POTENTILLA, DUCHESNEA, AND FRAGARIA IN MALESIA (ROSACEAE)

C. KALKMAN

SUMMARY

Nine species of *Potentilla* are recognized for the Malesian area, two more are insufficiently known. Of the nine species, one is new (*P. hooglandii*), a new variety is also described (*P. foersteriana* var. *ima*). *Duchesnea* is considered congeneric with *Potentilla*.

Although for *Fragaria* the same case could be made, it is kept separated for practical reasons and for reasons of nomenclatural stability. In Malesia two species occur, both introduced.

Some reductions and nomenclatural rectifications will also be found in the present revision which is a precursor towards a revision of the *Rosaceae* for Flora Malesiana.

1. THE LIMITS OF POTENTILLA

It is well-known that there exist very different views on the generic delimitation within the *Potentilleae*, and only a monographer for the whole tribe is in a position to judge adequately the value of the several genera proposed. In the meantime also a taxonomist working on a regional basis has to reach some decisions.

An extreme view on the matter is laid down in Hutchinson's recent (1964) treatment, in which the generic limits in the *Potentilleae*, and also the key to the genera, are without essential modification those of Rydberg (1908). The two authors mentioned recognize 16 genera in the *Potentilleae*.

On the other hand Wolf, in his monograph of *Potentilla* (1908), recognizes only 7 genera in the key. For the present study, a precursor towards a future Flora Malesiana revision of the *Rosaceae*, only two problems are in fact relevant.

The first is: do we have to recognize an inclusive genus *Potentilla* (more or less agreeing with Wolf's views) or has it to be divided into five genera: *Potentilla s.s.* (in which *P. sundaica* would have to be placed), *Argentina* (including most of the Malesian species), *Drymocallis*, *Sibbaldiopsis*, and *Pentaphylloides*? The differences between these 'genera', which are obviously closely connected, are to be found in the following characters: shrubby or herbaceous, leaves digitate, trifoliolate, or pinnate, style subterminal, lateral, or basal, shape of the style. I have taken *Potentilla* here in its wider sense, because I believe that the groups into which this could be devided (five or more) are more closely allied mutually than with e.g. the genera *Horkelia*, *Chamaerhodos*, or *Stellariopsis* which should be kept apart anyhow.

The second problem that I had to consider regards the genera that are separated from *Potentilla* on the strength of their enlarging torus: *Comarum*, *Duchesnea*, and *Fragaria*, the latter two also occurring in Malesia. This is a reputedly difficult problem. The fact itself that three different genera are characterized by the swelling torus, the other characters mentioned in keys being of a very minor importance, should be a warning that this property might have been acquired polyphyletically and this again calls for great caution when trying to evaluate it in a natural system.

Summarizing the differences between the four genera, we come to the following picture.

Potentilla (in the wider sense, as circumscribed above) — Torus usually not very much enlarged after anthesis, not becoming fleshy. However, several species from several corners of the system display a distinct postfloral enlargement of the torus, e.g. *P. arguta* with a fruiting torus of *c.* 6 by 4 mm grown from 2 by 2 mm in the flower, *P. elatior* (flowering 1 by 1 mm, fruiting 2½ by 2½ mm), *P. centigrana*, *P. cryptotaeniae.* The receptacles never become really juicy, the achenes are placed on the surface and are not sunken in the torus.

Comarum — The torus swells to a spongy structure, with the achenes on the surface, and notwithstanding a very superficial resemblance to a strawberry not juicy at all.

Duchesnea — As in *Comarum*, although the consistency of the fruiting receptacle may be more aptly described as subcarnose or something like it. They are in any case more or less edible, but not very juicy. Related to the dimensions of the torus during anthesis, the enlargement after that is much more pronounced than in *Potentilla.*

Fragaria — The achenes are sometimes sunken in pits, sometimes placed on the surface of the fruiting receptacle as in the genera mentioned above. The torus grows distinctly and becomes fleshy after flowering, and at least in some species juicy (although of course the strawberries obtained from the greengrocers' are not 'normal' in this respect).

In the above census the other differentiating characters (leaf shape, flower colour) are not mentioned, because they are of no use in discriminating the three other genera from *Potentilla.*

Put in this way, the differences between the four 'genera' are not impressive — to use an understatement. The conclusion can hardly be other than that the three smaller genera must be combined with *Potentilla* where they have to be placed in different sections.

In *Comarum* this has, in fact, often been done, including by Wolf, and no comment is further necessary. As to the other genera, *Potentilla*, *Duchesnea*, and *Fragaria*, the descriptions given above need further elucidation.

A character, not yet mentioned above, was seized by Wolf to keep *Fragaria* separate: the fact that in the latter genus the enlarged torus falls off as a whole, whereas in *Potentilla* (*s.l.*, incl. *Duchesnea* and *Comarum*) the achenes fall from the persistent torus. It may be difficult to maintain this, because sometimes the 'berries' of *Fragaria* may be firmly attached to the hypanthium and do not easily detach (e.g. *F. moschata*).

This brings us to the *dispersal methods* in the group under consideration. In this respect there is rather some variation in *Potentilla.* Many species form a 'pseudo-capsule' on the stiff, erect pedicel, a functional capsule the wall of which is formed by epicalyx and calyx leaves, closing around the torus with its achenes. Dispersal is then by ballistic anemochory, and examples are (Sernander, 1906): *P. recta*, *P. erecta*, and also *P. palustris* (= *Comarum palustre*).

These and other species may also be eaten by herbivores like deer, reindeer, cattle; they belong to the group of unspecialized endozoochores, the plants being eaten mainly for the foliage and not for some quality of their dispersal-units.

A specialized form of dispersal, i.c. myrmecochory, is also found in *Potentilla.* Several species have some kind of appendage on the achenes, and in some species the cells of the appendage contain fat and the appendage may be called an elaiosome: *P. alba*, *P. micrantha*, *P. sterilis* (Bresinsky, 1963). In those species of course the peduncles will bend down to the soil after anthesis and so make the fruitlets available for ants.

