex. *Pedicels* up to 1 cm long, hairy as are all other axes. *Flowers* bisexual, flower buds ovoid, pointed. *Hypanthium* cup-shaped, 5–6 mm across, densely woolly and with semi-appressed

longer hairs outside. *Sepals* triangular, 6.5–8 by 3.5–5 mm, long-pointed, outer ones with 2 short teeth on each uncovered margin, inner ones entire and narrower, indumentum outside as hypanthium. *Petals* 6–7 by 5 mm. *Stamens* c. 65, filaments up to 4.5 mm, glabrous, anthers 0.5–0.8 mm long, glabrous or with 1–2 long hairs on top. *Pistils* c. 30, ovaries with long hairs on the dorsal

side, on hairy torus, styles c. 3 mm long. *Fruits* not seen.

Distribution — Only known from two sheets bearing different localities, resp. Tidore (Moluccas) and Java, but probably originating from one collection made in the Moluccas.

Note — Resembling *Rubus cumingii* with which it may be related.

Subgenus Chamaebatus

Rubus subg. *Chamaebatus* (Focke) Focke, Bibl. Bot. 72 (1910) 17; Zandee & Kalkman, Blumea 27 (1981) 75. — *Rubus* sect. *Chamaebatus* Focke, Abh. Naturw. Ver. Bremen 4 (1874) 145, 146.

Herbaceous to slightly woody, creeping plants. *Leaves* simple, reniform to cordate, not or slightly lobed, rarely more deeply incised, nervation pedate with usually 2 or 3 main side nerves at the very base of the midrib, each with 2 or more basiscopic laterals, nerves terminating in the margin. *Stipules* free, on the junction of stem and petiole, persistent. *Flowers* bisexual, solitary, terminal, more rarely 2 or 3 on erect laterals. *Hypanthium* saucer-shaped, with prickles outside. Inner *sepals* narrower than outer ones, uncovered margins pinnately lobed. *Fruits* loosely cohering, becoming loose from the elevated torus when ripe.

Distribution — Few species, with a disjunct area: America (Pacific NW America and Mexico) and Asia (India, China, Taiwan, Japan, Philippines, Java). Two species in *Malesia*.

Note — A derived group of small herbaceous plants with reduced inflorescences.

45. *Rubus calycinus* [Wall. in litt.] ex D. Don, Prod. Fl. Nepal. (1825) 235; Backer & Bakhu. f., Fl. Java 1 (1964) 515; Steenis, Mount. Fl. Java (1972) pl. 46-1. — *Dalibarda calycina* (D. Don) Seringe in DC., Prod. 2 (1825) 568. — Type: Wallich, Gosaingsthan.

Rubus boschianus Zoll., Nat. Tijd.. Ned. Indië 14 (1857) 175, 176. — *Rubus calycinus* D. Don forma *javanicus* Kuntze, Meth. Speciesbeschr. (1879) 106, nom. nud. — *Rubus calycinus* D. Don var. *suffruticosus* Focke, Bibl. Bot. 72 (1910) 21. — Type: Zollinger 2964, Java.

Main stems creeping, up to 3 m long, rooting on the nodes, with erect, little or not branched laterals in the axils of leaves, all stems sparsely hairy, prickles rather few, small. *Leaves* reniform, 3–6.5 by 3.5–7 cm, usually shallowly 3–5(–7)-lobed, base deeply cordate, margin serrate, apex rounded, rather stiff and brittle when dry, nervation pedate with 2–3(–4) pairs of main side-nerves, venation reticulate, upper surface with short patent

hairs on the nerves and with small prickles between the veins, lower surface with long patent hairs and with needle-shaped, 2.5 mm long prickles on nerves and veins below. *Petiole* 2.5–9 cm long. *Stipules* ovate, 9–15 by 6–12 mm, base cordate to rounded, margin finely fimbriate. *Flowers* soli-



Fig. 7. *Rubus calycinus* D. Don. Mt Arjuno, Java.
Photo C.G.G.J. van Steenis.

tary, terminal on the laterals, up to 2 cm long stalked, rarely also one flower in the uppermost (reduced) leaf. *Hypanthium* 3.5–5 mm across, patently hairy outside and with many needle-like, up to 2.5 mm long prickles. *Sepals* elliptic to ovate, sometimes cordate, 11–16 by 5–13 mm, in fruit growing to 20 by 15 mm, exposed margins pinnately lobed with up to 14 lobes, indumentum outside as hypanthium. *Petals* elliptic to ovate, 10–11 by 5–7 mm, white. *Stamens* 30–40, glabrous, filaments up to 6 mm, anthers 0.8–1 mm long. *Pistils* 30–50(–70), ovaries glabrous, on elevated, glabrous torus, styles up to 5 mm long. *Fruits* orange to red, mesocarp fleshy, only a thin layer when dry, stone 3–4 mm long, endocarp rugulose. — Fig. 7.

Distribution — Himalaya region from Nepal to Arunachal Pradesh, NE India, N Burma, S China; *Malesia*: only E Java.

Habitat — In continental Asia in forests, at 1200–2600 m altitude, in Java in different forest types, locally gregarious, at 1900–2800 m altitude.

Note — The differences between plants from the Continent and from Java are very slight, see Zandee & Kalkman, l.c. The description above is based on plants from Java.

46. Rubus pectinellus Maxim., Mél. Biol. Acad. St. Pétersb. 8 (1872) 374 (= Bull. Acad. St. Pétersb. 17); Elmer, Leafl. Philipp. Bot. 2 (1908) 448; Merr., Enum. Philipp. Flw. Pl. 2 (1923) 229. — Type: *Maximowicz s.n.*, Japan.

Main stems thin and wiry, creeping, up to 2 m long, rooting, with up to 20 cm long, erect, little

or not branched laterals, all stems patently soft-hairy, prickles rather few, up to 3 mm. Leaves reniform, 2–5.5 by 2–6 cm, shallowly 3(–5)-lobed, base deeply cordate, margin serrate, apex rounded, thinly herbaceous, nervation pedate with (1–)2 pairs of main side-nerves, venation widely reticulate, upper surface long-hairy between the veins, lower surface long-hairy and with needle-like prickles on nerves and veins. Petiole (1–)2–6 (–8) cm long. Stipules up to 8 by 10 mm, deeply digitately divided into up to 8 lobes. Flowers solitary, terminal on the laterals, rarely also 1–2 flowers in the axils of the upper (reduced) leaves, up to 3 cm stalked above uppermost true leaf. Hypanthium 3–4(–6) mm across, with long, soft, patent hairs and many needle-like, up to 4 mm long prickles outside. Sepals elliptic, 8–10 by 3–10 mm, growing to 12 by 13 mm in fruit, exposed margins pinnately 5–10-lobed, indumentum outside as hypanthium. Petals elliptic, 10–13 by 6–9 mm, white. Stamens 16–30, glabrous, filaments up to 5 mm, anthers 1–1.2 mm long. Pistils 24–40, ovaries with few long hairs, on elevated, hairy torus, the styles 3–4 mm long. Fruits orange to red, mesocarp thin, juicy, stone 2.5–3 mm long, endocarp smooth at first, later rugulose.

Distribution — SE China, Taiwan, Japan; *Malesia*: Philippines (Luzon, Mindoro, Mindanao).

Habitat — In the Philippines in primary and secondary forest, also in mossy forest, altitude 750–2750 m. In China, Taiwan, and Japan in woods, at comparable altitude.

Note — The description is based on Philippine specimens only.

Subgenus Rubus

Subgenus Eubatus auct.

47. Rubus plicatus Weihe & Nees, Rubi Germ. (1822) 15, t. 1.

Small shrubs. Stems sparsely hairy, prickles few. Leaves pedately 5-foliate or 3-foliate, petiole 2–4.5 cm long. Stipules on the base of the petiole, linear, up to 12 by 1.5 mm, persistent. Leaflets ovate to elliptic, terminal ones largest, 3–5.5 by 2–4 cm, base rounded to slightly cordate, margin serrate, apex acute to acuminate, nervation pinnate with 8–10 pairs of nerves, upper surface sparsely hairy on and between the nerves, lower surface denser hairy all over. Inflorescence a terminal thyrsus with up to 5 few-flowered mono-

chasia under the terminal flower, the lower laterals in leaf-axils. Bracts and bracteoles persistent. Pedicels and other axes hairy. Flowers bisexual. Hypanthium c. 4 mm across. Sepals equal, ovate-triangular, c. 5 mm long, acuminate, entire. Petals orbicular, c. 8 mm, pink. Stamens c. 100, glabrous. Pistils c. 40, glabrous. Fruits not seen.

Distribution — This is one of the 'microspecies' of the *Rubus fruticosus* complex. It was introduced (probably from the Netherlands) in the 19th century and planted near the top of Mt Pangerango in West Java. Specimens have been collected several times, possibly always from the same bush. It may still be alive, but the most recent collection seen was

made in 1931. Fruits were never collected and the plants may be sterile. The description was made from the Java plants only.

Note — Other microspecies may also have been introduced from Europe.

INCOMPLETELY KNOWN SPECIES

Three species of which material is not yet satisfactory, are mentioned by Kalkman, Blumea 29 (1984) 381–382. They belong to subgenus *Malachobatus*.

DUBIOUS NAMES

Rubus chartaceus Kuntze, *R. edanoi* Merr., *R. grewiaefolius* Koord. ex Focke, *R. guttans* Focke,

R. koordersii Focke, *R. peltinervius* Focke, *R. reinwardtii* Kuntze, and *R. zambalensis* Elmer are dubious names for species reported from Malesia. Types of these species were either not seen or are insufficient.

Rubus diclinis F. Muell. var. *papuanus* Focke.

Neotypification with Brass 30932 not accepted as in serious conflict with protologue. The specimen mentioned is *Rubus trigonus*.

Rubus mindanaensis Focke, Ann. Cons. Jard. Bot. Genève 20 (1917) 104.

Considered by Focke to be related to *R. niveus* which, according to the material seen, is in the Philippines restricted to Luzon. Type (Warburg 14483) not seen.

TRIBUS POTENTILLEAE

Herbs, rarely shrubs. Leaves pinnate, trifoliolate, or palmate. Stipules adnate to petiole. Epicalyx present. Pollen opercular. Few to many pistils on a mostly elevated torus, not entirely enclosed by hypanthium. Ovule 1, pendulous. Achenes. $x = 7$.

FRAGARIA

Fragaria L., Sp. Pl. (1753) 494; Kalkman, Blumea 16 (1968) 349. — Type species: *Fragaria vesca* L.

Herbs, mostly with stolons. Leaves trifoliolate. Inflorescences cymose, few-flowered. Flowers 5-merous. Petals white. Stamens many. Pistils many, style ventral. Fruits on enlarged, fleshy torus, forming a spurious fruit.

Distribution — About 8 species, in Northern temperate regions and in Central and South America. Not indigenous in Malesia.

KEY TO THE SPECIES

- 1a. Flowers small: hypanthium up to 3 mm diam., sepals 3–4 mm long, petals 4–6 mm long 2. *F. vesca*
- b. Flowers larger: hypanthium 4–6 mm diam., sepals 7–12 mm long, petals 9–12 mm long 1. *F. × ananassa*

1. ***Fragaria vesca* L., Sp. Pl. (1753) 494;**
Backer & Bakh. f., Fl. Java 1 (1964) 517.

Leaflets 1.5–3 by 1–2.5 cm, terminal petiole 0–1(–2) mm. Hypanthium 2.5–3 mm diam. Epicalyx leaves and sepals 3–4 mm long. Petals 4–6 mm long. Stamens 20 or less. Spurious

fruits obovoid, up to c. 1.5 by 1 cm, achenes not sunken in fleshy torus.

Distribution — Temperate Eurasia; in Malesia introduced and cultivated (not commercially), in some places escaped and naturalized, seen from Sumatra, Malaya, Java, Philippines, and Papua New Guinea, but possibly also elsewhere.

2. *Fragaria × ananassa* (Duch.) Guédès, Taxon 33 (1984) 724, and see also the editorial note to this paper by D.H. Nicolson; Backer & Bakh.f., Fl. Java 1 (1964) 517. — *Fragaria chiloensis* (L.) P. Miller × *Fragaria virginiana* P. Miller.

Leaflets 2–7 by 1.5–6 cm, terminal petiolule up to 9 mm. *Hypanthium* 4–6 mm diam. *Epicalyx leaves* 5–8 by 2.5–3.5 mm. *Sepals* about equal to epicalyx or longer, 7–12 by 3–4.5 mm. *Petals* 9–12 by 9–12 mm. *Stamens* 25–40. *Spurious*

fruits globose, ovoid, or obovoid, up to 2 by 1.5 cm, achenes sunken in fleshy torus.

Distribution — Cultigen, dispersed all over the world, also running wild. In *Malesia* a female form not or rarely setting fruit (see Kalkman, Blumea 16, 1968, 352) naturalized on Mt Pangerango, W Java, where it was introduced around 1840.

Uses — Commercially grown for its fruits, e.g. in Java (Dieng) and Sumatra (Berastagi); see Choopong Sukumalanandana & E.W.M. Verheij in E.W.M. Verheij & R.E. Coronel (eds.), Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 171–175.

POTENTILLA

Potentilla L., Sp. Pl. (1753) 495; Kalkman, Blumea 16 (1968) 325–354; ibid. 34 (1989)

143–160. — Type species: *Potentilla reptans* L.

Duchesnea J.E. Sm., Trans. Linn. Soc. 10 (1811) 372. — Type species: *Duchesnea fragiformis* J.E. Sm., nom. illeg. = *Fragaria indica* Andrews = *Duchesnea indica* Focke in Engler & Prantl.

Herbs of different habit, rarely shrubs. *Leaves* compound (palmate, pinnate, trifoliolate, rarely unifoliolate). *Stipules* adnate to the petiole, herbaceous or membranous. *Flowers* solitary and axillary or opposite the leaves, or in cymose or thyrsoid inflorescences, 5-(4–6)-merous, bisexual. *Hypanthium* (shallowly) cup-shaped, lined inside by a sometimes hairy disc. *Epicalyx leaves* often incised. *Sepals* valvate, usually entire. *Petals* entire, yellow or white, rarely red or purple. *Stamens* many (up to c. 30) to few. *Pistils* many to few, on low to elevated torus; ovaries superior, 1-locular; style apical, ventral or basal, persistent or jointed and deciduous; ovule 1, pendulous or ascending, inserted near the place of style-insertion. *Fruits* free, dry achenes or mesocarp slightly fleshy, surrounded by persistent epicalyx and calyx, torus rarely enlarging and becoming spongy to fleshy. *Seed* with thin testa. — **Figs. 8, 9.**

Distribution — About 250–400 species, worldwide but mainly in the Northern hemisphere. In *Malesia* 18 species with a centre of diversity (14 species) in New Guinea.

Habitat — Plants from open and sunny, often wet places. In *Malesia* most species montane to subalpine or alpine, at altitudes between 2400 and 4600 m, two species (*P. indica* and *P. sundaica*) between 800 and 2400 m.

Ecology — The (sub)alpine species in New Guinea often growing in cushions.

Note — Sometimes parts of the genus as delimited here, are regarded as separate genera, e.g. *Argentina* (to which several Malesian species probably would have to be referred if the genus were accepted), *Comarum* (not in *Malesia*), and *Duchesnea*. The latter two differ from *Potentilla* in developing a swollen, spongy torus. It seems a certainty to me that this is a polyphyletically acquired character state. Separation and recognition of the two genera leads to a paraphyletic genus *Potentilla*. Also for *Fragaria*, and for the same reasons, the combination with *Potentilla* could be considered. This would, however, either necessitate hundreds of new combinations in *Fragaria*, or in the case of conservation, new and unfamiliar names for the strawberries. (See also Kalkman 1968).

KEY TO THE SPECIES

- 1a. Leaves pinnate 2
 b. Leaves ternate or palmate 17
- 2a. Flowering stems as long as or distinctly longer than the leaves. Stamens usually 10 or more (often 5 in *P. parvula*) 3
 b. Flowering stems shorter than the leaves. Stamens usually in one whorl of 4 to 6 (10–15 in *P. gorokana*) 10
- 3a. Leaflets densely silky hairy below, leaf surface not visible between the hairs 4
 b. Leaves glabrous to hairy, but not densely silky, leaf surface visible 7
- 4a. Stems, petioles, and rachis patently hairy. Flowering stems procumbent
 7. *P. hooglandii*
 b. Stems, petioles, and rachis appressed hairy 5
- 5a. Ovaries hairy 2. *P. borneensis*
 b. Ovaries glabrous 6
- 6a. Epicalyx leaves entire or practically so. Leaflets crowded, stiff 1. *P. adinophylla*
 b. Epicalyx leaves pinnatifid to pinnatisect. Leaflets distant, not stiff 13. *P. papuana*
- 7a. Lateral leaflets entire or some with one incision, apical leaflet bifid . 9. *P. indivisa*
 b. Leaflets incised 8
- 8a. Leaflets pseudodigitate (pinnately incised but with a minimally short midrib
 11. *P. linalaciiniata*
 b. Leaflets pinnatisect to pinnatipartite 9
- 9a. Upper leaflets normally shorter than 10 mm, leaf not more than 10 cm long. Stamens as many as petals or twice that number, rarely more (–20) 14. *P. parvula*
 b. Upper leaflets 10–30 mm, leaf 9–35 cm long. Stamens 4 times the number of petals or more 15. *P. polyphylla*
- 10a. Leaflets digitate, incisions going to the very base 6. *P. habbemana*
 b. Leaflets entire, bipartite, or pinnately incised 11
- 11a. Leaflets pinnatisect to pinnatipartite 12
 b. Leaflets undivided or bipartite to the very base 16
- 12a. Epicalyx leaves entire or apically shallowly notched 13
 b. At least part of the epicalyx leaves pinnatifid to pinnatipartite, or 3–4-partite .. 15
- 13a. Leaflets densely silky hairy below, leaf surface not visible between the hairs .. 14
 b. Leaflets with long hairs below but not densely silky, leaf surface visible
 4. *P. foersteriana*
- 14a. Leaflets 4–5 pairs 12. *P. mangenii*
 b. Leaflets 12–18 pairs 18. *P. wilhelminensis*
- 15a. Leaflets 3–6 pairs. Stamens same number as sepals 10. *P. irianensis*
 b. Leaflets 14–18 pairs. Stamens 2 or 3 times the number of sepals 5. *P. gorokana*
- 16a. Leaflets 8–13 pairs 16. *P. simulans*
 b. Leaflets 1–5(–8) pairs 3. *P. brassii*
- 17a. Leaves 5-foliate. Flowers in dichasial, terminal inflorescences 17. *P. sundaica*
 b. Leaves trifoliate. Flowers solitary, opposite normal leaves on prostrate stems
 8. *P. indica*

- 1. *Potentilla adinophylla* Merr. & Perry, J. Arnold Arbor. 21 (1940) 190; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2447, f. 719.**
— Type: *Brass 1308*, Mt Albert Edward.

Rosette plants with stout taproot, leaves and inflorescences erect. *Leaves* pinnate, up to 7 cm long, petiole 0.5–1 cm. *Stipules* membranous. *Leaflets* 12–18 pairs, crowded and often folded along midrib, up to 8 by 6 mm, serrate to pinnatisect with 3–8 pairs of incisions, densely sericeous below, less densely above; no intermediary leaves. *Flowering stems* almost scapose, erect, with 1 or 2 flowers, 4–12 cm long, sericeous. *Hypanthium* 3.5–4.5 mm diam., densely sericeous outside. *Epicalyx* leaves elliptic to ovate, 2–3.5 by 1.2–2 mm, entire or apically notched, sometimes with shallow incisions, densely sericeous outside. *Sepals* triangular, 2.5–4 by 1.2–2 mm, indumentum as epicalyx. *Petals* not seen. *Stamens* 10–20, filaments up to c. 1.5 mm, anthers c. 0.5 mm long. *Torus* elevated, densely hairy. *Pistils* many, ovary glabrous on hairy stalk, style inserted in the middle. *Achenes* c. 1.2 by 0.8 mm, brown, smooth.

Distribution – New Guinea.

Habitat – In grassland, 3100–4100 m altitude.

Note – Some ten specimens known from mountains in Papua New Guinea (Central and Milne Bay Prov.) and two from Mt Ngga Simanggela (Doorman) in Irian Jaya, the latter with a less rigid habit.

- 2. *Potentilla borneensis* (Stapf) Kalkman, Blumea 16 (1968) 332. — *Potentilla leuconota* D. Don var. *borneensis* Stapf, Trans. Linn. Soc. II, 4 (1894) 146. — Type: *Haviland 1058*, Mt Kinabalu.**

Potentilla leuconota auct. non D. Don: Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242; Merr., Not. Nat. Acad. Nat. Sc. Philad. n. 47 (1940) 3.

Rosette plant, taproot firm. Stems, petioles, rachis, underside of leaflets, and pedicels densely sericeous. *Leaves* pinnate, 5–18(–32) cm long, petiole 1–4(–9) cm. *Stipules* membranous. *Leaflets* 7–16(–24) pairs, elliptic to oblong, gradually larger to the tip, up to 7–19(–21) by 4–9(–10) mm, pinnatifid to pinnatisect, rarely incised to near the midrib, with (4–)6–11 incisions on either side; intermediary leaflets present or not. *Flowering stems* 1 to several, erect or ascending, (3–)5–30(–40) cm, caudine leaves few or none. Thyrse with up to 13 flowers. *Hypanthium* 2.5–3.5 mm diam., densely sericeous outside as are epicalyx and sepals. *Epicalyx* leaves elliptic or ovate to oblong,

2.5–5 by (0.7–)1–1.7 mm, apically notched or entire, rarely deeper incised. *Sepals* triangular to triangular-ovate, 2.5–4.5 by 2–3.2 mm. *Petals* elliptic to suborbicular, 6–8.5 by 4–6.5 mm, yellow. *Stamens* 20, filaments up to 2 mm, anthers 0.5 to 0.7 mm. *Torus* low, hairy. *Pistils* few to many, ovary hairy on a hairy stalk, style lateral. *Achenes* up to c. 2 by 1.5 mm, brown, smooth with some veins.

Distribution – Sumatra (only seen from Aceh), Borneo (only seen from Mt Kinabalu).

Habitat – In stony places on and between rocks, sheltered or open, in heath-like vegetation or shrubland, sometimes in swampy places. In Aceh collected at 2500–3500 m altitude, on Mt Kinabalu at 3500–4000 m.

Notes – Closely related to *P. leuconota* from the Himalayas and Taiwan, and to *P. papuana* from Celebes and New Guinea. For the distinction as species, see Kalkman (1968).

Recently Soják (Preslia 64, 1992, 221) separated the Sumatran material as *P. sumatrana* Soják. Recognition on a varietal level would have been more acceptable, as the differences between the populations from Aceh and Mt Kinabalu are either overlapping or of minor importance.

Some Sumatran specimens have deeply incised leaflets and may represent a variety (see also note under *P. papuana*).

- 3. *Potentilla brassii* Merr. & Perry, J. Arnold Arbor. 21 (1940) 185. — *Potentilla foersteriana* Laut. var. *brassii* (Merr. & Perry) Kalkman, Blumea 16 (1968) 343; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2435, pl. 173. — Types: *Brass & Meijer Drees 10156*, holotype; *Brass 9427*, *Brass & Meijer Drees 10390*; all Mt Trikora (Wilhelmina).**

Potentilla archboldiana Merr. & Perry, J. Arnold Arbor. 21 (1940) 185. — Types: *Brass & Meijer Drees 10133*, holotype; *9839*; both Mt Trikora.

Small and compact rosette-herbs, growing individually or in cushions up to 60 cm diam. *Leaves* pinnate, 1–1.5 cm long, petiole very short. *Stipules* membranous, hairy outside. *Leaflets* 1–5(–8) pairs, bipartite or entire, 2.5–5 by 0.5–2 mm, hard and stiff, glabrous to hairy. *Flowering stems* less than 1 cm, with 2 reduced leaves under the terminal flower. *Flowers* (3–)4–5-merous. *Hypanthium* 1.5–2 mm diam., growing after anthesis, glabrous to sparsely hairy outside. *Epicalyx* leaves elliptic, 1.2–1.5 by 0.5–1 mm, entire, sometimes partly or all bipartite, indumentum as hypanthium. *Sepals* triangular, about as long as

epicalyx, acute. Petals (ob)ovate, c. 2 by 1 mm, yellow. Stamens isomerous with sepals, filaments very short, anthers c. 0.5 mm. Torus low, hairy. Pistils 6–15, ovary glabrous on hairy stalk, style lateral. Achenes 1–1.2 mm long, red.

Distribution — New Guinea, several mountains in the main range.

Habitat — Only from altitudes above 3350 m.

KEY TO THE VARIETIES

- 1a. Leaves up to c. 1 cm long, leaflets 3–5 pairs, densely hairy below in the middle part
 - c. var. *strigosa*
- b. Leaves glabrous below or at most with few hairs 2
- 2a. Leaflets 2–5(–8) pairs, most bipartite to the base, rarely partly undivided or with an additional smaller third lobe . . . a. var. *brassii*
- b. Leaflets 1–2 pairs, undivided b. var. *simplex*
- a. var. *brassii* — Kalkman, Blumea 34 (1989) 150, f. 2. — *Potentilla archboldiana* Merr. & Perry.

Often growing in cushions. Leaflets 2–5(–8) pairs under the apical one, bipartite, usually to the base, rarely less deeply divided or some of them undivided, rarely with a third lobe, lobes 2.5–3.5 by 0.5–0.7 mm, glabrous to sparsely hairy. *Hypanthium* c. 2 mm diam., glabrous or sparsely hairy outside. Petals obovate. Pistils 6–15.

Distribution — New Guinea.

Habitat — Usually in boggy places, altitude 3400–4250 m.

- b. var. *simplex* Kalkman, Blumea 34 (1989) 151. — Type: *Hope ANU 10832*, Mt Jaya.

Cushions. Leaflets 1–2 pairs under the apical one, glabrous or few hairs on apex and margin, lateral leaflets undivided, 3–5 by 1–2 mm, apical leaflet bifid or trifid, up to 6 by 3 mm. *Hypanthium* c. 1.5 mm diam., glabrous outside. Petals ovate. Pistils 9–12.

Distribution — New Guinea: Irian Jaya.

Habitat — Vegetation on poor soils, 3350–c. 4000 m altitude.

- c. var. *strigosa* Kalkman, Blumea 34 (1989) 151. — Type: *Mangen 2011*, Valentijn Mts.

Cushions. Leaflets 3–5 pairs under the apical one, unequally bipartite to the base, the largest lobe up to c. 3 by less than 1 mm, glabrous above, den-

sely long appressed hairy below except near margins, petiole and rachis densely long-hairy. *Hypanthium* c. 2 mm diam., glabrous outside except near the rim. Petals elliptic-ovate. Pistils 8–10.

Distribution — New Guinea, only seen from Valentijn Mts, Irian Jaya.

Habitat — Boggy open places, 3340–3500 m.

4. ***Potentilla foersteriana* Laut, Fedde Rep. 13 (1914) 240; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242; Kalkman, Blumea 16 (1968) 341, excl. var. *brassii*; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2434, pl. 172, f. 717, excl. var. *brassii*. — Type: *Keysser 309*, Finisterre Mts.**

Rosette plants with firm taproot, solitary or in cushions. Leaves pinnate, 2–13 cm long, petiole up to 1.5 cm. Stipules membranous, long-hairy below, at least in the central part. Leaflets (5–)8–16 pairs, elliptic to ovate, base rounded to cordate, often unequal, pinnatisect to pinnatifid, rarely with small intermediary leaflets. Flowering stems short, 1- to 3-flowered. Flowers (4–)5(–6)-merous. *Hypanthium* densely long-hairy outside. Epicalyx leaves elliptic to ovate, 2–4.5 by 1–2.5 mm, normally undivided, rarely notched apically, usually with long hairs outside. Sepals triangular, 2–4.5 by 1–3 mm, acute, indumentum as epicalyx. Petals elliptic to obovate, 3–7 by 1.5–3.5 mm, yellow. Stamens 5–10, filaments up to 1.5 mm, anthers c. 0.8 mm. Torus low, hairy. Pistils 12–50 or more, ovary glabrous on short hairy stalk, style lateral. Achenes up to 1.5 mm long, brown (to black). — Fig. 8.

Distribution — New Guinea.

Habitat — Open vegetation, (2300–)2700–4150 m altitude.

Note — *Potentilla brassii* was reduced to a variety of the present species in Kalkman (1968), but reinstated as a species in 1989.

KEY TO THE VARIETIES

- 1a. Leaflets (5–)8–12 pairs
 - a. var. *foersteriana*
 - b. Leaflets 12–16(–22) pairs . . . b. var. *ima*
- a. var. *foersteriana* — Kalkman, Blumea 34 (1989) 152, f. 3.
- Rosettes loose to compact, single or in cushions. Leaves 2–5 cm, with short petiole. Petiole and rachis almost glabrous to densely hairy. Leaflets (5–)8–12 pairs, 3.5–7 by 3–6 mm, pinnatisect



Fig. 8. *Potentilla foersteriana* Laut. var. *ima* Kalkman. Flowering rosette (Kalkman 4642). Photo C Kalkman.

to pinnatipartite with (1-)2-7 incisions on either side, usually with long hairs at least on margin and apex, rarely almost glabrous. *Flowering stems* very short, at most 3 cm, with only 1 flower, rarely up to 3, peduncle with 1-2 small leaves or stipular bracts. *Hypanthium* 3-4 mm diam. *Epicalyx* leaves 2-4.5 by 1-3 mm. *Sepals* 2-4.5 by 1-3 mm. *Petals* (3-)4-6 by 1.5-3.5 mm. *Stamens* 5. *Pistils* 12-32.

Distribution – New Guinea, all over the island.

Habitat – Grasslands and other open vegetation, altitude 3225-4150 m.

b. var. *ima* Kalkman, Blumea 16 (1968) 342, pro max. parte; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2436, pro max. parte; Kalkman, Blumea 34 (1989) 152, f. 4. — Type: Kalkman 4642, Mt Kerewa.

Solitary growing rosettes. Leaves 3-13 cm, petiole up to 1.5 cm. *Petiole* and *rachis* densely long-hairy. *Leaflets* 12-16 pairs, 6-11 by 3.5-8 mm, pinnatipartite with 1-4 incisions on either side, with long hairs below. *Flowering stems* short, up to 5(-7) cm, usually with 2 flowers, peduncle with 1-2 small leaves. *Hypanthium* 3-5 mm diam. *Epicalyx* leaves 2.5-4 by 1-2.5 mm. *Sepals* 2-3 by 1-3 mm. *Petals* 3-7 by 2-3.5 mm. *Stamens* 5-10. *Pistils* many, up to 50 or more. – Fig. 8.

Distribution – New Guinea, only seen from several mountains in Papua New Guinea.

Habitat – Often in grassland, altitude (2300-) 2700-3350(-4100) m.

Note – In its original circumscription this variety also included *P. gorokana*, now recognized as a separate species.

5. *Potentilla gorokana* Kalkman, Blumea 34 (1989) 155. — Type: *Hoogland & Pullen 5513*, Mt Kerigomna.

Solitary growing rosettes with stout, woody taproot, densely silky on petiole, rachis, underside of stipules, underside of leaves. Leaves pinnate, 5–11 cm long, petiole up to 0.5 cm. Stipules membranous. Leaflets 14–18 pairs, elliptic, 7–9 by 4–6 mm, pinnatisect with 2–5 incisions on each side, rarely with small intermediary leaflets. Flowering stems up to 3 cm, with 1–4 flowers, peduncle with few small leaves or stipular bracts. Flowers 5- or 6-merous. *Hypanthium* 3–5 mm diam., densely long-hairy outside. *Epicalyx* leaves elliptic, 3.5–4.5 by 1.5–3 mm, mostly pinnatifid to pinnatisect with 1–3 incisions on each side, long-hairy outside. *Sepals* triangular, 3–4 by 1.5–3 mm, indumentum as epicalyx. *Petals* 5–7 by 3–4 mm, yellow. *Stamens* 10–15, filaments c. 1 mm, anthers 0.5 mm. *Torus* low, hairy. *Pistils* many, c. 100, ovary glabrous, stalked, style lateral. *Achenes* c. 1 mm long, brown.

Distribution — New Guinea, the three specimens seen all from Goroka Subprov., Papua New Guinea.

Habitat — Open places, altitude 2650–3200 m.

6. *Potentilla habbemana* Merr. & Perry, J. Arnold Arbor. 21 (1940) 186; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2452, f. 720. — Types: *Brass* 9594, holo; 9553, 9590; all Mt Trikora (Wilhelmina).

Loose rosettes. Leaves pinnate, (2–)5–8 cm long, petiole up to 2.5 cm. Stipules membranous, underside silky in the middle. Petiole and rachis long silvery hairy to glabrous. Leaflets 6–12 pairs, digitately divided to the base, lobes 3–6, up to 4 by 1 mm, acute to obtuse, entire, lower side silvery in the middle. Flowering stems 1.5–4.5 cm, 1-flowered, peduncle with 1–2 leaves, silvery. Hypanthium up to 4 mm diam., outside long-hairy or only hairs on rim. Epicalyx leaves elliptic to ligulate, 2–2.5 by 0.5–1 mm, entire or one apically notched, glabrous to sparsely hairy. Sepals triangular, 1.5–3 by 1.2–2 mm, indumentum as epicalyx. Petals obovate, 3–3.5 by 1.5–2 mm, yellow. Stamens 5, filaments 1 mm, anthers 0.5 mm. Torus low, hairy. Pistils 7–20, ovary glabrous on hairy stalk, style lateral. Achenes 1.2 mm long, greyish brown.

Distribution — New Guinea, only seen from Mt Trikora, Irian Jaya.

Habitat — Boggy places, heath-like vegetation, 3225–4000 m altitude.

7. *Potentilla hooglandii* Kalkman, Blumea 13 (1968) 339; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2444, pl. 174. — Type: *Hoogland & Schodde 7245*, Lagaip Valley.

Rosette plants, forming prostrate, not-rooting, often long and branched runners bearing leaves and flowering laterals, taproot stout, all stems up to the pedicels patently long-hairy. Leaves pinnate, those of the rosette 5.5–21 cm long, petiole up to 4 cm. Stipules membranous, up to 2 cm long, sericeous outside. Petiole and rachis densely covered with long, soft, patent hairs. Leaflets 11–16 pairs, ± elliptic, basal ones 3–6 mm long, larger to the apex, up to (8–)10–24 by (4–)6–11 mm, pinnatifid to pinnatisect with 6–12 incisions on each side, densely sericeous below, intermediary leaflets usually present. Flowering stems procumbent, in axils of rosette and runner leaves, 4–27 cm long, with a terminal flower and one or few below it, peduncle with some (reduced) leaves. Flowers 5- or 6-merous. Hypanthium 3–4 mm diam., densely sericeous outside. Epicalyx leaves elliptic to ovate, 3–6.5 by 1.5–3.5 mm, serrate in upper part, indumentum outside as on hypanthium. Sepals (broadly) triangular to ovate, 3–4.5 by 2–3 mm, usually entire, indumentum as on hypanthium. Petals (sub)orbicular to obovate, 5–6 by 4–5 mm, yellow. Stamens 10–12(–c. 20), filaments 1–1.2 mm long, anthers c. 0.5 mm. Torus thin to thick, hairy. Pistils very many, ovary glabrous, on short stalk with some hairs, style lateral below the middle. Achenes 1 by 0.8 mm, brown to dark purplish with lighter dorsal line, smooth. — Fig. 9.

Distribution — New Guinea, on several mountains.

Habitat — Open grasslands, altitudes 2440 to 3560 m.

8. *Potentilla indica* (Andr.) Wolf in Asch. & Graebn., Syn. Mitt.-Eur. Fl. 6, 1 (1904) 661; Wolf, Bibl. Bot. 71 (1908) 664; Kalkman, Blumea 16 (1968) 344. — *Fragaria indica* Andr., Bot. Repos. 7 (1807) t. 479; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 241; Backer & Bakh. f., Fl. Java 1 (1964) 517. — *Duchesnea indica* Focke in Engler & Prantl, Nat. Pflanzenfam. 3, 3 (1888) 33. — Type: Andrews, l.c., t. 479, picturing a plant from a garden in England, originating from NE Bengal, India.