The presence of an appendage to the achene, however, is not sufficient evidence for myrmecochory. The achenes of *P. paradoxa* (by Wolf considered as a variety of *P. supina*) for instance have very large appendages, described as corky, and according to Sernander (1906) consisting of thin-walled, empty cells. This kind of appendage could assist in transport by air, but more probably by water. A capacity to survive long floating periods has been established for instance for *P. anserina* and *P. palustris.*

The attractive-looking red 'berry' (sometimes whitish or greenish) of *Fragaria* and *Duchesnea* suggests of course endozoochorous dispersal by birds. This is certainly true for *Fragaria,* and has been established indisputably for *F. vesca.* Snails also play a role in effective dispersal, and many other animals (including man) like to eat strawberries.

For *Duchesnea* the evidence is vague. Wolf says that *D. indica* is only rarely eaten by birds, Ridley (1930) mentions the species under his account of *Fragaria,* the species of which are 'certainly eaten by birds'. Neither Sernander (1927) nor Ulbrich (1928) give any information, but also in the 2nd edition (Huber 1964) of Hegi's Flora von Mittel-Europa no new evidence has been mentioned, so we may safely assume that there is none.

It is remarkable that the achenes of *Duchesnea* are sometimes provided with distinct appendages of the same kind as those in the *Potentilla* species of the *Fragariastrum* group (*P. sterilis,* etc.) However, myrmecochory is quite improbable, and the appendage may be functionless.

To summarize the facts of dispersal: in *Potentilla* (*s.l.,* and incl. *Comarum*) there are several methods. A swelling of the torus, where it occurs, seems not to have any important function in dispersal. The achenes come free from the torus and are dispersed as such.

In *Fragaria,* on the other hand, dispersal is effected mainly by birds who eat the pseudocarps as a whole. Understandably, the achenes remain on the torus. In most species — as far as can be judged — the spurious fruit comes off easily.

Duchesnea is not well-known in this respect. The aspect of the pseudocarps is more or less like that of *Fragaria,* but they are less juicy and consequently less attractive for man. Whether birds and other animals react similarly, is not clear. The achenes come off easily when ripe, but also the spurious fruits as a whole can be loosened easily from the hypanthium.

Genetical experiments have not contributed much to a solution of this problem in classification. It is established that *Potentilla, Duchesnea,* and *Fragaria* belong to one comparium. *Duchesnea indica* (♀) was already in 1902 artificially crossed with *Potentilla reptans* (♂), and the F^1 was very luxurious, flowered extensively, but reproduced only vegetatively (Wolf, 1908). *Fragaria* spp. and *Potentilla* spp. have also been hybridized, with different results but usually with a very weak or (sub)sterile F^1 (Ellis, 1960). Mangelsdorf & East (1927) mentioned their crossing of *Fragaria vesca* (♀) with *Duchesnea indica* (♂), the hybrids setting fruit and the fruits germinating rather well, but the resulting F^1 being extremely weak and not obtaining anything like maturity.

So the results of the genetic experiments may be used as an argument for merging the three genera, or on the other hand they may be considered as inconclusive or as examples of intergeneric crossability.

Pollen morphology is of little value in this group of genera. Reitsma (1966) placed the pollen of the 13 species he investigated in one type, and devided this in 4 subtypes differing only in unessential characters. In one of the subtypes (*Fragaria vesca* subtype) he placed two *Fragarias* and two *Potentillas.*

The results of *chromatography,* published by Bate-Smith (1961), are similar. *Duchesnea indica, F. moschata,* and *F. ananassa* were tested by him together with many species of *Potentilla,* but no consistent differences were found.

I know of no further published facts, anatomical, embryological, or otherwise, which might throw new light on the problem.

I do not think that the facts recorded above justify keeping the genus *Duchesnea* separated from *Potentilla*. It only differs from the latter in the postfloral enlargement of the torus being more pronounced than in any *Potentilla* species. I have therefore decided to merge *Duchesnea* with *Potentilla*, following Wolf who was the first to do this, although this monographer's decision was not accepted by later authors. The place that Wolf gave the species, viz. near *P. reptans*, seems quite acceptable to me.

For *Fragaria*, however, the situation is more complicated. It is certainly a natural unit, and does not seem to be very closely related to any part of *Potentilla*. For *Fragaria*, consequently, the choice has to be between generic or subgeneric (sectional) status. The very slight differences from *Potentilla* make an evaluation at infrageneric rank more desirable, but the nomenclatural effects of such a treatment advise retention of generic independence for practical reasons. Crantz (1763, 1766) already transferred the *c.* 20 species that Linnaeus had described in *Potentilla*, to *Fragaria* (including the type species, *P. reptans* L.). The merging of *Potentilla* and *Fragaria* would now necessitate about 300 new combinations in *Fragaria*. On the other hand, a proposal to conserve *Potentilla* over *Fragaria* would of course be unsuccessful.

It is admittedly inconsistent not to merge *Potentilla* with *Fragaria*, the main argument being for practical reasons. Therefore, I am glad to be in the company of Bentham, who wrote a hundred years ago already that they should be combined, but who also did not bring his conviction into practice.

2. THE MALESIAN SPECIES OF POTENTILLA

Up till the end of the 19th century, the only species known from Malesia were *P. indica* and *P. sundaica*, both of them first described under *Fragaria*.

For *F. indica* Andr. (1807), described from continental Asia, a new genus *Duchesnea* was erected by J. E. Smith (1811), although the correct combination was not made before 1888 (Focke). Blume (1826) mentioned the species for Java, but later Zollinger and Moritzi (1846) made a separate species *F. chrysantha* (= *Duchesnea chrysantha* Miquel, 1855) for this Javanese counterpart of *F. indica*. Transfer to *Potentilla* was proposed by Wolf (1904), but most authors retained the species (one or two) in *Duchesnea*.

F. sundaica Blume (1826) was also temporarily included in *Duschesnea* (Miquel, 1855) but later on it became incorporated in *Potentilla* (O. Kuntze, 1891) where it has remained ever since. Wolf (1908) combined the continental Asian *P. kleiniana* W. & A. with it (under the illegitimate name *P. wallichiana* Del.).