Fragaria chrysanthia Zoll. & Moritzi, Syst. Verz. (1846) 7. — *Duchesnea chrysanthia* Miq., Fl. Ind. Bat. I, 1 (1855) 372. — Type: Zollinger 1987, Mt Tangkubanperahu.

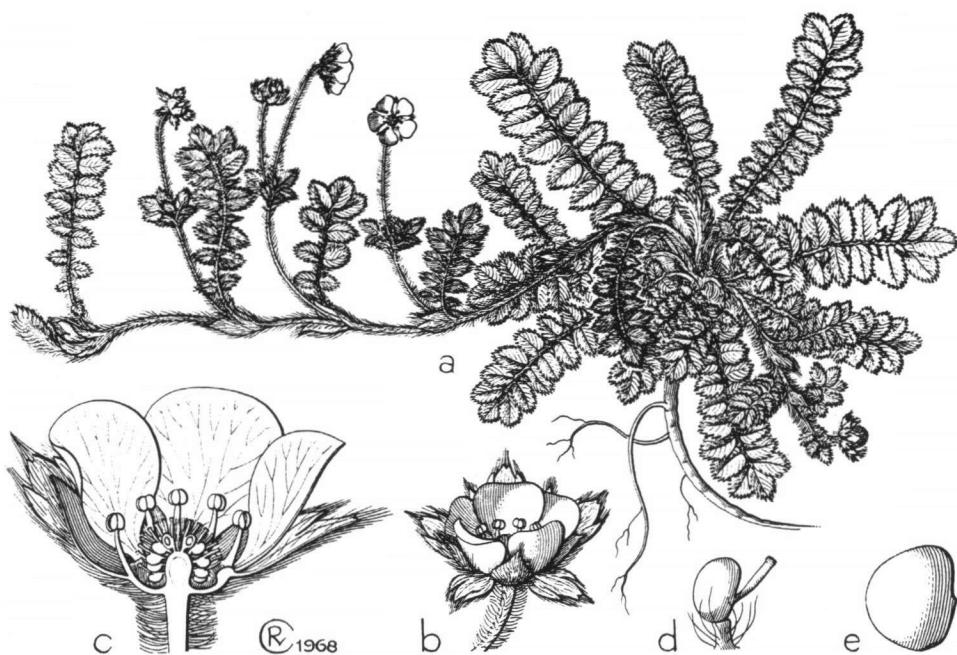


Fig. 9. *Potentilla hooglandii* Kalkman. a. Flowering plant, $\times 0.7$; b. flower, $\times 2$; c. flower, halved lengthwise, $\times 4$; d. ovary, $\times 12$; e. fruit, $\times 12$ (a: Hoogland 9693; b-d: Kalkman 4874, e: Kalkman 4745).

Rosette herbs with long, prostrate, partly sympodial stems (stolons) bearing leaves and flowers and also reduced leaves, daughter plants produced on the nodes bearing reduced leaves. Stems, pedicels and petioles with long, \pm patent hairs and usually many multicellular glandular hairs. Leaves trifoliate, petiole up to 12(–16) cm. Stipules membranous, c. 1 cm long, long-hairy outside. Leaflets sessile or shortly petioluled, apical leaflets rhomboid to obovate, 1.5–3.5 by 1–2.5 cm, base cuneate, apex rounded, serrate in upper part, lateral leaflets elliptic to ovate, slightly smaller and usually with unequal base, all leaflets long hairy below and on the nerves also with glandular hairs. Flowers solitary, seemingly placed opposite the runner-leaves, rarely 6-merous, pedicels 2–8 cm long. Hypanthium 2–3.5 mm diam., sparsely hairy outside. Epicalyx leaves \pm obovate, 3–5 by 2–3 mm during anthesis, distinctly growing afterwards, with 2–6 incisions in the apical part, sparsely hairy outside. Sepals narrowly triangular, 4–6 by 2–3 mm during anthesis, indumentum outside as epicalyx. Petals obovate, 3.5–4.5 by 2–3.5 mm, yellow. Stamens 15–20, filaments

up to 2.5 mm, anthers c. 0.5 mm. Torus elevated, hairy or glabrous, distinctly enlarging after anthesis. Pistils many, sessile, ovary glabrous, style inserted laterally above the middle and in anthesis much longer than the ovary. Collective fruit 5–11 mm diam, soft and fleshy, red. Achenes 0.9–1.3 by 0.7–1 mm, red to brownish, smooth or distinctly rugose to tuberculate.

Distribution – South, Southeast, and East Asia. In Malesia probably indigenous in Java, Lesser Sunda Islands and Philippines, cultivated as an ornamental, escaped from cultivation or at least doubtfully indigenous in Sumatra, Malaya, and Singapore. Also introduced and established in many places in Europe, America, and Africa.

Habitat – Mostly in disturbed habitats: roadsides, plantations, rarely in forest, rather often in damp or wet places; altitude 700–2300 m.

Uses – Perry & Metzger (Medicinal plants of E and SE Asia, 1980, 342) report many medicinal uses from China, especially for burns, bites, boils, etc. The fruits are almost tasteless but edible; they are, however, reported to be poisonous when too many are eaten.

Vernacular name — As a garden plant often called the Indian strawberry.

Notes — An extensive overview of the variation was given earlier (Kalkman 1968). Two groups can be distinguished, one with tuberculate achenes on a hairy torus, another with smooth achenes on a glabrous torus, the correlation of achene and torus characters not being absolute. Plants of the first-mentioned group have proven to be diploid $2n = 14$, plants of the second group were observed to be dodecaploid $2n = 84$. Japanese authors call them, respectively, *Duchesnea chrysanthia* and *D. indica*. Published chromosome counts were almost exclusively made from Japanese or cultivated plants and none from Malesia. Sterile hybrids obviously occur in the wild in Japan and can also be artificially made; they are $7x$ or $8x$ and have been named *Duchesnea × hara-kurosawae* Naruhashi & Sugimoto (J. Phytogeogr. & Taxon. 34, 1986, 11–14; see also Naruhashi et al. in La Kromosomo II-42, 1986, 1330–1335).

Because of the lack of any karyological evidence it is not warranted to extrapolate these findings to areas outside Japan, but chromosome counts of vouchered, wild growing specimens of both groups may establish the occurrence of two (sub)species in Malesia. Plants with tubercled achenes are in Malesia known from Luzon, Java, Bali, and Timor, plants with smooth achenes were seen from Luzon and other islands and seem to be always introduced or escaped.

For the distinction of *Duchesnea* as a genus, see the note on p. 286 under the genus description. When brought under *Potentilla* the group with the tubercled achenes cannot be called *P. chrysanthia*, that combination being already occupied.

9. *Potentilla indivisa* Kalkman, Blumea 34 (1989) 155, f. 5. — Type: Mangen 1163, Mt Trikora (Wilhelmina).

Rosette herbs with stout taproot. Leaves pinnate, 9–10 cm long, petiole up to 2.5 cm. Stipules membranous, densely long-hairy outside. Petiole and rachis with few long, soft hairs, sticky when living (?). Leaflets 10–12 pairs, elliptic-ovate, oblique, 6–8 by 3–4 mm, lateral ones undivided and entire, rarely bifid with one smaller lobe, apical ones bifid, all leaflets leathery and glabrous except few short hairs at apex. Flowering stems up to 16 cm, branched, with c. 4 reduced leaves and a number of bracts, with up to 7 flowers, peduncle and pedicels sparsely hairy. Hypanthium c. 4 mm diam., hairy outside. Epicalyx leaves elliptic to triangular-elliptic, 2–2.5 by 1–1.5 mm in anthesis,

afterwards distinctly enlarging up to 5 mm, obtuse, entire, hard, with few hairs outside. Sepals triangular, 4 by 2.5 mm in anthesis, afterwards up to 6 mm long, indumentum as epicalyx. Petals obovate, 10 by 7 mm, yellow. Stamens 20, filaments c. 1 mm, anthers c. 0.8 mm. Torus hairy. Pistils 20–25, ovary glabrous on hairy stalk, style lateral. Achenes c. 1.5 mm long, brown.

Distribution — New Guinea, only one collection seen from Irian Jaya, N of Mt Trikora.

Habitat — In tussock grassland, 3100 m altitude.

Note — Related to *P. parvula*, but with entire lateral leaflets.

10. *Potentilla irianensis* Kalkman, Blumea 34 (1989) 156. — Type: Hope ANU 16027, Mt Jaya (Carstensz).

Rosettes growing in cushions of up to 40 cm diam. and 30 cm high. Leaves pinnate, very small, 0.5–1.5 cm long, petiole up to 2 mm, perpendicular to the stipule. Stipules membranous, sparsely to densely hairy outside. Petiole and rachis practically glabrous to long-hairy. Leaflets 3–6 pairs, elliptic, up to 2–3 by 1–2.5 mm, base rounded, tripartite to pinnatisect or pinnatifid with 1–3 incisions on each side, with few hairs, intermediary leaflets sometimes present. Flowering stems at most (in fruiting stage) 1.5 cm long, with 1 or 2 flowers and few reduced leaves on the peduncle. Hypanthium up to 2.5 mm diam., almost glabrous outside. Epicalyx leaves ovate to obovate, tri- or quadripartite with incisions from the top, 1.2–1.5 by 0.7–1 mm, with few hairs. Sepals triangular-ovate, 1–1.5 by 0.7 mm, with some hairs or glabrous. Petals elliptic, c. 2 by 1 mm, yellow. Stamens 5(–7), very small. Pistils 8–12, on the hairy bottom of the hypanthium, ovary glabrous on hairy stalk, style lateral. Achenes c. 1.2 mm long, brown, on thick stalks.

Distribution — New Guinea, 6 collections seen, all from Mt Jaya in Irian Jaya.

Habitat — Alpine grassland and stony places, 3850–4600 m altitude.

11. *Potentilla linilaciniata* P. van Royen, Alpine Fl. New Guinea 4 (1983) 2455, f. 721. — Type: Van Royen 30113.

Solitary rosette herbs with stout, woody taproot. Leaves pinnate, 3–15(–30) cm long, petiole up to 3(–6) cm. Stipules membranous, silky outside. Petiole and rachis long appressed-hairy when young, glabrescent. Leaflets 12–18(–22) pairs, pseudo-digitately divided with incisions going to

the very short midrib, the 4–9 lobes 3–7 by 0.5–1 mm, acute, long-appressed-hairy to almost glabrous below. *Flowering stems* 4–20(–35) cm long, with (1–)2–5(–12) flowers. *Flowers* (4–)5–merous. *Hypanthium* 2–4.5 mm diam., long-hairy outside. *Epicalyx* leaves elliptic, 2–4(–5) by 0.5–2 mm, entire or apically notched, rarely deeper incised, hairy to almost glabrous. *Sepals* triangular, 2.5–4(–5.5) by 1–2.5 mm, indumentum as epicalyx. *Petals* obovate, 5–8.5 by 3.5–5 mm, yellow. *Stamens* 15–20, filaments up to 1.5 mm long, anthers c. 1 mm. *Torus* low to elevated, hairy. *Pistils* 15–35, ovary glabrous on hairy stalk, style lateral. *Achenes* c. 1.2 mm long, lightbrown, smooth.

Distribution – New Guinea, seen from several mountains in Papua New Guinea.

Habitat – Grasslands, usually swampy or boggy, 2700–3800 m altitude.

Note – The leaflets are not truly digitate but have a recognizable, although very short midrib. The large variation in length of leaf and inflorescence may hide two varieties (see discussion in Kalkman, Blumea 34, 1989, 157).

12. *Potentilla mangenii* Kalkman, Blumea 34 (1989) 158. — Type: *Mangen 495bis*, Mt Trikora (Wilhelmina).

Cushion-forming rosettes. *Leaves* pinnate, up to 1.5–2.5 cm long, petiole less than 0.5 cm. *Stipules* membranous, silky hairy outside. *Petiole* and *rachis* long and densely silky hairy. *Leaflets* 4–5 pairs, elliptic, up to 5–7 by 3–3.5 mm, pinnatisect with 1–3(–5) incisions each side, densely silky hairy below. *Flowering stems* up to 1 cm, 1-flowered, with 2 reduced leaves on the densely hairy peduncle. *Hypanthium* 3.5 mm diam., long-hairy outside. *Epicalyx* leaves elliptic, 2–2.5 by c. 1 mm, entire or rarely notched at apex, long-hairy outside. *Sepals* narrowly triangular, 2–2.5 by 1.2 mm, indumentum as on epicalyx. *Petals* elliptic, 3.5 by 1.5 mm, yellow. *Stamens* 5, filaments 1 mm, anthers 0.2 mm. *Pistils* c. 25, on the hairy bottom of the hypanthium, ovary glabrous, stalked, style lateral. *Achenes* 1.2 mm long, shining dark purple.

Distribution – New Guinea, only two specimens seen, both from Mt Trikora, Irian Jaya.

Habitat – Dry, low vegetation, c. 4100 m altitude.

13. *Potentilla papuana* Focke, Abh. Naturw. Ver. Bremen 13 (1895) 162; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243; Merr. &

Perry, J. Arnold Arbor. 21 (1940) 189; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2449, pl. 175. — *Potentilla leuconota* D. Don var. *papuana* F. Muell., nomen. — Type: *MacGregor s.n.*, Owen Stanley Range.

Potentilla leuconota auct. non D. Don: F. Muell., Trans. Roy. Soc. Vict. 1, 2 (1889) 5; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242.

Rosette herbs, occasionally forming long, prostrate stems, taproot stout. *Leaves* pinnate, (4.5–) 6–15(–20) cm long, petiole up to 5.5(–7) cm. *Stipules* of the rosette leaves membranous, light brown, outside hairy at least in the centre. *Petiole* and *rachis* densely hairy. *Leaflets* 7–11 pairs, elliptic to oblong or ovate, the upper ones (7–)11–22 by (4–)6–13 mm, pinnatifid to pinnatisect with 4–14 incisions on either side, densely silvery sericeous below and less densely above, intermediary leaves usually present. *Flowering stems* several per rosette, prostrate or ascending, (5–)10–30 (–45) cm, with some (reduced) leaves with herbaeuous, green stipules, usually branched with under the terminal flower 1–6 laterals with 1–3 flowers each. *Bracts* leaf-like but small. *Flowers* 5(–7)–merous. *Hypanthium* 4–5 mm diam., densely sericeous outside. *Epicalyx* leaves ovate to obovate, 3–6 by 2–4 mm, growing after anthesis, pinnatifid to pinnatisect with (1–)3–6 incisions on either side, densely sericeous outside. *Sepals* triangular to ovate, 3–6 by 2–3 mm, indumentum as epicalyx. *Petals* elliptic to obovate, 5–8 by 3.5–6 mm, yellow. *Stamens* 10–30, filaments 1–2 mm, anthers 0.5–0.8 mm long. *Torus* low to high, hairy. *Pistils* very many, ovary glabrous on a hairy stalk, style lateral at about the middle. *Achenes* 1.2–1.5 mm long, brown to dark purplish brown, smooth.

Distribution – Philippines (only one collection seen, Mt Tabayoc, Luzon), Celebes, New Guinea.

Habitat – Alpine and subalpine grasslands, wet or dry, more rarely in shrubland, at (2100–)2600–3900 m altitude.

Notes – Some New Guinean specimens have deeply incised leaflets, as also occur in Sumatran specimens of *P. borneensis* (see note under that species).

One chromosome count has been made by Borgmann (Zs. f. Bot. 52, 1964, 143), $2n = 42$. See under *P. parvula*.

14. *Potentilla parvula* Hook. f. ex Stapf in Hook., Ic. Plant. IV, 3 (Jan. 1894) pl. 2294; Stapf, Trans. Linn. Soc. Lond. II, 4 (Dec. 1894) 147; Steenis, Bull. Jard. Bot. Buitenzorg III, 13

(1934) 243; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2441. — Type: *Haviland 1057K*, Mt Kinabalu.

Potentilla philippensis Merr., Philipp. J. Sc. 29 (1926) 480; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243. — Type: *Clemens 5006*, Mt Pulog.

Potentilla novoguineensis Merr. & Perry, J. Arnold Arbor. 21 (1940) 187. — Types: *Brass 10727*, Lake Habbema, holo; 4229, Mt Albert Edward; 4636, Wharton Range; *Brass & Meijer Drees 9863*, Mt Trikora.

Lax to compact rosette herbs, rarely with prostrate runner-like branches, taproot stout to slender. Indumentum of vegetative parts variable but usually sparsely long-hairy. Leaves pinnate, 2–10 cm long, in shaded places up to 25 cm, petiole 0.3–2.5 cm long. Stipules of rosette leaves membranous, about halfway adnate. Leaflets 6–21 pairs, suborbicular to elliptic, ovate, or obovate, up to 3–9(–13) by 2–6(–9) mm, pinnatisect to pinnatifid with 1–5(–8) incisions on either side, intermediary leaflets mostly present in the larger plants. Flowering stems several per rosette, 2.5–20 cm long, in deep shade up to 38 cm, with some caudine leaves with herbaceous stipules, bearing up to 4(–6) flowers, usually sparsely long-hairy. Flowers (4–)5(–6)-merous. Hypanthium 2–4 mm diam., hairy outside. Epicalyx leaves suborbicular to elliptic or obovate, 1.5–3.5 by (0.5–)1–3.5 mm, growing after anthesis, entire or notched at apex, subglabrous to sparsely hairy outside. Sepals triangular, 1.8–4 by 1–2.5 mm, indumentum as on epicalyx. Petals elliptic to obovate, up to 8 by 4 mm but usually smaller, yellow. Stamens 5–10 (–20), filaments 1–2 mm, anthers 0.5–0.8 mm long. Torus cone-shaped, hairy. Pistils many, rarely few, ovary glabrous, on short, ± hairy stalk, style lateral at about the middle. Achenes up to 1.3 mm long, brown to purplish or blackish, smooth.

Distribution — Borneo (only seen from Mt Kinabalu), Philippines (seen from some mountains in Luzon), Celebes (only seen from Mt Rante Mario), New Guinea.

Habitat — Mostly in alpine or subalpine grasslands, wet or dry, more rarely in shaded places like open forest, forest edges, and shrubland, at (2065–) 2600–3800(–4100) m altitude.

Notes — The habit seems to be related to the light conditions in the growing place. Solitary growing plants in open conditions may form compact rosettes while in shaded places the rosette is lax and open, with longer and more slender leaves and inflorescences. See Kalkman, Blumea 16 (1968) 337.

One chromosome count has been made by Borgmann (Zs. f. Bot. 52, 1964, 144, sub *P. novoguineensis*), $2n = 42$. The voucher, *Borgmann 24*, is not quite homogeneous. See also under *P. papuana*.

15. *Potentilla polyphylla* Wall. [Cat. (1829) nr. 1026, nomen] ex Lehm., Nov. et Min. Cogn. Stirp. Pug. 3 (1831) 13. — Type: *Wallich 1026*, Gossain Than.

Potentilla mooniana Wight, Ic. 1 (1840) t. 233, text p. xlvi; Steenis, Trop. Natur 21 (1932) 101, f. 3, 4; Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243; Backer & Bakh.f., Fl. Java 1 (1964) 518. — Type: *Wight*, Nuwara Eliya, Sri Lanka.

Rosette herbs with leafy flowering stems. Leaves pinnate, 9–35 cm long, petiole 1.5–10 cm. Stipules of rosette leaves membranous, hairy outside. Petiole and rachis hairy. Leaflets 10–20 pairs, elliptic, up to 10–30 by 5–12 mm, pinnatisect to serrate with (5–)7–12 incisions on either side, sparsely long-hairy, intermediary leaflets present. Flowering stems several per rosette, ascending to prostrate, 14–45 cm long, with some caudine leaves with herbaceous stipules, hairy. Inflorescence a thyrs with a terminal flower and some lateral monochasias, 4–10 flowers per inflorescence. Flowers 5(–6)-merous. Hypanthium 3.5–5 mm diam., sparsely long-hairy outside. Epicalyx leaves ± elliptic, 3–4(–5) by 2–4(–5) mm, growing after anthesis, usually with 1–4 incisions going half-way or deeper, sparsely long-hairy outside. Sepals triangular, 3–4.5(–5) by 2–4 mm, indumentum as on epicalyx. Petals obovate to suborbicular, 5.5–6 by 5–6 mm, yellow. Stamens 19–24, filaments up to 2 mm, anthers 0.5–0.8 mm long. Torus cone-shaped, hairy. Pistils many, ovary glabrous on hairy stalk, style lateral in the middle. Achenes c. 1.5 mm long, brown, smooth.

KEY TO THE VARIETIES

- Leaflets serrate, the incisions always less than halfway. Stems, and especially leaf-rachis and pedicels soft-hairy, the hairs usually distinctly spreading. Intermediary leaflets often large, not rarely 2 or 3 between two primary leaflets. b. var. *polyphylla*
- Leaflets pinnatisect, incised about halfway. Leaf-rachis and pedicels appressed soft-hairy, sometimes rather sparsely so. Intermediary leaflets present, small, never more than one between two primary leaflets.
 - a. var. *kinabaluensis*

a. var. *kinabaluensis* (Stapf) Kalkman, Blumea 16 (1968) 339. — *Potentilla mooniana* Wight var. *kinabaluensis* Stapf, Trans. Linn. Soc. Lond. II, 4 (1894) 146; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243. — Type: *Haviland 1056*, Mt Kinabalu.

Distribution — Borneo, only seen from Mt Kinabalu.

Habitat — Sheltered, damp to peaty places, altitude c. 3300–4000 m.

b. var. *polyphylla*

Distribution — India, Nepal, Sikkim, Pakistan, Sri Lanka; *Malesia*: Java (Mt Papandayan).

Habitat — In Java in herbaceous vegetation, under *Anaphalis javanica* and *Alchemilla villosa*, altitude c. 2400 m.

Note — This variety has never been re-collected in Java since 1940, nor has it been collected in Sumatra as could be expected. One wonders about the possibility of its having been intentionally planted, but Mt Papandayan is not known as a place where plants have been introduced, like Mt Gede.

16. *Potentilla simulans* Merr. & Perry, J. Arnold Arbor. 21 (1940) 187; Kalkman, Blumea 16 (1968) 341, in syn. sub *P. foersteriana*; ibid. 34 (1989) 159. — Type: Brass 9594A, Mt Trikora (Wilhelmina)

Loose rosettes. Leaves pinnate, up to 5 cm long, petiole up to 8 mm. Stipules membranous, hairy outside. Petiole and rachis densely long-hairy. Leaflets 8–13 pairs, bipartite to the very base, lobes divergent, elliptic, unequal, the largest one up to 3.5 by 1.5 mm, with long appressed hairs underneath, especially in the middle. Flowering stems up to 1.5 cm long, 1-flowered and with some small leaves, densely hairy. Hypanthium c. 2 mm diam., long-hairy outside. Epicalyx leaves elliptic, entire or one shallowly notched, 1.5–2 by 1 mm, long-hairy outside. Sepals triangular, 1.5–2 by 1.5 mm, indumentum as epicalyx. Petals broadly obovate, 2–3 mm long, yellow. Stamens 5, filaments 0.5 mm, anthers 0.5 mm. Pistils 10–12, on the bottom of the hypanthium, ovary glabrous, on hairy stalk, style lateral. Achenes c. 1.2 mm long, shining dark purple.

Distribution — New Guinea, only seen from Irian Jaya.

Habitat — Grassland on peaty soil, altitude 3225–4350 m.

Note — Two of the three specimens seen were

taken from mixed collections so the epithet seems to be quite appropriate.

17. *Potentilla sundaica* (Blume) O. Kuntze, Rev. Gen. Pl. 1 (1891) 219; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243; Backer & Bakh. f., Fl. Java 1 (1964) 518. — *Fragaria sundaica* Blume, Bijdr. (1826) 1106. — *Duchesnea sundaica* Miq., Fl. Ind. Bat. I, 1 (1855) 372, t. 6, incl. var. *hirsuta* Miq., l.c. 373. — Type: *Blume s.n.*, Mt Gede, L sheet nr 909.111-40. *Potentilla kleiniana* Wight & Arn. in Wight, Ill. Ind. Bot. 1 (1831) t. 85. — Type: *Wight 914*, India.

Loose rosettes with erect to prostrate, often rooting, flowering stems, stolons (prostrate stems without normal leaves) sometimes present. Leaves palmately (pedately) 5-foliolate, petiole 6–40 cm long. Stipules 1.5–4 cm long, membranous, little hairy outside. Petiole sparsely to densely soft-hairy. Leaflets obovate, terminal one shortly petioluled, 2–4.5 by 1–2.5 cm, lateral ones smaller, coarsely serrate, pinninerved, with few soft appressed hairs underneath. Flowering stems up to 45 (–60) cm, with the caudine leaves smaller than the rosette leaves and with herbaceous stipules, rarely 3-foliolate, stems and pedicels sparsely to densely soft-hairy. Daughter plants sometimes developing on the nodes of the stems. Inflorescences terminal and axillary, compound dichasial, whole inflorescence up to 5–10 cm long. Bracts and bracteoles leaf-like. Hypanthium 2–3 mm diam., sparsely hairy outside. Epicalyx leaves ± oblong, 2–3 mm long, entire or bifid, sparsely hairy outside. Sepals triangular, 2–3 by 1–2 mm, growing after anthesis, indumentum as epicalyx. Petals obovate, 3–3.5 by 2–3 mm, yellow, falling early. Stamens 20 or few missing, filaments c. 1 mm, anthers c. 0.5 mm long. Torus high and thin in anthesis, thicker under the fruit, with few hairs. Pistils many, ovary glabrous on hairy or glabrous stalk, style terminal to subapical. Achenes 0.7–1 mm long, reddish brown to brown, rugose.

Distribution — India, Sri Lanka, S China, N Vietnam, Laos, Korea, Japan; *Malesia*: only in N Sumatra and W and C Java.

Habitat — Damp or marshy places like banks of brooks and lakes, also on roadsides and in villages, in Sumatra and Java at altitudes of 1200–2300 m.

18. *Potentilla wilhelminensis* P. van Royen, Alpine Fl. New Guinea 4 (1983) 2440, f. 718. — Type: Versteeg 2534, Mt Trikora (Wilhelmina).

Potentilla prob. nov. spec. Kalkman, Blumea 16 (1968) 348.

Rosette herbs, taproot stout. Leaves pinnate, 4–8 cm long, petiole up to 0.5 cm. Stipules membranous, silky outside. Petiole and rachis densely appressed-silky. Leaflets 12–18 pairs, suborbicular to elliptic, up to 5–8 by 4–5 mm, stiff and folded, pinnatifid to pinnatisect with 2–4 incisions on either side, long silky on both sides. Flowering stems up to 3 cm, with 1–4 flowers and some reduced leaves. Hypanthium hairy outside. Epicalyx leaves elliptic, 2–3 mm long, entire or apically notched, hairy outside. Sepals triangular, 2–3 mm

long, indumentum as epicalyx. Petals elliptic, 3–3.5 by 2–2.8 mm, yellow. Stamens 5, filaments c. 1.5 mm, anthers c. 0.7 mm long. Torus low, hairy. Pistils many, ovary glabrous, on hairy stalk, style lateral. Achenes c. 1 mm long, brown.

Distribution — New Guinea, only seen from Irian Jaya.

Habitat — Unknown, altitude 4000–4600 m.

Note — The species was collected on Mt Trikora in 1913 and on Mt Jaya in 1936. Remarkably it has not been re-collected during more recent explorations of these mountains by G.S.Hope, J.-M. Mangen and J. Raynal.

TRIBUS POTERIEAE

Herbaceous, rarely woody, plants with pinnate leaves. Stipules adnate to petiole. Epicalyx absent. Petals sometimes absent. Pistils several or only 1, superior, enclosed in hypanthium. Ovule 1, pendulous. Achenes, sometimes drupaceous. $x = 7$.

ACAENA

Acaena L., Mant. Pl. alt. (1771) 200; Bitter, Bibl. Bot. 74 (1911) 1–336. — Type species: *Acaena elongata* L.

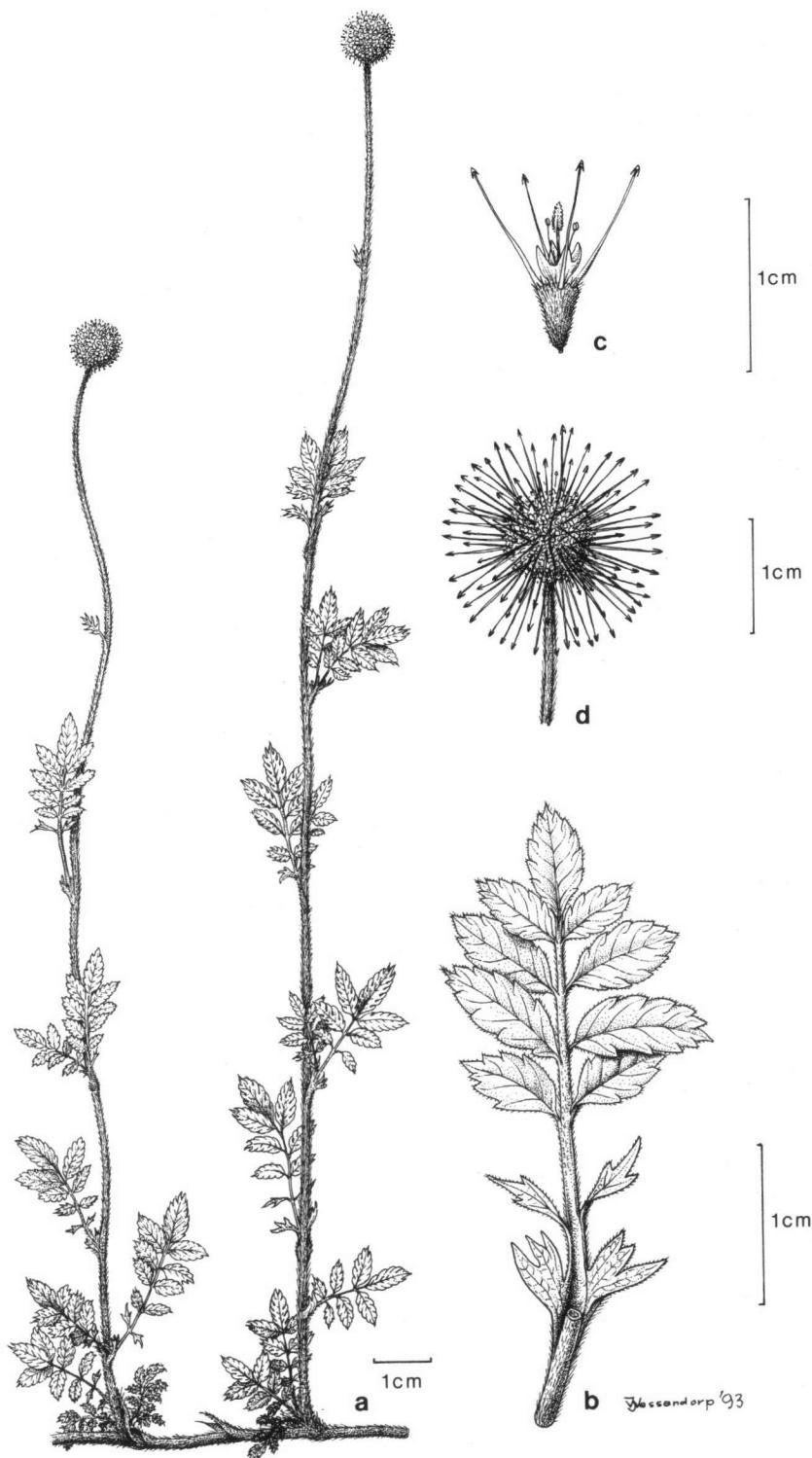
Herbs, usually creeping, rarely suffrutescent. Leaves imparipinnate, rarely subdigitate. Inflorescences axillary or terminal, spicate or capitulate. Flowers usually 4-merous, bisexual. Hypanthium ± obconoid, narrowed at the throat, usually armed with few to many barbed spines. Sepals 3–7, usually 4, valvate, free or shortly connate. Petals absent. Stamens 1–8, often 4, episepalous. Pistils usually 1, sometimes 2–4, free; ovary 1-locular; style terminal, stigma plumose. Achene(s) remaining enclosed in hypanthium. — Fig. 10.

Distribution — About 40 species (or c. 150 when a much narrower species concept is followed), almost restricted to the Southern Hemisphere, most richly developed in South America, going northwards through Central America to California (1 species). Also in Hawaii (1 species), South Africa (2 species), in the Australian region (several species, in Australia, Tasmania, New Zealand and neighbouring islands, New Guinea), and on the subantarctic islands. In Malesia one species in New Guinea.

Acaena anserinifolia (J.R. & G. Forster)

Druce, Bot. Soc. Exch. Club Rep. 1916, Suppl. 2 (1917) 602; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 241; P. van Royen, Alpine Fl. New Guinea 4 (1983) 2427. — *Ancistrum anserinifolium* J.R. & G. Forster, Char. Gen. Pl. (1776) 2, pl. 2, 'anserinaefolium'. — Type: Forster s.n., no exact locality.

Prostrate herbs, stems long-hairy. Leaves 2–4 (–9) cm long, petiole up to 0.5(–1) cm. Stipules membranous, up to 1–1.5 cm long, the free tips leaflet-like, long-hairy. Petiole and rachis with long appressed hairs. Leaflets 4–6 pairs, elliptic to oblong-lanceolate, upper lateral ones largest, 7–11 (–18) by 2–5(–10) mm, serrate, with long appressed hairs underneath. Flowering stems procumbent



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or erect. *Inflorescence* a solitary, terminal, globose head, 5–8 mm diam. in anthesis, white, with 50–80 flowers, peduncle 2–9 cm, hairy, in fruiting stage head up to 2.5 cm diam. incl. the spines on the hypanthia. *Bracts* 7–10, membranous, forming an involucre close under the head, also some between the flowers. *Flowers* bisexual, (sub)sessile. *Hypanthium* obovoid, quadrangular in cross section, 1–2 mm long, with an ascending spine of 1–2 mm on each of the angles (often one or more missing), densely long- and stiff-hairy. *Sepals* 4, obovate to elliptic, up to 1.8 by 1 mm, erect, persistent. *Stamens* 2 (or 3), filaments up to 2 mm, anthers up to 0.5 mm long. *Pistil* 1, ovary spindle-shaped, glabrous, only the 1 mm long style protruding, stigma fimbriate. *Achene* enclosed in the enlarged hypanthium, the latter then obpyramidal, quadrangular or with 4 narrow wings, up to 3 mm long, densely hairy, the barbed spines up to 1 cm long, reddish to purple. — Fig. 10.

Distribution — Australia from Queensland to S Australia and Tasmania, New Zealand and nearby island groups; in *Malesia*: only in New Guinea.

Habitat — In New Guinea in edges of forest and shrubland, in open places like landslides and riverbanks, more rarely in subalpine grassland, altitude 1900–4100 m.

Ecology — Epizoochorous by means of the barbed spines. Certainly also anthropochorous.

Notes — *Acaena anserinifolia* is a complex species. Bitter, l.c., who certainly cannot be accused of irresponsible lumping, placed the many forms (19 varieties and subspecies) he recognized all in one species. For New Zealand Allan (Flora New Zeal. 1, 1961, 361) changed several of those varieties etc. into independent species, admitting that "the close relationship of these groups is undoubtedly." He also remarked (l.c.: 363) that "fertile hybrids between them are ± common, yet in the absence of hybridism they are true-breeding," which seems to indicate that his species are actually ecotypes.

The description given here is based on New Guinean material only. This material is very homogeneous and matches well the Australian specimens seen.

AGRIMONIA

Agrimonia L., Sp. Pl. (1753) 448. — Type species: *Agrimonia eupatoria* L.

Perennial herbs with creeping rhizomes and erect leafy stems, usually hairy and often glandular. *Leaves* interruptedly imparipinnate. *Stipules* large. *Inflorescences* terminal, spike-like racemes. *Flowers* rather small, 5-merous, bisexual. *Hypanthium* ± turbinate, apically armed with erect or patent, hooked bristles, throat almost closed by a dome-shaped disc with a central pore. *Sepals* persistent, connivent after anthesis. *Petals* yellow, rarely white. *Stamens* 5–numerous. *Pistils* 2, free; ovaries 1-locular; style terminal. Usually one *achene* developing, enclosed in the indurate, 10-ribbed, armed hypanthium, pericarp thin. — Fig. 11.

Distribution — About 15 species, in temperate regions and montane in the tropics, on the Northern Hemisphere, in S America and S Africa, one species in *Malesia* (Java).