Potentilla species from the group of the *Anserinae* became known from Malesia only at the end of the 19th century. The first specimen to enter botanical literature was a collection made by McGregor in the eastern part of Papua, New Guinea. Ferd. v. Müller (1889) referred to it as *P. leuconota*, a Himalayan species, although he had at first intended to recognize it as a new, endemic species. This change of mind was due to Hooker who had (either in a letter, or on a specimen) referred a specimen from Mt Kinabalu, Borneo, to this same Himalayan species.

Shortly after, Stapf (1894) described a species (*P. parvula*) and two varieties of continental Asian species (*P. mooniana* var. *kinabaluensis* and *P. leuconota* var. *borneensis*) from Mt Kinabalu. *P. leuconota* was also mentioned from Mt Bonthain on Celebes by Hemsley (1896) on the strength of a specimen collected by Everett (identified by me as *P. papuana*).

The Papuan specimens referred to above, were described as *P. papuana* by Focke in 1895, and in 1914 Lauterbach named the second species for New Guinea: *P. foersteriana.*

The Philippines were to follow: in 1926 Merrill described *P. philippinensis.* Java also appeared to harbour a species of this group: in 1930 van Steenis discovered *P. mooniana* on Mt Papandajan, publishing the find in 1932.

No further new species were published until 1940, when Merrill and Perry described six New Guinea species, all based on Brass collections: *P. adinophylla, archboldiana, brassii, habbemana, novoguineensis,* and *simulans.*

The first publication on Sumatran *Potentillas* was in the same year 1940, when Merrill mentioned *P. leuconota* from a 1939 collection on Mt Losir (Ripley and Ulmer). The same species was already collected on that mountain by van Steenis in 1937.

From the above it is evident that the last monographer of the genus, Wolf (1908), could not have much Malesian material of the *Anserinae* at his disposal. He mentioned from New Guinea *P. papuana,* and from Kinabalu *P. parvula, P. polyphylla,* and *P. leuconota* (the latter two on the authority of Stapf, since Wolf did not see the Bornean specimens). *P. microphylla,* a Himalayan species that Focke (1894), and on his authority also Wolf, recorded for New Guinea, does not occur in the latter island; the plants so identified are *P. habbemana,* and probably also small representatives of *P. foersteriana* and/or *P. parvula.*

Although the number of collections on which to base a revision has greatly increased in the 60 years that passed since the publication of Wolf's monograph, not all questions can be answered as yet. The problem of *P. indica* in particular cannot be completely solved (see p. 346).

I have recognized for Malesia nine species of *Potentilla,* not counted two insufficiently known ones. In the following table the geographical distribution of the species has been indicated. It is seen that New Guinea is richest, with 5 species.

	Cont. Asia	Sum.	Mal. Pen.	Born.	Java	Phil.	Cel.	Less. Sunda I	N.G.
3. adinophylla									×
1. borneensis		×		×					
7. foersteriana									×
6. hooglandii									×
9. indica	×	×1)	×1)		×	×		×	
2. papuana						×	×		×
4. parvula				×		×	×		×
5. polyphylla	×			×	×				
8. sundaica	×	×			×				
Insufficiently known:									2

1) not indigenous

The large genus *Potentilla,* which is most profusely developed in the temperate to cold regions of Eurasia, has only a few species in Malesia. Most of these belong to one group, viz. (in Wolf's classification) the grex *Anserinae* which is the only grex of subsection *Leptostylae.*

The most familiar species of the *Anserinae* is of course *P. anserina* itself. This is, as is well-known, a very complex species which for instance was divided by Wolf into eight varieties, by others (Rydberg a.o.) even into a number of species. Rousi (1965) in his extensive paper on the biosystematics of the group, divided *P. anserina* into 3 subspecies (together covering a large part of the northern hemisphere) and recognized the New Zealand *P. anserinoides* as a separate species. Rousi's work did not comprise any of the tropical-Asian species of the *Anserinae*.

The authors who are in favour of splitting *Potentilla* into a number of genera (Rydberg, Hutchinson) recognize for the *P. anserina* group the genus *Argentina*.

Certain items in the description that Rydberg (1908), and in his footsteps Hutchinson (1964), give of that genus, make clear that it has been drawn up to fit *P. anserina* s.l. itself, and not at all the Malesian species (stolons, flowers solitary on the stolons, stamens 20—25). *Mutatis mutandis*, *Argentina* would be characterized by its herbaceous habit, its (often interruptedly) pinnate leaves, and its lateral, filiform style.

A chemical feature which distinguishes *P. anserina* from all other (± 50) *Potentilla* species tested, is the presence of the trihydroxy-flavonoid constituents myricetin and leuco-delphinidin (Bate-Smith, 1961).

Although I had only herbarium material at my disposal, I decided to test a few specimens of Malesian species chromatographically in order to see whether these constituents could be detected¹). A positive anthocyanidin reaction (after boiling of 100 mg of dried leaf with 5 cc of 2N HCl) was obtained in half of the specimens of section *Anserinae* tested. Paper chromatography (circular and ascending, in Forestal solvent) showed that cyanidin was present in all these specimens and that the positive AC-reaction has mainly to be ascribed to this anthocyan. Leuco-delphinidin could only be detected in one of the Malesian species, viz. in *P. foersteriana* var. *foersteriana*. A red spot at R_F 0.82—0.85 (circular) was interpreted as caused by the presence of pelargonidin and was found in two specimens of *P. parvula* and in one of *P. anserina*. With the methods used and in the limited scope of my investigations the presence of myricetin could not be established because of the omnipresence of ellagic acid, the large spot of which completely obscures a spot of myricetin, might that be present.

	AC-reaction	delph.	cyan.	pelarg.
P. anserina (sample 1)	+	+	+	+
(sample 2)	+	+	+	—
P. borneensis (2 samples)	—	—	—	—
P. foersteriana var. foerst.	+	+	+	—
P. foersteriana var. ima	—	—	—	—
P. hooglandii	—	—	—	—
P. parvula (2 samples)	+	—	+	+
(3rd sample)	—	—	—	—
P. polyphylla var. kinab. (2 samples)	+	—	+	—
P. sundaica	—	—	—	—

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¹) I want to extend my thanks to Miss Dr L. H. Fikenscher who guided my chromatographical steps.