***Agrimonia nepalensis* D. Don, Prod. Fl.**

Nepal. (1825) 229. — Type: *Hamilton s.n.*, Nepal.

***Agrimonia blumei* G. Don, Gen. Hist. Dichl. Pl.**

2 (1832) 563, excl. specimens from Japan. —

***Agrimonia suaveolens* auct. non Pursh (1814): Blume, Bijdr. (1826) 1113, excl. specimens from Japan. — *Agrimonia javanica* Jungh., Java 1**

(1853) 664, nom. superfl., illeg.; Miq., Fl. Ind.

Bat. I, 1 (1855) 370; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 241. — Type: probably *Reinwardtii* 1605 (or 1609?), Tengger Mts.

***Agrimonia eupatoria* L., p.p.: Koord., Exk. Fl. Java 2 (1912) 333; Backer & Bakh. f., Fl. Java 1 (1964) 519; Steenis, Mount. Fl. Java (1972) pl. 44-1.**

Fig. 10. *Acaena anserinifolia* (J. R. & G. Forster) Druce. a. Flowering branches; b. leaf with stipules; c. fruit; d. fruiting head (a, b: Hoogland & Schodde 7619; c, d: Hoogland & Schodde 7428).

Erect herbs, sparsely branched, up to 1 m, stems, rachises and petioles with long and short patent hairs, glandular. Leaves 8–16 cm long, petiole 1–5 cm. Stipules herbaceous, amplexicaul, 3 by 3 cm, deeply serrate, hairy and glandular outside. Leaflets up to 4 pairs, elliptic to oblong, 2–6 by 1–2 cm, intermediary leaflets 1–3 between primary ones, (very) small, all leaflets subsessile, deeply serrate, appressed-hairy and glandular, also patent hairs on midrib below. Raceme simple or branched at base, 15–30 cm, in lower part the flowers far apart. Bracts trifid to tripartite, up to 4.5 mm, bracteoles 2. Pedicels up to 2.5 mm. Flowers staying erect after anthesis. Hypanthium oboconoid, 1–2 mm long, with 10 obtuse ribs going to the base but most distinct in upper part, appressed-hairy, under the sepals with many erect spines, those curved inwards at apex, up to 1.2 mm. Sepals 2–2.5 by 0.8–1 mm, appressed-hairy mainly on the 3 prominent nerves. Petals elliptic to obovate, 2.5–3.5 by 1.5–2 mm, yellow. Stamens c. 10, filaments up to 2.8 mm, anthers consisting of 2 subglobular thecae. Ovary 1 mm, style up to 2 mm. Achenes usually 1 per flower, fruiting hypanthium 2.5–3 by 3–4 mm, distinctly ribbed, spines all erect and the larger ones about as long as the calyx. — Fig. 11.

Distribution — Continental SE Asia (Nepal, Assam, Burma, S China, N Thailand, Laos, Vietnam); in Malesia only on some mountains in C and E Java.

Habitat — Montane, open, often grassy habitats, altitude c. 1200–2200 m.

Notes — The Java specimens of *Agrimonia* cannot be separated from the continental *A. nepalensis* D. Don: there is not a single difference.

Some authors place *A. nepalensis* in synonymy under *A. pilosa* Ledeb. (e.g. Nakai, Bot. Mag. Tokyo 47, 1933, 245; Hara & Kurosawa, J. Jap. Bot. 43, 1968, 392; Yü & Li, Acta Phytotax. Sin. 15, 1977, 89; Purohit & Panigrahi, J. Jap. Bot. 58, 1983, 289) without, however, giving an opinion about the disposition of the plants from Java. Other specialists keep the two species mentioned above separate (Juzepchuk, Fl. U.S.S.R. 10, 1941, 415; Vidal, Fl. Camb., Laos & Vietnam 6, 1968, 134; Skalicky, in litt., 1969). On the basis of differences in stipules, petals, and indumentum, and in the absence of a full modern monographic treatment of the genus over its whole area I prefer to keep the species separate.

To place *A. nepalensis* and *A. blumei* within a then almost all-embracing species *A. eupatoria* L., as practised in some treatments for Java, does not seem a sensible classification to me. The most

conspicuous difference between series *Eupatoria* Juz. and *Pilosae* Juz. is that in the latter the 'fruits' (fruiting hypanthia) remain erect after anthesis.

There is in BO (and to a lesser degree also in L) a fair amount of old herbarium material from Java, but the species has seemingly not been re-collected since 1941.

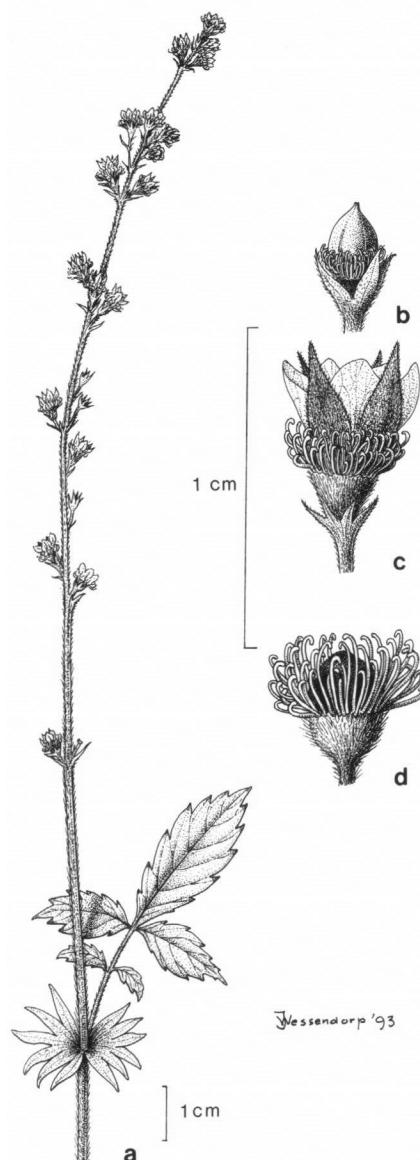


Fig. 11. *Agrimonia nepalensis* D. Don. a. Top of flowering stem; b. bud; c. flower; d. hypanthium in fruiting stage (*Reinwardt* 1605).

SANGUISORBA

Sanguisorba L., Sp. Pl. (1753) 116. — Type species: *Sanguisorba officinalis* L.

Perennial herbs or shrubs, unarmed. *Leaves* often in rosettes, imparipinnate. *Flowers* in terminal spikes or heads on usually long and slender peduncles, 4-merous, bi- or unisexual. *Hypanthium* urceolate, constricted at apex, persistent. *Sepals* deciduous. *Petals* absent. *Stamens* 2–50. *Pistils* 1 or 2, rarely 3, free; ovaries 1-locular; style terminal, with penicillate stigma. *Achenes* included in hardened hypanthium.

Distribution — About 20 species, North temperate.

Note — Nordborg, Opera Bot. Lund 11 (2) (1966) 1–103, united not only *Sanguisorba* L. and *Poterium* L. pro max. p., which is often done, but also *Poteridium* Spach, *Dendropoterium* Svent., and *Marcetella* Svent. The description given here is in accordance with this large circumscription.

Sanguisorba minor Scop., Fl. Carn. ed. 2, 1 (1771) 110; Backer & Bakh. f., Fl. Java 1 (1964) 519. — Type: Nordborg 8040, Spain, neotype, see Nordborg, Opera Bot. Lund 16 (1967) 98.

Herb, 0.5 m, stems faintly soft-hairy. *Leaves* 5–9 cm long. *Leaflets* 3 or 4 pairs, 1.5–2.5 cm long. *Heads* globose, up to 1.5 cm diam., with up to 15 crowded flowers, peduncle up to 10 cm long. *Flowers* sessile, bisexual (rarely male) in lower part, female in upper part of head. *Hypanthium* 4-

ribbed. *Sepals* imbricate. *Stamens* 10–30 in male and bisexual flowers, filaments up to 8 mm. *Pistils* 2. *Achenes* glabrous, pericarp bony in upper part.

Distribution — W, C and S Europe, N Africa, W Asia, introduced and naturalized in N America. According to Backer & Bakhuizen f., l.c., the species is in the mountains of Java sometimes cultivated as a pot-herb. I have seen only one sheet of such a cultivated plant. Also in Europe the leaves are (were?) used as a vegetable, in soups, and in salads.

TRIBUS ALCHEMILLEAE

Herbaceous or shrubby plants with simple, but often deeply palmately incised leaves. Stipules adnate to petiole. Epicalyx present. Pistils few, superior, enclosed in hypanthium. Ovule 1, basal. Achene(s) enclosed in hardened hypanthium. $x = 8$. Only genus: *Alchemilla* s.l., sometimes divided into several genera.

ALCHEMILLA

Alchemilla L., Sp. Pl. (1753) 123. — Type species: *Alchemilla vulgaris* L.

Perennial or annual, erect or prostrate herbs or suffrutices. *Leaves* simple, usually petiolated, ± orbicular in outline, palmately to pedately nerved and palmately incised, folded in bud. *Stipules* rather large. *Flowers* sometimes solitary, usually in cymes, corymbs, or racemes, small, 4-merous (more rarely 5-merous), bisexual. *Hypanthium* ± urceolate, throat almost closed by the disc. *Epicalyx* leaves usually smaller than sepals, rarely 0. *Sepals* valvate. *Petals* absent. *Stamens* 1, 2, or 4, rarely 5, inserted outside or inside the disc, epi- or alternisepalous, short, pollen in many species sterile (apogamy). *Pistils* 1–4

(-10), free; ovaries sessile or shortly stalked, 1-locular, style ventral or subbasal, protruding through the disc. Achenes 1-4, remaining enclosed in indurate hypanthium, pericarp bony to membranous. — Fig. 12.

Distribution — Subcosmopolitan, in all continents. Many species synanthropous and areas not always entirely natural. In *Malesia* one species (Java).

Notes — The number of species may be about 200-400 but as in other apogamous groups it depends very much on the species concept used. Over 300 microspecies have been described in Europe.

For the description given above, a broad delimitation of the genus is used, i.e. including *Aphanes*, *Lachemilla*, and *Zygalchemilla*.

***Alchemilla villosa* Jungh., Nat. Geneesk. Arch.**

Ned. Ind. 2 (1845) 46; Java 1 (1853) 596; Miq., Fl. Ind. Bat. I, 1 (1855) 369; Backer & Bakh.f., Fl. Java 1 (1964) 518; Steenis, Mount. Fl. Java (1972) pl. 44-2. — Type: *Junghuhn s.n.*, Java, lecto in L. sh. 908.195-1315.

***Alchemilla dendoidea* Zoll. & Mor. in Zoll., Nat. Geneesk. Arch. Ned. Ind. 1 (1844) 484, nomen, in obs.**

***Alchemilla vulcanica* Zoll. & Mor. in Zoll., Nat. Geneesk. Arch. Ned. Ind. 2 (1845) 587, nomen, in obs., non Schlechtend. & Cham. (1830).**

Perennial herbs, main stems ± decumbent, older parts covered with remains of stipules and petioles, lateral stems prostrate to sub-erect, up to 1 m, not rooting (?), stems and petioles with patent long hairs. *Stipules* of the leaves on the main stems membranous, those of the leaves of the long shoots herbaceous, up to c. 1 cm long, shortly adnate, shortly connate at opposite side of stem, long-hairy outside. *Leaves* very variable in size, blades from 6 by 8 mm to 5 by 8 cm, petioles 1-20 cm. *Leaf-blades* reniform, (5-)7-9-fid, base deeply incised, serrate, the apical tooth of each lobe normally shorter than adjacent ones, pedately nerved, both sides with semi-appressed hairs. *Inflorescences* axillary, sympodially stretched cincinni, usually simple, 2-15 cm long, up to c. 12 flowers, peduncle up to 5 cm. *Bracts* 2 with each flower, herbaceous. *Flowers* 4-merous. *Hypanthium* narrowly infundibuliform, 1-1.5 by 0.8-1 mm, densely hairy outside. *Disc* almost closing throat of hypanthium, intrastaminal, cushion-shaped. *Epicalyx* leaves apert, ovate to elliptic, 0.8-1.2 by 0.5-0.8 mm, hairy outside. *Sepals* ovate-triangular, 1.2-1.5 by 0.8-1 mm, indumentum as epicalyx. *Stamens* 4, alternisepalous, filaments 0.5 mm, anthers c. 0.2 mm, falling early. *Pistil* 1, ovary glabrous, shortly stalked, style subbasal. *Achene* enclosed in endurated, slightly enlarged hy-

panthium, ovoid, c. 1.2 mm long, style persistent, pericarp bony, smooth.

Distribution — *Malesia*: Java, from Mt Papan-dayan eastwards on many mountains.

Habitat — Grassy places, also in light shade (*Casuarina* forest), found at altitudes from 2100 to 3300 m.

Note — The most recent subdivision of the genus as a whole is to be found in Rothmaler's paper in Fedde Rep. 40 (1936) 208-212. Rothmaler did not place *A. villosa* and its relative from India and Sri Lanka, *A. indica*, in section *Brevicaules* to which the bulk of the Eurasian species belong, but in section *Longicaules* which — apart from the two Asian species — only contains species from Africa and Madagascar.

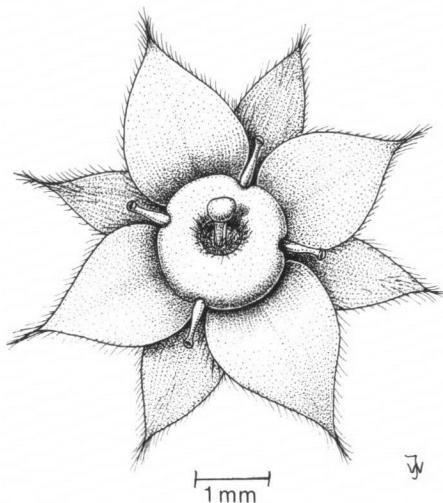


Fig. 12. *Alchemilla villosa* Jungh. Flower (Holstvoogd 295).

TRIBUS ROSEAE

Woody plants with pinnate leaves. Stipules adnate to petiole. Epicalyx absent. Pistils many, superior, enclosed in hypanthium. Ovules 1 (or 2), pendulous. Achenes enclosed in fleshy hypanthium. $x = 7$. Only genus: *Rosa*.

ROSA

Rosa L., Sp. Pl.(1753) 491; Kalkman, Blumea 21 (1973) 281. — Type species: *Rosa centifolia* L. See, however, Taxon 41 (1992) 568 where *R. cinnamomea* L. is proposed as the type species.

Erect, climbing, or prostrate shrubs, nearly always armed with straight or curved prickles, often with glands. *Leaves* imparipinnate, leaflets pinninerved, usually serrate. *Stipules* adnate (rarely, not in Malesia: leaves unifoliolate without stipules). *Flowers* solitary and terminal or in terminal thyrses or racemes, large and showy, bisexual, nearly always 5-merous, cultivars often double. *Hypanthium* usually globular to urceolate, throat almost closed by a thickened annular disc. *Sepals* imbricate, often foliaceous and at least the outer ones often pinnately incised, persistent or caducous. *Petals* imbricate, different shades of red, white, or yellow. *Stamens* many. *Pistils* many, rarely few; ovaries superior, shortly stalked or subsessile, free, included in the hypanthium, 1-locular, styles terminal or lateral, free or with their upper parts coherent to connate, protruding through the hole in the disc; ovule 1, rarely 2, pendulous. *Fruits* achenes with usually bony pericarp, included in the accrescent, ± fleshy, coloured hypanthium (hip). *Seed* with thin testa; endosperm absent. — Fig. 13.

Distribution — Probably more than 100 species, in temperate to subtropical regions of the Northern Hemisphere, some in the montane parts of the tropics. Ornamentals with a long history of hybridization and with innumerable cultivars of untraceable origin. In *Malesia* 2 species indigenous in Luzon, Philippines.

Uses — The modern cultivated roses are almost all complex hybrids. Any of these may be found cultivated also in SE Asia but they never come beyond the local market. See D.O.Wijnands in E.Westphal & P.C.M.Jansen (eds.), Plant Res. SE Asia (PROSEA Handbook). A selection (1989) 240–241.

Note — Occasionally cultivated roses may run wild. See Backer & Bakh.f., Fl. Java 1 (1964) 519–520 and Kalkman, Blumea 21 (1973) 281–291. Only the truly wild species are treated here.

KEY TO THE SPECIES

- 1a. Apical leaflets up to 4 cm long. Flowers 7–30, rarely more, in a terminal raceme or thyrsse. Styles hairy **1. R. luciae**
- b. Apical leaflets up to 1.5 cm long. Flowers usually solitary, terminal on leafy laterals, rarely also 1 or 2 flowers in the upper leaf-axil(s). Styles glabrous
 2. **R. transmorrisonensis**



M.H. van Geijp

1. Rosa luciae Franch. & Rochebr. ex Crépin, Bull. Soc. Roy. Bot. Belg. 10 (1871) 324; Kalkman, Blumea 21 (1973) 284, f. 2. — Type: Savatier specimen in herb. Franchet, Japan.

Rosa wichuraiana Crépin, Bull. Soc. Roy. Bot. Belg. 15 (1876) 204, nomen; ibid. 25 (1887) 189, descr. — *Rosa luciae* var. *wichuraiana* Koidz., J. Coll. Sc. Imp. Univ. Tokyo 34, art. 2 (1913) 232. — Type: not indicated.

Rosa philippinensis Merr., Philipp. J. Sc. 17 (1921) 260, incl. var. *depauperata* Merr., l.c.; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243. — Type: Elmer 5794, holo; several paratypes; all Luzon.

Suberect to straggling or ± climbing shrubs, up to 4 m. *Twigs* (scarcely) glandular, otherwise mostly glabrous, prickles 2 under each leaf, , up to 4 mm usually no other prickles present. *Leaves* 4–10 (–12) cm long, free part of petiole up to 1(–1.5) cm long. *Stipules* adnate over (3.5–)8–11 mm, wings 0.7–1.5 mm wide, free tips 1–2.5 mm long, margin dentate and with stalked glands. *Leaflets* 7–9, lateral ones elliptic to elliptic-ovate or elliptic-oblong, up to 12–32 by 7–20 mm, apical one larger than upper lateral ones, margin serrate, glabrous or with few hairs, lateral leaflets subsessile, apical petiolules up to 1 cm. *Flowers* 7–30 or more in a terminal raceme or thyrsse, the lower flowers or partial inflorescences in the axils of small leaves. *Bracts* linear or with expanded apex. *Pedicels* 1–2.5 cm long, glandular, otherwise glabrous or slightly hairy. Closed *flowerbuds* globular, mucronate to abruptly acuminate, flowers strongly fragrant. *Hypanthium* ellipsoid to ovoid, 3–4.5 by 2–3.5 mm in anthesis, outside glandular, with few hairs or glabrous, long-silky inside. *Sepals* reflexed during and after anthesis, caducous, ovate to elliptic-ovate, acuminate, (6.5–)8–11 by 2.5–4 mm including acumen of up to 4 mm, 1–2 side-lobes on exposed margins, glandular and sparsely hairy outside. *Petals* (broadly) obovate, 11–18 by 9–11 mm, retuse, white. *Stamens* 100 or more, filaments up to 7 mm, anthers up to 1.5 mm long. *Pistils* 12–25, ovary with a plume of long stiff hairs on one side at apex, styles 5.5–7 mm long, cohering, hairy. *Hips* globular, 6–8(–10) mm, smooth, bluish-black. *Achenes* angular ovoid, c. 4.5 mm long, with hairs on one side, pericarp thick, woody. — Fig. 13.

Distribution — Japan, Korea, Ryukyu Is., E China, Taiwan; in *Malesia*: Philippines (Luzon: several places in the Mountain Prov.).

Habitat — Hardly any information available. According to Merrill, Enum. Philipp. Flow. Pl. 2 (1923) 231, growing in thickets, 1200–1700 m altitude.

Note — The description given only pertains to the specimens from Luzon and does not reflect the existing variation in the entire area.

2. Rosa transmorrisonensis Hayata, Ic. Pl. Formos. 3 (1913) 97; Kalkman, Blumea 21 (1973) 284, f. 1. — Type: Mori s.n., Mt Morrison.

Rosa luzoniensis Merr., Philipp. J. Sc. 17 (1921) 259; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 243. — Types: Santos BS 31876, Mearns 4300, McGregor BS 8336, Pauai.

Climbing shrubs. *Twigs* thin, glabrous, prickles 2 under each leaf, up to 7 mm. *Leaves* up to 5 cm, glabrous, free part of petiole 1–4 mm long. *Stipules* adnate over c. 5 mm, wings c. 1.2 mm wide, free tips c. 3 mm long, margins fimbriate and with glandular teeth. *Leaflets* (5 or) 7, lateral ones elliptic, apical one larger than lateral ones, 8–15 by 4–6 mm, margin finely serrate, lateral petiolules up to 1 mm, apical one up to 4 mm. *Flowers* solitary, terminal on short and leafy laterals, rarely also 1 or 2 in the upper leaf-axils. *Pedicels* up to 1 cm long, glabrous, not glandular. Closed *flowerbuds* globular, mucronate. *Hypanthium* ellipsoid, c. 4 by 2.5 mm, glabrous and without glands outside, hairy inside. *Sepals* reflexed in anthesis, ovate to elliptic, acuminate, 6–7 by 2.5–3.2 mm not including the 1–3 mm long acumen, glandular and with 1–3 side-lobes on the exposed margins, glabrous outside except parts covered in bud. *Petals* obovate, up to 11 mm long, retuse, white. *Stamens* c. 100, filaments up to 5.5 mm, anthers c. 1.2 mm long. *Pistils* c. 12, ovary spindle-shaped, with a plume of long silky hairs near apex, styles c. 5 mm long, firmly cohering, glabrous. *Hips* and *achenes* not seen.

Distribution — Taiwan; in *Malesia*: Philippines (Luzon: Mountain Prov.).

Habitat — In thickets, altitude c. 1200 m and higher.

Fig. 13. *Rosa luciae* Crépin. a. Flowering branch, × 1; b, c. flower buds, × 3.5; d. flower halved lengthwise, × 3.5; e. infructescence, × 1 (a: Ramos & Edaño BS 37920; b, e: Jacobs 7595; c, d: Conklin & del Rosario PNH 72379).

TRIBUS MALEAE

Woody plants. Leaves simple, rarely pinnate. Stipules on the very base of the petiole, free or connate. Hypanthium hollowed, entirely or partly connate with pistils, becoming fleshy. Epicalyx absent. Carpels (1-)2-5, partly or entirely connate with each other. Ovules 2, rarely 1, ascending. Pome with bony or membranous endocarp, or multipyrenous drupe with woody endocarps. $x = 17$. — Figs. 14, 15.

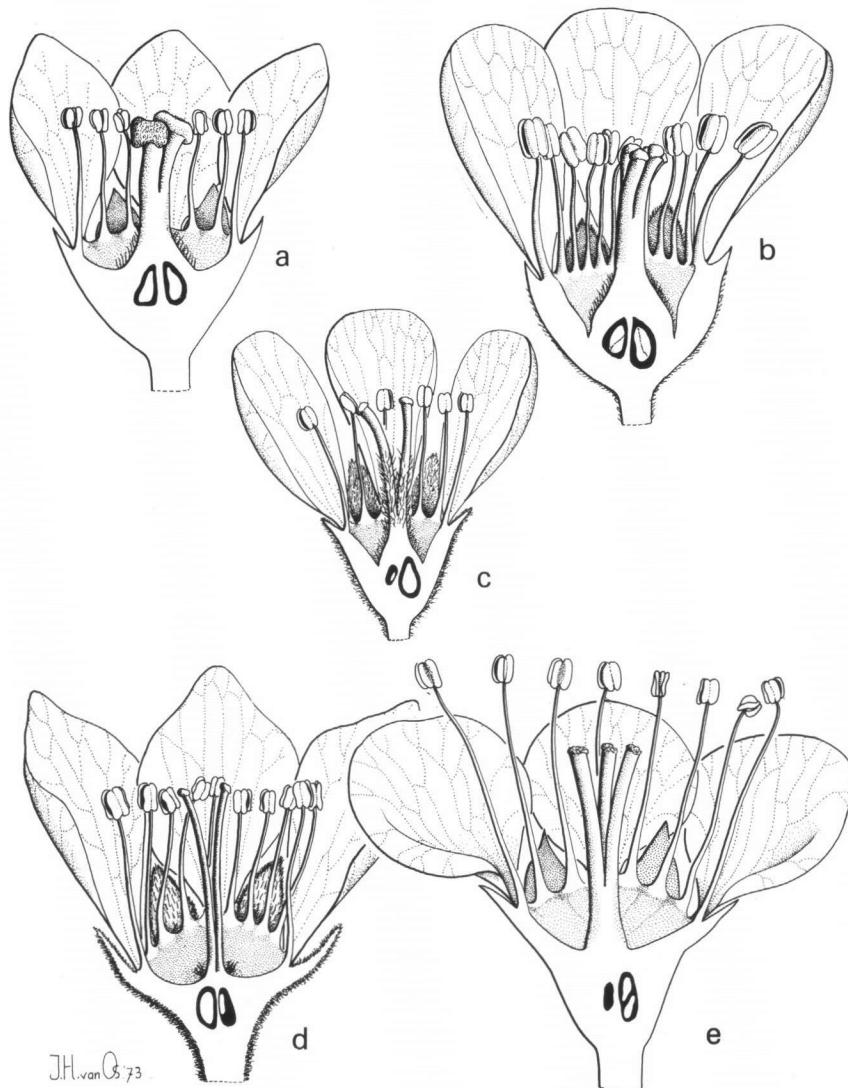


Fig. 14. Flowers of tribus Maleae, representative Malesian species, slightly idealized. a. *Photinia integrifolia* Lindley; b. *Photinia davidiana* (Decne.) Cardot; c. *Eriobotrya bengalensis* (Roxb.) Hook. f.; d. *Rhaphiolepis philippinensis* (Vidal) Kalkman; e. *Micromeles corymbifera* (Miq.) Kalkman (a: Meijer 1669; b: Fuchs & Collenette 21455; c: Krukoff 4086; d: Sulit PNH 12452; e: Meijer 3466).

Note — The tribe as recognized here confirms to the subfamily *Maloideae* of most classifications. In that group often two taxa are recognized, e.g. as *Sorbeae* and *Crataegeae*. Of the genera in Malesia only the non-indigenous *Cotoneaster* and *Pyracantha* belong to the latter group. Iketani & Ohashi in a recent paper [J. Jap. Bot. 66 (1991) 319–351] recorded the anatomical structure of the fruits of 'Sorbeae' and drew conclusions about evolutionary trends and phylogenetic relationships. The inclusion of *Stranvaesia* in *Photinia* is supported by them, *Micromeles* is included in *Aria*, and *Pourthiaeae* is considered to be a genus distinct from *Photinia* [see also Iketani & Ohashi, J. Jap. Bot. 66 (1991) 352–355].

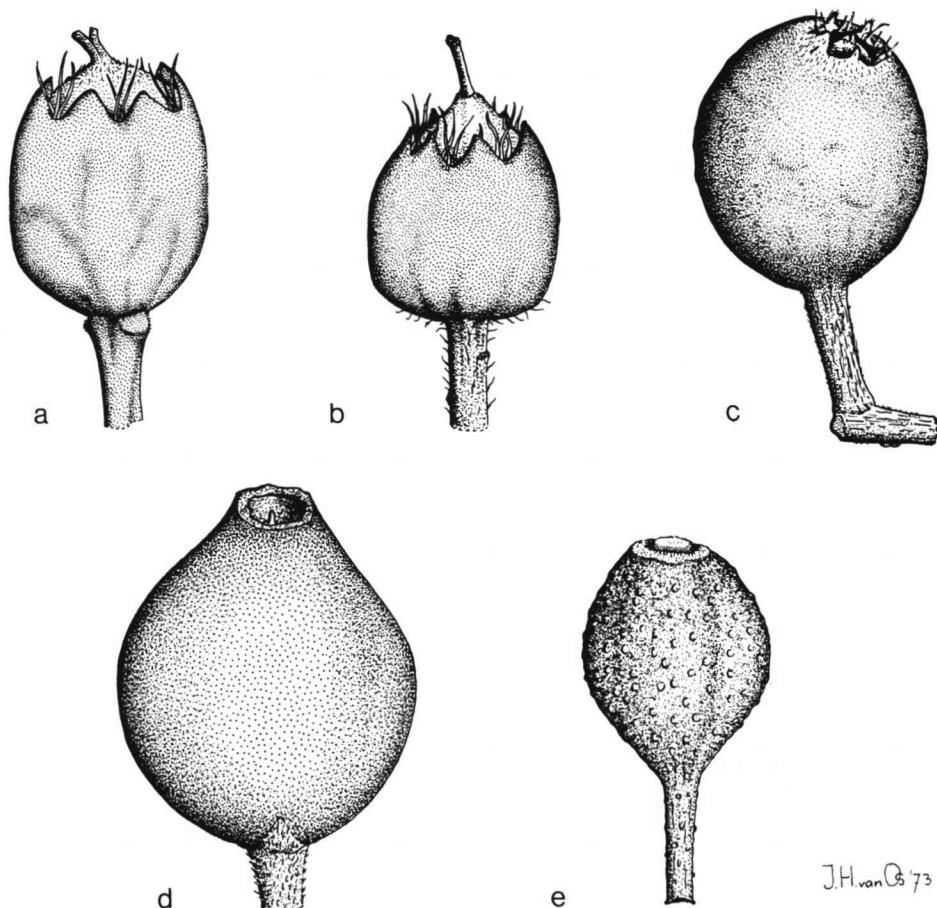


Fig. 15. Fruits of tribus Maleae, representative Malesian species. a. *Photinia integrifolia* Lindley; b. *Photinia davidiiana* (Decne.) Cardot; c. *Eriobotrya bengalensis* (Roxb.) Hook. f.; d. *Rhaphiolepis philippinensis* (Vidal) Kalkman; e. *Micromeles corymbifera* (Miq.) Kalkman (a: Hochreutiner 908; b: Fuchs & Collenette 21431; c: Thorenaar 101; d: Sulit PNH 7760; e: Rahmat Si Boeaa 10727).

COTONEASTER

Cotoneaster Medikus, Philos. Bot. 1 (1789) 154. — Type species: *Cotoneaster vulgaris* Lindley (*Mespilus cotoneaster* L.).

Evergreen or deciduous shrubs or small trees. *Twigs* not thorny. *Carpels* 2–4, free from each other but connate with the hypanthium, ovary semi-inferior, styles free, ovules 2. *Fruits* crowned by persistent sepals, containing 2–4 pyrenes.

Distribution — About 50 species [261 species according to Robertson et al., Syst. Bot. 16 (1991) 391], centred in E Asia, many species cultivated as ornamentals all over the world.

Cotoneaster lacteus W.W. Smith, Notes Roy.

Bot. Gard. Edinb. 10 (1917) 23 ('*lactea*'). — Types: *Forrest* 10419, 11338, 12720, China.

Shrubs or trees up to 7 m. *Twigs* hairy when young, glabrate. *Leaves* elliptic, 5–6 by 2.5–4 cm, base acute, margin entire, apex rounded and mucronate, coriaceous, with 6–8 pairs of nerves, not terminating in the margin, when young sparsely hairy above and densely short-woolly below, when mature sparsely hairy to glabrous. *Petiole* up to 8 mm long. *Stipules* narrowly triangular, c. 6 by 0.7 mm, hairy outside. *Inflorescence* a terminal, umbel-shaped, compound raceme, the lower 1 to 3 branches in the axils of (reduced) leaves, c. 2.5 cm high, 5 cm wide, rachises densely hairy in anthesis and still hairy in fruit, pedicels up to 4 mm long, densely hairy. *Hypanthium and sepals* densely hairy outside, upper rim of hypanthium free from ovary. *Petals* orbicular, spreading in anthesis, white. *Stamens* c. 20. *Pistils* 2, in their basal half connate with the hypanthium, free from each other and long-hairy on the free top, styles terminal. *Fruits* obovoid, c. 6 by 5 mm when dry

(8 by 6 mm when living), when developing the free rim of hypanthium and sepals closing around the top, with 2 stones protruding at the top when ripe, reddish.

Distribution — Three specimens collected by J. Sterly in the Gembogl Subprovince, Papua New Guinea, said to be introduced there from Goroka, also in Chimbu Province. Cultivated in these places as an ornamental, but also running wild.

Habitat — At altitudes from 1980 to 2650 m.

Ecology — Fruits eaten and propagated by birds (Sterly 1751).

Notes — In this predominantly apogamous genus which, moreover, contains a large number of cultivars, species delimitation is difficult. I am by no means certain that the identification of the three specimens available is correct, but it did not seem useful to me to pursue the matter further.

J. M. B. Smith, Science in New Guinea 16 (1990) 13–21, reported the presence in 1989 of *Cotoneaster glaucophyllus* on Mt Wilhelm, Papua New Guinea, as planted and growing well. I did not see a specimen from that locality but the same species may be involved as in the other places.

ERIOBOTRYA

Eriobotrya Lindley, Trans. Linn. Soc. Lond. 13 (1921) 102; Blume, Bijdr. (1826) 1102; Hutch., Gen. Flow. Pl. 1 (1964) 214; Vidal, Fl. Camb., Laos & Vietnam 6 (1968) 60; Fl. Thailand 2 (1970) 42; Kalkman, Blumea 21 (1973) 430. — Type species: *Eriobotrya japonica* (Thunb.) Lindley.

Unarmed trees or shrubs, evergreen. *Leaves* simple, margin dentate or entire, main nerves terminating in the margin. *Stipules* free or intrapetiolarly connate. *Inflorescence* a terminal, compound raceme. *Flowers* bisexual, 5-merous. *Hypanthium* obconoid, elongated above the ovary. *Sepals* persistent. *Petals* clawed, white. *Stamens* 15–40. *Ovary* semi-inferior to inferior, the hairy top of the connate carpels free from the hypanthium,

2–5-celled, styles as many as cells, usually connate at base, ovules 2 per cell. *Fruit* a pome, crowned by the persistent sepals, mesocarp fleshy or with many stone-cells, endocarps free from each other, membranous, each containing one seed. *Seeds* large, testa thin but hard, endosperm absent, embryo with thick cotyledons. — **Figs. 14c, 15c.**

Distribution — About 20 species, from Himalayan region to Japan and throughout SE Asia southwards to Sumatra, Malaya and Borneo. Only one species indigenous in Malesia.

KEY TO THE SPECIES

- 1a. Leaves soon glabrate, practically glabrous when mature, with 7–10 pairs of nerves. Stipules free. Petiole 1.5–2.5 cm. Ovary semi-inferior, 2(–3)-celled
 1. **E. bengalensis**
- b. Leaves tardily glabrescent, still densely woolly when mature, with 10–22 pairs of nerves. Stipules intrapetiolarily cohering or connate. Petiole up to 1 cm. Ovary inferior, 5-celled **2. E. japonica**

1. Eriobotrya bengalensis (Roxb.) Hook. f., Fl. Brit. India 2 (1878) 371; Ridley, Fl. Mal. Penins. 1 (1922) 681; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 326, f. 2. — *Mespilus bengalensis* Roxb., Fl. Ind. 2 (1832) 510. — Type: Wallich 668/2.

Trees up to 27 m, sometimes shrubs, rarely buttressed, with spreading branches having flat foliage ('terminalian' branching), bark rough and lenticellate, white or grey. *Twigs* densely hairy when young, rapidly glabrescent. *Leaves* oblong to oblong-lanceolate, 6–17 by 2–6.5 cm, base gradually tapering, margin shallowly serrate, apex acute to shortly acuminate, coriaceous, with 7–10 pairs of nerves, each often with one stronger side-nerve, those and the primary nerves terminating in the marginal teeth, venation transverse, almost glabrous when mature but with a woolly indumentum on midrib and nerves when young, red when young and also when old. *Petiole* 1.5–2.5 cm, dark. *Stipules* caducous, triangular, up to c. 4 by 1 mm, free, ciliolate, sometimes large and semi-foliaceous, up to 14 by 4 mm. *Inflorescence* a terminal compound raceme with up to 12 laterals, the lowermost of those in the axils of (reduced) leaves, upper ones in axils of bracts, the panicle up to 14 cm long, peduncle very short, lower laterals up to 12 cm, pedicels 2–3(–5) mm long, densely hairy as are all other axes in the panicle. *Flowers* fragrant. *Hypanthium* 1.5–2.5 mm high, densely hairy outside. *Sepals* triangular, 2–2.5 by 1–1.5 mm, patent to reflexed during anthesis, densely hairy outside. *Petals* ovate to broadly obovate, 4–4.5 by 2–4.5 mm, reflexed in anthesis, with hairs at base inside,

otherwise glabrous, white. *Stamens* c. 20, filaments up to 3 mm, glabrous, anthers 0.6–0.8 mm long. *Ovary* inferior when young, later semi-inferior, 2(–3)-celled (see Note), long and densely hairy on top, styles shortly connate at base, 2–2.5 mm long, hairy in the lower part. *Fruits* globular, 10–15 by 9–15 mm (in dry state), exocarp more or less hairy, grey-green when young, reddish when ripe, mesocarp hard and gritty, endocarps firm-membranous. *Seeds* 1 or 2 per fruit, with thin papery testa. — **Figs. 14c, 15c.**

Distribution — SE Asia from Eastern part of Himalayas to Vietnam and West Malesia (Sumatra, Malaya incl. offshore islands, Bangka?, Borneo).

Habitat — Primary forest, often on limestone, found from sea-level up to 1200 (to over 1500) m altitude.

Ecology — Often on limestone, see also Chin See Chung, The limestone flora of Malaya (1973) 430.

Note — One specimen seen had consistently 5 styles, but this is quite exceptional.

2. Eriobotrya japonica (Thunb.) Lindley, Trans. Linn. Soc. Lond. 13 (1821) 102; Backer & Bakh. f., Fl. Java 1 (1964) 512. — *Mespilus japonicus* Thunb., Fl. Japon. (1784) 206. — Type: Thunberg s.n., Japan.

Small trees. *Twigs* rather stout, rough. *Leaves* more or less crowded at twig ends, oblong to lanceolate, 12–28 by 3.5–8 cm, margin shortly dentate in upper part, coriaceous, with 10–22 pairs of nerves, woolly above when very young but soon

glabrate, densely woolly and tardily glabrescent below. *Petiole* 4–10 mm long. *Stipules* intrapetiolar, cohering or connate into a 2-topped scale, up to 1 cm long. *Inflorescence* a compound raceme, 15–20 cm long, peduncle short, pedicels very short. *Flowers* rather large, very hairy. *Sepals* persistent. *Petals* long remaining, white. *Ovary* inferior or almost so, the densely hairy top free from the hypanthium, 5-celled, styles (practically) free, hairy at base. *Fruits* globular to ovoid, up to 8 cm diam. but usually (much) smaller, exocarp hairy, yellow to orange, mesocarp juicy, endocarps mem-

branous. *Seeds* 2 or 3, large, with firm, glabrous, brown testa.

Distribution — Native in SE China, there and in Japan cultivated for many years. Now throughout the tropics and subtropics cultivated as a fruit tree. In *Malesia*: cultivated in home gardens, not commercially, at medium altitudes.

Uses — The juicy fruits (*loquat*) are eaten raw and made into jam. See Nguyen Tien Hiep & E.W.M. Verheij in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 161–164.

MALUS

Malus Miller, Gard. Dict. (1754). — Type species: *M. sylvestris* Miller (*Pyrus malus* L.).

Trees or shrubs, unarmed or with thorns, mostly deciduous. *Leaves* simple, lobed or toothed. *Flowers* in few-flowered, simple racemes. *Hypanthium* with a free rim above the ovary, the rim persistent or rupturing after anthesis. *Ovary* inferior, carpels completely adnate with the hypanthium and without exposed free top, 3–5-celled, styles connate at base. *Fruit* a pome, mesocarp fleshy, in most species without stone cells, endocarp cartilaginous.

Distribution — About 50 species in Eurasia and N America. In *Malesia* only a cultivated species.

Malus domestica Borkh., Hand. Forstbot. 2 (1803) 1272. — *Malus sylvestris* Miller. — *Malus pumila* Miller.

Small trees, up to 10 m. *Twigs* hairy when young. *Leaves* elliptic-ovate, 4–13 by 3–7 cm, base rounded, margins serrate, apex acute, with 3–6 pairs of nerves, usually hairy underneath. *Inflorescence* a simple raceme, terminal on short shoots. *Hypanthium* hairy outside. *Sepals* persistent on the fruit. *Petals* white to pinkish. *Ovary* 4- or 5-celled, inferior, ovules 2 per cell. *Fruit* a pome, globular to obovoid, exocarp glabrous, variously coloured, mesocarp fleshy, without stone cells, endocarp leathery to bony. *Seeds* usually 2 per cell.

Distribution — Originated in West Asia, now

spread over the entire world. In *Malesia*: cultivated in E Java, Timor, the Philippines, and probably some other islands.

Uses — See Surachmat Kusumo & E.W.M. Verheij in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 200–203 for a review of the cultivation of the apple in Malesian countries.

Note — The name accepted pertains to the cultivated apple which is supposed to be derived from wild *Malus pumila* and several other species hybridized with it. Since the genetic make-up of its many cultivars cannot be ascertained, a separate specific epithet seems warranted, although other ways of reasoning may lead to the acceptance of one of the other names mentioned above.

MICROMELES

Micromeles Decne., Nouv. Arch. Mus. Paris 10 (1874) 168; Kalkman, Blumea 21 (1973) 437. — *Pyrus* L. sect. *Micromeles* Hook. f., Fl. Brit. India 2 (1878) 377. — *Sorbus* L. sect. *Micromeles* Rehder, Manual Cult. Trees & Shrubs (1927) 382; Vidal, Fl. Camb., Laos & Vietnam 6 (1968) 24. — Type species: not designated.

Aria (Pers.) Host, Fl. Austral. 2 (1831) 7, p.p.: Robertson et al., Syst. Bot. 16 (1991) 389.

Unarmed trees or shrubs, deciduous. *Leaves* simple, with the main nerves terminating in the serrate margin. *Stipules* free. *Inflorescence* a terminal, panicle-shaped, compound raceme. *Flowers* bisexual, 5-merous. *Hypanthium* obconoid, elongated above the ovary, the free part transversely rupturing after anthesis and falling with sepals and other flower-parts, its inside covered with a disc. *Stamens* c. 20. *Ovary* inferior, apex covered by the hypanthial disc, 2–5-, most often 3-celled, styles as many as cells, usually connate at base, ovules 2 per cell. *Fruit* a pome, exocarp usually lenticellate, mesocarp hard and dry, endocarp thin. *Seeds* several, testa rather thin, endosperm absent, embryo with flat cotyledons. — **Figs. 14e, 15e, 16.**

Distribution — Less than 15 species, in SE and E Asia, one species also in W Malesia.

Note — There is considerable disagreement about the status of this genus: must it be combined with *Pyrus*, with *Sorbus*, with *Aria*, or be kept separate? For the time being I prefer to cling to my earlier (1973) decision to keep the genus separate.

Micromeles corymbifera (Miq.) Kalkman, Blumea 21 (1973) 437. — *Vaccinium? corymbiferum* Miq., Fl. Ind. Bat. Suppl. 1 (1861) 588. — *Sorbus corymbifera* (Miq.) Hiep & Yakovlev, Bot. J. 66 (1981) 1188. — Type: *Junghuhn s.n.* (*Pl. Jungh. Ined. 1035*), Sumatra.

Pyrus granulosa Bertoloni, Mem. Accad. Sc. Bologna II, 4 (1864) 312, pl. 3; Ridley, Fl. Mal. Penins. 1 (1922) 680; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242; Blumea 12 (1964) 14 (transfer of *Vaccinium corymbiferum*). — Type: *Hookerf. & Thomson 'Pyrus c'*, India.

Micromeles malayensis Ridley, J. Bot. 62 (1924) 296. — Type: *Nur 11241*, Malaya.

Photinia bartlettii Merr., Pap. Mich. Acad. Sc. 19 (1934) 155; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242. — Type: *Bartlett 8662*, Sumatra.

Trees up to 30 m, or shrubs, sometimes hemi-epiphytic, deciduous, bark brown, scaly. *Twigs* glabrous or with very few hairs, with light-coloured lenticels. *Leaves* oblong to elliptic-oblong, rarely ovatish, 7–13 by 4–7.5 cm, base acute, more rarely rounded, margin shallowly serrate with usually the basal quarter entire, apex acute to acuminate, herbaceous, with 8–11 pairs of nerves, venation transverse, not very prominent, sometimes with small, cylindrical glandular outgrowths on midrib above, very young leaves sometimes (see Note) ferruginous-woolly, but also in that case mature leaves entirely glabrous, the indumentum disappearing completely. *Petiole* 1–3 cm long, red as are midrib and leaf margin. *Stipules* early falling, very small and bristle-like, but sometimes on the basal leaves of a shoot well-developed and up to 6 by 1 mm. *Inflorescence* up to 7 cm long, branched

up to the third order with the lower primary branches axillary to normal leaves, all axes, including the up to 5 mm long pedicels, glabrous, sometimes with few hairs, rarely densely hairy (see Note). *Flowers* 5-merous, fragrant. *Hypanthium* obconoid, often more or less abruptly widened in upper part, 2–3 mm high, the upper 1 mm free from the ovary and falling after anthesis, glabrous outside or with some hairs, inside covered by a glabrous disc. *Sepals* triangular, 1.5–2.5 by 1.5–3 mm, glabrous. *Petals* (broadly) elliptic, ovate or obovate, 4.5–6 by 3–4.5 mm, white, glabrous. *Stamens* 19–24, filaments up to 6 mm, anthers 0.7–1 mm long. *Ovary* (2–)3(–4)-celled, styles distinctly connate in lower part, up to 5.5 mm long. *Fruits* globular to ellipsoid, sometimes more ovoid or obovoid, rarely pear-shaped (see Note), with a large circular scar



Fig. 16. *Micromeles corymbifera* (Miq.) Kalkman. Fruiting branch. Mt Sago, Sumatra. Photo W. Meijer.

at apex, usually still present when young flush appears, 9–19 by 8–17 mm, exocarp brownish, always with corky lenticels, mesocarp very hard and woody. Seeds 1 or 2 per cell, flat, up to 5 by 3.5 mm, testa firm-membranous, glabrous. — Figs. 14e, 15e, 16.

Distribution — Continental Asia: India (Assam), China (Yunnan), Thailand, Laos, Cambodia, Vietnam; Malesia: Sumatra, Peninsular Malaysia.

Habitat — Primary montane forest, also in mossy forest, and in more open, shrubby vegetation, at (600?)–1100–3000 m altitude.

Ecology — One of the few examples of the hemi-epiphytic life-style. The plant may start as an epiphytic shrub, later sending down roots and acquir-

ing the tree-habit. It does not seem to be a strangler, killing its host, as some *Ficus* do. See Van Steenis, Flora Malesiana I, 4 (1948) xxix, and Corner, Way-side Trees, ed. 3 (1988) 620, sub *Pyrus corymbifera* (nom. illeg., non Nakai, 1935).

Notes — Some collections have (traces of) a dense woolly indumentum on inflorescences and leaves, but mostly the specimens are (almost) glabrous, the indumentum that may have been present at a young stage having disappeared rapidly and thoroughly.

In only one collection from Sumatra (van Steenis 10031) the fruits are pyriform as in var. *turbinata* Cardot which is known from the continent.

PHOTINIA

Photinia Lindley, Trans. Linn. Soc. Lond. 13 (1821) 103; Kalkman, Blumea 21 (1973)

418. — Type species: *Photinia serrulata* Lindley.

Stranvaesia Lindley in Edw., Bot. Reg. 23 (1837) t. 1956. — Type species: *Stranvaesia glaucescens* Lindley.

Unarmed trees or shrubs, evergreen or deciduous, Malesian species all evergreen. Leaves simple, entire to serrate, the secondary nerves not running to the margin. Stipules free. Inflorescence a terminal, panicle- or corymb-shaped compound raceme. Flowers bisexual, 5-merous. Hypanthium obconoid to campanulate, elongate above the ovary. Sepals persistent. Petals more or less distinctly clawed. Stamens 16–25. Ovary semi-inferior, usually hairy on the exposed, free top, (1–)2–5-celled, styles as many as cells, connate at base or free, ovules 2 per cell. Fruit a pome, covered at apex by the persistent free part of the hypanthium and the sepals, core consisting of the bony endocarp. Seeds 1 or 2 per cell, rather small, testa rather hard, endosperm thin or absent. — Figs. 14a, b, 15a, b, 17.

Distribution — About 50 species in E Asia, 5 species extending into Malesia.

Note — Robertson et al., Syst. Bot. 16 (1991) 391, included the N American genus *Aronia* in *Photinia*.

KEY TO THE SPECIES

- 1a. Leaves, when dry, with many black to brown glandular dots scattered on the underside 4. *P. prunifolia*
- b. Leaves without dark dots 2
- 2a. Leaves entire 3
- b. Leaves crenate to serrate, at least in upper part 4
- 3a. Ovary 2- (or 3-)celled 2. *P. integrifolia*
- b. Ovary 4- or 5-celled 1. *P. davidiana*
- 4a. Inflorescences glabrous. Ovary 2- or 3-celled 5. *P. serratifolia*
- b. Inflorescences rather densely shortly woolly. Ovary 4- or 5-celled 3. *P. nussia*

1. Photinia davidianna (Decne.) Cardot, Bull. Mus. Nat. Hist. Nat. Paris 25 (1919) 399. — *Stranvaesia davidianna* Decne, Nouv. Arch. Mus. Paris 10 (1874) 179. — Type: *David s.n.*, Tibet.

Stranvaesia integrifolia Staph., Hook. Ic. Pl. 23 (1894) t. 2295; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 246. — Type: *Haviland 1071 K*, Mt Kinabalu.

Shrubs or trees, up to 4.5 m. Twigs shortly hairy when young. Leaves elliptic to elliptic-oblong or slightly ovate or obovate, 4–9 by 2–4 cm, base rounded to acute, margin entire, apex usually acute and mucronate, sometimes shortly acuminate, stiff-coriaceous, with 7–9 pairs of nerves, often not distinctly different from strong intermediate veins, venation widely reticulate, reddish when young, red before falling, shortly hairy on main nerves when young, glabrescent. Petiole 0.5–1 cm long. Stipules narrowly triangular, up to 3 by 0.5 mm, keeled inside, sparsely hairy, glandular on the keel, caducous. Racemes pyramidal, up to 4 cm long, with up to 8 first order laterals of up to 3.5 cm long and usually branched again, lowermost laterals usually in axils of leaves, rachises hairy, pedicels up to 3 mm long, hairy. Hypanthium campanulate, up to 2 mm high, only the basal half connate with the ovary, sparsely hairy outside. Sepals triangular, 1–1.5 by 1.7–2 mm, usually ciliolate. Petals elliptic to broadly orbicular, up to 4.5 by 4 mm, white to pinkish. Stamens 17–20, filaments up to 3 mm, anthers up to 1 mm long. Ovary semi-inferior, shortly hairy on the dome-shaped free top, 3-, 4- or 5-celled, styles up to 3.5 mm long, halfway connate, hairy at extreme base. Fruits (sub)globular, up to 8 by 8 mm when dry, free part of hypanthium and sepals closely appressed against the top, exocarp sparsely hairy, red, mesocarp thick and fleshy, up to 2 mm thick when dry, endocarp thin, bony. Seeds 1–5, ellipsoid to ovoid, c. 4 by 2 mm, with firm, brown testa. — Figs. 14b, 15b.

Distribution — China, Taiwan, N Vietnam; Malesia: Sumatra (only few seen, from Aceh), Borneo (only seen from Mt Kinabalu, rather many collections).

Habitat — In Malesia in subalpine shrubland, at 2600–3900 m altitude, on the continent lower.

2. Photinia integrifolia Lindley, Trans. Linn. Soc. Lond. 13 (1821) 103; Blume, Bijdr. (1826) 1103; Miq., Fl. Ind. Bat. I, 1 (1855) 387; Backer & Bakh. f., Fl. Java 1 (1964) 513. — Type: *Wöllich 669*, Nepal.

Photinia notoniana Wight & Arn., Prod. 1 (1834) 302; Koord. & Vleton, Bijdr. Booms. Java 5 (1900) 361; Koord., Exk. Fl. Java 2 (1912) 318; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242. — Type: *Wight 1014*, lecto chosen by Vidal, from India.

Photinia notoniana Wight & Arn. forma *grandiflora* Koord. & Vleton, Bijdr. Booms. Java 5 (1900) 361 — Type: not indicated, described from Mt Gedeh, Java.

Shrubs or trees up to 15 m. Twigs glabrous or somewhat hairy when young. Leaves elliptic to oblong, 4–15(–21) by 2.5–8 cm, base cuneate to rounded, entire (rarely faintly toothed), apex obtuse to acute, usually shortly acuminate, coriaceous, with 6–12 pairs of secondary nerves which are usually not well distinguishable from stronger tertiary ones, venation widely reticulate, glabrous or with few hairs when young. Petiole 0.5–4 cm long, often red as are midrib and leaf margins. Stipules triangular, up to 2 by 1 mm, early caducous. Inflorescence up to 7(–12) cm long, branched up to the 4th order, with up to 12 or more spreading branches of the first order, the lower ones often in axils of leaves and up to 8(–10) cm long, all rachises up to the 0–7 mm long pedicels short-hairy or glabrous. Flowers fragrant. Hypanthium obconoid, 1–2 mm high, usually glabrous outside. Sepals triangular, obtuse, (0.5–) 0.8–1(–1.5) by 1–2 mm. Petals (sub)orbicular, 2.5–4 by 2–4 mm, white. Stamens 17–21, filaments up to 2.5(–4) mm, glabrous, anthers 0.5–0.8 mm long. Ovary usually hairy on the exposed top, 2- (rarely 3-)celled, styles up to 3 mm, usually shortly to halfway connate. Fruits subglobular, 4–8 by 3.5–6.5 mm, upper part of hypanthium and sepals closely appressed against top, exocarp red, mesocarp fleshy, endocarp hard, bony. Seeds usually 2 per cell, ovoid, up to 4 mm long, with hard, brown, glabrous testa, endosperm thin. — Figs. 14a, 15a, 17.

Note — The species has in various ways been divided into varieties, see discussion in Kalkman, Blumea 21 (1973) 418. The two varieties as accepted here, certainly have no phylogenetic value whatsoever.

a. var. *integrifolia* — Kalkman, Blumea 21 (1973) 423.

The synonyms given above under the species pertain to the type variety.

Twigs always glabrous. Rachises of the inflorescence, including the pedicels glabrous.



Fig. 17. *Photinia integrifolia* Lindley. Fruiting shrub. Mt Arjuno, Java. Photo J. Jeswiet.

Distribution – Continental Asia (Tibet, Nepal, Sikkim, Bhutan, NE India, S China, Thailand, Sri Lanka); *Malesia*: Java, Lesser Sunda Islands.

Habitat – In Malesia in montane forest and subalpine shrubbery, altitude (1400–)2000–3350 m.

b. var. *sublanceolata* Miq., Fl. Ind. Bat. I, 1 (1855) 387; Kalkman, Blumea 21 (1973) 423.
— Type: *Horsfield* 432, Java.

Photinia dasylhysa Miq., Fl. Ind. Bat. I, 1 (1855) 387; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242. — Type: fragment in U?

Photinia integrifolia Lindley var. *subdenticulata* Miq., Fl. Ind. Bat. I, 1 (1855) 387. — Type: *Horsfield* 1135, Java.

Twigs glabrous to distinctly hairy when young. Rachises of the inflorescence, including the pedicels with a cover of short, appressed hairs which do not entirely disappear with age.

Distribution – Continental Asia (NE India, Burma, S China, Laos, S India, Sri Lanka; *Malesia*: Sumatra, Malaya, Java, Lesser Sunda Islands).

Habitat – In Malesia in montane forest and subalpine vegetation, altitude 1300–3200 m.

3. *Photinia nussia* (D. Don) Kalkman, Blumea 21 (1973) 429. — *Pyrus nussia* D. Don, Prod. Fl. Nepal. (1825) 237. — *Stranvaesia nussia* (D. Don) Decne., Nouv. Arch. Mus. Paris 10 (1874) 178; Vidal, Adansonia 5 (1965) 231, 577. — Type: *Hamilton* s. n., lecto, Nepal; Wallich 658, para.

Eriobotrya ambigua Merr., Philipp. Bur. Gov. Lab. Pub. 35 (1906) 19; Enum. Philipp. Flow. Pl. 2 (1923) 226. — *Stranvaesia ambigua* Nakai, J. Arnold Arbor. 5 (1924) 72. — Type: Meyer FB 2796, Luzon; paratypes: Whiford 1155, 1168, 1307, Luzon.

Eriobotrya oblongifolia Merr. & Rolfe, Philipp. J. Sc., Bot. 3 (1908) 102; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 226. — Type: Mearns & Hutchinson FB 4680, Mindanao.

Trees up to 10 m. Twigs densely shortly woolly when young, glabrescent. Leaves oblong to oblanceolate, 5–11 by 2–4 cm, base acute, margin entire in lower half, shallowly crenate to serrate in upper part, apex acute to shortly acuminate, coriaceous, with 8–15 pairs of secondary nerves, often not distinguishable from stronger tertiary nerves, venation widely reticulate, both surfaces shortly woolly when young, hairs soon vanishing and ultimately quite glabrous. Petiole 1–2 cm long. Stipules narrowly triangular, 1.5–6 by 0.5–0.8 mm, not very early caducous. Inflorescences corymbose in shape, up to 8 cm long, branched up to the 4th order, with up to 8(–12) branches of the first order, the lower of these in the axils of leaves or bracts, up to 6 cm long, all rachises sparsely and shortly appressed-hairy, pedicels up to 5 mm long, with long appressed hairs. Hypanthium obconoid, 1–2 mm high, sparsely hairy to glabrous outside. Sepals triangular, 1–1.5 by 1.5–2 mm. Petals elliptic, 4–4.5 by 2.5–3 mm, white. Stamens c. 20, filaments up to 3 mm, glabrous, anthers 0.7–1 mm long. Ovary hairy on exposed top, 5- (rarely 4-)celled, styles up to 4.5 mm, half-way connate, with hairs at base. Fruits globular, up to 6 mm diam., upper rim of hypanthium and sepals closely appressed against its bulging, dome-shaped, now almost glabrous top, the pericarp thin and brittle when dry, practically glabrous, colour unknown. Seeds not seen in mature state.

Distribution — Continental Asia (E Himalayas, NE India, N Burma, N Thailand, N Laos, S China, but not recorded from Taiwan); Malesia: Philippines.

Habitat — On the continent in evergreen forest types, altitude 500–1800 m, in the Philippines hardly any information available, but up to 2500 m altitude.

Note — The description only pertains to the Philippine material.

4. Photinia prunifolia ((Hook. & Arn.) Lindley in Edw., Bot. Reg. 23 (1837) t. 1956. — *Photinia serrulata* β *prunifolia* Hook. & Arn., Botany Beechey's Voy. (1833) 185. — Type: Beechey's Coll. s.n., Macao.

Small trees up to 12 m, bark (dark) brown. Twigs glabrous. Leaves lanceolate, 9–14 by 2–4.5 cm, base cuneate, margin irregularly and finely glandular-serrate except at very base, apex gradually taper-

ing, with 12–16 pairs of secondary nerves, not always distinguishable from stronger intermediary tertiary nerves, venation reticulate, glabrous on both sides, glossy above, with many scattered brown to black glandular dots on the dull underside. Petiole 0.7–1.5 cm long. Stipules subulate, 3–6 mm long, very early caducous. Inflorescences corymbose in shape, up to 8 cm long, branched up to the 4th order, with up to 8(–12) branches of the first order, the lower of these in the axils of leaves or bracts, up to 6 cm long, all rachises sparsely and shortly appressed-hairy, pedicels up to 5 mm long, with long appressed hairs. Hypanthium obconoid, 1–2 mm high, sparsely hairy to glabrous outside. Sepals triangular, 1–1.5 by 1.5–2 mm. Petals elliptic, 4–4.5 by 2.5–3 mm, white. Stamens c. 20, filaments up to 3 mm, glabrous, anthers 0.7 mm long. Ovary hairy on exposed top, 2-celled, styles up to 3 mm long, halfway connate, hairy at base. Fruits obovoid, c. 6 by 4 mm, free part of hypanthium and sepals closely appressed against its top, exocarp glabrous, colour unknown, mesocarp fleshy, endocarp hard and bony. Seeds 3 or 4 per fruit, ellipsoid, 4 by 2 mm, testa with a hard inner layer and a mucilaginous outer layer, endosperm thin, cotyledons flat.

Distribution — China, Vietnam; Malesia: Sumatra (only seen from Mt Sago), Borneo (only seen from Mt Kinabalu).

Habitat — In Malesia in primary and secondary forest, altitude 1100–1700 m.

5. Photinia serratifolia (Desf.) Kalkman, Blumea 21 (1973) 424. — *Crataegus serratifolia* Desf., Catal. Hort. Paris, ed. 3 (1829) 288, 408. — Type: probably non-existent, see discussion in Kalkman, l.c.

Photinia serrulata Lindley, Trans. Linn. Soc. Lond. 13 (1821) 103, nom. illeg., superfl.; DC., Prod. 2 (1825) 631; Blume, Bijdr. (1826) 1103; Miq., Fl. Ind. Bat. I, 1 (1855) 388; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 226; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242. — *Crataegus glabra* auct. non Thunb., Fl. Japon. (1784) 205: i.a. Aiton, Hort. Kew., ed. 2, 3 (1811) 202; Lindley, l.c., in syn.

Small trees up to c. 15 m. Twigs glabrous, bud scales up to 13 by 11 mm, dark and hard. Leaves oblong to elliptic, 8.5–13.5 by 3.5–5.5 cm, base acute to rounded, margin finely crenate to serrate, entire only at extreme base, apex acute, sometimes acuminate, with up to 14 pairs of secondary nerves, often not distinguishable from stronger tertiary nerves, venation widely reticulate, not prominent,

with few hairs on both surfaces when very young, quite glabrous when mature. *Petiole* 2–3 cm long. *Stipules* awn-shaped, 4.5–5.5 by 1 mm, with excentric midrib, early caducous. *Inflorescence* corymbose to semi-globular in shape, up to c. 8 cm long, with up to 12 first order laterals, these up to 9 cm long and branched again, the lowermost ones in axils of leaves, rachises including the 2.5–4 mm long pedicels glabrous or faintly hairy. *Flowers* 5-merous, rarely 4-merous. *Hypanthium* obconoid, 1.5–2 mm high, upper half free from the ovary, glabrous outside. *Sepals* broadly triangular, 1–1.2 by 1.2–1.8 mm. *Petals* suborbicular to broadly ovate, 3–4.5 by 3–3.5 mm, white. *Stamens* 16–20, filaments up to 3 mm, glabrous, anthers 0.5–0.8 mm long. *Ovary* hairy on the free top, 2-, rarely 3-celled, styles up to 2.5 mm long, free. *Fruits* subglobular to ovoid with flattened apex, up to

c. 5.5 by 6 mm when dry, upper part of hypanthium and sepals closely appressed against top of fruit, exocarp red (to purple?), mesocarp fleshy, endocarp rather hard. *Seeds* 2–4(–6), ellipsoid, c. 3 mm long, with firm, brown testa, endosperm a thin layer, cotyledons rather flat.

Distribution – S India, China, Japan, Taiwan; *Malesia*: Philippines (seen from Luzon and Mindanao) and doubtfully Sumatra. Often cultivated in Europe.

Habitat – In the Philippines in mossy forest at c. 2500 m altitude.

Notes – About the name change, necessitated by Lindley's name being illegitimate, see Kalkman, l.c.

The one specimen from Sumatra (*Jacobs* 4363) is too poor for reliable identification. The description given only pertains to Philippine collections.

PYRACANTHA

Pyracantha Roemer, Fam. Nat. Syn. Monogr. 3 (1847) 104, 219. — Type species: *Pyracantha coccinea* Roemer (*Mespilus pyracantha* L.), according to some authors, but not designated according to Index Nominum Genericorum.

Evergreen shrubs. *Twigs* often thorny. *Carpels* 5, free from each other but connate with the hypanthium, ovaries semi-inferior, styles free, ovules 2. *Fruits* crowned by persistent sepals, containing 5 pyrenes.

Distribution — Some 12 species in Eurasia. In *Malesia* one planted species.

Pyracantha angustifolia (Franch.) Schneider, Ill. Handb. Laubholzk. 1 (1906) 761. — *Cotoneaster angustifolius* Franchet, Pl. Delav. (1889) 221. — Types: *Delavay* 47, 61, 3730, China.

Shrubs, c. 3 m high. *Twigs* glabrous, some transformed into thorns. *Leaves* on short shoots, oblong, 1–3.5 by 0.5–1 cm, base acute to rounded, margin entire, apex rounded, often retuse, mucronate, nerves and veins reticulate, hardly visible, coriaceous, when mature glabrous except remnants of indumentum near midrib above. *Flowers* in short racemes at apex of short shoots, pedicels hairy, up to 8 mm long. *Hypanthium* low-campanulate, c. 1 mm high, hairy outside, above the ovaries with a free rim lined inside by a disc. *Sepals* triangular, 1 by 2 mm. *Petals* orbicular, 3 by 3

mm, spreading in anthesis, white. *Stamens* c. 20, filaments up to 2 mm, glabrous, anthers 0.5 mm long. *Ovaries* connate with hypanthium over half their length, hairy on top and dorsally, styles 2 mm, glabrous. *Fruits* depressed globular, 3 by 5 mm, exocarp glabrous, orange (to red?), mesocarp thin-fleshy, 5 pyrenes remaining free from each other, their upper parts exposed, endocarps woody. *Seeds* 2 per cell, flat.

Distribution – Originating from Yunnan, China, planted as an ornamental in Europe and N America. Three herbarium specimens seen, collected (in 1953 and 1958) from planted bush(es) along the Baguio–Bontoc Road, Benguet, Mountain Prov., Luzon.

Habitat – Roadside, at an altitude of 1000 (or 2000?) m.

PYRUS

Pyrus L., Sp. Pl. (1753) 479. — Type species: *Pyrus communis* L.

Trees or shrubs, unarmed or with thorns, deciduous. *Leaves* simple. *Flowers* in few-flowered, simple racemes. *Hypanthium* with a free rim above the ovary, the rim persistent or falling with the sepals. *Ovary* inferior, carpels completely adnate with the hypanthium at base connate with each other, 5-celled, styles free. *Fruit* a pome, mesocarp fleshy and with stone cells, endocarp cartilaginous.

Distribution — In Eurasia c. 12 species.

Note — *Pyrus communis* L., the European pear, is not or hardly cultivated in Malesia. The Oriental pear, *P. pyrifolia* (Burm.) Nakai (syn. *P. serotina* Rehder) is cultivated in some places and is a promising product. See L.P.A. Oyen in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 272–276.

RHAPHIOLEPIS

Rhaphiolepis Lindley ex Ker in Edw., Bot. Reg. 6 (1820) t. 468, nom. et orthogr. cons.; Nakai, J. Arnold Arbor. 5 (1924) 61. — Type species: *Rhaphiolepis indica* (L.) Lindley ex Ker.

Unarmed small trees or shrubs, evergreen. *Leaves* simple, margins entire or incised, nerves not terminating in the margin. *Stipules* free. *Inflorescence* a terminal, compound, rarely simple raceme. *Flowers* bisexual, 5-merous. *Hypanthium* obconoid, elongate above the ovary, the free part at inside covered by a disk. *Sepals* and upper part of hypanthium caducous after anthesis. *Petals* clawed. *Stamens* 15–20. *Ovary* inferior, top covered by the glabrous disk, 2-celled, styles 2, free or connate at base, ovules 2 per cell. *Fruit* a pome, globular to (ob)ovoid, with a distinct circular scar at top, mesocarp fleshy, thin, endocarp thin. *Seeds* 1 or 2 per fruit, large, testa thin and firm, endosperm absent, cotyledons thick. — Figs. 14d, 15d.

Distribution — Few species in SE and E Asia, two of them often cultivated as ornamentals. In Malesia one wild species and a cultivated one.

KEY TO THE SPECIES

- 1a. Leaves densely woolly when young, glabrate, with finely reticulate darker venation which is distinctly visible underneath. Hypanthium up to 2.5 mm long, less than half of it free from the ovary 2. *R. philippinensis*
- b. Leaves only slightly hairy when young, soon quite glabrous, with a more coarse venation, not darker and not so clearly visible. Hypanthium 3 mm or longer, half of it or even more free from the ovary 1. *R. indica*

1. Rhaphiolepis indica (L.) Lindley ex Ker in Edw., Bot. Reg. 6 (1820) t. 468. — *Crataegus indica* L., Sp. Pl. (1753) 477. — Type: LINN sheet 643.11.

Shrubs or small trees. Leaves more or less crowded, oblong to obovate-oblong, 3–7 by 1–2.5 cm, base gradually narrowed, margin serrate, apex acute to obtuse and acuminate, with c. 5 pairs of nerves, herbaceous to subcoriaceous, with some hairs when very young, soon glabrous. Petiole up to 0.5 cm long. Stipules small, caducous. Racemes compound, up to 13 cm long, the peduncle very short, rachises practically glabrous, pedicels up to 5 mm long. Flowers fragrant. Hypanthium 3–3.5 mm high, sparsely hairy outside. Sepals pointed-triangular, up to 5 by 1–1.5 mm long. Petals up to 6 mm long, usually white, sometimes pinkish. Ovary glabrous, styles loosely connate at base. Fruits globular, c. 6 mm diam., black when ripe.

Distribution — SE Asia from Thailand to S China, also in Taiwan and Hainan. The species is cultivated as an ornamental in many countries, also in Malesia.

Habitat — On the continent in open types of evergreen forest, up to c. 1300 m altitude.

Note — The description given is based on specimens cultivated in Java. The variation in the wild is much larger. See also the note under the following species.

2. Rhaphiolepis philippinensis (Vidal) Kalkman, Blumea 21 (1973) 434. — *Eriobotrya philippinensis* Vidal, Rev. Pl. Vasc. Filip. (1886) 123; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 226; Vidal, Adansonia 5 (1965) 577, in obs. — Types: Vidal 1350, 1353, both Luzon.

Photinia luzoniensis Merr., Philipp. Bur. Gov. Lab. Pub. 17 (1904) 18; Philipp. J. Sc., Suppl. 1 (1906) 60; Enum. Philipp. Flow. Pl. 2 (1923) 226; Steenis, Bull. Jard. Bot. Buitenzorg III, 13 (1934) 242. — Types: Merrill 3223, holo; 3714, para; both Luzon.

Eriobotrya acuminatissima Nakai, J. Arnold Arbor. 5 (1924) 71. — Type: Martelino & Edaño BS 35622, Panay.

Shrubs or small trees up to 10(–18) m, bark flaky. Twigs densely woolly when young, glabres-

cent. Leaves oblong or obovate-oblong to lanceolate, rarely elliptic, 5–17 by 2.5–5 cm, base tapering or more rounded, margin sometimes entire, mostly variously incised, at least in the upper part, apex acute or rounded and acuminate, coriaceous, with 7–12 pairs of nerves, often a smaller nerve of about the same strength between two primary nerves, venation finely reticulate, woolly hairy when young on lower surface and near midrib above, indumentum (almost) disappearing with age. Petiole 0.5–2.5 cm long. Stipules triangular, 2.5–4 by 0.7–1.5 mm, usually rather long persistent. Inflorescences 2–7.5 cm long, with up to 8 branches, the lower ones often in the axils of leaves, up to 6 cm long, all rachises including the 2–10 mm long pedicels densely woolly. Hypanthium obconoid, 2–2.5 mm high, upper rim free, densely hairy outside. Sepals triangular, 1.5–3.5 by 1.2–2 mm. Petals elliptic to suborbicular, up to 6.5 by 4.5 mm, white or whitish. Stamens 16–20, filaments up to 3.5 mm, glabrous, anthers 0.5–0.8 mm long. Ovary 2-celled, styles free or shortly cohering, up to 4 mm long, sometimes glabrous but usually with some hairs at base. Fruits ovoid to subglobular, 6–9 by 4–9 mm when dry, with a more or less flattened top but sepals and hypanthium rim sometimes dropping off late, exocarp hairy to glabrous, dark purple when ripe, the mesocarp thin and fleshy, stony when dry, the endocarp thin. Seeds 1 or 2 per fruit, rather large, with thin but firm testa. — Figs. 14 d, 15 d.