Although my knowledge of the genus is restricted, it does seem very likely that species like *P. leuconota* and its allies (*P. papuana, P. borneensis*), *P. parvula*, and *P. foersteriana* (and the species centering around those) have to be placed near *P. anserina*. This is to my mind also true for *P. polyphylla* which Wolf placed in quite another group, viz. in grex *Rupestres* of subsectio *Closterostylae*. The relationship of *P. polyphylla* (and the continental Asian *P. siemersiana*, which seems to be very close to it) with the other pinnate-leaved Malesian species is rather evident (see remark 3 under *P. parvula*, p. 337), and I do not see sufficient reason to separate them so widely.

P. sundaica, with its digitate leaves and subterminal style, belongs in another part of the genus. Wolf placed it in the grex *Rivales* of subsectio *Conostylae*, but thought it not to be very closely related to the other species of that grex which in his opinion is heterogeneous and polyphyletic.

As to the third species that Wolf did not place in the *Anserinae*, viz. *P. indica* (*Duchesnea indica*), enough has been said in the first chapter of the present paper.

It is well-known that *Potentilla* species do cross rather easily and it is not astonishing that indications of hybridization can also be found in the Malesian species. I am convinced that wherever species of the *Anserinae* are growing together, hybridization is possible or even probable. Given a sufficiently large herbarium-sample or (which is better) during field-research introgressions from one species into another will often be found. The ordinary small herbarium sample, consisting (when it is not too scrappy) of maybe 10 or 12 rosettes, scattered over several herbaria, is of course generally quite inadequate to give more than a hint or a suspicion. However, when in a collection of species A (normally possessing notched epicalyx leaves) plants are found to have deeply incised epicalyx leaves, this arouses suspicion of introgression from species B (for which this is a normal character). Sometimes one is so lucky to find also a collection of species B, from the same collector, day and locality. The hint may become more substantiated when other specimens of the A collection show the epicalyx less incised or even only notched as it 'should' be. But this is about how far herbarium investigation is able to go. Real confirmation of introgressive hybridization cannot be obtained in this way. However, from herbarium as well as from field experience I am convinced that it is a regular phenomenon. See also remark 2 to *P. hooglandii*, p. 341.

Experimental evidence for apomixis, a common phenomenon in certain groups of *Potentilla*, is still lacking for the Malesian species.

KEY TO THE MALESIAN SPECIES OF POTENTILLA [1]

1. Leaves pinnate.
  2. Flowering stems (peduncles) shorter than the rosette leaves and the flowers not elevated above the rosette. . . . . 7. **P. foersteriana**
  2. Flowering stems about as long as or distinctly longer than the rosette leaves, flowers elevated above the rosette.
    3. Leaflets densely sericeous beneath (leaf surface not visible between the hairs).
      4. Stems, petioles, and leaf-rachises patently hairy. Flowering stems procumbent. 6. **P. hooglandii**
      4. Stems, petioles, and leaf-rachises appressed-sericeous.
        5. Ovary hairy . . . . 1. **P. borneensis**
        5. Ovary glabrous.
          6. Leaflets crowded and stiff, intermediary leaflets absent. Inflorescence erect, almost scapose, bearing only 1 or 2 flowers. . . . . 3. **P. adinophylla**

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[1] Not entered in the key the two insufficiently known taxa:
10. *P. prob. nov. spec.* (densely sericeous leaves, very short inflorescence);
11. *P. habbemana* (with digitate leaflets).

6. Leaflets distant, intermediary ones usually present. Flowering stems prostrate or ascending, normally bearing more than 2 (up to *c.* 10) flowers. . . . . . . **2. P. papuana**
3. Leaflets more or less hairy, but not densely sericeous beneath.
7. Upper leaflets normaly shorter than 10 mm, leaf normally not more than 10 cm long. Stamens as many as petals or twice that number (rarely more; up to 20). . . . **4. P. parvula**
7. Upper leaflets 10—30 mm, leaf 9—35 cm long. Stamens four times the number of petals or more. . . . . **5. P. polyphylla**
1. Leaves ternate or palmate.
8. Leaves 5-foliolate. Flowers in dichasial, terminal inflorescences . . . . **8. P. sundaica**
8. Leaves trifoliolate. Flowers solitary, opposite normal leaves on prostrate stems. . **9. P. indica**

1. Potentilla borneensis (Stapf) Kalkm., *comb. nov.* — *P. leuconota* D. Don var. *borneensis* Stapf, Trans. Linn. Soc. Lond. II, 4^2 (1894) 146; Wolf, Bibl. Bot., Heft 71 (1908) 680. — Type: Stapf mentioned a specimen of *Low*, and *Haviland 1058*. Lectotype: *Haviland 1058*, holotype in K (not seen), isotype seen from SING.

P. leuconota auct. *non* D. Don, Prodr. Fl. Nepal. (1825) 230: Hook. *f.*, Fl. Brit. Ind. 2 (1878) 352; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 242; Merr., Not. Nat. Acad. Nat. Sc. Philad. n. 47 (1940) 3.