Distribution — *Malesia*: Philippines (several islands, also on Palawan), Borneo (only seen from Sabah).

Habitat — In forest, found at 300–2600 m altitude.

Ecology — Several specimens seen were collected on ultramafic soil. For some other collections bearing no notes this may also be the case.

Notes — It is certainly not impossible that a future monographer will decide that this species has to be included in *Rhaphiolepis indica*. The differences are vegetative and unimpressive but that holds for all species recognized in the genus up till now.

The leaves of the Philippine specimens are averagely shorter than those in Sabah, but the overlap is large: Philippines 5–14 by 2.5–5 cm, Borneo 11–17 by 3.5–5 cm.

TRIBUS PRUNEAE

Woody plants with simple leaves. Stipules on the twigs. Epicalyx absent. Pistil 1, superior, enclosed in hypanthium. Ovules 2, pendulous. Drupaceous fruits, mesocarp sometimes dry. $x = 8$.

PRUNUS

Prunus L., Sp. Pl. (1753) 473; Kalkman, Blumea 13 (1965) 1–115.

Trees or shrubs, rarely with thorns. *Buds* protected by bud-scales or naked. *Leaves* simple, pinnately nerved, margin incised or entire, with glands in the margin and/or on the underside or on the petiole. *Stipules* free or (rarely) connate, on the twigs. *Inflorescence* basically a raceme, rarely branched, in a large part of the genus reduced to a few-flowered umbel or to only one or two flowers. *Flowers* normally 5-merous, usually bisexual. *Sepals and petals* well distinct except in sect. *Mesopygeum* where the perianth segments are (sub)equal or irregularly differentiated without (much) difference in size. *Petals* usually white or pink. *Stamens* many (up to 85). *Pistil* 1, at the bottom of the cup-, bell- or funnel-shaped hypanthium, at its base often with hairs implanted on the hypanthium, also when the ovary itself is glabrous; ovary superior, 1-locular; style terminal, stigma capitate; ovules 2, pendulous, only 1 normally developing. *Fruit* a drupe, mesocarp in wild species not very thick, fleshy to (rather) dry, endocarp bony to woody, thin to thick. *Seed* with thin testa, without endosperm. — Figs. 18–20.

Distribution — At least 200 species, cosmopolitan. In *Malesia* c. 35 species and one or two rarely cultivated ones.

Habitat — The majority of the species is formed by medium (up to 15 m high) or large (up to 35 m, rarely higher) trees, in different types of forest: primary lowland forest, montane forest, mossy forest. A good number of species are also found in montane or subalpine shrubland and then they often are (large) shrubs.

About 44% of the species *only* occur from sea-level to c. 1500 m altitude, about 32% *only* above 1000 m. The remaining 24% of the species can be found as well below 1000 m as above 1500 m. Only some four species have regularly been collected from altitudes surpassing 3000 m, going up to c. 3700 m.

Taxonomy — The genus *Prunus* contains a fair number of useful species with edible fruits that have since long been domesticated, cultivated, and changed by man. Taxonomy has in the past often over-classified such groups, giving generic status to each of the cultivated species. This has also happened in *Prunus*, where apricot, cherry, almond, peach have been placed in *Armeniaca*, *Cerasus*, *Amygdalus*, *Persica*, respectively. It is more in agreement with standards set in the classification of ‘useless’ groups to unite these genera and recognize subgenera for some of them. A useful classification of the genus is:

Subgenus *Prunus*

(among others *P. armeniaca* L., apricot; *P. domestica* L., European plum; *P. salicina* Lindl., Japanese plum)

Subgenus *Amygdalus* (L.) Focke

(among others *P. amygdalus* Batsch, almond; *P. persica* (L.) Batsch, peach and nectarine)

Subgenus *Cerasus* (Miller) Focke

(among others *P. avium* L., sweet cherry; *P. cerasus*, sour cherry)

Subgenus *Padus* (Miller) Focke

(among others *P. padus*; *P. serotina*)

Subgenus *Laurocerasus* (Tourn. ex Duhamel) Rehd.

The order in which the subgenera are placed, is not phylogenetical, *Padus* probably being the most 'primitive' subgenus.

Of the subgenera, only *Laurocerasus* is represented in Malesia by native wild species, *Padus* has one insufficiently known species which may or may not be wild (see *Prunus C*), the other three subgenera are distinctly temperate and not successful in cultivation in the Malesian region. Only *P. persica* has been mentioned at the end of the present treatment.

KEY TO FLOWERING SPECIMENS

Specimens bearing flowers only are often not identifiable except by comparing the vegetative parts with fruiting material.

- 1a. Leaves densely dark-dotted on underside. Stipules intrapetiolarly connate 2
- b. Leaves not densely dark-dotted on underside, sometimes pitted on the underside where hairs have been. Stipules connate or free 3
- 2a. Leaves without basal glands. Petals 6–7.5 mm long 3. *P. mirabilis*
- b. Leaves with 2 basal glands, usually on petiole, rarely in margin. Petals up to 4 mm long 2. *P. javanica*
- 3a. Basal glands on the petiole 4
- b. Basal glands on the leaf surface, sometimes in a contraction of the leaf-base, sometimes absent 5
- 4a. Racemes without leaves on the basal part of the rachis 1. *P. adenopoda*
- b. Racemes with 2 leaves under the flowers Prunus C
- 5a. Leaves with 2 or more basal glands and with usually many additional glands in two rows parallel with the midrib. Petals 3–8 times as long as sepals . 4. *P. wallichii*
- b. Additional glands, when present, not distinctly in two rows parallel with the midrib. Petals at most twice as long as sepals 6
- 6a. Basal leaf-glands deeply hollowed, distinctly bulging above. 7
- b. Basal leaf-glands flat or only slightly hollowed and hardly bulging above, or in all leaves absent 14
- 7a. Racemes solitary and simple. Basal leaf-glands in blade proper 8
- b. Racemes in bundles (short shoots without or with terminal bud) or truly compound. Basal glands sometimes in contraction of the leaf-base 12
- 8a. Stipules free 9
- b. Stipules with the bases of their midribs intrapetiolarly connate 11

- 9a. Stamens 50 or more 23. *P. polystachya*; 26. *P. rubiginosa*
 b. Stamens not more than c. 50 10
- 10a. Ovary densely hairy 20. *P. marsupialis*
 b. Ovary glabrous or with few hairs 12. *P. fragrans*
- 11a. Stamens 20–40 9. *P. clementis*
 b. Stamens 50–85 23. *P. polystachya*
- 12a. Stamens 50 or more. Inflorescences 3.5–11 cm long
 19. *P. malayana*; 23. *P. polystachya*
 b. Stamens not more than 50 13
- 13a. Leaves with 5–9 pairs of nerves. Inflorescences up to 1.5(–4) cm long. Ovary densely hairy 5c. *P. arborea* var. *densa*
 b. Leaves with 8–12 pairs of nerves. Inflorescences up to 3.5 cm long. Ovary sparsely hairy to glabrous 31. *P. turfosa*
 See also *Prunus A* with inflorescences up to 10 cm long
- 14a. Racemes in bundles (short shoots with or without terminal bud) or truly compound 15
 b. Racemes solitary and simple 19
- 15a. Stipules intrapetiolarly connate. Inflorescence a compound raceme, 5–10 cm long, with 1–5 laterals. Stamens 50–80. Ovary glabrous or with few hairs
 19. *P. malayana*
 b. Stipules free 16
- 16a. Ovary glabrous or with few hairs. Basal leaf-glands absent. Stipules usually with one large, hollowed gland outside. Stamens 15–40 6. *P. beccarii*
 b. Ovary densely hairy 17
- 17a. Perianth differentiated as triangular sepals and elliptic to obovate petals. Stamens 35–45 33. *P. versteeghii*
 b. Perianth segments subequal 18
- 18a. Stamens 10–20 22. *P. oocarpa*
 b. Stamens 10–50(–60) 5. *P. arborea*
- 19a. Ovary densely hairy 20
 b. Ovary glabrous or with few hairs 28
 N.B.: Ovary unknown in *Prunus D*, fruits sparsely hairy.
- 20a. Stipules intrapetiolarly connate 9. *P. clementis*
 b. Stipules free 21
- 21a. Racemes short (~1 cm), peduncle almost none, pedicels up to 2 mm 22
 b. Racemes and pedicels longer 24
- 22a. Leaves thin-papyraceous 15c. *P. grisea* var. *tomentosa*
 b. Leaves coriaceous, stiff 23
- 23a. Leaves usually with 2 basal glands. Stipules with 1–3 flat or pustular glands on the outside. Racemes with up to 6 flowers. Flowers small (hypanthium 1.5 mm long, perianth segments less than 1 mm long) 14. *P. glabrifolia*
 b. Leaves usually without basal glands. Stipules with glands in margin but not on surface. Racemes with up to 10 flowers. Flowers slightly larger (hypanthium 2–3 mm, perianth segments 1–1.5 mm long) 21. *P. oligantha*

24a.	Leaves herbaceous or papyraceous.	25
b.	Leaves coriaceous, often hard and thick	
8.	<i>P. brassii</i> ; 15a. <i>P. grisea</i> var. <i>grisea</i> ; 22. <i>P. oocarpa</i> ; 24. <i>P. pulgarensis</i> ;	
25.	<i>P. pullei</i> ; 27. <i>P. schlechteri</i> ; 30. <i>P. subglabra</i> ; 32. <i>P. turneriana</i>	
25a.	Racemes short, never over 5 cm long.	26
b.	Racemes (at least some) longer than 5 cm	
27.	<i>P. schlechteri</i> ; 29. <i>P. spicata</i> ; 32. <i>P. turneriana</i> ; 33. <i>P. versteeghii</i>	
26a.	Leaves thin-herbaceous to papyraceous	15c. <i>P. grisea</i> var. <i>tomentosa</i>
b.	Leaves herbaceous	27
27a.	Perianth segments subequal, 7–15	
17.	<i>P. lamponga</i> ; <i>P. odorata</i> (Insufficiently known species)	
b.	Perianth differentiated as sepals and petals	18. <i>P. laxinervis</i>
N.B.: See also the insufficiently known <i>P. odorata</i> .		
28a.	Leaves herbaceous to papyraceous.	29
b.	Leaves coriaceous, stiff	34
29a.	Racemes up to 3 cm long.	30
b.	Racemes longer than 3 cm	32
30a.	Leaves papyraceous	31
b.	Leaves herbaceous	
15a.	<i>P. grisea</i> var. <i>grisea</i> ; 16. <i>P. kinabaluensis</i> ; 17. <i>P. lamponga</i>	
31a.	Perianth segments subequal	15c. <i>P. grisea</i> var. <i>tomentosa</i>
b.	Perianth differentiated as sepals and petals, but equal in size	
7.	<i>P. brachystachya</i>	
32a.	Leaves hairy when young, indumentum still present when mature. Stipules often connate	13. <i>P. gazelle-peninsulae</i>
b.	Leaves glabrous or practically so when mature.	33
33a.	Stipules often connate. Racemes up to c. 30 cm long	11. <i>P. dolichobotrys</i>
b.	Stipules free. Racemes not longer than 10 cm	
15a.	<i>P. grisea</i> var. <i>grisea</i> ; 16. <i>P. kinabaluensis</i> ; 34. <i>P. wallaceana</i>	
34a.	Racemes shorter than 3 cm	
15b.	<i>P. grisea</i> var. <i>microphylla</i> ; 28. <i>P. sclerophylla</i>	
b.	Racemes longer than 3 cm	
10.	<i>P. costata</i> ; 15a, b. <i>P. grisea</i> var. <i>grisea</i> and var. <i>microphylla</i> ;	
16.	<i>P. kinabaluensis</i> ; <i>Prunus B</i>	

Flowers only known as remnants in *Prunus D* from New Guinea.

Not entered in the key the rarely cultivated *P. persica*.

KEY TO FRUITING SPECIMENS

1a.	Fruits ovoid or ellipsoid, distinctly longer than wide	2
b.	Fruits (sub)globular or transversely ellipsoid to didymous.	11
2a.	Leaves dark-punctate on underside	3
b.	Leaves not dark-punctate on underside.	4

- 3a. Fruits 21–29 by 13–16 mm. Basal leaf-glands absent 3. *P. mirabilis*
 b. Fruits 15–23 by 7–12 mm. Basal leaf-glands 2, on petiole or in blade-margin 2. *P. javanica*

4a. Basal leaf-glands on the petiole 1. *P. adenopoda*
 b. Basal leaf-glands on the undersurface 5

5a. Leaves with 2 or more basal glands and with usually many additional glands in 2 rows parallel with the midrib 4. *P. wallichii*
 b. Additional leaf-glands, if present, not in two rows parallel with the midrib 6

6a. Inflorescence a compound raceme 7
 b. Inflorescence a simple, solitary raceme 8

7a. Fruits 8–11 by 6–8 mm 22. *P. oocarpa*
 b. Fruits 18–25 by 16–21 mm 19. *P. malayana*

8a. Fruits not longer than 13 mm, not wider than 11 mm 9
 b. Fruits at least 14 mm long, at least 10 mm wide 10
 N.B.: Fruits 13–21 by 10–15 mm, prominently beaked, in insufficiently known taxon, see Note to 15c. *P. grisea* var. *tomentosa*.

9a. Leaves with acute base, with 5–8 pairs of nerves. Fruits 10–13 by 8–11 mm 21. *P. oligantha*
 b. Leaves with rounded to cordate base, with 7–11 pairs of nerves. Fruits 8–11 by 6–8 mm 22. *P. oocarpa*
 N.B.: 10–15 pairs of nerves in *Prunus B*, of which the fruits are insufficiently known.

10a. Basal leaf-glands deeply hollowed, distinctly bulging above. Fruits 24–30 by 15–17 mm, not with an apical point or beak 12. *P. fragrans*
 b. Basal leaf-glands flat or only slightly hollowed. Fruits 13–24 by 10–20 mm, included an apical point or beak of 1–4 mm. 17. *P. lamponga*; see also *Prunus D*

11a. Basal leaf-glands deeply hollowed, distinctly bulging above 12
 b. Basal leaf-glands flat or only slightly hollowed, or in all leaves absent 22

12a. Basal glands in a contraction of the leaf-base 13
 b. Basal glands in the leaf-blade proper 15

13a. Fruits 13–21 by 17–27 mm 23. *P. polystachya*
 b. Fruits not longer than 10 mm, not wider than 12 mm 14
 N.B.: Fruits insufficiently known in *Prunus A*.

14a. Leaves with 8–12 pairs of nerves. Fruits subglobular, 7–9 by 8–9 mm 31. *P. turfosa*
 b. Leaves with 5–9 pairs of nerves. Fruits transversely ellipsoid, 6–8.5 by 8–11.5 mm 5c. *P. arborea* var. *densa*

15a. Fruits not longer than 10 mm, not wider than 12 mm 16
 b. Fruits longer and/or wider 17

16a. Most of the racemes in bundles (short shoots with or without terminal bud) 5c. *P. arborea* var. *densa*
 b. Racemes always solitary 20. *P. marsupialis*

17a. Racemes simple and solitary 18
 b. Racemes branched or in bundles (short shoots with or without terminal bud) 21

- 18a. Stipules intrapetiolarly connate 9. *P. clementis*
 b. Stipules free 19
- 19a. Fruits subglobular to obscurely transversely ellipsoid, 16–17 by 16–20 mm
 26. *P. rubiginosa*
 b. Fruits transversely ellipsoid, distinctly wider than long 20
- 20a. Leaves with 5–8 pairs of nerves. Fruits 6–13 by 7.5–15 mm 20. *P. marsupialis*
 b. Leaves with 9–12(–14) pairs of nerves. Fruits 13–21 by 17–27 mm
 23. *P. polystachya*
- 21a. Fruits ellipsoid to subglobular, 18–25 by 16–21 mm 19. *P. malayana*
 b. Fruits transversely ellipsoid, 13–21 by 17–27 mm 23. *P. polystachya*
- 22a. Racemes in bundles (short shoots with or without terminal bud) or branched, sometimes mixed with solitary, simple ones 23
 b. Racemes all solitary and simple 26
- 23a. Fruits less than 12 mm long, less than 17 mm wide 24
 b. Fruits more than 15 mm long, more than 16 mm wide 25
- 24a. Leaves with 2 basal glands. Fruits 5–11.5 by 7–17 mm 5. *P. arborea*
 b. Leaves without basal glands. Fruits 5–7 by 6.5–10 mm 6. *P. beccarii*
 N.B.: Basal glands usually absent in 5a. *P. arborea* var. *robusta*, in which fruits are 9–11.5 by 13.5–17 mm.
- 25a. Racemes compound (branched). Fruits subglobular (or ellipsoid), 18–25 by 16–21 mm 19. *P. malayana*
 b. Racemes in bundles (and sometimes partly solitary). Fruits transversely ellipsoid to didymous, 15–19 by 22–28(–30) mm 33. *P. versteeghii*
- 26a. Seeds hairy, sometimes only sparsely so or only near hilum or apex 27
 b. Seeds entirely glabrous 32
- 27a. Ovary and fruit glabrous 28
 b. Ovary densely hairy, fruit still with hairs 30
- 28a. Leaves stiff-coriaceous. Fruits transversely ellipsoid, 6–10 by 8–11.5 mm
 10. *P. costata*
 b. Leaves herbaceous 29
- 29a. Leaves glabrous. Stipules free. Fruits subglobular, 12–14 by 13–16 mm
 16. *P. kinabaluensis*
 b. Leaves more or less densely hairy when young, hairs not quite disappearing when mature. Stipules often intrapetiolarly connate. Fruits transversely ellipsoid, 8–12 by 11–17 mm 13. *P. gazelle-peninsulæ*
- 30a. Fruits 17–33 by 18–34 mm, with thick and woody endocarp 32. *P. turneriana*
 b. Fruits (distinctly) smaller, endocarp not thick and woody 31
- 31a. Leaves very hard and stiff, 4–8.5 by 2–3.5 cm, with 6–9 pairs of nerves. Fruits transversely ellipsoid, 6–7.5 by 7–9 mm 8. *P. brassii*
 b. Leaves herbaceous to coriaceous, 6–17(–20) by 2–8(–10) cm, with 6–13 pairs of nerves. Fruits transversely ellipsoid to subglobular, 9–16 by 9–18 mm
 27. *P. schlechteri*
- See also 5. *P. arborea*, with racemes normally in bundles but sometimes mixed with solitary ones.

32a. Fruits more than 20 mm wide	33
b. Fruits at most 20 mm wide	34
33a. Fruits compressed subglobular, 17–33 by 18–34 mm, with thick and woody endocarp	32. <i>P. turneriana</i>
b. Fruits transversely ellipsoid to didymous, 15–19 by 22–28(–30) mm	33. <i>P. versteeghii</i>
34a. Fruits (sub)globular, not or not much wider than long	35
b. Fruits transversely ellipsoid to didymous, distinctly wider than long	47
35a. Fruits more than 13 mm long	36
b. Fruits up to 15 mm long	39
36a. Fruits 13–24 by 10–20 mm, including a distinct apical point or beak of 1–4 mm	17. <i>P. lamponga</i>
b. Fruits not distinctly beaked or pointed	37
37a. Fruits with thick, woody endocarp	32. <i>P. turneriana</i>
b. Endocarp not thick	38
38a. Leaves sparsely hairy when young, glabrous when mature	30. <i>P. subglabra</i>
b. Leaves densely hairy when young, lower surface remaining hairy when mature	24. <i>P. pulgarensis</i>
39a. Stipules intrapetiolarly connate	9. <i>P. clementis</i>
b. Stipules free	40
40a. Racemes usually not longer than 1 cm	41
b. Racemes normally longer than 1 cm	42
41a. Leaves papyraceous	15c. <i>P. grisea</i> var. <i>tomentosa</i>
b. Leaves coriaceous	21. <i>P. oligantha</i>
42a. Leaves herbaceous	43
b. Leaves stiff-coriaceous	46
43a. Ovary densely hairy and fruit still with hairs	44
b. Ovary and fruit glabrous	45
44a. Leaves (rather) densely hairy when young and hairs remaining on underside when mature	29. <i>P. spicata</i>
b. Leaves glabrous when mature	18. <i>P. laxinervis</i>
N.B.: See also 15a. <i>P. grisea</i> var. <i>grisea</i> , where specimens from Java and Lesser Sunda Islands rarely have a densely hairy ovary.	
45a. Leaves with usually more than 2, large glands, all or partly above the base in the blade	16. <i>P. kinabaluensis</i>
b. Leaves usually with 2 glands at the base	15a. <i>P. grisea</i> var. <i>grisea</i>
46a. Leaves (almost) glabrous when mature	15. <i>P. grisea</i>
b. Leaves densely hairy when young and usually still hairy on underside when mature	25. <i>P. pullei</i>
47a. Stipules intrapetiolarly connate	48
b. Stipules free	49
48a. Rachis of inflorescence hairy. Fruits 13–14 by 14–17(–20) mm	9. <i>P. clementis</i>
b. Rachis glabrous or sparsely short-hairy. Fruits 8–11.5 by 11–15 mm	11. <i>P. dolichobotrys</i>

49a. Leaves stiff-coriaceous	50
b. Leaves herbaceous to papyraceous	53
50a. Leaves (almost) glabrous when mature	51
b. Leaves (densely) hairy when young, still hairy on underside when mature	52
51a. Stipules with 1–3 flat or pustular glands on the outside	14. <i>P. glabrifolia</i>
b. Stipules not with glands on the outside	15. <i>P. grisea</i>
52a. Remnant of hypanthium under the fruit often enlarged, 1.5–8 mm diameter. Leaves often with revolute margins, apex obtuse, sometimes retuse	25. <i>P. pullei</i>
b. Hypanthium remnant under the fruit small. Leaves not with revolute margins, apex acute or shortly acuminate	28. <i>P. sclerophylla</i>
53a. Leaves papyraceous. Inflorescences not exceeding 3 cm in length	54
b. Leaves herbaceous. Inflorescences usually longer	55
54a. Fruits 8–12.5(–13.5) mm wide. West Malesia	15c. <i>P. grisea</i> var. <i>tomentosa</i>
b. Fruits 10–19 mm wide. New Guinea, Australia	7. <i>P. brachystachya</i>
55a. Ovary densely hairy and on fruit still hairs left	56
b. Ovary and fruit glabrous	57
56a. Leaves (rather) densely hairy when young, hairs on underside remaining when mature. Flowers and fruits sessile	29. <i>P. spicata</i>
b. Leaves (practically) glabrous when mature. Pedicels longer than 1 mm	15a. <i>P. grisea</i> var. <i>grisea</i>
57a. Flowers and fruits sessile	7. <i>P. brachystachya</i>
b. Pedicels at least 1 mm long	58
58a. Leaf apex rounded to broadly acuminate	11. <i>P. dolichobotrys</i>
b. Leaf apex gradually tapering to acuminate	59
59a. Leaves with 5–9 pairs of nerves	15a. <i>P. grisea</i> var. <i>grisea</i>
b. Leaves with 8–14 pairs of nerves	34. <i>P. wallaceana</i>

Fruits not seen or only in a too young stage in the following species, mentioned under Insufficiently known: *Prunus odorata* from Malaya; *Prunus A* from Borneo; *Prunus B* from Sumatra; *Prunus C* from Luzon.

Not entered in the key the rarely cultivated *P. persica*.

Subgenus Laurocerasus

Laurocerasus [Tourn., Inst. (1700) 627, t. 245, 'Lauro-cerasus'] ex Duhamel, Traité Arbres 1 (1755) 345, t. 133. — *Prunus* subg. *Laurocerasus* (Tourn. ex Duhamel) Rehder, Manual Cult. Trees (1927) 478. — Type species: *Prunus laurocerasus* L. *Pygeum* Gaertner, Fruct. Sem. Pl. 1 (1788) 218, t. 46; Koehne, Bot. Jahrb. 51 (1913) 177–224; ibid. 52 (1915) 334–345. — Type species: *Pygeum zeylanicum* Gaertn. = *Prunus ceylanica* (Wight) Miq.

Evergreen, rarely deciduous trees and shrubs. *Leaves* with entire or incised margin, basal glands either flat and on the underside of the blade, or flat to cushion-shaped and in the margin, or on the petiole. *Inflorescence* a raceme, usually simple but sometimes branched, the racemes sometimes placed in bundles, in axils of extant or fallen leaves or cata-

phylls. *Hypanthium* circumscissile after anthesis and its basal part persistent under the fruit. *Perianth* regular and biseriate or with (sub)equal segments.

Taxonomy — The inclusion of *Pygeum* in *Prunus* subg. *Laurocerasus* was elaborated and explained in Blumea 13 (1965).

Laurocerasus and *Padus* were united into one subgenus of *Prunus* by Koehne, Bot. Jahrb. 52 (1915) 279–333, but nowadays it is more usual to keep them as separate subgenera (if not as genera, see under the genus description).

The subgenus *Laurocerasus* can be divided into three sections, as explained in 1965:

- section *Laurocerasus*, also in Malesia;
- section *Mesopygeum* containing most but not all of the former genus *Pygeum*, predominantly Malesian;
- a section of South-, Central-, and some North-American species which does not yet have a formal name.

Uses — None of the species is a well-recognized source of useful timber, although of course the wood may be used locally. Medicinal uses of the bark are less often reported than could be expected from the presence of cyanogenetic glycosides. Culinary uses of the leaves are rare. In New Guinea bark of several species is used for the manufacturing of waist-belts, and it seems to be suitable for basket-work too.

Note — The variation in fruit size is in some cases very large, as appears from the descriptions. This recorded variation is partly caused by the fact that measurements were taken from dried specimens, where it is often impossible to distinguish between full-grown fruits and the not yet fully developed ones. Especially in fruits with a fleshy mesocarp this may give significant differences in size. However, this will not be the only explanation and at least in some species (e.g. *P. turneriana*) natural variation seems to be large also within one individual.

Section Laurocerasus

Leaves entire or with incised margin, basal glands on undersurface, in margin, or on petiole. *Perianth* regularly biseriate, petals by shape and texture distinct from sepals and (1.2–) 2–8 times as long as the latter. *Fruits* usually longer than wide, sometimes (sub)globular, rarely transversely ellipsoid.

Distribution — About 14 species in tropical Africa and tropical Asia, and in adjoining subtropical to cool-temperate regions: Macaronesia, Portugal, SE Europe, N Iran, China, Japan. In Malesia 4 species, only *Prunus javanica* of wide distribution.

- 1. *Prunus adenopoda* Koord. & Valeton, Bull. Inst. Bot. Buitenzorg 2 (1899) 10. — *Prunus macrophylla* Sieb. & Zucc. var. *adenopoda* Vidal, Adansonia 4 (1964) 145, comb. illeg. — *Laurocerasus adenopoda* (Koord. & Valeton) Browicz, Arbor. Körn. 15 (1970) 6. — Types: *Koorders 6419*, holotype; *Koorders 10014*; both Java.**

- Prunus pseudoadenopoda* Koord., Bull. Jard. Bot. Buitenzorg III, 1 (1918) 84, f. 5. — Type: *Koorders 40165*, Java.**

Prunus javanica auct. non (Teijsm. & Binn) Miq.: Meeuse & Adelb. in Backer, Bekn. Flora Java, emerg. ed. IV C 2 (1943) fam. 116, 24, p.p.; Backer & Bakh. f., Fl. Java 1 (1964) 521, p.p.

Trees up to 12 m. Twigs glabrous. Leaves elliptic to oblong, 8–17 by 4–6.5 cm, base acute to ± rounded, margin entire, apex acuminate, coriaceous, with 7–10 pairs of nerves, these hardly prominent below, venation hardly visible, both sides glabrous,

basal glands mostly 2 on the petiole, large and protruding. *Petiole* 7–10(–12) mm long. *Stipules* narrowly triangular, 5–12 by c. 1 mm, free, (almost) glabrous. *Racemes* solitary, in the axils of extant or (rarely) fallen leaves, up to 2.5 cm, peduncle ± absent, rachis pubescent, some empty bracts at base of raceme, pedicels up to 2.5 mm, longer under fruit. *Hypanthium* 1.5–2 mm high, (almost) glabrous outside. *Sepals* triangular, c. 1 mm long, ciliate at apex. *Petals* orbicular, 2.5–3 mm long. *Stamens* 25–35, filaments up to 5 mm long, anthers up to 0.5 mm long. *Ovary* glabrous, style up to 4.5 mm. *Fruits* ellipsoid, base attenuate, apex acute, 19–22 by 10–13 mm, mesocarp probably thick when fully ripe and living fruits possibly up to c. 24 by 18 mm, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution – Java, from Ujung Kulon in West to Malang Prov. in East), also on Nusakambangan Island.

Habitat – At low altitudes, up to 500 m, in forest but data scarce, also coastal.

Ecology – Some specimens collected on lime-containing soil.

2. *Prunus javanica* (Teijsm. & Binn.) Miq., Fl. Ind. Bat. I, 1 (1855) 365; Koord. & Valeton, Ic. Bogor. 2 (1904) 169, t. 140; Koord., Atlas 1 (1913) pl. 95; Merr., Enum. Born. Flow. Pl. (1921) 289; Backer & Bakh. f., Fl. Java 1 (1964) 521, excl. syn. *P. adenopoda*; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 338; Cockburn, Trees Sabah 2 (1980) 98, f. 26. — *Cerasus javanica* Teijsm. & Binn., Natuurk. Tijdschr. Ned. Indië 2 (1851) 309. — *Laurocerasus javanica* (Teijsm. & Binn.) Browicz, Arbor. Kórn. 15 (1970) 6. — Type: *Teijsmann s.n.*, Java.

Prunus junghuhniiana Miq., Pl. Jungh. (1855) 402; Miq., Fl. Ind. Bat. I, 1 (1855) 366; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 234. — Type: *Jung-huhn s.n.*, Java.

Prunus martabanica Kurz, For. Fl. Brit. Burma 1 (1877) 434; Ridley, Fl. Mal. Penins. 1 (1922) 672. — Type: *Wallich* 4902.

Platea oblonga Korth. ex Valeton, Crit. Overz. Olacinae (1886) 252. — Type: *Korthals s.n.*, Borneo. See Sleumer, Blumea 17 (1969) 248.

Prunus scortechinii (King) Koehne, Bot. Jahrb. 52 (1915) 297. — *Prunus martabanica* Kurz var. *scortechinii* King, J. As. Soc. Bengal 66, 2 (1897) 286. — Types: *King's Coll.* 5638, *Scortechini* 1782, Malaya.

Prunus forbesii Koehne, Bot. Jahrb. 52 (1915) 297. — Type: *Forbes* 2728, Sumatra.

Prunus papuana Koehne, Bot. Jahrb. 52 (1915) 299. — Types: *Schultze* 22, 49, New Guinea, probably lost.

Trees up to 35 m, rarely buttressed, bark smooth, peeling, red- to darkbrown, with distinct smell. *Twigs* glabrous, small cataphylls at base of shoots. *Leaves* ovate to oblong-ovate, rarely lanceolate, 8–20 by 3–7.5 cm, base rounded to acute, margin entire, apex tapering to long-acuminate, surface densely black-punctate beneath, herbaceous to slightly coriaceous, with 8–12 pairs of nerves, venation not very distinct, both sides glabrous, basal glands small, usually 2 on the petiole just below the blade, sometimes in the margin of the blade. *Petiole* 0.5–1(–1.5) cm. *Stipules* narrowly triangular to lanceolate, up to 5 by 1.5 mm, connate with their excentric keeled midribs. *Racemes* solitary, in axils of usually fallen leaves, 2–5 cm, in fruit longer, peduncle very short, rachis glabrous or pubescent, some empty bracts at base of raceme, pedicels up to 5(–7) mm. *Flowers* 5(–6)-merous. *Hypanthium* c. 2 mm high, glabrous outside or with few hairs. *Sepals* triangular, 0.5–1 mm long, hairy at apex. *Petals* elliptic to orbicular, 2.5–4 mm long, white. *Stamens* 25–50, filaments up to 6 mm, anthers up to 1 mm long. *Ovary* glabrous, style up to 4.5 mm. *Fruits* ovoid to ellipsoid, base rounded, apex acute, 15–23 by 7–12 mm, red when ripe, the endocarp glabrous inside. *Seed* with glabrous testa.

Distribution – Burma, Thailand, Vietnam, S Andaman I.; **Malesia**: Sumatra, Peninsular Malaysia, Borneo, Java (not seen from East), Palawan, Celebes, Bali (dubious, only one specimen with obscure label), Moluccas, New Guinea (only seen from Irian Jaya, up to the border with Papua New Guinea).

Habitat – In primary and secondary forest, altitude 0–1500 m.

Uses – Rarely noted. Bark used for rice-bins (Sabah, *Tikau SAN* 26474), as vermicide for buffalo (Sabah, *Kandilis SAN* 10323) and as fish poison (Kalimantan, *Nooteboom* 4449).

Note – The length/width index of the leaves varies from 2 to 4, but narrow-leaved specimens (especially collected in Borneo, but by no means restricted to the island) are not separated by a discontinuity from the others.

3. *Prunus mirabilis* Kalkman, Blumea 13 (1965) 49. — *Laurocerasus mirabilis* (Kalkman) Browicz, Arbor. Kórn. 15 (1970) 6. — Type: *Chew, Corner & Stainton* 1097, Mt Kinabalu, Sabah.

Trees up to 12 m. *Twigs* glabrous, with 2 cataphylls at base of shoots. *Leaves* elliptic to elliptic-oblong, 10–15 by 4–6 cm, base rounded, margin entire, apex acuminate, dark-punctate below, coriaceous; with 9–12 pairs of nerves, often on lower surface a rather strong parallel vein between two nerves, both sides glabrous, basal glands absent. *Petiole* 1–1.2 cm long. *Stipules* oblong-ovate, c. 4 by 1.5–2 mm, connate by their excentric keels, almost glabrous. *Racemes* solitary, in axils of fallen leaves, in fruit up to 14 cm long, peduncle 0.5 cm, rachis sparsely pubescent, pedicels 4–6 mm, growing after anthesis. *Flowers* 5–6-merous. *Hypanthium* c. 4 mm high, glabrous outside. *Sepals* rounded-triangular, 2–3 by 1.7–2 mm, ciliate. *Petals* ± orbicular, 6–7.5 by 5–7.5 mm, (almost) glabrous. *Stamens* c. 40, filaments 6–10 mm, anthers 1 mm long. *Ovary* glabrous. *Fruits* ellipsoid, base rounded to tapering, apex acute, 21–29 by 13–16 mm, glabrous, probably red when ripe, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — Only known from few specimens collected in different places on Mt Kinabalu, Sabah.

Habitat — Few notes, at altitudes 1950–c. 3200 m, probably in forest.

Note — Resembling the wider-leaved forms of *P. javanica*, but by its large flowers conspicuously different.

4. *Prunus wallichii* Steudel, Nomencl., 2nd ed., 2 (1841) 404; Merr., Contr. Arnold Arbor. 8 (1934) 72; Merr., Brittonia 4 (1941) 88; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 337. — *Prunus acuminata* (Wall.) Dietr., Syn. 3 (1843) 42, comb. illeg. non Michx. (1803); Koehne, Bot. Jahrb. 52 (1915) 296, incl. varieties. — *Cerasus acuminata* Wall., Pl. As. Rar.

2 (1831) 78. — *Laurocerasus wallichii* (Steudel) Browicz, Arbor. Kórn. 15 (1970) 5. — Type: Wallich 719.

Shrubs or trees rarely larger than 12 m, bark smooth or warty, brown. *Twigs* glabrous, some small cataphylls at base of shoots. *Leaves* elliptic to oblong or ovatish, 7–15 by 2–6 cm, base mostly acute, margin entire, sometimes in upper half serr(ul)ate, apex acuminate, often thin-herbaceous, with 6–9 pairs of nerves, often distinctly looped and joined, venation hardly visible, both sides glabrous, basal glands 2 or more, on the blade-surface, additional glands usually many, in two rows ± parallel with the midrib. *Petiole* 0.2–1 cm long. *Stipules* narrowly triangular, 4–6 by 0.7–1 mm, free, glabrous. *Racemes* solitary or in fascicles of 2–4, axillary, 2–10 cm, peduncle short, rachis ± glabrous, pedicels 2–8 mm, ± glabrous. *Hypanthium* 1.5–2 mm high, glabrous outside. *Sepals* triangular, 0.5–0.8 mm long, glabrous outside. *Petals* elliptic, 2–4 mm long, white. *Stamens* 10–20(–30), filaments up to 3 mm, anthers 0.6–0.8 mm long. *Ovary* densely to sparsely hairy but usually glabrous on the suture, sometimes reduced, style up to 4 mm. *Fruits* ovoid to ellipsoid, base rounded, apex ± acute, 10–18 (–20) by 6–11 mm when dry, probably up to 22 by 15 mm in living state, glabrous, purplish black, mesocarp thick and fleshy when ripe, endocarp thin, glabrous inside. *Seed* with glabrous testa.