Rosette plant with firm taproot. *Rosette leaves* pinnate, 5—18(—32) cm long, *petiole* 1—4(—9) cm, petiole and rachis densely-sericeous. *Stipules* up to 2½ cm adnate and up to 2½ cm free, brown-membranous, outer surface hairy in central part. *Leaflets* 7—16(—24) pairs, elliptic to oblong, more or less opposite in upper part, basal ones smallest, 1½ mm or longer, gradually larger towards tip, up to 7—19(—21) by 4—9(—10) mm, sessile, base rounded to acute, apex rounded to obtuse, margin pinnatifid to pinnatisect, rarely (see remark 2) incised to near the midrib, with (4—)6—11 pairs of incisions, lower surface densely sericeous, upper surface usually less densely so; intermediary leaflets present or not. *Flowering stems* 1 to several per rosette, erect but sometimes ascending from a prostrate lower part, from slightly shorter to distinctly longer than the rosette leaves, (3—)5—30 (—40) cm long, with only few cauline leaves or none at all, terminating in a thyrsus of up to 13 flowers (often much fewer or even only 1); stems and pedicels densely sericeous; the stipules of the upper cauline leaves not membranous but herbaceous with serrate margins. *Flowers* 5-merous. *Floral cup* 2½—3½ mm diam., densely sericeous outside. *Epicalyx leaves* elliptic or ovate to oblong, 2½—5 by (¾—)1—1¾ mm, usually entire or with a shallow apical notch, rarely with 2 or more deeper incisions, densely sericeous outside, less densely so or almost glabrous inside. *Sepals* triangular to triangular-ovate, 2½—4½ by 2—3¼ mm, acute, entire, indumentum as in epicalyx. *Petals* elliptic to suborbicular, 6—8½ by 4—6½ mm, entire, glabrous, yellow. *Stamens* 20 (or a few missing), filaments up to 2 mm, anthers ½—¾ mm long. *Torus* low cushion-shaped, hairy as is the disc. *Pistils* few to many, on a hairy stalk; ovary hairy, especially in the upper part, style lateral, narrowed at base, sometimes also hairy at base. *Achenes* up to *c.* 2 by 1½ mm, brown, smooth with some veins, usually still with some hairs.

SUMATRA. Gaju and Alas lands, Mt Losir: *Scheepens 2*, *Van Steenis 8513*, *8613*, *8666*; Putjuk Angasan: *Van Steenis 8361*; Goh Lembuh: *Van Steenis 9036*; Mt Kemiri: *Van Steenis 9608*, *9680*.

BORNEO. Sabah, Mt Kinabalu, several localities: *Chew & Corner RSNB 5974*, *Clemens 26958*, *51409*, *Enriquez SF 18176*, *Haviland 1058K* (*e.f.o.*), *Holttum s.n.* (SING), *Jacobs 5745*, *5746*, *Sinclair c.s. 9159*, *Weber SAN 54710*.

Collectors' notes. On Mt Kinabalu collected between *c.* 3500 and *c.* 4000 m altitude, in Sumatra between 2700 and 3500 m. Growing in exposed as well as sheltered places. The leaves are silvery white, also in the living plant.

Remarks. 1. *P. borneensis* has always been considered as a variety of *P. leuconota*, and some authors did not even make that distinction. Another member of this same group has variously been called *P. leuconota, P. leuconota var. papuana*, or *P. papuana*. In my opinion the best way of classifying the three taxa involved, is to give them the rank of species, which accordingly has been done here:

P. leuconota in Continental Asia (E. Himalaya, W. China, Taiwan),
P. borneensis in Borneo and Sumatra,
P. papuana in Celebes and New Guinea.

Some differences between the three species are as follows. In *P. leuconota* the side-branches below the terminal flower are close together and this gives the many-flowered inflorescence a typical umbel-like appearance. In the other two species this is not the case, although a Sumatran specimen (*Van Steenis 9608*) approaches it. The specimens from Borneo and Sumatra, however, are distinctly and constantly distinguished by their hairy ovary, a feature which has hitherto never been recorded. It may be recalled that Wolf used the presence c.q. absence of hairs on the ovary to divide the genus *Potentilla* into two sections (*Potentillae trichocarpae* and *gymnocarpae*).

The Papuan species has, like the continental Asian one, a glabrous ovary but is quite different in the shape of the inflorescence, and also in habit.

In cases like this, where one has to classify some replacing taxa which are obviously closely related, but nevertheless can clearly be distinguished from each other, it is difficult to assess differences and likenesses: one hesitates between species and subspecies. I believe that as a rule it is wisest then to place them tentatively on the level of species. Only investigation of the karyological characters and of the breeding behaviour may eventually lead to an understanding of the (phylo)genetical relations and maybe to a better arrangement ('better' here used in the sense of: more in accordance with the historical and biological relationships).

The above is not meant as a general plea for the 'biological species concept'. In fact, I am of the opinion that in all macroscopic plant groups taxonomists are due to make their species morphologically distinguishable. Distinctions that are not visible under say 20 times magnification, must — on practical, not theoretical grounds — not as a rule lead to species, but at most to infraspecific entities.

There are cases, however, — and the *P. leuconota* complex is one example — where morphological distinctions can be made but where there is strong indication for a close (phyletic) relationship which, if established, could make it more appropriate to place one or more of the groups under discussion on an infraspecific level. The thing to do would be of course setting up a series of breeding experiments and a series of chromosome studies in different populations throughout the area. It is also evident that this is as a rule not feasible with tropical plants. The decision on the status of the three groups rests on an incomplete and inadequate basis, but must nevertheless be taken. The practical argument that a binary name is more convenient than a ternary name, then gains importance.

2. Part of the Sumatran specimens differ from the rest in some vegetative characters. The plants are generally smaller and somewhat less densely hairy, and they have leaflets with fewer, but distinctly deeper incisions than normal. *Van Steenis 9680* is more or less intermediate and I do not as yet see a possibility to distinguish this '*laciniata*' form sufficiently sharp from the typical form.

3. Hayata, J. Coll. Sc. Imp. Univ. Tokyo 25, art. 19 (1908) 83, pl. V, described *P. leuconota* var. *morrisonicola* from Taiwan. I did not see the specimen(s) on which the record was based, but according to the plate and new material it is true *P. leuconota* and not *P. borneensis*.

2. Potentilla papuana Focke, Abh. Naturw. Ver. Bremen 13 (1895) 162; Wolf, Bibl. Bot., Heft 71 (1908) 678; Diels, Bot. Jahrb. 62 (1929) 480; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 243; Merr. & Perry, J. Arn. Arb. 21 (1940) 189; Borgmann, Zs. f. Bot. 52 (1964) 143. — *P. leuconota* D. Don var. *papuana* F. v. M., *nomen*. — Type: *MacGregor s.n.* from Owen Stanley Range; the holotype must be in MEL (not seen), isotype seen from K, and fragment from WRSL. The original description mentions also Mt Musgrave, no specimens seen from this locality.

P. leuconota auct. *non* D. Don, Prodr. Fl. Nepal. (1825) 230: F. v. M., Trans. Roy. Soc. Vict. 1^2 (1889) 5; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 242.

Rosette plant, occasionally forming long, prostrate stems which may terminate as inflorescences; taproot stout. *Rosette leaves* pinnate, (4½—)6—15(—20) cm long, *petiole* (1—)2—5½(—7) cm, petiole and rachis densely sericeous. *Stipules* of the rosette leaves up to 2½ cm adnate, up to 1½ cm free, up to 1½ cm wide, entire, membranous, lightbrown, outside with at least a central hairy streak, inside glabrous; stipules of the cauline leaves more leaflet-like, green, herbaceous, with incised margins. *Leaflets* 7—11 pairs, elliptic to oblong or ovate, more or less opposite in upper part of leaf, often alternate in lower part, basal ones 4—9 by 2—5 mm, gradually larger towards apex of leaf, up to (7—)11—22 by (4—)6—13 mm, base rounded to acute, apex rounded to acute, margin pinnatifid to pinnatisect, with 4—14 pairs of incisions; both surfaces densely sericeous, but on upper surface epidermis usually visible between the hairs; intermediary leaflets generally present, small or large, sometimes even two between a pair of primary leaflets. *Flowering stems* several per rosette, prostrate or ascending, as long as or longer than the leaves, (5—)10—30 (—45) cm, with some spaced leaves which are gradually smaller and may become ternate or unifoliolate near the top, rarely with vegetative laterals; stems and pedicels densely sericeous; thyrsus with under the terminal flower usually only one or few (in large specimens up to 6) flowering laterals, with 1—3 flowers each; bracts and bracteoles small but leaf-like. *Flowers* 5-merous, rarely 6- or 7-merous. *Floral cup* 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, lobes acute, densely sericeous outside, sparsely so to glabrous inside. *Sepals* triangular to ovate, 3—6 by 2—3 mm, apex acute, entire (rarely with 1 or 2 small side-lobes), indumentum like in epicalyx. *Petals* elliptic to obovate, 5—8 by 3½—6 mm, entire, glabrous, yellow. *Stamens* 10—29 (in New Guinea usually about 20, in Celebes usually about 10), filaments 1—2 mm, anthers ½—¾ mm long. *Torus* from low cushion-shaped to high and thin, hairy as is the disc. *Pistils* very many, ovary glabrous, on a hairy stalk, style inserted at about the middle of the ovary, slightly narrower at base. *Achenes* 1¼—1½ by ¾—1 mm, smooth, brown to dark purplish brown. *Chromosome number* 2n = 42.

PHILIPPINES. Luzon, Mt Tabayoc: *Jacobs 7438.*

CELEBES. Subdiv. Enrekang, Ranto Mario: *Eyma 714, Kjellberg 3872.* — Subdiv. Gowa, Bawakara Ridge: *Van Zijll de Jong 26.* — Mt Bonthain, different localities: *Bünnemeijer 11895, 11941, 12251, 12318, Everett 77, Monod de Froideville 210, Van der Pijl 736, Van der Vlies 12.*

NEW GUINEA. West New Guinea. Mt Wilhelmina: *Brass & Meijer Drees 9746*; Lake Habbema: *Brass 9543.* — Terr. New Guinea. West. Highl. Dist., Mt Sugarloaf: *Hoogland & Schodde 7121*; Mt Hagen: *Robbins 310*; Kubor Range: *Vink 16201*; Wahgi Divide: *Womersley NGF 5183*; Tubongas Mission Station: *Flenley ANU 2229.* East. Madang Dist., Finisterre Range, Mt Abilala: *Pullen 6060.* East. Highl. Dist., Mt Wilhelm, different localities: *Van Balgooy 267, Borgmann 3, Brass 30174, Flenley ANU 2430, Hoogland & Pullen 5680, Millar NGF 14666, Van Royen NGF 15137, Walker ANU 5052*; Mt Michael: *Brass & Collins 31211, Womersley NGF 11473*; Mt Piora: *Henty & Carlquist NGF 16536*; Sepik-Wahgi Divide, Mt Ormogadzin: *Van Royen NGF 18098.* Morobe Dist., Saruwaged Range: *Hartley 11128, Hoogland 9727, 9836*; Cromwell Mts: *Hoogland 9470.* — Terr. Papua. South. Highl. Dist., Mt Ambua: *Kalkman 4954.* Centr. Dist., Owen Stanley Range: *MacGregor s.n.* (K); Mt Albert Edward: *Brass 4230*; Mt Victoria: *MacGregor* *s.n.* (WRSL); Mt Scratchley: *Giulianetti s.n.* (K); Wharton Range, Murray Pass: *Brass 4635*; Mt Awormange: *Van Royen NGF 20373*. Milne Bay Dist., Mt Dayman: *Brass 22246, 22261*; Mt Aniata: *Crutwell 1065*; Kiraguba: *Borgmann 376*.

Collectors' notes. The species has been collected from 2450 to 3700 m altitude, nearly always in grassland, dry as well as wet or peaty. The silvery colour of the leaf-underside is striking also in the field. Sometimes the plant is recorded as prostrate, sometimes as having erect or semi-erect stems; Brass mentions on a label: 'Branches prostrate or ascending, according to station', and this summarizes well the differences in habit.

Remarks. 1. About the relation of this species to the continental Asian *P. leuconota*, see under *P. borneensis*.

2. An exceptionally large specimen is *Borgmann 376* from Kiraguba, with leaves (rosette or cauline?) up to 35 cm long and leaflets up to 35 by 20 mm.

3. The chromosome number (2n = 42) was established by Borgmann (voucher: *Borgmann 3*, in L).

3. Potentilla adinophylla Merr. & Perry, J. Arn. Arb. 21 (1940) 190. — Type: *Brass 4308*, holotype in A, isotypes in BO and NY.