Distribution — Continental Asia (NE India, Pakistan, China, Burma, Thailand, Laos, Vietnam); *Malesia*: Sumatra (West and North Prov.), Peninsular Malaysia (only seen from Pahang).

Habitat — Montane and subalpine forest and thickets, at altitudes (600–)1000–3000(–3600) m.

Uses — Seeds edible (W. Meijer, in litt., 1965).

Section Mesopygeum

Leaves always with entire margin, basal glands, if present, on the undersurface. *Perianth* with 5–14 segments which are subequal or more or less distinctly differentiated as sepals and petals, but the latter at most 1.5(–2) times as long as the former. *Fruits* usually transversely ellipsoid or didymous, sometimes (sub)globular, in few species ellipsoid.

Distribution — 33 species in tropical Asia, from India to Solomon Islands, 2 species also in Australia. In *Malesia* 30 species.

5. *Prunus arborea* (Blume) Kalkman, Blumea 13 (1965) 90; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 338; Cockburn, Trees Sabah 2 (1980) 96, f. 26; Corner, Wayside Trees Malaya,

ed. 3, 2 (1988) 619. — *Polydonta arborea* Blume, Bijdr. (1826) 1105. — *Pygeum arboreum* (Blume) Blume, Mél. Bot. nr. 2 (1855) 11; C. Muell. in Walp., Ann. 4 (1857) 642; Backer & Bakh.f.,

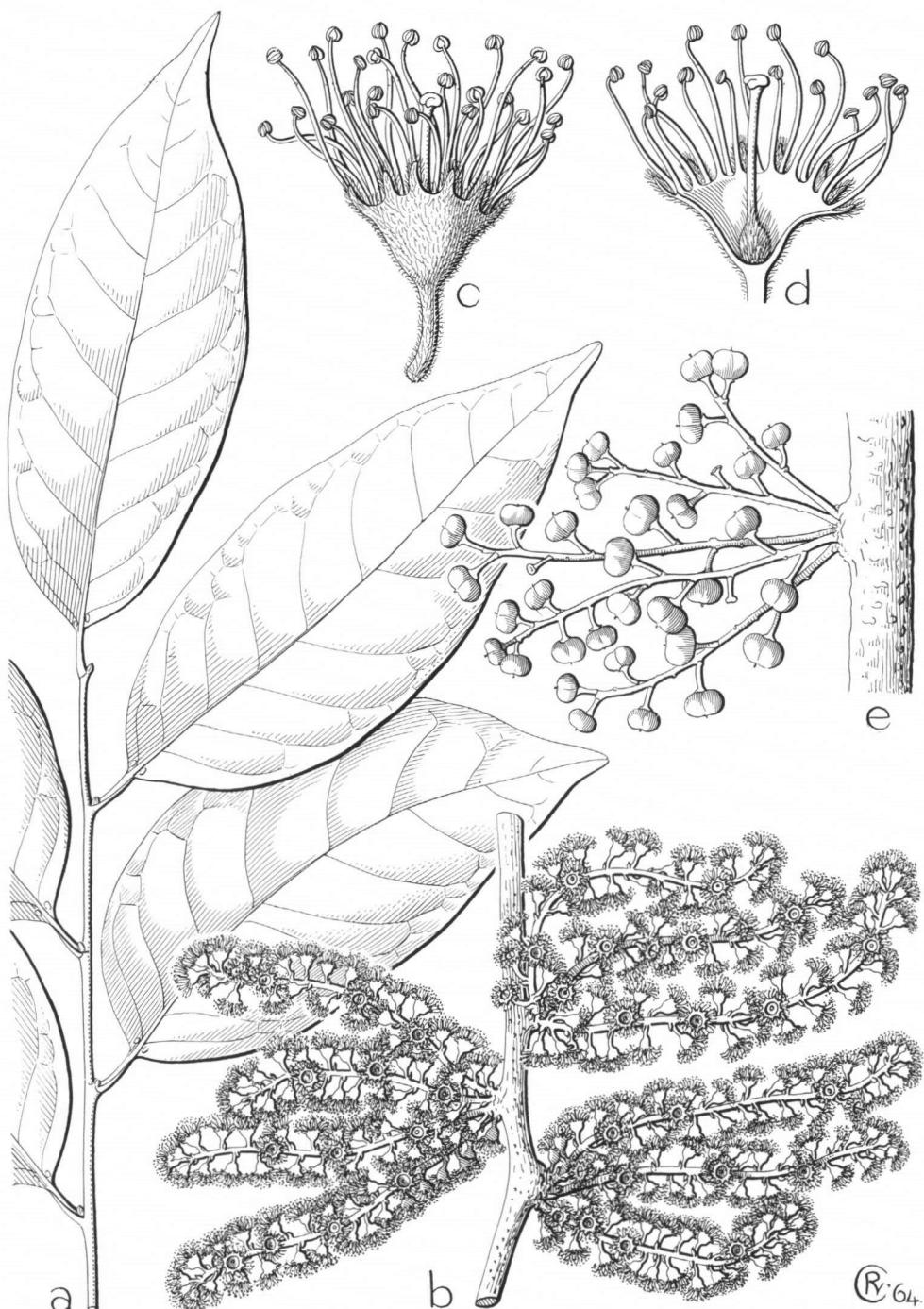


Fig. 18. *Prunus arborea* (Blume) Kalkman. a. Leafy twig, $\times 0.7$; b. bundles of flowering racemes, $\times 0.7$; c, d. flower, from outside and halved lengthwise, $\times 4$; e. fruiting racemes, $\times 0.7$ (a: De Monchy 1; b-d: Koorders 6389; e: Goodenough & Ridley 1561).

(R. 64)

Fl. Java 1 (1964) 520, p.p., syn. *Pygeum latifolium* excluded. — *Pygeum blumei* Teijsm. & Binn., Cat. Hort. Bog. (1866) 252, nom. superfl. — Type: *Blume 654*, Java. Blume, Mél. Bot. was effectively published in 1855, see Van Steenis, Taxon 35 (1986) 272–285. *Pygeum arboreum*, therefore, does not have (Blume) Endl. ex C. Muell. in Walp. as author, but (Blume) Blume. Endlicher, Gen. Pl. (1840) already reduced *Polydonta* to *Pygeum*, but did not make the specific combination.

Pygeum parviflorum Teijsm. & Binn., Nat. Tijd. Ned. Indië 2 (1851) 309; Miq., Fl. Ind. Bat. I, 1 (1855) 361; Koord. & Valeton, Bijdr. Boomk. Java 5 (1900) 350, incl. vars.; Koord., Atlas 1 (1913) pl. 112, 113; Ridley, Fl. Mal. Penins. 1 (1922) 675. — Type: *Teijsmann & Binnendijk s.n.*, cult. Java, L sheet 908.196–192.

Digaster sumatrana Miq., Sum. (1861) 129, 330. — *Pygeum sumatranum* (Miq.) Miq., Sum. (1861) 619. — Types: *Teijsmann HB 3968*, lecto; *Jung-huhn s.n.*, L sheet 908.191–907; both Sumatra. For more complete synonymy, see Kalkman, l.c.

Trees up to 35 m, sometimes buttressed, bark usually smooth, brown or grey, strongly smelling, sometimes (var. *densa*, *stipulacea*, *alticola*) shrubs. Twigs more or less densely hairy, more or less glabrate with age. Leaves elliptic to oblong or ovate to lanceolate, 3–25 by 1.5–13 cm, base acute to subcordate, apex acute to acuminate, herbaceous to coriaceous, with 5–16 pairs of nerves, sparsely to densely pubescent when young, indumentum rapidly disappearing or persistent, basal glands usually 2, flat or slightly to distinctly hollowed. Petiole (0.2–)0.5–1.5(–2) cm. Stipules variable in shape and size, free, sometimes with conspicuous glands outside, sometimes rather persistent. Racemes in axils of extant or fallen leaves, usually fascicled but sometimes solitary, sometimes truly compound, 0.5–6(–9) cm long, peduncle short, rachis (densely) pubescent, pedicels 0–6 mm long, pubescent. Flowers fragrant. Hypanthium 1–3 mm high, pubescent outside. Perianth segments 5–11, usually subequal, sometimes recognizable as sepals and petals, 0.5–1 mm long. Stamens 10–50(–60), filaments up to 7 mm, often hairy at base, anthers 0.2–1 mm long. Ovary densely hairy, style up to 5.5 mm, hairy at base. Fruits globular (not in Malesia) or subglobular to transversely ellipsoid or didymous, 5–11.5 by 7–17 mm, more or less hairy, from green turning white, red, and ultimately purple or black, the endocarp glabrous or hairy inside. Seed with hairy or glabrous testa. — Fig. 18.

Distribution — Continental Asia, throughout Malesia.

Uses — Timber useful in house building. Bark once reported to be suitable for making rice containers (var. *robusta*, Flores, Schmutz 2803).

Note — This variable species was previously (Kalkman, l.c.) divided into five varieties of which one, var. *montana* (Hook. f.) Kalkman, does not occur in Malesia. A sixth variety, var. *alticola*, can now be added. The varieties are connected by odd intermediary specimens.

KEY TO THE VARIETIES

- | | |
|------------------------------------------------------------------------------------------------------------------------|---|
| 1a. Seeds hairy | 2 |
| b. Seeds glabrous | 5 |
| 2a. Twigs and leaves pubescent when young but soon glabrous | 3 |
| b. Twigs and leaves long retaining their dense indumentum | 4 |
| 3a. Fruits 5–10.5 by 7.5–13.5 mm. Flowers small: hypanthium 1–2 mm high | |
| b. var. <i>arborea</i> | |
| b. Fruits 9–11.5 by 13.5–17 mm. Flowers larger: hypanthium 2–3 mm high | |
| d. var. <i>robusta</i> | |
| 4a. Leaves elliptic to oblong, rarely ovatish, 10–22(–25) by 4–9(–13) cm, with usually 10–13 pairs of nerves | |
| e. var. <i>stipulacea</i> | |
| b. Leaves ovate to elliptic, 6–13(–16) by 2.5–8.5(–12) cm, with 8–10 pairs of nerves | |
| a. var. <i>alticola</i> | |
| 5a. Nerves 5–9 pairs. Racemes 0.5–1.5 cm long | |
| c. var. <i>densa</i> | |
| b. Nerves 8–13 pairs. Racemes longer than 2 cm | |

a. var. *alticola* Kalkman, Blumea 37 (1993) 378.
— Type: *De Wilde c.s. 15994*, Sumatra.

Twigs densely hairy when young, tardily glabrescent. Leaves ovate to elliptic, 6–13(–16) by 2.5–8.5(–12) cm, hard and stiff, densely hairy when young and also mature leaves usually still distinctly hairy on midrib above, on midrib and nerves below, and on petiole, nerves 8–10 pairs, basal glands 0–2, flat or slightly hollowed. Stipules elliptic to (broadly) ovate, 3–7 by 2.5–7 mm, sometimes with one or more glands outside. Racemes solitary or in bundles of 2–4, (1–)2–4(–6) cm long. Fruits transversely ellipsoid, rarely subglobular, 6–10.5 by 7–14(–16) mm, usually still (sparsely) hairy. Seed glabrous or with few hairs on testa.

Distribution — Sumatra, Borneo (seen from Sabah and Sarawak only), Celebes (one specimen only).

Habitat — Montane forest, also mossy forest, montane scrub, altitude c. (1000–)1500–3000 m.

Note — See note under var. *stipulacea*. For a comparison with *Prunus oocarpa* see under that species.

b. var. arborea — Kalkman, Blumea 13 (1965) 93. The synonyms given above under the species pertain to the type variety.

Twigs pubescent when young, soon glabrous. **Leaves** oblong to ovate, sometimes more lanceolate, 6–21 by 2.5–8.5(–10) cm, pubescent when young but early glabrescent, nerves 7–12 pairs, basal glands usually 2, flat. **Stipules** elliptic to ovate, 1.5–6(–8) by 1–4 mm. **Racemes** in bundles of usually 2–5, (1–)2–6(–9) cm long. **Fruits** transversely ellipsoid to didymous, 5–10.5 by 7.5–13.5 mm. **Seed** with densely hairy testa, rarely more sparsely hairy.

Distribution — Throughout *Malesia*.

Habitat — Primary (and secondary) forest, altitude 0–1800 m.

c. var. densa (King) Kalkman, Blumea 13 (1965) 100.

Pygeum parviflorum Teijsm. & Binn. var. *densum* King, J. As. Soc. Beng. 66, 2 (1897) 292. — Type: *King's Coll. 10753*, holo; *King's Coll. 6986*; both Malaya.

Twigs densely pubescent, glabrescent. **Leaves** ovate or elliptic to elliptic-oblong, 3–15 by 1.5–8 (–9) cm, densely pubescent when young, usually still hairy beneath when mature, nerves 5–9 pairs, basal glands usually 2, flat or distinctly hollowed and sometimes situated in the contracted leaf-base. **Stipules** ovate to elliptic, 1.5–6 by 1–4 mm, sometimes with one or more crater-like glands outside. **Racemes** in bundles of 2–4, mixed with solitary ones, rarely compound, 0.5–1.5(–4) cm long. **Fruits** transversely ellipsoid, 6–8.5 by 8–11.5 mm. **Seed** with glabrous testa.

Distribution — Peninsular Thailand; *Malesia*: Sumatra, Malaya incl. Penang and Tioman Is., Borneo.

Habitat — Lowland and montane forest, altitude (50–)500–2400 m.

d. var. robusta (Koord. & Valeton) Kalkman, Blumea 13 (1965) 96.

Pygeum robustum (Koord. & Valeton) Koehne, Bot. Jahrb. 51 (1913) 198. — *Pygeum parviflorum* Teijsm. & Binn. var. *robustum* Koord. & Valeton, Bijdr. Booms. Java 5 (1900) 353. — Types: *Koorders 23039*, lecto; 6466, 21598, all Java.

Twigs pubescent when young, soon glabrous. **Leaves** ovate or ovate-lanceolate, 10–19 by 4–7 (–10) cm, pubescent when young, early glabrescent, nerves 6–10 pairs, basal glands usually absent. **Stipules** ovate to elliptic, 3.5–6 by 1.5–3 (–6) mm, often with inconspicuous flat glands outside. **Racemes** usually in bundles, sometimes compound (branched from the base), mixed with solitary ones, 3–6 cm long. **Fruits** transversely ellipsoid to didymous, 9–11.5 by 13.5–17 mm. **Seed** with hairy testa.

Distribution — East Java, Bali, Flores.

Habitat — Forest in periodically (very) dry regions, 800–1800 m altitude.

e. var. *stipulacea* (King) Kalkman, Blumea 13 (1965) 98, p.p.

Pygeum stipulaceum King, J. As. Soc. Beng. 66, 2 (1897) 287; Ridley, Fl. Mal. Penins. 1 (1922) 673. — Type: *King's Coll. 11020*, Malaya.

Twigs densely hairy when young, tardily glabrescent. **Leaves** elliptic to oblong, sometimes ovatif, 10–22(–25) by 4–9(–13) cm, densely hairy when young, glabrescent but when mature usually still distinctly hairy at least on midrib, nerves and petiole, nerves (7–)10–13(–16) pairs, basal glands 0–2, flat or slightly hollowed. **Stipules** (broadly) ovate, 4–9(–11) by 2.5–6 mm, sometimes with 1–3 glands outside. **Racemes** in bundles of 2–6, not rarely also solitary ones, 2–5(–7) cm long. **Fruits** transversely ellipsoid, 6–8(–11) by 8–13 mm, still hairy. **Seed** with hairy testa, sometimes sparsely so, rarely glabrous.

Distribution — Sumatra, Bangka, Malaya, Singapore, Borneo.

Habitat — Primary and secondary forest, also in kerangas and mossy forest types, altitude 0–1500 (–2000) m.

Note — In my 1965 revision (p. 98) a possible subdivision of var. *stipulacea* was alluded to, but not executed. New collections make it possible to extract the higher altitude specimens as a new variety, *altiloba*.

6. *Prunus beccarii* (Ridley) Kalkman, Blumea 13 (1965) 104. — *Pygeum beccarii* Ridley, Kew Bull. (1938) 281. — Types: *Haviland b.r.o.b.*, holo; *Haviland 755*, *Beccari 3516*; all Borneo.

Trees up to 27 m, or shrubs, bark smooth, brown(ish). **Twigs** sparsely hairy when young. **Leaves** elliptic to elliptic-ovate, (6.5–)8–15(–18) by (3–)4.5–8(–9) cm, base rounded or acute, apex rounded or obtuse or shortly acuminate, coria-

ceous, with 4–7(–11) pairs of nerves, venation inconspicuous to invisible, lower side and midrib on upper side sparsely pubescent when young, indumentum rapidly disappearing, basal glands absent, often some flat foliar glands along the margin. *Petiole* 1–2 cm long. *Stipules* ovate to cuate-elliptic, 5–7 by 2–5 mm, free, usually with one large, hollowed gland outside, ciliate. *Racemes* mostly in axils of fallen leaves, in fascicles of 3 or 4, or compound with up to 3 laterals, up to 5.5 cm long, peduncle short, rachis pubescent, pedicels up to 2 mm long. *Hypanthium* 1.5–2 mm high, hairy outside. *Perianth segments* subequal, 6–10, 0.5–1 mm long, often distant, usually densely hairy. *Stamens* 15–40, filaments up to 3.5 mm, anthers 0.3–0.5 mm long. *Ovary* with few hairs or glabrous, style up to 4.5 mm long. *Fruits* transversely ellipsoid, 5–7 by 6.5–10 mm, exocarp sparsely hairy or glabrous, black when ripe, mesocarp thin, endocarp glabrous or with hairs inside. *Seed* with glabrous or hairy testa.

Distribution — Sumatra, Borneo.

Habitat — In forest, altitude 0–900 m.

Note — Only few collections seen from Borneo, and only two sterile collections from Sumatra. The relatively large, hollowed glands in the stipules are characteristic. The seeds are glabrous in five of the fruiting specimens seen (most of them immature), hairy in only one specimen. Judged from the fruits, the ovary may sometimes be more densely short-hairy than seen in the flowering specimens.

7. *Prunus brachystachya* Kalkman, Blumea 13 (1965) 63. — Type: *Henty NGF 10526*, Papua New Guinea.

Usually small trees up to 15(–26) m, sometimes with low buttresses, bark grey to brown. *Twigs* soon glabrous. *Leaves* oblong to ovate, 7–17 by 2–8.5 cm, base rounded to more acute, apex acuminate, herbaceous to papyraceous, with 7–11 pairs of nerves, venation inconspicuous, both sides glabrous (maybe some hairs when young), basal glands 2, flat. *Petiole* up to 1 cm long. *Stipules* narrowly triangular to linear, 4–5.5 by 0.5–1.5 mm, free, hairy outside. *Racemes* solitary, in axils of extant or fallen leaves, (0.5–)1.5–3 cm long, peduncle very short, rachis (sparsely) hairy, pedicels 0–1 mm long. *Flowers* often (?) unisexual, 4- or 5-merous. *Hypanthium* 1.5–2.5 mm high, hairy outside, once noted as orange by the collector. *Perianth segments* differentiated as sepals and petals, but the two almost equal in size. *Sepals* triangular to elliptic, c. 1 mm long, densely hairy outside. *Petals* elliptic, c. 1 mm long, greenish or

white, hairy. *Stamens* 15–25, glabrous, filaments up to 3.5 mm, anthers 0.3–0.5 mm long. *Ovary* and pistillodium glabrous. *Fruits* transversely ellipsoid to didymous, 9–13 by 10–19 mm, exocarp glabrous, red to black when ripe, mesocarp juicy, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — Papua New Guinea, Irian Jaya (one collection just on the border with PNG), Australia (Queensland).

Habitat — Rain forest, also on riverbanks, altitude up to 450 m.

Notes — The length/width index of the leaves varies from 2 to 4, but the transition from wide to narrow leaves is continuous.

Of the four flowering specimens seen, three had male flowers, the fourth had the stamens and the ovary both well-developed.

8. *Prunus brassii* Kalkman, Blumea 13 (1965) 82. — Type: *Brass 22814*, Papua New Guinea.

Trees up to 25 m, or shrubs, bark pale brown. *Twigs* densely hairy when young, glabrescent. *Leaves* elliptic to elliptic-oblong, 4–8.5 by 2–3.5 cm, base acute to obtuse, apex obtuse and often retuse, very hard and stiff, with 6–9 pairs of nerves, nerves and venation impressed above, venation inconspicuous underneath, both surfaces (rather) densely short hairy when young, glabrescent, basal glands usually 2, flat. *Petiole* 0.5–1.2 cm long. *Stipules* narrowly triangular, 2.5–5 by 1–2 mm, free, hairy outside. *Racemes* solitary, in axils of extant or fallen leaves, 1.5–4.5 cm long, peduncle 0–0.5 cm, rachis densely hairy, pedicels 1–4 mm long. *Hypanthium* 2–3 mm high, densely hairy outside. *Perianth segments* 10–12, more or less differentiated as sepals and petals, but the two whorls not entirely regular, 1–1.5 mm long, sepals slightly shorter than petals and with broader base, densely hairy outside. *Stamens* 20–30, filaments up to 3.5 mm long, glabrous or hairy at base, anthers 0.5–0.8 mm long. *Ovary* densely hairy, style up to 2.5 mm long. *Fruits* transversely ellipsoid, 6–7.5 by 7–9 mm, exocarp hairy, colour unknown, endocarp sparsely hairy inside. *Seed* with hairy testa.

Distribution — Papua New Guinea, seen from Central and Milne Bay Provinces, and with doubt from S Highlands Province.

Habitat — Montane forest types, also mossy forest, and in shrubland, 1900–2250(–2750?) m altitude.

Note — Differs from *Prunus pullei*, to which it seems related, in its hairy seeds.

9. *Prunus clementis* (Merr.) Kalkman, Blumea
13 (1965) 70. — *Pygeum clementis* Merr., Philipp. J. Sc., Bot. (1908) 227; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 232. — Types: *Clemens* 760, lecto; 966; both Mindanao.

Pygeum apoense Elmer, Leafl. Philipp. Bot. 5 (May 1913) 1623. — *Pygeum apoanum* Elmer [in herb.] ex Koehne, Bot. Jahrb. 51 (Dec. 1913) 205, nom. illeg. — Type: *Elmer* 11729, Mindanao.

Trees up to 30 m, bark grey, rough (only one note). Twigs hairy, glabrescent. Leaves oblong, 10–22 by 3.5–9 cm, base rounded, apex gradually tapering to acuminate, herbaceous, with 9–15 pairs of nerves, venation usually not conspicuous, both surfaces hairy when young, (almost) glabrous when mature, basal glands 2–4, distinctly hollowed to flat. Petiole 0.5–0.8 cm long. Stipules ovate to narrowly triangular, 5–7.5 by 2–4.5 mm, intrapetiolarly connate by their keeled midribs, with inconspicuous marginal glands. Racemes solitary, axillary, 3–7 cm long, peduncle short, rachis hairy, pedicels 1–4 mm long, up to 6 mm under the fruit. Hypanthium 2–3 mm high, hairy outside. Perianth segments 7–10, equal or subequal, c. 1 mm long, hairy. Stamens 20–40, filaments up to 4.5 mm, hairy at base, anthers 0.3–0.4 mm long. Ovary densely to more sparsely hairy, style up to 4.5 mm long. Fruits compressed subglobular to transversely ellipsoid, 13–14 by 14–17(–20) mm, exocarp more or less hairy to glabrous, dark red (information scarce), endocarp glabrous inside. Seed with glabrous testa.

Distribution – Mindanao, Celebes (N peninsula and central part).

Habitat – Primary and secondary forest, altitude 200–1050 m. Some of the fieldnotes on specimens from Celebes indicate a preference for volcanic sand and ultrabasic soil.

Uses – Used as medicine for headache and skin eruptions (*Frake PNH* 36173, probably referring to the bark).

Note – Only two from the c. 10 collections seen were collected in more or less recent times, i.e. after World War II. The Philippine species *Prunus clementis*, *fragrans*, and *rubiginosa* are poorly known.

10. *Prunus costata* (Hemsley) Kalkman, Blumea
13 (1965) 78. — *Pygeum costatum* Hemsley, Kew Bull. 1898 (1901) 98. — Type: *Julianetti* (via McGregor) s.n., Mt Scratchley.

Pygeum papuanum Hemsley, Kew Bull. 1898 (1901) 99. — Type: *Julianetti* (via McGregor) s.n., Mt Scratchley.

Pygeum rigidum Koehne, Bot. Jahrb. 52 (1915) 339. — Type: *Ledermann* 11453, Papua New Guinea, not seen.

Pygeum retusum Merr. & Perry, J. Arnold Arbor. 21 (1940) 195. — Types: *Brass* 9035, holo; *Brass & Meijer Drees* 10428, 10439; all Lake Habbema.

Pygeum hagenianum Gilli, Ann. Naturhist. Mus. Wien 83 (1980) 455; Kalkman, Blumea 28 (1982) 168 (reduction). — Types: *Dosedla* 129B, holo; 145; both Mt Hagen.

Shrubs or small trees, up to 25 m, buttresses not reported, bark grey to brown, finely fissured and lenticelled. Twigs glabrous or sparsely hairy when young. Leaves elliptic to oblong, 3–13(–16) by 2–7 cm, base usually rounded, apex obtuse or bluntly acuminate, often retuse, stiff coriaceous, 6–10(–14) pairs of nerves, venation impressed above, inconspicuous below, puberulous only when young, both sides glabrous when mature, basal glands (0–)2–4, flat. Petiole up to 1 cm long. Stipules oblong, 2.5–9 by 1.2–3.5 mm, free. Racemes solitary, in axils of extant or fallen leaves, (4–)5–12(–15) cm long, peduncle short, rachis sparsely hairy, pedicels 1–4 mm long, longer under the fruit. Hypanthium 2–3(–4) mm high, sparsely hairy to almost glabrous outside. Perianth regularly 4- to 6-merous, sometimes irregular, hairy outside. Sepals triangular to ovate, 1–2 mm long. Petals ovate to elliptic, 1–3 mm long, white. Stamens 20–35, filaments up to 5.5 mm, anthers 0.5–1 mm long. Ovary glabrous, style up to 4 mm long. Fruits transversely ellipsoid, 6–10 by 8–11.5 mm, fruiting calyx (i.e. lower part of hypanthium) saucer- to cup-shaped, 3–5 mm diam., exocarp glabrous, red to purplish, endocarp usually hairy inside. Seed with hairy testa.

Distribution – Throughout New Guinea.

Habitat – Forest and also more open subalpine habitats like thickets, altitude 1500–3700 m.

Uses – Bark used for making waistbands (like other species of the genus).

Notes – The species is very similar to *Prunus grisea* var. *grisea* and differs only in the indumentum of the seeds, which is considered to be an important, usually decisive character for species delimitation. When in flower, the two species can hardly or not be distinguished. The indumentum of the hypanthium may give a clue: less hairy in *costata*.

11. *Prunus dolichobotrys* (K. Schum. & Lauterb.) Kalkman, Blumea 13 (1965) 75. — *Pygeum dolichobotrys* K. Schum. & Lauterb., Fl. Schutzgeb. Südsee (1901) 340; Nachtr. (1905)

274. — Type: *Rodatz & Klink 168*, Bismarck Mts, fragment of holotype in WRSL, neotypification (*Schlechter 14700*) in Kalkman, l.c., was not necessary.

Combretum flavovirens Lauterb., Nova Guinea 8 (1912) 847. — Type: *Gjellerup 577*, Humboldt Bay.

Trees up to 30 m, buttresses small or absent, bark brown, lenticelled, peeling off in thin flakes. Twigs glabrous, often lenticelled. Leaves elliptic to ovate, (8–)12–26 by 5–12(–15) cm, base rounded to subcordate, apex rounded to broadly acuminate, herbaceous, with 7–14 pairs of nerves, venation transverse, not conspicuous, both sides entirely glabrous, basal glands 2–4(–6), flat or slightly hollowed. Petiole up to 1.5(–2) cm long. Stipules linear to linguiform, 5.5–7.5 by 1.5–2.2 mm, keeled inside and often intrapetiolarly conate, glabrous, sometimes ciliolate. Racemes solitary, axillary, (3–)5–21(–33) cm long, peduncle up to 1.5 cm, some empty bracts at the base, rachis glabrous or sparsely puberulous, pedicels 1.5–5 mm long. Flowers sometimes functionally male, cream-coloured. Hypanthium 2–3 mm high, (almost) glabrous outside. Perianth differentiated, (4–)5-merous. Sepals triangular, 0.8–1.5 mm long, glabrous except sometimes apex and margin. Petals elliptic to obovate, 1–2 mm long, usually more hairy than sepals. Stamens 10–30, filaments up to 6 mm, anthers 0.8–1.5 mm long. Ovary glabrous, style up to 4.5 mm long, pistillodium in male flowers small. Fruits transversely ellipsoid to didymous, 8–11.5 by 11–15 mm, exocarp glabrous, black when ripe, mesocarp thin, juicy, endocarp glabrous inside. Seed with glabrous testa. — Fig. 19.

Distribution — Throughout New Guinea, including the Papuan Islands to the East, and also in the Bismarck Archipelago (New Britain, New Ireland).

Habitat — Primary and secondary forest, often on riverbanks, altitude 0–1000(–1800) m.

Uses — Hardly ever reported by collectors. *Dornstreich 76* (E Sepik Prov.): wood used for smaller house poles, bark for making eel traps, leaves to flavour soup or cooked greens.

12. *Prunus fragrans* (Elmer) Kalkman, Blumea 13 (1965) 74. — *Pygeum fragrans* Elmer, Leafl. Philipp. Bot. 2 (1908) 475; 5 (1913) 1622; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 232. — Type: *Elmer 7504*, lecto, Luzon.

Parinarium coccineum Elmer, Leafl. Philipp. Bot. 2 (1909) 578. — *Pygeum coccineum* (Elmer) Elmer, Leafl. Philipp. Bot. 5 (1913) 1621. — Type: *Elmer 9787*, Negros.

Pygeum megaphyllum Elmer ex Merr., Philipp. J. Sc., Bot. 10 (1915) 312. — Type: *Ramos BS 14923*, Luzon.

Small trees, up to 15 m. Twigs sparsely hairy when young. Leaves elliptic or elliptic-ovate, more rarely oblong, (10–)12–19(–23) by 4.5–10(–13) cm, base usually rounded, sometimes shortly decurrent, rarely acute, apex usually acuminate, herbaceous to ± coriaceous, with 6–10 pairs of nerves, sparsely pubescent on both sides, basal glands 2, hollowed and bulging on upper side, other foliar glands often also hollowed. Petiole 1–2.5 cm long. Stipules oblong, 4–8 by 1.5–3 mm, free, with glandular margin. Racemes solitary, in axils of extant or fallen leaves, up to 8 cm long, in fruit up to 14 cm, peduncle short, rachis hairy, pedicels 1.5–4(–5) mm long. Flowers bisexual or (rarely) male. Hypanthium 2.5–3.5 mm high, densely hairy outside. Perianth segments 7–13, subequal, up to 1.5(–2.5) mm long, hairy. Stamens 25–55, glabrous, filaments up to 7 mm, anthers 0.5–0.7 mm long. Ovary glabrous or with few hairs, style up to 6.5 mm long, also with some hairs or glabrous. Fruits ellipsoid, 24–30 by 15–17 mm, exocarp glabrous, black when ripe, mesocarp thick and fleshy, hard when dry, endocarp sparsely hairy inside. Seed with glabrous testa.

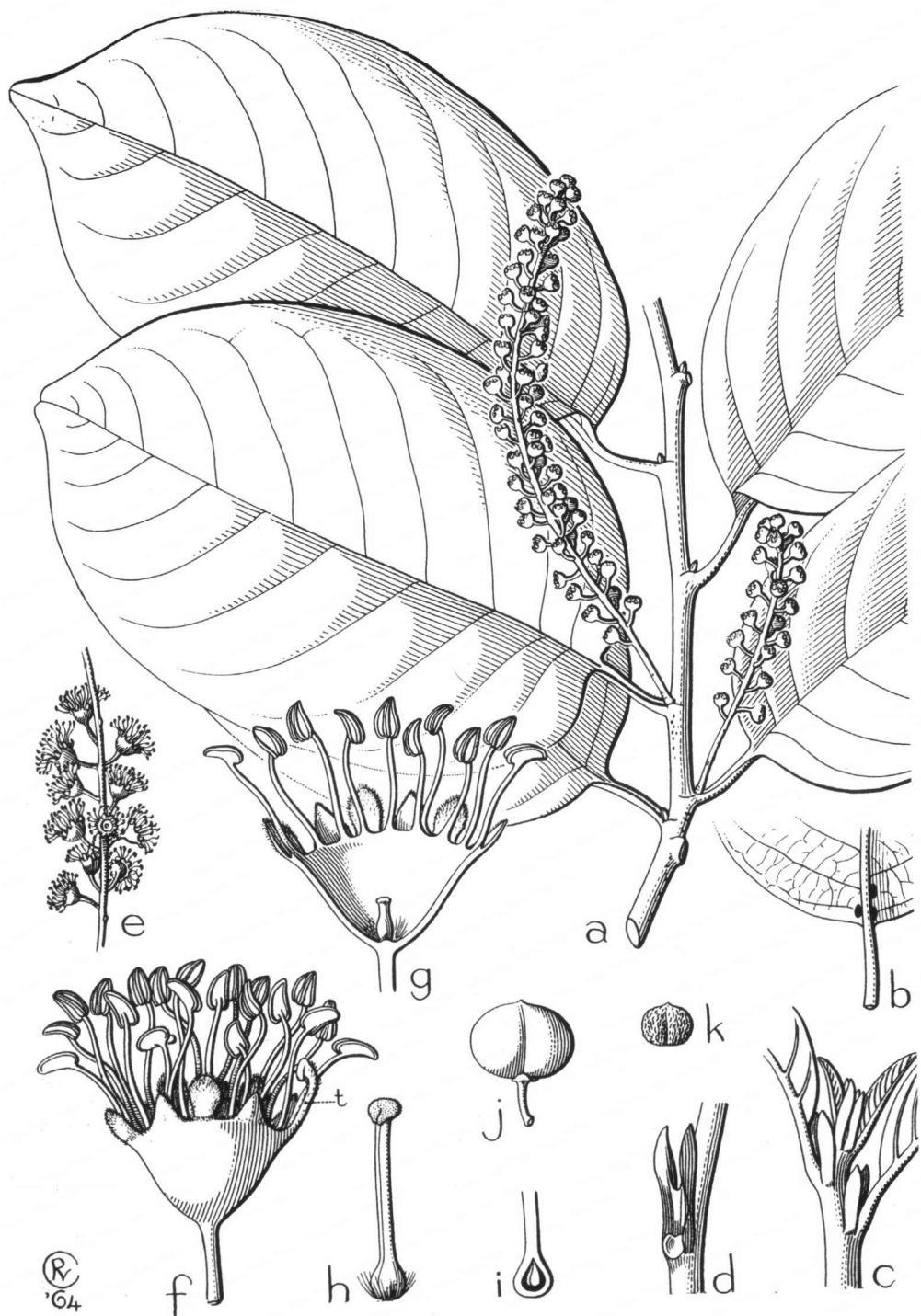
Distribution — Philippines, seen from Camiguin, Luzon, Mindoro, Panay, and Negros. T.C. Huang, Checklist in Fl. Taiwan 6 (1979) 63, mentions the species (as *Pygeum megaphyllum*) for Taiwan, which is quite plausible. I saw a sterile collection (C.E. Chang 3080) from Lanyu (Botel Tobago), a small island off the SE coast of Taiwan. This specimen may belong to *P. fragrans*, although identification remains a bit doubtful.

Habitat — Primary and secondary forest (few data), altitude 150–2500 m.