Rosette plant with erect leaves and inflorescences; taproot stout. *Rosette leaves* pinnate, up to 7 cm long, *petiole* ½—1 cm, petiole and rachis densely sericeous. *Stipules* membranous. *Leaflets* 12—18 pairs, crowded and often somewhat folded along midrib, up to 8 by 6 mm, smaller towards the base but about equal over a large part of the leaf, sessile, with rounded base and apex, serrate to pinnatisect with 3—8 pairs of incisions, sericeous on both surfaces, very densely so underneath; intermediary leaflets absent. *Flowering stems* erect, almost scapose, with one or few reduced leaves, with a terminal flower and usually one axillary flower under it, 4—12 cm long, stems and pedicels sericeous. *Flowers* 5-merous, only seen in fruiting stages. *Floral cup* 3½—4½ mm diam., densely sericeous outside. *Epicalyx leaves* elliptic to ovate, 2—3½ by 1¼—2 mm, entire or notched at apex, sometimes with some shallow incisions, densely sericeous outside, inside with hairs near margin and apex. *Sepals* triangular, 2½—4 by 1¼—2 mm, acute, entire, indumentum as in epicalyx. *Petals* not seen. *Stamens* 10—20, filaments up to *c.* 1½ mm, anthers *c.* ½ mm long. *Torus* elevated, densely hairy as is the disc. *Pistils* many, ovary glabrous, on a hairy stalk, style inserted in the middle, thin and relatively long. *Achenes c.* 1.2 by 0.8 mm, brown, smooth, with a visible but not prominent dorsal line.

NEW GUINEA. Terr. Papua. Centr. Dist., Mt Albert Edward: *Brass 4308, 4754, 4755*; Mt Scratchley: *Giulianetti s.n.* (K).

Dubious specimens:

NEW GUINEA. West New Guinea. Mt Doorman: *Lam 1702, 1764*.

Collectors' notes. The Brass specimens were found in grassland, at an altitude of 3680 m, rocky and with shallow soil. The leaves are silvergrey. The Lam specimens are from swampy places, altitude 3200—3210 m.

Remarks. This species is related to *P. papuana* and *P. parvula*, but cannot at the moment be referred to either of them, mainly because of its ± scapose habit and its erect and stiff leaves with crowded leaflets. The type and only specimen mentioned by Merrill and Perry, was collected on Mt Albert Edward, at about the same place as the other Brass specimens mentioned above. The specimens collected by Lam on Mt Doorman are not quite the same and lack the stiffness and erectness which is characteristic for the Papuan collections. They are placed here with considerable doubt, since intermediate collections (intermediate in locality and in morphology) are absent as yet.

The description given was drawn from the Papuan specimens only.

4. **Potentilla parvula** Hook. *f. ex* Stapf in Hook. Ic. Plant. IV, 3 (Jan. 1894) pl. 2294; Stapf, Trans. Linn. Soc. Lond. II, 4^2 (Dec. 1894) 147; Wolf, Bibl. Bot., Heft 71 (1908) 683; Ridley, Trans. Linn. Soc. Lond. II, 9^1 (1916) 36; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 243. — Type: *Haviland 1057K*, holotype (*e.g.e.*) in K, isotype (*e.f.c.*) in SING; *Low s.n.* in K, paratype.

? P. microphylla auct. *non* D. Don, Prodr. Fl. Nepal. (1825) 231: Focke, Abh. Naturwiss. Ver. Bremen 13 (1895) 164; Wolf, Bibl. Bot., Heft 71 (1908) 681. — The New Guinea material which at one time was referred to this continental Asian species, not seen (MacGregor specimens from Mt Victoria and Mt Musgrave).

P. philippinensis Merr., Philipp. J. Sc. 29 (1926) 480; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 243. — Type: *Clemens 5006*, holotype in UC.

P. novoguineensis Merr. & Perry, J. Arn. Arb. 21 (1940) 187; Borgmann, Zs. f. Bot. 52 (1964) 144. — Type: *Brass 10727*, holotype in A, isotype in L; paratypes: *Brass 4229* (A, NY), *Brass 4636* (BO, NY), *Brass & Meijer Drees 9863* (A, L).

P. foersteriana Laut. var. *keysseri* auct. *non* Diels, Bot. Jahrb. 62 (1929) 480: Merr. & Perry, J. Arn. Arb. 21 (1940) 189, *pro max. parte.*

Rosette herb, usually rather lax, sometimes more compact, with a slender to stout taproot, rarely with prostrate, runner-like branches. *Rosette leaves* pinnate, 2—10 cm long, but when growing in shaded places up to 25 cm; *petiole* 3—25 mm, petiole and rachis with long, appressed or patent hairs, usually only sparsely hairy. *Stipules* of the rosette leaves up to 6 mm adnate, up to 6 mm free, up to 7 mm wide, membranous, entire, with appressed hairs outside, glabrous inside; stipules of upper cauline leaves herbaceous, entire or serrate. *Leaflets* 6—21 pairs, suborbicular to elliptic, ovate or obovate, the basal ones sometimes smaller than 1 mm, the largest ones (below the apical leaflet) up to 3—9(—13) by 2—6(—9) mm, base acute to cordately rounded, often oblique, apex truncate to rounded, margin pinnatisect to pinnatipartite with 1—5(—8) pairs of incisions, upper surface usually (practically) glabrous, sometimes (mainly in the larger forms) sparsely long-hairy, lower surface with few to many long hairs, especially on midrib and main nerves, margin usually ciliate and this sometimes the only hairs present; intermediary leaflets usually absent in the smaller plants, often present in the larger forms. *Flowering stems* several per rosette, in well-developed plants about the same length as or longer than the rosette leaves, erect or ascending, rarely prostrate, 2½—20 cm long, in deep shade up to 38 cm, with a terminal flower and usually 1—3 more flowers in the axils of the upper cauline leaves which are smaller than the rosette leaves; the bracteoles of the axillary flowers usually not supporting flowers, occasionally one of them doing so, then the whole inflorescence with up to 6 flowers; stems, peduncles, and pedicels long-hairy, usually only sparsely so. *Flowers* normally 5-merous, occasionally 4- or 6-merous. *Floral cup* 2—4 mm diam. (in fruiting state up to 5 mm), hairy outside. *Epicalyx leaves* suborbicular to elliptic or obovate, 1½—3½ by (½—)1—3½ mm, growing after anthesis and then up to 5 by 4½ mm, usually entire or notched at apex, sometimes part or all of them with one or more deeper incisions, subglabrous to distinctly but not very densely hairy outside, usually glabrous inside, margin ciliate. *Sepals* triangular, slightly shorter to slightly longer than epicalyx, 1¾—4 by 1—2½ mm, after anthesis growing till up to 6 mm, acute, entire, indumentum as in epicalyx but often with short woolly hairs at apex inside. *Petals* elliptic to obovate, up to 8 by 4 mm but usually much smaller, entire, glabrous, yellow. *Stamens* most often the same number, not rarely up to twice as many as petals, rarely more (up to 20), filaments 1—2 mm, anthers ½—¾ mm long. *Torus* cone-shaped, hairy as is the disc. *Pistils* many, rarely only few, ovary glabrous, on a short, more or less hairy stalk, style inserted at about the middle of the ovary, slightly to distinctly narrowed at base. *Achenes* 1.1—1.3 by 0.8—1 mm, smooth, brown to purplish. *Chromosome number* 2n = 42.