13. *Prunus gazelle-peninsulae* (Kaneh. & Hatus.) Kalkman, Blumea 13 (1965) 77. — *Pygeum gazelle-peninsulae* Kaneh. & Hatus., Bot. Mag. Tokyo 52 (1938) 355, f. 1 ('gazelle-peninsulatum'). — Type: *Kanehira 3966*, New Britain.

Pygeum platiphyllum K. Schum. in K. Schum. & Lauterb., Fl. Schutzgeb. Südsee, Nachr. (1905) 273. — Type: *Nyman 593*, 'Sattelberg', Papua New Guinea.

Trees up to 37 m, buttresses absent or small spurs, bark brown to grey-brown, smooth or shallowly fissured, flaking. Twigs hairy, glabrescent, older twigs usually lenticelled. Leaves elliptic to



ovate, rarely oblong, (10–)12–25 by 6–14 cm, base rounded to subcordate, apex rounded or shortly acuminate, herbaceous, with 9–14(–17) pairs of nerves, venation transverse, both sides more or less densely hairy when young and indumentum not quite disappearing with age, basal glands mostly 4, flat to slightly hollowed. *Petiole* up to 1.5(–2) cm. *Stipules* triangular to ovate, 3–6.5 by 1.2–2.5 mm, keeled inside and often intrapetiolarly connate in the lower half, hairy outside and on margins. *Racemes* solitary, in axils of extant or fallen leaves, 5–16 cm long, peduncle very short, pedicels usually not longer than 1 mm, hairy as is the rachis. *Flowers* bisexual or male. *Hypanthium* 2.5–4 mm high, densely hairy outside. *Perianth* regular, 5-merous. *Sepals* triangular to linguiform, 1–2 mm long, densely hairy. *Petals* elliptic to oblong, 1–2 mm long, also hairy, cream-coloured. *Stamens* 18–40, filaments up to 8 mm, glabrous, anthers up to 1.5 mm long. *Ovary* glabrous except at very base, style up to 6 mm long, pistillode in male flowers small to minute. *Fruits* transversely ellipsoid, 8–12 by 11–17 mm, fruiting calyx (basal part of hypanthium) saucer-shaped, 2–3.5 mm diam., exocarp glabrous, black when ripe, mesocarp fleshy, endocarp mostly hairy inside. *Seed* with hairy testa.

Distribution — Moluccas (one flowering specimen seen from Ceram), throughout New Guinea, and Bismarck Archipelago (New Britain).

Habitat — Primary and secondary forest, altitude 0–1600(–2100) m.

Ecology — "Birds feed upon the fruits" (Sayers 21333).

Note — When fruits are absent, distinguishable from the very similar *Prunus dolichobotrys* by the indumentum of the leaves and on the exterior of the hypanthium.

14. *Prunus glabrifolia* Kalkman, Blumea 13 (1965) 64; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 338. — *Pygeum brevifolium* Hook. f., Fl. Brit. India 2 (1878) 321; Ridley, Fl. Mal. Pen. 1 (1922) 676. — Types: Griffith 2051, holo; Lobb s.n.; both Mt Ophir, Malaya.

***Pygeum scortechinii* King, J. As. Soc. Beng. 66, 2 (1897) 290; Ridley, Fl. Mal. Penins. 1 (1922) 674. — Type: Scortechni 357, Perak.**

Shrubs or trees up to 15 m. *Twigs* hairy, soon glabrescent. *Leaves* elliptic to oblong or ovatish, 3.5–7.5(–11) by 1.5–4(–5) cm, base acute to rounded, apex acute to acuminate, coriaceous, with 4–7 pairs of nerves, venation inconspicuous, both sides entirely glabrous when mature, basal glands 2, flat. *Petiole* up to 1 cm long. *Stipules* oblong to narrowly triangular, 1.5–4 by 0.5–1.5 mm, free, with 1–3 flat or pustular glands on the surface (only seen in Malayan specimens) and sometimes (also) with marginal glands. *Racemes* solitary, axillary, up to 1 cm long, with up to 6 flowers, in fruit up to 3.5 cm, peduncle 0, pedicels 0–2 mm long. *Hypanthium* 1.5 mm high, hairy outside. *Perianth segments* 6–9, subequal, less than 1 mm long, hairy. *Stamens* 12–20, filaments up to 3.5 mm, glabrous or with hairs at base, anthers up to 0.7 mm long. *Ovary* densely hairy at least in lower part, style up to 2.5 mm, hairy or glabrous. *Fruits* transversely ellipsoid, 6–9 by (7–)8.5–12.5 mm, exocarp sparsely hairy, colour unknown, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — W Sumatra, Malaya (mountains in Perak, Selangor, Malacca, Johore), Borneo (Sarawak, dubious specimen from Sabah).

Habitat — Both Sumatran specimens and 2 out of 5 Bornean specimens come from limestone hills, no notes about the substrate on the 7 specimens from Malaya. The altitude varies from 650 to 1800 m.

Notes — In 1965 the species was only seen from Malaya and Sumatra; it has now also been collected in the Gunung Mulu National Park, Sarawak. A dubious specimen comes from Mt Kinabalu, Sabah.

The species differs from the rather similar *Prunus grisea* var. *tomentosa* in the stiff and hard (not papyraceous) leaves.

The epithets *brevifolia* and *scortechinii* were used previously in *Prunus*.

Fig. 19. *Prunus dolichobotrys* (K. Schum. & Laut.) Kalkman. a. Twig with young racemes, $\times 0.7$; b. Basal leaf glands, $\times 0.7$; c, d. stipules, $\times 1$, $\times 2$; e. male flowers, $\times 0.7$; f, g. male flower, from outside and halved lengthwise, $\times 4$ (t = transition petal-stamen); h, i. pistil from bisexual flower, $\times 4$; j. fruit, $\times 1$; k. seed, $\times 1$ (a, b, e: Hoogland 3966, c, d: Brass 7308; f, g: Womersley NGF 3700; h-k: Derbyshire & Hoogland 8249).

15. *Prunus grisea* (Blume) Kalkman, Blumea 13 (1965) 56; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 337. — *Pygeum griseum* Blume, Mél. Bot. nr. 2 (1855) 11; C. Muell. in Walp., Ann. 4 (1857) 642. — Type: *Kuhl & van Hasselt s.n.*, L sheet 908.197-535, Java. Blume, Mél. Bot. was effectively published in 1855, see Van Steenis, Taxon 35 (1986) 272-285. *Pygeum griseum*, therefore, does not have Blume ex C. Mueller in Walpers as its author, but simply Blume.

Germaria latifolia Presl, Epim. Bot. (1851) 221. — *Pygeum preslii* Merr., Philipp. J. Sc., Bot. 3 (1908) 227; Elmer, Leafl. Philipp. Bot. 5 (1913) 1621. — *Pygeum latifolium* (Presl) Rehder, Bradl. Bibliogr. 2 (1912) 278, comb. illeg. — Type: *Cuming 1815*, Bohol, Philippines.

Pygeum latifolium Miq., Pl. Jungh. (1855) 401; Fl. Ind. Bat. I, 1 (1855) 361; Koord. & Valetin, Bijdr. Booms. Java 5 (1900) 355, incl. varieties; Koord., Exk. Fl. Java 2 (1912) 336; Atlas 1 (1913) pl. 114, 115. — Type: *Junghuhn 107*, Java.

Pygeum preslii Merr. var. *vulgare* Koehne, Bot. Jahrb. 51 (1913) 203. — *Pygeum vulgare* (Koehne) Merr., Enum. Philipp. Flow. Pl. 2 (1923) 234. — Type: *Borden FB 1806*, Luzon.

Pygeum melanocarpum Merr. & Perry, J. Arnold Arbor. 21 (1940) 191. — Types: *Brass 11532*, holo; *Brass 11531*, *Brass & Versteegh 10480*; all Irian Jaya.

Pygeum arboreum (Blume) Blume, p.p.: Backer & Bakh.f., Fl. Java 1 (1964) 520.

For more complete synonymy, see Kalkman, l.c.

Trees or shrubs. Twigs hairy but rapidly glabrescent. Leaves elliptic to oblong, or ovate to lanceolate, 2-20 by 1-9 cm, base rounded or acute, apex various, usually 5-9 pairs of nerves, venation inconspicuous to invisible, sparsely pubescent to glabrous on both sides, basal glands usually 2, flat. Petiole 0.2-1.5(-2) cm long. Stipules 1.5-8 by 0.2-1.8 mm, free. Racemes solitary, in axils of extant or fallen leaves, 0.5-6.5(-9) cm long, peduncle 0-1 cm, pedicels 0-7 mm long. Hypanthium 1.5-4 mm high, (sparsely) hairy outside. Perianth segments 6-13, subequal or more or less distinctly differentiated, 0.5-2 mm long. Stamens 15-50, filaments up to 6 mm, anthers 0.2-0.8 mm long. Ovary usually glabrous, sometimes with some hairs, rarely distinctly hairy, style up to 7 mm long. Fruits transversely ellipsoid to globular, 6-13 by 7-16 mm, sometimes pointed or beaked and larger (see note under var. *tomentosa*), exocarp

(almost) glabrous, via whitish and red turning purple and finally black, mesocarp thin, endocarp glabrous or sparsely hairy inside. Seed with glabrous testa.

Distribution — Peninsular Burma, Thailand, Vietnam; throughout Malesia, var. *grisea* more in the eastern part, var. *tomentosa* more to the west, var. *microphylla* endemic to New Guinea.

KEY TO THE VARIETIES

- 1a. Racemes 0.5-1(-2.5) cm, dense, pedicels 0-2 mm. Leaves thin, papyraceous
 - c. var. *tomentosa*
- b. Racemes 1.5-6.5(-9) cm, loose, pedicels 1-7 mm. Leaves herbaceous or coriaceous ... 2
- 2a. All or at least most of the full-grown leaves shorter than 7 cm ... b. var. *microphylla*
- b. All or at least most of the full-grown leaves longer than 9 cm a. var. *grisea*

a. var. *grisea* — Kalkman, Blumea 13 (1965) 58. The synonyms given above under the species pertain to the type variety.

Trees up to 40 m, bark different shades of brown, smooth or lenticellate. Leaves elliptic to oblong or ovate to lanceolate, (5-)9-20 by 2.5-9 cm, apex long-tapering to acuminate, rarely obtuse, herbaceous or coriaceous, basal glands (0-)2(-4). Racemes 1.5-6.5(-9) cm, pedicels 1-7 mm. Hypanthium 2-4 mm high. Perianth segments subequal, sometimes (especially in New Guinea) more or less regularly divided into sepals and petals, up to 2 mm long. Ovary glabrous, rarely with some hairs, in Java and Lesser Sunda Islands rarely densely hairy. Fruits transversely ellipsoid to globular, 6-13 by 8-16 mm, hypanthium remnant under the fruits up to 2 mm across, but in New Guinea 3-5 mm.

Distribution — Java, Kangean, Philippines, Celebes, Lesser Sunda Islands, Moluccas, New Guinea. According to the literature also on Taiwan. In Java and Palawan this variety overlaps with var. *tomentosa*, in New Guinea with the endemic var. *microphylla*.

Habitat — Primary and secondary forest, mostly between sea-level and 2500 m altitude, but especially in New Guinea often higher (up to 3400 m altitude), see below.

Notes — The New Guinean plants differ in several respects from the plants in Celebes and the Philippines: their perianth is sometimes larger and somewhat regularly divided in sepals and petals (those differing in shape but hardly in size), the

'calyx' (remnant of hypanthium) under the fruit is large, and the leaves are generally thick and hard. In New Guinea the collections come from (370-) 1200–3400 m altitude, collections from the Philippines often bear no data on altitude, but only two collections were seen from altitudes higher than 800 m. Also in Celebes all (rather few) collections come from below 1000 m. However, the morphological differences are very gradual and characters overlap very much. When two separate varieties were distinguished, identification would usually only rest on geography and altitude.

The shapes and dimensions of the fruits show geographical variation: in New Guinea fruits are smallest (up to 9 mm long, up to 12 mm wide), in Java they are also short but often wider (7–10 by 10–15 mm), in the Philippines fruits are largest (8–14 mm long, 9–16 mm wide), with the fewer specimens from Celebes and the Moluccas falling within this range. Some specimens from Palawan have fruits at the extreme end of the variation and these specimens (*Manalo FB 7424, Ridsdale 182, 191, Soejarto & Fernando 7381*) can only be distinguished from *Prunus kinabaluensis* by their foliar glands, see note under that species.

As mentioned under *Prunus costata*, that species and the present variety are much alike, among other characters by their thick and hard leaves and by the large fruiting calyx (hypanthium remnant). Flowering specimens cannot always be identified with certainty.

b. var. *microphylla* Kalkman, Blumea 13 (1965) 63. — Type: Sleumer & Vink 14250, Irian Jaya.

Usually small trees (rarely over 20 m) or shrubs, bark rough, brown to grey. Leaves elliptic to elliptic-oblong, (1.5–)2–6(–8.5) by 1–3(–5) cm, apex obtuse or retuse, stiff-coriaceous, basal glands 2 or 4. Racemes 2–5 cm, pedicels 1–4 mm. Hypanthium 1.5–3(–3.5) mm high. Perianth segments usually subequal, sometimes regularly divided into sepals and petals, 0.5–1.5 mm long. Ovary glabrous. Fruits transversely ellipsoid to subglobular, 6–9 by 7–10.5 mm, hypanthium remnant under the fruits sometimes large, 1.5–5 mm.

Distribution — Throughout New Guinea.

Habitat — Montane and subalpine forest, altitude 1400–3660 m.

Uses — One collector (*Robbins 845*) noted the use of the bark for belts, also known for other species.

Note — This is not just a high altitude form of var. *grisea*. Both varieties occur at the same altitudes and within var. *microphylla* the dimensions

of the leaves are not at all correlated with altitude. The only differences with var. *grisea* are in the leaf dimensions and transitional specimens are few.

c. var. *tomentosa* (Koord. & Valeton) Kalkman, Blumea 13 (1965) 60. — *Pygeum latifolium* Miq. var. *tomentosum* Koord. & Valeton, Bijdr. Booms. Java 5 (1900) 358. — Type: Koorders 22255, lecto, Java.

Pygeum maingayi Hook. f., Fl. Brit. India 2 (1878) 319. — *Pygeum lanceolatum* Hook. f. var. *maingayi* (Hook. f.) Ridley, Fl. Mal. Penins. 1 (1922) 674. — Type: *Maingay* 625, Malaya.

Pygeum hookerianum King, J. As. Soc. Beng. 66, 2 (1897) 293; Ridley, Fl. Mal. Penins. 1 (1922) 676. — Type: Wray 3969, Malaya.

Small trees (rarely over 15 m) or shrubs, bark brown. Leaves ovate or elliptic to oblong, 4–14 by 1.5–6 cm, apex (long-) acuminate, papyraceous, basal glands (0–)2(–4). Racemes up to 1(–2.5) cm long, pedicels 0–2 mm. Hypanthium 1.5–2(–3) mm high. Perianth segments 7–10, subequal, rarely more or less regularly differentiated as sepals and petals, up to 1.3 mm long. Ovary usually glabrous, sometimes sparsely hairy, rarely more densely hairy. Fruits transversely ellipsoid with obtuse apex, to subglobular with an apical point or beak of up to 1(–2) mm, 7–12 by 8–12.5(–13.5) mm (and see note below).

Distribution — Peninsular Burma, Peninsular and SE Thailand, Vietnam; in *Malesia*: N Sumatra, throughout Malaya incl. Penang, Singapore, Borneo (only Sabah, Sarawak), C and E Java, Philippines (Palawan only), Celebes (only one specimen seen from Mt Nokilalaki, 1500–1700 m altitude).

Habitat — Primary and secondary forest, altitude 0–1300(–1650) m.

Note — This variety is normally not difficult to recognize by its thin leaves and short racemes. A group of (five) collections from Sarawak, mostly from riverbanks, stands out by having identical leaves but quite different fruits: those are compressed globular to ovoid, 13–21 by 10–15 by 8–11 mm, with a prominent apical beak of up to 4 mm. These fruits are rather similar to those of *Prunus lamponga*, which has, however, different leaves. The taxonomic status of this Sarawak group remains unsolved as yet.

See also under the insufficiently known *Prunus odorata* (p. 349).

16. *Prunus kinabaluensis* Kalkman, Blumea 13 (1965) 64. — Type: Clemens 29527, Mt Kinabalu.

Small trees up to 15 m, bark smooth, pale green to brown. *Twigs* glabrous. *Leaves* elliptic to elliptic-oblong, 6–12 by 2.5–5.5 cm, base acute to rounded, apex usually gradually tapering, firm-herbaceous, with 5–7 pairs of nerves, venation inconspicuous, both sides glabrous, basal glands 0–6, usually more than 2, large, flat, all or part of them above the base in the blade. *Petiole* 0.5–1.5 cm long. *Stipules* oblong, free, 3.5–5.5 by 0.8–2 mm, ciliolate and sometimes with marginal glands. *Racemes* solitary, axillary, 2–6 cm long, peduncle up to 1 cm, rachis sparsely hairy, pedicels up to 3 mm long. *Hypanthium* 2–3 mm high, densely short-hairy to almost glabrous outside. *Perianth segments* 7–12, not regularly differentiated as sepals and petals, triangular to elliptic or ovate, 1–2 by 0.7–1 mm, cream-coloured to white, densely hairy to glabrous. *Stamens* 24–32, filaments up to 4 mm, glabrous, anthers up to 0.5 mm long. *Ovary* glabrous, style up to 4 mm long. *Fruits* (sub)globular, 12–14 by 13–16 mm, exocarp black when ripe, endocarp glabrous or hairy inside. *Seed* with glabrous or sparsely hairy testa.

Distribution – Borneo (only seen from Sabah, Ranau District), Philippines (only seen from Luzon).

Habitat – Forest, at altitudes between 1300 and 2400 m.

Note – Since the description of this species in 1965, more specimens have been collected in Sabah, but it is now also known from two collections from Luzon. The large foliar glands positioned above the base remain a conspicuous character of *P. kinabaluensis* and by this character it is distinguishable from the large-fruited specimens of *P. grisea* var. *grisea* that occur on some Philippine islands, especially on Palawan.

17. *Prunus lamponga* (Miq.) Kalkman, Blumea 13 (1965) 66; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 338. — *Pygeum lampongum* Miq., Ann. Mus. Bot. Lugd.-Bat. 1 (1864) 212.

— Type: Teijmann HB 4434, Sumatra.

Pygeum goethartianum Koehne, Bot. Jahrb. 51 (1913) 191. — Type: Korthals s.n., Sumatra.

Pygeum gracilipes Koehne, l.c. 191. — Type: Korthals 126, Sumatra.

Pygeum coriifolium Ridley, J. Str. Br. Roy. As. Soc. 75 (1917) 30; Fl. Mal. Penins. 1 (1922) 675. — Type: Ridley 14614, lecto; 14616; both Malaya.

Small trees, rarely more than 15 m high, bark smooth, brown or greyish. *Twigs* sparsely hairy only when very young. *Leaves* elliptic to oblong,

7–18(–21) by 3–6(–9) cm, base acute to rounded, margin often somewhat revolute, apex (usually shortly) acuminate, herbaceous, with 4–9(–11) pairs of nerves, often rather wide apart, venation usually almost invisible, glabrous on both sides when mature, puberulous only when very young, rarely more permanently short-hairy on both sides, basal glands 2(–4), flat. *Petiole* up to 1 cm long. *Stipules* linear, 3–7 by 0.5–1 mm, free, sometimes with marginal glands. *Racemes* solitary, in axils of extant or fallen leaves, up to 2.5 cm long, peduncle very short, rachis shortly hairy, pedicels 0–2 mm long. *Flowers* sometimes male. *Hypanthium* 1.7–3 mm high, sparsely hairy outside. *Perianth segments* 7–12(–15), subequal or at least not regularly differentiated as sepals and petals, up to 1 mm long, (sparsely) hairy outside. *Stamens* 17–32(–40), filaments up to 4 mm, glabrous, anthers up to 0.5 mm long. *Ovary* sparsely to densely hairy, rarely glabrous, style up to 4 mm long. *Fruits* ellipsoid to (compressed) subglobular, 13–24 by 10–20 (by 12–14) mm, the length including an apical point or more distinct beak of 1–4 mm length, exocarp usually sparsely hairy, rarely glabrous, rarely densely hairy, colour unknown, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution – Malaya, Sumatra, Bangka, Borneo.

Habitat – Primary and secondary forest of different types, altitudes from sea-level up to c. 850 (–1500) m.

Notes – See the note under *P. grisea* var. *tomentosa* for a comparison with a group of specimens from Sarawak, which have fruits matching the present species, but different leaves.

Recently collected specimens have not supported the recognition of a variety with more hairy and also large leaves, as suggested in Kalkman, l.c. The transitions to small and glabrous leaves are gradual.

18. *Prunus laxinervis* Kalkman, Blumea 13 (1965) 69. — Type: Clemens 28477, Borneo.

Trees up to 18 m. *Twigs* sparsely hairy. *Leaves* elliptic to oblong, 10–18 by 5–8 cm, base acute to rounded, apex acuminate, herbaceous, with 7–9 pairs of nerves, arcuating at some distance from the margin, venation inconspicuous, both sides (almost) glabrous, basal glands 2, flat. *Petiole* up to 1.3 cm long, hairy to glabrous. *Stipules* narrowly triangular, 4.5–7 by 1–2 mm, free. *Racemes* solitary, axillary, up to 5 cm long, peduncle very short, rachis hairy, pedicels 1–3 mm long. *Hypan-*

thium 1.5–3 mm high, hairy outside. *Sepals* 4, triangular, up to 1.5 mm long, hairy outside. *Petals* 4, ovate, up to 1.5 mm long, sometimes thinner than sepals, hairy, cream-coloured. *Stamens* 25–40, filaments up to 3 mm, glabrous, anthers c. 0.5 mm long. *Ovary* densely hairy, style up to 4 mm long. *Fruits* subglobose, 11–13 by 12–14 mm, exocarp sparsely hairy, colour unknown, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — Only known from Borneo, Sabah (several collections from Mt Kinabalu and two slightly deviating ones from other districts).

Habitat — Forest, 1000–1830 m altitude (also lower?).

19. *Prunus malayana* Kalkman, Blumea 13 (1965) 102; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 338. — Type: Nur SFN 32695, Malaya.

Trees up to 30 m, buttresses none or short, bark grey to brown, smooth or lenticellate. Twigs hairy when young. Leaves elliptic, 12–22 by 6–13 cm, base truncate to subcordate, apex obtuse to shortly and bluntly acuminate, herbaceous, with 9–15 pairs of nerves, venation indistinct, upper side glabrous, lower side shortly hairy and glabrescent, basal glands usually 2, large, flat or slightly hollowed and bulging above, sometimes glands absent. Petiole up to 1.5 cm long. Stipules pointed ovate, 3–5 (–11) by 2–4 mm, connate over up to 1 mm by their eccentric, keeled midribs. Racemes compound, in axils of extant or fallen leaves, 5–10 cm long, with 1–5 laterals up to c. 7 cm, peduncle c. 1 cm, rachis hairy, pedicels up to 2.5 mm long. Flowers sometimes male, sex disposition in trees unknown. Hypanthium 2–3 mm high, shortly hairy outside, with long hairs at base inside. Perianth differentiated as sepals and petals, but these only differing in shape, not in size, 5–6-merous. Sepals triangular, c. 1 mm long. Petals elliptic, c. 1 mm long, densely hairy. Stamens 50–80, filaments up to 4.5 mm, glabrous, anthers c. 0.5 mm long. Ovary glabrous or with some few hairs, style up to c. 3 mm long, pistillodium in male flowers minute, hidden in the hairs on the bottom of the hypanthium. Fruits ellipsoid to (rarely) subglobular, 18–25 by 16–21 mm, exocarp glabrous, colour when ripe unknown, endocarp glabrous or sparsely hairy inside. Seed with glabrous testa or with few hairs especially near apex.

Distribution — Peninsular Malaysia: Pahang, Trengganu, Perak.

Habitat — Forest, primary or disturbed, at altitudes from c. 100 to c. 1200 m.

Note — This species is, by its large leaves and compound racemes similar to *Prunus polystachya*, and is obviously closely related. The main difference is in the fruits (ellipsoid vs. transversely ellipsoid) and in flower the two are not always easy to distinguish. See also under Insufficiently known species, *Prunus A*.

20. *Prunus marsupialis* Kalkman, Blumea 13 (1965) 71. — *Pygeum glandulosum* Merr., Philipp. J. Sc., Bot. 3 (1908) 226; Elmer, Leafl. Philipp. Bot. 5 (1913) 1621; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 233. — Types: Williams 642, lecto; 25 syntypes; all Philippines.

Pygeum pubescens Merr., Philipp. J. Sc., Bot. 9 (1914) 359. — Type: Wenzel 333, lecto; 5 paratypes; all Philippines.

Small trees up to 13 m. Twigs hairy when young. Leaves elliptic to oblong, or somewhat ovatish, (6–)8–13(–16) by 3–6.5 cm, base rounded to acute, apex obtuse to acuminate, herbaceous, with 5–8 pairs of nerves, venation reticulate to more or less transverse, usually not conspicuous, both sides pubescent when young, glabrate, basal glands normally 2, hollowed and distinctly bulging above, rarely absent. Petiole up to 1 cm long. Stipules linear, free, often persistent, 4–12(–17) by 0.5–3 mm, with marginal glands. Racemes solitary, in axils of extant or fallen leaves, up to 7(–10.5) cm long, peduncle short, rachis hairy, pedicels up to 1.5(–3.5) mm long. Hypanthium c. 2 mm high, densely hairy outside. Perianth segments 8–12, subequal, up to 1.5 mm long, hairy. Stamens 20–30(–40), filaments up to 5 mm, glabrous, anthers 0.3–0.4 mm long. Ovary densely hairy, style up to 4 mm long, base hairy. Fruits transversely ellipsoid, 6–13 by 7.5–15 mm, exocarp still sparsely hairy, via red ultimately becoming black, endocarp glabrous or with some hairs inside. Seed with glabrous testa. — Fig. 20.

Distribution — Philippines, many islands from north to south, but not (yet) seen from Mindanao and Palawan. T.-C.Huang, Checklist in Fl. Taiwan 6 (1979) 63, mentions the species for Taiwan, from where I have not seen any specimens.

Habitat — Forest and forest edges, from sea-level to c. 1100 m altitude.

Note — Both epithets published in *Pygeum* are not available in *Prunus*.

21. *Prunus oligantha* Kalkman, Blumea 13 (1965) 83. — Type: Hoogland & Pullen 5439, Papua New Guinea.

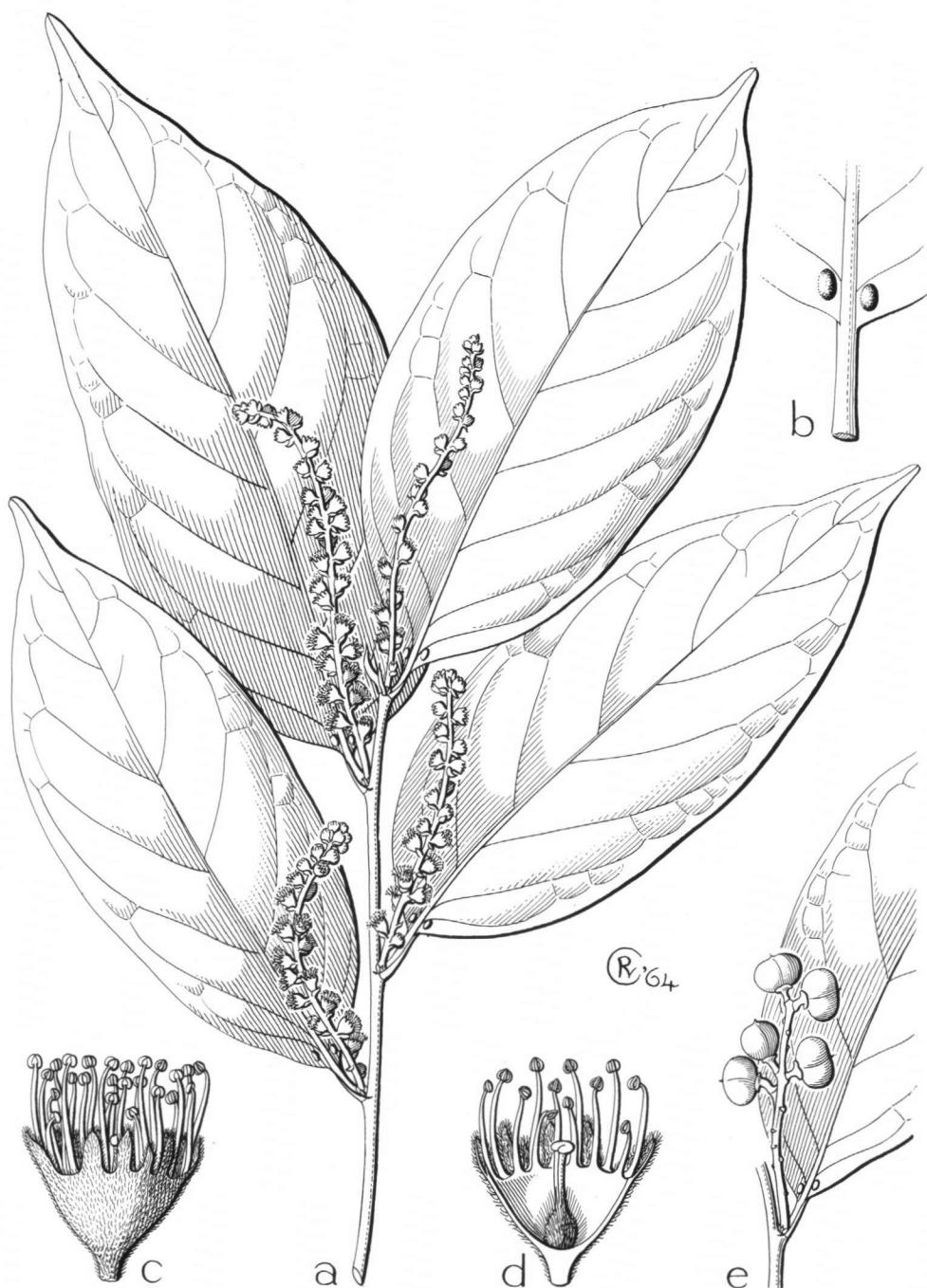


Fig. 20. *Prunus marsupialis* Kalkman. a. Flowering twig, $\times 0.7$; b. basal leaf glands, $\times 2$; c, d. flower, from outside and halved lengthwise, $\times 4$; e. fruits, $\times 0.7$ (Loher 2225).

Small trees, rarely over 15 m high, sometimes shrubs, bark dark brown or grey. *Twigs* hairy. *Leaves* oblong to ovate-oblong, 4–11(–14) by 1–4 cm, base acute, rarely rounded, apex acute to acuminate, coriaceous, with 5–8 pairs of nerves, venation invisible, densely hairy when young, hairs persistent on lower side, basal glands 0(–2), small, flat. *Petiole* up to 1 cm long. *Stipules* narrowly triangular, 2.5–5 by 1–1.5 mm, free, with marginal glands. *Racemes* solitary, axillary, up to 1 cm long, in fruit no longer than 2 cm, rachis densely hairy. *Flowers* up to 10, sessile, yellowish. *Hypanthium* 2–3 mm high, hairy outside. *Perianth segments* subequal, 6–12, 1–1.5 mm long. *Stamens* 12–30, filaments up to 2.5 mm, glabrous or hairy at base, anthers c. 0.5 mm long. *Ovary* densely hairy, style up to 3 mm long, sometimes hairy at base. *Fruits* ellipsoid or subglobular, 10–13 by 8–11 mm, exocarp still hairy when ripe, red, turning black when ripe, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — New Guinea, only one collection seen from Irian Jaya.

Habitat — Primary or disturbed montane forest, at 1500–2900 m altitude.

Uses — The bark is used for making waist-belts (*Clunie & Katik LAE 63312, Vink 16519*), as reported for other species too.

22. *Prunus oocarpa* (Stapf) Kalkman, Blumea 13 (1965) 102. — *Pygeum oocarpum* Stapf, Trans. Linn. Soc. Bot. 4 (1894) 144; Merr., Enum. Born. Flow. Pl. (1921) 289. — Type: *Haviland 1118*, Mt Kinabalu.

Shrubs or trees up to 15 m. *Twigs* densely hairy when young and rather tardily glabrescent. *Leaves* ovate to elliptic-ovate, 4–10(–13) by 3–6 (–8) cm, base rounded to cordate, sometimes decurrent, margin often revolute, apex rounded to obtuse, thick and coriaceous, with 7–11 pairs of nerves, venation slightly impressed above, flat underneath, densely hairy when very young, hairs disappearing with age, leaving the surfaces distinctly pitted and midrib above usually still hairy, basal glands 2(–4), flat to slightly hollowed and bulging above. *Petiole* up to 0.5 cm long, rarely longer. *Stipules* triangular, 3–5 by 2–3 mm, free. *Racemes* solitary, simple or with 1(–2) side-branch(es) at very base, in axils of extant or (more rarely) fallen leaves, up to 3(–5) cm long, peduncle absent, rachis hairy, pedicels up to 2 mm long. *Hypanthium* 1.5–2 mm high, densely and rather long hairy outside. *Perianth segments* (sub)equal, 7–11, 1–2 by 0.3–0.7 mm, densely hairy, brown-

ish to yellowish. *Stamens* 11–18(–21), filaments up to 2.5 mm, anthers 0.3–0.5 mm long. *Ovary* densely long-hairy, style 2–3 mm long, sometimes hairy at base. *Fruits* ellipsoid, 8–11 by 6–8 mm, hairy, red when ripe (?), endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — Borneo, known from Sabah (Mt Kinabalu, Mt Trusmadi), Brunei (Mt Pagon Periok), and Sarawak (Mt Api).

Habitat — Mossy forest and other types of forest, often on mountain ridges, also in shrubland, reported from limestone as well as from ultramafic soil and from sandstone, alt. 1200–3000 m.

Note — This species is quite homogeneous in appearance. It resembles some specimens of *P. arborea* var. *alticola*, but differs in the shape of the fruits: transversely ellipsoid and nearly always broader than long, rarely subglobular, in var. *alticola*, ellipsoid and always longer than wide in *P. oocarpa*. Flowering specimens are sometimes more difficult to distinguish, but var. *alticola* has more and often longer stamens (16–40, filaments up to 6 mm). The crater-like glands that sometimes occur on the stipules of var. *alticola*, were not seen in *P. oocarpa*.

23. *Prunus polystachya* (Hook. f.) Kalkman, Blumea 13 (1965) 88; Prance & Whitmore in Tree Fl. Malaya 2 (1973) 339; Corner, Wayside Trees of Malaya ed. 3. 2 (1988) 619. pl. 199. — *Pygeum polystachyum* Hook. f., Fl. Brit. India 2 (1878) 320; Ridley, Fl. Mal. Penins. 1 (1922) 674. — Type: *Maingay 627*, Malacca. *Pygeum myriandrum* Merr., Pap. Mich. Acad. Sc. 19 (1934) 155. — Type: *Bartlett 6871*, Sumatra.

Deciduous trees, up to 35 m high and more than 60 cm diam., sometimes with buttresses, bark grey to black or blackish brown. *Twigs* hairy only when young. *Leaves* elliptic to elliptic-ovate, 8–26 by 5–15 cm, base rounded to truncate, rarely acute, apex obtuse or shortly acuminate, herbaceous to coriaceous, with 9–12(–14) pairs of nerves, venation inconspicuous, glabrous on both sides, finely pubescent below only when very young, basal glands (0–)2, deeply hollowed, distinctly bulging above, not rarely in the contracted leaf-base. *Petiole* 0.5–1.5 cm long. *Stipules* narrowly triangular to oblong, oblique, 4–10 by 1.5–3 mm, usually free, rarely shortly intrapetiolarly connate. *Racemes* solitary, mainly in the basal part of shoots and appearing with the flush of new leaves, in the axils of leaves or in kataphylls below the leaves, or united into pseudo-panicles (leafless shoots usually retaining their terminal bud) or fascicled by contrac-

tion of the main axis, or truly compound with some side-branches and without terminal bud, 3.5–11 cm long, rachises short-hairy, pedicels 1–3 mm long. *Flowers* sometimes male, fragrant. *Hypanthium* 2–3 mm high, shortly hairy outside. *Perianth segments* 7–11, subequal or unequal but only rarely by their shape somewhat regularly differentiated as sepals and petals, 1–1.5 mm long, hairy. *Stamens* 50–85, filaments up to 5 mm, glabrous, anthers 0.3–0.7 mm long. *Ovary* glabrous except around insertion, or with some long hairs higher up, often on one side only, rarely more densely hairy, style 4–5 mm long, pistillodium in male flowers minute. *Fruits* transversely ellipsoid, 13–21 by 17–27 mm, exocarp glabrous, remaining green when mature (?), endocarp glabrous inside. *Seed* with glabrous or hairy testa.

Distribution – Sumatra (only seen from the middle part), Malaya, Singapore, Borneo? (From this island only one collection was seen, viz. *Forman & Blewett* 946, Brunei; it has the typical large leaves and fruits of this species but deviates in having flat instead of marsupial basal leaf glands).

Habitat – Primary and secondary forest, altitude 0–600 m.

Ecology – Corner, l.c., records pollination by "crowds of hover-flies and small beetles", attracted by the fragrant flowers. He invented the queer English name "bat's laurel" for the species but the role of bats was not elucidated.

Notes – See Kalkman, Blumea 13 (1965) 9, fig. 4, for a discussion of the morphology of the inflorescence in this species.

Closely related is *Prunus malayana*, see the note under that species. See also under Insufficiently known species, *Prunus A*.

24. *Prunus pulgarensis* (Elmer) Kalkman, Blumea 13 (1965) 67. — *Pygeum pulgarensense* Elmer, Leafl. Philipp. Bot. 5 (1913) 1627; Merr., Enum. Philipp. Flow. Pl. 2 (1923) 234. — Type: Elmer 13200, Palawan.

Pygeum monticolum Merr., Philipp. J. Sc., Bot. 10 (1915) 312. — Type: Whitford 1203, Luzon.

Small trees. *Twigs* densely hairy. *Leaves* elliptic to oblong or ovatish, 7–14 by 3–5.5 cm, base acute or rounded, apex acuminate, coriaceous, with 6–9 pairs of nerves, venation reticulate, impressed above, inconspicuous below, densely hairy when young, lower surface remaining hairy when mature, basal glands 2–4 or absent, flat. *Petiole* 0.5–1.2 cm long. *Stipules* elliptic, c. 3–4.5 by 1–2 mm, free. *Racemes* solitary, in axils of extant or fallen leaves, 1–12 cm long, peduncle 0–1.5 cm, rachis densely hairy, pedicels 0–7 mm long. *Hypanthium* 2–4 mm high, densely hairy outside. *Perianth segments* 8–12, subequal or unequal but not regularly differentiated as sepals and petals, 1–2 mm long, hairy outside. *Stamens* 15–40, filaments up to 7 mm, glabrous or with some hairs at base, anthers 0.4–1 mm long. *Ovary* densely hairy, style up to 5 mm long, sometimes hairy at base. *Fruits* subglobular to transversely ellipsoid, 6–11 by 7–11.5 mm, exocarp hairy, shining purplish black when ripe, endocarp glabrous or with some hairs inside, calyx (i.e. remnant of hypanthium) under the fruit 1.5–4 mm diam., but in specimens from high altitudes up to 8 mm diam. *Seed* with glabrous testa.

Distribution – Philippines (Luzon, Palawan). **Habitat** – Mountain forest, c. 1000–1200 m altitude.

Note – Little known species and no new material added to what was known in 1965.

25. *Prunus pullei* (Koechne) Kalkman, Blumea 13 (1965) 85. — *Pygeum pullei* Koechne, Bot. Jahrb. 52 (1915) 338. — Type: Pulle 1005, Irian Jaya.

Prunus pullei (Koechne) Kalkman var. *grandiflora* Kalkman, Blumea 13 (1965) 86. — Type: Pulle 252, Papua New Guinea.

Small trees, up to 15(–24) m, in higher altitudes usually treelets of some metres or large shrubs, bark brown, usually rough and lenticellate, sometimes grey. *Twigs* densely hairy. *Leaves* elliptic to oblong, 2–12 by 1.5–5 cm, base acute to rounded, margins often revolute also when living, apex obtuse, often retuse, stiff-coriaceous, with 5–9 pairs of nerves, distinctly looped and joined near the margin, densely hairy when young and usually still hairy below when mature, basal glands 2(–4), flat. *Petiole* 0.2–1 cm long. *Stipules* narrowly triangular, 2.5–7 by 0.7–1.8 mm, free. *Racemes* solitary, in axils of extant or fallen leaves, 1–12 cm long, peduncle 0–1.5 cm, rachis densely hairy, pedicels 0–7 mm long. *Hypanthium* 2–4 mm high, densely hairy outside. *Perianth segments* 8–12, subequal or unequal but not regularly differentiated as sepals and petals, 1–2 mm long, hairy outside. *Stamens* 15–40, filaments up to 7 mm, glabrous or with some hairs at base, anthers 0.4–1 mm long. *Ovary* densely hairy, style up to 5 mm long, sometimes hairy at base. *Fruits* subglobular to transversely ellipsoid, 6–11 by 7–11.5 mm, exocarp hairy, shining purplish black when ripe, endocarp glabrous or with some hairs inside, calyx (i.e. remnant of hypanthium) under the fruit 1.5–4 mm diam., but in specimens from high altitudes up to 8 mm diam. *Seed* with glabrous testa.

Distribution – New Guinea.

Habitat – All kinds of montane forest, also mossy forest, and in subalpine shrubland, at (1500–) 2000–3700 m altitude.

Uses — As for other species, there are a few reports (*Bowers* 843, *Pullen* 252) of the use of the bark for making men's waist belts.

Notes — Herbarium material has more than doubled since 1965 and it has become clear that the earlier distinction of two varieties (Kalkman, l.c.) cannot be upheld. Leaf and flower characters are not really correlated and intermediates occur frequently. The infraspecific variation of course remains. Large leaves (more than 8 cm in length) are only found in lower altitudes (below 3000 m), but there is not a real correlation of leaf size and altitude since small leaves (up to 7 cm long) occur throughout the altitudinal range. The distinctness of the nervation underneath depends much on the size of the leaves: larger leaves often have more prominent nerves. The size of the flowers, i.e., the hypanthium, and correlated with it the size of the fruiting calyx, is variable but a boundary can only arbitrarily be drawn. There is a tendency that larger flowers especially occur in higher altitudes.

26. *Prunus rubiginosa* (Elmer) Kalkman, Blumea 13 (1965) 72. — *Pygeum rubiginosum* Elmer, Leafl. Philipp. Bot. 5 (May 1913) 1624; Merr., Enum. Philipp. Fl. Pl. 2 (1923) 234. — Type: *Elmer* 11857, holotype; 14067; both Mindanao.

Pygeum elmerianum Koehne, Bot. Jahrb. 51 (Dec. 1913) 206; Merr., Enum. Philipp. Fl. Pl. 2 (1923) 232. — Type: *Elmer* 12210, Sibuyan.

Trees up to c. 17 m, bark dark brown, smooth (few reports only). Twigs rapidly glabrescent. Leaves elliptic to oblong, 7–15.5 by 3–7.5 cm, base acute or rounded and decurrent, apex gradually narrowing or subacute, herbaceous, with 7–10 pairs of nerves, venation not conspicuous, sparsely hairy to glabrous, basal glands 1–2, distinctly hollowed and bulging above. Petiole 0.5–1.5 cm long. Stipules 3–6 by 1–1.8 mm, free, hairy, with marginal glands. Racemes solitary, in axils of extant or fallen leaves, 2–7 cm long, peduncle very short, rachis hairy, pedicels 0–1 mm long. Hypanthium 2.5–3 mm high, hairy outside. Perianth segments 10–12, not regularly differentiated as sepals and petals, up to 2 mm long. Stamens 60–75, filaments c. 3.5 mm, glabrous, anthers 0.3–0.5 mm long. Ovary more or less hairy, style c. 5 mm long. Fruits compressed subglobular to obscurely transversely ellipsoid, 16–17 by 16–20 mm, exocarp almost glabrous, red turning purple, mesocarp leathery-fleshy, endocarp glabrous inside. Seed with glabrous testa.

Distribution — Philippines, known from Luzon, Mindoro, Sibuyan, and Mindanao, but in each island only from 1 or 2 collections.

Habitat — Forest, altitude 250–1200 m.

Note — Young fruits seem to be ellipsoid.

27. *Prunus schlechteri* (Koehne) Kalkman, Blumea 13 (1965) 79. — *Pygeum schlechteri* Koehne, Bot. Jahrb. 51 (1913) 210. — Type: *Schlechter* 17621, Papua New Guinea.

Pygeum forbesii Koehne, l.c. 210. — Type: *Forbes* 529, Papua New Guinea.

Pygeum laurocerasus Koehne, l.c. 208. — Type: *Schlechter* 18621, Papua New Guinea.

Pygeum tetradenium Koehne, Bot. Jahrb. 52 (1915) 341. — Type: *Ledermann* 7889, Papua New Guinea.

Pygeum salomonense Merr. & Perry, J. Arnold Arbor. 21 (1940) 196. — Type: *Brass.* 2727, San Cristóbal.

Trees up to 35 m, sometimes buttressed, bark (dark to greyish) brown, smooth or shallowly fissured and with vertical lines of lenticels. Twigs sparsely to densely hairy. Leaves elliptic to oblong, rarely ovate, 6–17(–20) by 2–8(–10) cm, base rounded to acute, apex tapering or acuminate, herbaceous to coriaceous, with 6–13 pairs of nerves, venation usually inconspicuous, sparsely to densely hairy when young, upper surface becoming (almost) glabrous, lower surface usually still hairy when mature, basal glands (0–)2–6, flat. Petiole 0.2–1 cm long. Stipules ovatish to triangular, 2.5–6(–14) by 1–2.5 mm, free, usually with marginal glands. Racemes solitary, mostly in axils of fallen leaves, 1.5–7(–15) cm long, peduncle short, rachis densely hairy, pedicels 0–2(–4) mm long. Flowers fragrant, sometimes male. Hypanthium 1.5–3 mm high, hairy outside. Perianth segments subequal and not regularly differentiated as sepals and petals, 7–13, up to 2 mm long. Stamens 15–40, filaments up to 5 mm, glabrous or hairy at base, anthers 0.5–1 mm long. Ovary densely hairy, style up to 3 mm long, often hairy, pistillode in male flowers minute, hairy. Fruits transversely ellipsoid to subglobular (see note), in New Guinea and New Ireland 9–16 by 9–18 mm, in the Solomon Islands up to 17.5 mm long and 20(–23) mm wide, usually hairy, purplish black when ripe, mesocarp often rather thick, endocarp glabrous or with few hairs inside. Seed with hairy testa, sometimes hairs only near the hilum.

Distribution — New Guinea, Bismarck Archipelago (New Ireland), Solomon Islands (from Bougainville to San Cristóbal).

Habitat – Primary and secondary forest, in New Guinea from sea-level to c. 2600(–2800) m altitude, in the Solomon Islands not above 1200 m.

Uses – Few reports on medicinal use are known only from the Solomon Islands (*Kajewski* 2383, 2483): a macerate of the bark is applied to aching teeth and sore legs.

Notes – In New Guinea one could distinguish two groups differing in the shape and size of the fruits:

I Mature fruits transversely ellipsoid, sometimes distinctly bilobed, 10–13 by 12–18 mm. Seen from low altitudes, up to 1220 m.

II Mature fruits (sub)globular, 9–16 by 9–16 mm. Seen from higher altitudes, (1280–)1680–2620 m.

The two groups overlap in the measurements of their fruits and the distinction in shape is not always evident: the (sub)globular fruits of group II may tend to be transversely ellipsoid. Moreover, the characters of leaves and flowers do not show any correlation with the differences in fruit and flowering material cannot be matched with the groups as based on the fruits.

The few specimens seen from New Ireland fit in with group I. The populations from the Solomon Islands have, as mentioned in the description, fruits reaching larger sizes than the New Guinean plants of group I, but with an ample overlap.

The shape, size, and consistency of the leaves are somewhat variable in this species without, however, permitting the distinction of infraspecific taxa.

Some specimens with exceptionally long racemes and large leaves may resemble *P. dolichobracts*, but differ in the hairy ovaries, fruits, and seeds.

28. *Prunus sclerophylla* Kalkman, Blumea 13 (1965) 67. — Type: *Robbins* 573, Papua New Guinea.

Small to medium-sized trees or shrubs. *Twigs* densely hairy. *Leaves* elliptic to oblong, or ovateish, 1.5–7 by 1–3 cm, base acute, apex acute or shortly acuminate, coriaceous, with 4–7 pairs of nerves, venation not conspicuous, hairy when young, glabrescent but remaining hairy underneath, basal glands 0–2, flat. *Petiole* 0.2–0.5 cm long. *Stipules* narrowly triangular, 3–4 by 0.7–1 mm, free. *Racemes* solitary, in axils of extant or fallen leaves, up to 2.5 cm long, peduncle up to 0.5 cm, rachis hairy, pedicels up to 2.5 mm long. *Hypanthium* 2–2.5 mm high, densely hairy out-

side. *Perianth segments* subequal or at least not regularly differentiated as sepals and petals, 10–12, 1–1.5 mm long, hairy. *Stamens* 18–28, filaments up to 3 mm, glabrous, anthers 0.5 mm long. *Ovary* glabrous or with few hairs especially near suture, style up to 2.5 mm long. *Fruits* transversely ellipsoid, 6–8 by 7–9.5 mm, exocarp glabrous, black when ripe, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution – Papua New Guinea, seen from a number of mountains in W and E Highlands Provinces.

Habitat – Forest, also mossy forest, and subalpine shrubland, altitudes 2100–3100 m.

Uses – The bark of larger trees is, like that of other species of *Prunus*, used for native waist-belts (*Pullen* 148, Mt Hagen area).

Note – The extremely limited value of recording vernacular names is well illustrated by the three different names for this species, given in the course of two weeks by one or more informants speaking the Minj language to one collector, *R. Pullen* (5197 yurih, 5226 beindangan, 5329 bugl-bakl)!

29. *Prunus spicata* Kalkman, Blumea 13 (1965)

69. — Type: *Clemens* 40755, Sabah.

Trees up to 12(–25) m, or large shrubs, bark dark purplish or brownish. *Twigs* densely hairy. *Leaves* elliptic to oblong or lanceolate to ovate, 6–18 by 2.5–6.5 cm, base rounded, apex acute, long tapering or acuminate, herbaceous, with 6–12 pairs of nerves, venation inconspicuous to invisible, (rather) densely hairy when young, hairs usually remaining underneath, basal glands 0–2 (–4), flat. *Petiole* 0.2–1 cm long. *Stipules* narrowly triangular to oblong, 3–8 by 0.5–2.5 mm, free, rather persistent, margin hairy, with glands. *Racemes* solitary, axillary, 1–10(–17) cm long, peduncle 0–0.5 cm, rachis hairy, pedicels 0–1 mm long. *Flowers* sometimes male. *Hypanthium* 1.5–3 mm high, densely to sparsely hairy outside. *Perianth segments* subequal or at least not regularly differentiated as sepals and petals, 8–10, 0.5–2 mm long, hairy. *Stamens* 15–30, filaments up to 4 mm, glabrous or sparsely hairy at base, anthers 0.3–0.5 mm long. *Ovary* densely hairy, style up to 4.5 mm long, often partly hairy, pistillode in male flowers minute. *Fruits* globular to transversely ellipsoid, 9–14.5 by 9–14.5 mm, exocarp hairy to almost glabrous, red when ripe (becoming black?), endocarp glabrous inside. *Seed* with glabrous testa.

Distribution – Borneo, Philippines (Luzon, a sterile specimen from Mindoro).

Habitat — Primary (and secondary?) forest, also on riverbanks, at 1100–1500 m altitude.

Note — Judging from the c. 8 fruiting specimens seen, the fruits in Luzon are more globular, those in Borneo more transversely ellipsoid and averagely somewhat smaller.

30. *Prunus subglabra* (Merr.) Kalkman, Blumea 13 (1965) 87. — *Pygeum subglabrum* Merr., Philipp. J. Sc. 30 (1926) 395. — Type: *Ramos & Edaño BS 45014*, Mt Pulog.

Small trees up to 7 m. *Twigs* sparsely hairy when young. *Leaves* elliptic, 6–10 by 4–5 cm, base acute, apex shortly acuminate, coriaceous, with 6–8 pairs of nerves, venation inconspicuous, sparsely hairy when young, glabrescent, basal glands 0–2, flat or slightly hollowed but not bulging above. *Petiole* 0.5–1.5 cm long. *Stipules* elliptic, c. 8 by 3–4 mm, free, keeled inside, sparsely hairy outside. *Racemes* solitary, in axils of extant or fallen leaves, 2–5 cm long (in fruiting stage), rachis stout, hairy, fruit pedicels up to 3 mm long. *Flowers* only known from some old fragments. *Hypanthium* c. 3 mm high, densely hairy outside. *Perianth segments* subequal, c. 9(?), c. 2 mm long. *Stamens* c. 45, filaments up to 3.5 mm, anthers c. 0.5 mm long. *Ovary* hairy, probably densely so. *Fruits* subglobular, 15–20 by (?12–)17–19 mm, exocarp with few hairs, red, endocarp sparsely hairy inside. *Seed* with glabrous testa.

Distribution — Luzon: only seen from Mt Pulog and nearby Mt Tabayog.

Habitat — Forest, one collection from mossy forest, altitude 2400–2700 m.

Note — Two recent collections are both in fruit and do not add to the incomplete information on the flowers of this still badly known species, of which only three collections seem to exist, although Mt Pulog on Luzon is a well-explored place.

31. *Prunus turfosa* Kalkman, Blumea 13 (1965) 90. — Type: Anderson 13123, Sarawak.

Small trees up to 12 m, rarely buttressed, bark grey, smooth or slightly rough. *Twigs* sparsely hairy or glabrous. *Leaves* elliptic to oblong, 8–13(–18) by 4–6.5 cm, base acute, rarely rounded, apex obtuse to acuminate, herbaceous, with 8–12 pairs of nerves, venation inconspicuous, sparsely hairy to entirely glabrous, basal glands 2, deeply hollowed, in the contracted leaf-base. *Petiole* 0.5–1 cm long. *Stipules* not seen. *Racemes* in fascicles

of up to 4, in axils of extant or fallen leaves, up to 3.5 cm long, peduncle less than 0.5 cm, rachis hairy, pedicels 1.5–2 mm long. *Hypanthium* 1.7–2.5 mm high, sparsely hairy outside. *Perianth segments* subequal, 5–8, up to 1 mm long. *Stamens* 15–30, filaments up to 3.5 mm, glabrous or slightly hairy at base, anthers 0.2–0.5 mm long. *Ovary* sparsely hairy (to entirely glabrous?), style up to 4.5 mm long. *Fruits* subglobular, 7–9 by 8–9 mm, exocarp with some hairs or glabrous, colour unknown, endocarp glabrous inside. *Seed* with glabrous testa.

Distribution — Borneo: Sarawak, Kalimantan (one collection from W Kalimantan, near the border with Sarawak), Brunei [according to Anderson, Check-list Trees Sarawak (1980) 295, but specimens not seen].

Habitat — Peat swamp forest, about sea-level.

Note — New data about this species are not available and it seems that there has not been done any collecting in the habitat of *Prunus turfosa* after 1961.

32. *Prunus turneriana* (F.M. Bailey) Kalkman, Blumea 13 (1965) 81. — *Pygeum turnerianum* F.M. Bailey, Bot. Bull. Queensl. Dep. Agr. 8 (1893) 75; Queensl. Fl. 2 (1900) 525, pl. 19. — Type: Cowley s.n., Queensland.

Prunus glomerata (Koehne) Kalkman, Blumea 13 (1965) 81. — *Pygeum glomeratum* Koehne, Bot. Jahrb. 52 (1915) 340. — Type: Ledermann 9497, Papua New Guinea.

Trees up to 30 m, sometimes slightly buttressed, bark smooth or with lenticels in longitudinal lines, brown to grey. *Twigs* hairy, glabrescent. *Leaves* elliptic to ovate or obovate, 7–23 by 4–11 cm, base rounded to acute, apex acute to rounded, coriaceous to herbaceous, with 7–12(–15) pairs of nerves, venation more or less transverse, usually conspicuous beneath when dry, densely to sparsely hairy when young, glabrescent, basal glands 2–6, flat. *Petiole* 0.5–1.5 cm long. *Stipules* ovate to triangular, sometimes large, 4–7(–15) by 1–3(–10) mm, free. *Racemes* solitary, in axils of extant or fallen leaves, 2–9 cm long, peduncle absent or very short, rachis hairy, pedicels 0–2 mm long. *Flowers* often male. *Hypanthium* (2–)3–4 mm high, hairy outside and also inside. *Perianth* subequal to more or less regular, 6–14, up to 1.5 mm long. *Stamens* 15–50, filaments up to 4.5 mm, often hairy at base, anthers 0.5–1.2 mm long. *Ovary* hairy, style up to 5 mm long, hairy, pistilode in male flowers minute. *Fruits* compressed subglobular, 17–33 by 18–34 mm, hairy, black

when ripe, mesocarp rather thick when living, endocarp c. 1 mm thick, woody, usually hairy inside. *Seed* with usually sparsely hairy testa, hairs often especially near apex, sometimes glabrous, rarely densely hairy.

Distribution – Moluccas (one specimen seen from Bacan), Papua New Guinea (and one sterile collection from Irian Jaya), Bismarck Archipelago (only one specimen, from New Hanover), Australia (N Queensland).

Habitat – Forest, from sea-level to 2400 m altitude.

Notes – The species is characterized by its thick-walled, compressed subglobular fruits. In Australia the species is much more uniform than in New Guinea, but on the evidence available now, it is not possible to discriminate two taxa, as done in the 1965 revision. In New Guinea the species is found at low altitudes (as in Queensland) but also in montane forest. In the higher altitudes the leaves are often relatively small and densely hairy, but the variation in these two characters is continuous.

The fruits are very variable in dimension, also within one specimen; the extremely large fruits all come from New Guinea. The indumentum on the seedcoat is in Australian specimens usually sparse and often restricted to the apex. In New Guinean specimens the seeds are sometimes quite glabrous, rarely densely hairy.

33. *Prunus versteeghii* Kalkman, Blumea 13 (1965) 104. — Type: *Versteegh BW 4843*, Irian Jaya.

Trees up to 25 m, buttresses sometimes present, bark grey(-brown), strongly smelling. Twigs sparsely hairy to glabrous. Leaves oblong to oblong-ovate, 10–15 by 4–8 cm, base rounded to acute, apex acute, herbaceous, with 7–9 pairs of nerves, venation not conspicuous, glabrous to very sparsely hairy, basal glands 2, flat. Petiole 0.7–1 cm long. Stipules (few seen) c. 6 by 2 mm, free. Racemes solitary or in fascicles of 2–3, in axils of extant or fallen leaves, 3–10 cm long, peduncle very short, rachis hairy, pedicels 1–2 mm long. Only male flowers seen. Hypanthium c. 2 mm high, hairy outside. Sepals triangular, c. 1 mm long,

hairy. Petals elliptic to obovate, c. 1 mm long, hairy. Stamens 35–45, filaments 1.5 mm, anthers 0.5–0.7 mm long. Pistillode in male flowers minute, ovary in bisexual flowers probably hairy. Fruits transversely ellipsoid to didymous, 15–19 by 22–28(–30) mm, exocarp sparsely hairy to glabrous, purplish black when ripe, mesocarp rather thick, endocarp glabrous inside. Seed with glabrous testa.

Distribution – New Guinea, seen from five localities far apart.

Habitat – Forest, probably preferring wet places. Altitude 0–300 m.

34. *Prunus wallaceana* Kalkman, Blumea 13 (1965) 86. — Type: *Kostermans 18587*, Sumbawa.

Trees up to 30 m, rarely buttressed, bark smooth, grey to darkbrown, with lenticels. Twigs hairy to glabrous. Leaves elliptic to oblong, sometimes ovatish, 10–18 by 4–8 cm, base usually rounded, rarely more acute, apex gradually tapering to shortly acuminate, herbaceous, with 8–14 pairs of nerves, venation widely transverse, not conspicuous, usually glabrous, rarely with some pubescence, basal glands (0–)2, flat. Petiole (0.5–)1–2.5 cm long. Stipules oblong, 3–9 by 0.8–2.3 mm, free, sometimes slightly keeled inside, sometimes with marginal glands. Racemes solitary, in axils of extant or fallen leaves, 4–10 cm long, peduncle very short, rachis sparsely hairy, pedicels (0.5–)3–6 mm long. Hypanthium 2–3 mm high, (sparsely) hairy outside. Perianth 5- or 6-merous. Sepals triangular, 1–1.5 mm long, hairy outside. Petals obovate, 1.5–3 mm long, hairy outside, white. Stamens 35–55, filaments up to 4.5 mm, glabrous or hairy at base, anthers 0.3–0.7 mm long. Ovary glabrous, style up to 6 mm long. Fruits transversely ellipsoid, 10–13 by 13–18 mm, exocarp glabrous, red when ripe (or ultimately becoming black?), endocarp glabrous inside. Seed with glabrous testa.

Distribution – Celebes (S peninsula, Talaud I.), Lesser Sunda Islands (seen from Sumbawa, Sumba, Flores), Moluccas (seen from Ternate, Ceram).

Habitat – Primary and secondary forest, also along rivers, altitude 0–1700 m.

Subgenus Padus

See under Insufficiently known species, *Prunus C.*

Subgenus Amygdalus

In Malesia only cultivated.

Prunus persica (L.) Batsch, Beitr. Entw. Pragm. Gesch. 1 (1801) 30. — *Amygdalus persica* L., Sp. Pl. (1753) 472. — *Persica vulgaris* Miller, Gard. Dict. (1768) 465. — Type: in LINN.

Deciduous shrubs or trees, up to 8 m. *Twigs* glabrous. *Leaves* lanceolate, 5–8(–15) by 1.5–2 cm, margin serrate, basal glands on top of petiole or at base of blade in the margin. *Flowers* appearing before the leaves, often in pairs next to axillary buds, 5-merous, pedicels 0. *Petals* pink. *Stamens* 35–40. *Ovary* hairy to glabrous. *Fruits* globular, faintly furrowed longitudinally, 3–8 cm diam., exocarp hairy (peach) or glabrous (nectarine),

yellow to red, mesocarp fleshy, yellow to red, endocarp thick and hard, deeply pitted and furrowed.

Distribution — Native in China, cultivation spread from there, now cultivated wherever the climate is suitable. In Malesia rarely cultivated in montane areas, among others in East Java.

Uses — Fruits edible and according to many one of the world's most delicious table fruits. See information on aspects of cultivation in tropical Asia: S. Subhadrabandhu in E.W.M. Verheij & R.E. Coronel (eds.), Edible fruits and nuts, Plant Res. SE Asia (PROSEA Handbook) 2 (1991) 262–266.

Common names — Peach, nectarine (English), Persik (Indonesia, Malaysia), Peras (Philippines).

INSUFFICIENTLY KNOWN SPECIES

Prunus odorata (Henderson) Whitmore in Tree Fl. Malaya 2 (1973) 338. — *Pygeum odoratum* Henderson, Gard. Bull. Str. Settl. 7 (1933) 101, pl. 20. — Type: Henderson SFN 23278, Malaya.

Small trees. *Twigs* glabrous. *Leaves* ovate-elliptic, 6.5–11 by 3.5–5.5 cm, base rounded to acute, apex acute to acuminate, herbaceous, with 6–9 pairs of nerves, venation inconspicuous, glabrous, basal glands 2–4, flat. *Petiole* 0.5–1 cm long. *Stipules* 4 by 1 mm, free. *Racemes* solitary, up to 4 cm long, rachis hairy, pedicels up to 5 mm long. *Flowers* fragrant (Henderson SFN 23278). *Hypanthium* c. 2.5 mm high, hairy outside. *Perianth segments* subequal, 7–9, 1–1.2 mm long. *Stamens* 28–38, filaments up to 5 mm long. *Ovary* hairy, style up to 5 mm long, hairy at base. *Fruits* not seen.

Distribution — Malaya, Pahang, Cameron Highlands.

Habitat — Nothing known except the altitude: 1440 m.

Note — Although now formally transferred from *Pygeum* to *Prunus*, this taxon — if it is one — has not become better known than in 1965, when I put it under the 'incompletely known species', only flowers and flowerbuds being present on the two collections. There is a distinct likeness to *Prunus grisea* var. *tomentosa*.

Prunus A

Trees up to 25 m high and 30 cm diam., bark light to darkbrown, smooth. *Twigs* practically glabrous. *Leaves* elliptic, 14–17 by 8–10 cm, base rounded to truncate, rarely more acute, apex shortly acuminate to rounded, herbaceous, with 8–10 pairs of nerves, venation transverse, not very conspicuous, glabrous above, sparsely short-hairy below, basal glands 2, deeply hollowed and bulging above, situated in a contraction of the leaf-basae. *Petiole* 1–1.5 cm long. *Stipules* ovate, sometimes oblique, 6–9 by 1.5–3 mm, free(?), with glands on margin and (often?) with 1–3 flat to slightly hollowed glands on the outer surface, sparsely hairy outside. *Inflorescence* a compound raceme, in axils of leaves or scars, up to 10 cm long, with up to 4 side-branches of 4–6 cm long, rachis sparsely short-hairy, pedicels up to 1 mm long. *Flowers* sometimes male. *Hypanthium* 1.5–2 mm high, hairy outside. *Perianth segments* 8–10, subequal, 0.5–1 by 0.2–0.5 mm, hairy outside. *Stamens* 20–25, filaments up to 3.5 mm, glabrous or with few hairs at base, anthers 0.2 mm long. *Ovary* glabrous, style up to 4 mm long, pistillode in male flowers small. *Fruits* (only young ones seen) probably globular or transversely ellipsoid, 8 by 10 mm when immature, glabrous. *Seed* with glabrous testa (when young).

Distribution — Borneo, seen from Sarawak and Sabah.

Habitat — Forest on hillsides and riverbanks, up to 450 m altitude.

Note — The leaves of the six collections, here indicated as *Prunus A* (belonging to sect. *Mesopygeum*), are of the same kind as those of *Prunus polystachya*, having the large marsupial glands in a contraction of the leaf-base.

The young fruits present on three of the specimens do certainly not give the impression that they could grow into the large fruits as in *malayana* or *polystachya*.

Prunus B — *Pygeum macropetalum* Koehne, Bot. Jahrb. 51 (1913) 198, 222; Baker f., J. Bot. 62 (1924) Suppl. 33. — Types: *Forbes* 2343, 2354a, Sumatra, Mt Dempo.

Trees. Twigs glabrous. Leaves ovate-lanceolate to elliptic or oblong, 8–17 by 3.5–9 cm, base acute to rounded, apex tapering to acuminate, coriaceous, with 10–15 pairs of nerves, venation transverse, not conspicuous, both surfaces glabrous when mature, sparsely hairy below when very young only, basal glands 0–2, flat. Petiole 1–2 cm long. Stipules 7–8.5 by 2–3 mm, free, glabrous, margin glandular. Racemes solitary, in the axils of fallen leaves, 7–15 cm long, peduncle 1–2 cm long, rachis hairy, pedicels 4–8 mm long, pink. Hypanthium 3–4 mm high, short-hairy outside. Perianth differentiated as sepals and petals, but not rarely with irregularities, 4- or 5-merous. Sepals triangular, 1.5–2 mm long, hairy outside. Petals suborbicular to elliptic, 2–3.5 mm long, hairy outside, white. Stamens 35–55, filaments up to 7 mm, glabrous or with some hairs at base, anthers 0.7–1 mm long. Ovary glabrous, style up to 5 mm long. Fruits subglobose-ovoid, 10–12 mm long, see note. Seeds with glabrous testa.

Distribution — Sumatra, see note. Part of *Forbes* 2354a has 'Java' printed on the labels.

Habitat — Altitude 1700–2000 m.

Note — The two specimens cited with the original description seem to be conspecific with *De Wilde & De Wilde-Duyffes* 14087 from Mt Ketambe and with the sterile specimen *Meijer* 6434 from Mt Kerinci, both also from Sumatra but rather wide apart. The species belongs to sect. *Mesopygeum* and is obviously related to *Prunus grisea* and *P. ceylanica*, but the very long racemes and the rather large flowers are differentiating. It is entered here because of the insufficient data on the fruits. The description given rests on the field note of *De Wilde* c.s. 14087, but on the herbarium

specimens only some immature fruits are present and a possibly full-grown one which is subglobular and measures 8 by 7 mm, with some few hairs.

Prunus C — *Prunus luzoniensis* Merr. & Quis., nomen on herbarium sheet.

Small trees. Twigs glabrous. Leaves lanceolate, 8–10.5 by 2.5–3 cm, base acute, margin finely serrate, apex gradually narrowed, herbaceous, with c. 15 pairs of nerves, between two primary nerves often with an ± equally strong and parallel nerve, venation not conspicuous, upper surface glabrous, lower surface with hairs on and near midrib, domatia absent, basal glands usually 2, on the top of the petiole. Petiole 1–1.5 cm long. Stipules narrowly triangular, 9–10 by 1–1.5 mm, free, on the twig, both sides hairy, margin dentate-glandular. Racemes terminal on lateral branches, bearing two normal but small (up to 7.5 cm long) leaves in the part below the flowers, entire branch 9–13 cm long, with c. 20 flowers, rachis hairy, pedicels 2–3 mm long. Hypanthium c. 2.5 mm high, sparsely hairy outside. Sepals 5, triangular with rounded apex, c. 1.5 by 1.5–2 mm, margin with some glandular teeth, (almost) glabrous outside. Petals 5, broadly obovate, 3–4 by 3.5–4.5 mm, glabrous, white. Stamens c. 20, filaments up to 3 mm, glabrous, anthers 0.7–1 mm long. Ovary glabrous, style up to 1.5 mm long. Fruits not seen.

Distribution — One specimen seen from Mt Pulog, Luzon, Philippines.

Habitat — The specimen comes from a "partly open field, close to stream", 2000 m altitude.

Note — *Celestinó* c.s. PNH 4337 is the first and up till now the only collection of a Malesian *Prunus* belonging to the subgenus *Padus* which is characterized by the leaves on the basis of the raceme. It was collected in 1948 on a well-visited mountain and it can be doubted whether it came from a wild tree. Identification is difficult since too many badly demarcated species have been described in this subgenus. Also because of the absence of fruits it seems better to keep it under the insufficiently known species than to create another synonym which later will have to be reduced.

Prunus D

Tall trees. Twigs hairy. Leaves elliptic to ovate-oblong, 11–16 by 4.5–7.5 cm, base acute, apex gradually narrowing, coriaceous, with 7–9 pairs of nerves, venation inconspicuous, glabrous above, sparsely hairy below, basal glands 2, flat, at the very base of the midrib. Petiole c. 1 cm long.

Stipules not seen. *Racemes* solitary, only seen in fruit, on old twigs, 1–2.5 cm long, stout, peduncle almost absent, rachis hairy, fruiting pedicels up to 2 mm long. *Flowers* only seen as remnants. *Hypanthium* c. 2 mm high, densely hairy outside. *Perianth segments* subequal, 10–12, 2–2.5 mm long, hairy. *Stamens* short, filaments up to 2 mm, anthers 0.6 mm long. *Fruits* compressed (broadly) ovoid, 16–18 by 14–18 mm, exocarp sparsely hairy, especially at top, green when ripe (?), mesocarp thin, endocarp thin (c. 0.5 mm), sparsely hairy inside. *Seed* with glabrous testa.

Distribution — One specimen seen (*Hoogland & Craven 11086*), from E Sepik Province, Papua New Guinea.

Habitat — Rain forest, at 1160 m altitude.

Note — This species belongs to sect. *Mesopygeum* and seems to be rather well distinct. The

fruits are not like any described species, much too large for *Prunus grisea*, too small for *P. turneri*-*ana*, two species which could be considered.

EXCLUDED

Prunus zippeliana Miq., Fl. Ind. Bat. I, 1 (1855) 367. — Type: *Zippel s.n.*, Java, holo in L, sheet 908.202-880.

Obviously collected from a cultivated tree, probably in the Botanic Garden at Buitenzorg (Bogor) and originating from Japan. The natural range of the species is China, Taiwan, Japan, and Vietnam.

Several *Pygeum* species names cannot be accounted for, types being lost or insufficient. See lists of 'Incompletely known species' and 'Dubious species' in Kalkman (1965).