BORNEO. Sabah. Mt Kinabalu, different localities: *Carr SF 27613, Clemens 10580, 10652, 29922, 32381, Haviland 1057K, Jacobs 5763, Low s.n.* (*K*), *Sinclair c.s. 9141.*

PHILIPPINES. Luzon, Mt Pulog: *Clemens 5006, Steiner 1985*; Mt Tabayoc: *Jacobs 7487* (See remark 3).

CELEBES. Subdiv. Enrekang, Rante Mario: *Eyma 713, Kjellberg 3868.*

NEW GUINEA. West New Guinea. Mt Wilhelmina: *Brass 9394, Brass & Meyer Drees 9863*; Lake Habbema: *Brass 10727*; Waterval Bivouac: *Versteeg 2479*; Mt Wichmann: *Pulle 1016*; Mt Carstensz: *Kloss s.n.* (BM, 4 collections). — Terr. New Guinea. West Highl. Dist., Mt Hagen: *Robbins 312*; Kubor Range: *Vink 16169*; Sirunki: *Walker ANU 601.* Madang Dist., Finisterre Mts: *Sayers NGF 21404, 21413, 21421.* East. Highl. Dist., Mt Wilhelm, different localities: *Van Balgooy 247, 743, 913* (see remark 3), *Borgmann 24, Brass 29976, Flenley ANU 2420, Hoogland & Pullen 5693, Womersley NGF 8968*; Mt Michael: *Brass & Collins 31210*; Mt Otto: *Brass & Collins 30997*; Mt Piora: *Henty & Carlquist NGF 16540*; Mt Kerigomma: *Hoogland & Pullen 5559.* Morobe Dist., Saruwaged Range, different localities: *Clemens 5317, Hartley 11121, 11137, 11184, 11186, Hoogland 9694, Van Royen NGF 16163, 16194*; Ulap: *Clemens 41143*; Samanzing: *Clemens 9378*; Rawlinson Range: *Clemens 12374bis*; Mt Amungwiwa: *Womersley NGF 17934.* — Terr. Papua. South. Highl Dist., Mt Ambua: *Kalkman 4955, 5046, 5059, 5108*; Mt Kerewa: *Kalkman 4754, 4766, 4779.* Centr. Dist., Mt. Albert Edward, different localities: *Brass 4229, 4231, Van Royen NGF 30064*; Wharton Range, Murray Pass: *Brass 4636, Giulianetti & English s.n.* (K); Mt Scratchley: *Giulianetti s.n.* (K, 2 collections). Milne Bay Dist., Duiri: *Crutwell 1345.*

Collectors' notes. The species has been collected between *c.* 2400 and 4100 m altitude, usually in grassland, but also in other open places. See also remarks below.

Remarks. 1. The ample material that is available from New Guinea, and field observations during an expedition[1] in the Southern Highlands District, make it possible to give a survey of the variability of this species. From the other parts of the area too little material is available.

Usually *P. parvula* is a small rosette plant with more or less erect leaves, sparsely hairy, and with some few-flowered stems of about the same length as the leaves or longer. When growing in shaded places (under rocks, under banks of brooks, under a high grass-cover, etc.) the plants become more slender and elongate: longer leaves with more, and more spaced, leaflets, and longer flowering stems with more cauline leaves and a laxer inflorescence. According to the labels the species may also occur in lighter places in the forest (glades, forest edges) and it seems to be especially there that a tendency to a more creeping habit is displayed. This form was described as *P. novoguineensis* and has prostrate stems with leaves as well as inflorescences. I have not been able to separate this form from typical *parvula.*

A clinal variation according to altitude, as is visible in *P. foersteriana,* cannot be detected in *P. parvula.*

2. The chromosome count, 2n = 42, was made by Borgmann (as *P. novoguineensis*). The voucher, *Borgmann 24,* is not quite homogeneous. The Leiden sheet has three plants and one of these is a very small and much more hairy specimen.

3. In Borneo there is no difficulty in distinguishing *P. parvula* and *P. polyphylla,* because in the dimensions of the leaves there is a distinct gap. In New Guinea, however, *P. parvula* may become a larger plant — as was explained above — and the largest specimens may approach the dimensions of the Bornean *P. polyphylla.* As an example *Van Balgooy 913* (Mt Wilhelm, 4150 m alt.) may be cited. This is a very richly developed plant, collected 'under overhanging rocks in rich organic soil' and it represents a very luxurious shade-form, certainly not unlike *P. polyphylla.* Similarly, the Luzon specimen *Jacobs 7487* has, according to its flowers, to be identified as *P. parvula,* but its leaves are

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[1]) Sponsored by the Netherlands Foundation for the Advancement of Tropical Research WOTRO.

large and approach those of *P. polyphylla.* On the strength of these specimens, however, it cannot be considered to unite *P. polyphylla* and *P. parvula.* From the field-notes given by Kinabalu collectors, it is also not clear whether there is any consistency insofar that *P. polyphylla* would grow in the more shaded places and *P. parvula* in open, low vegetations.

5. **Potentilla polyphylla** Wall. [Cat. (1829) nr. 1026, *nomen*] *ex* Lehm., Nov. et Min. Cogn. Stirp. Pug. 3 (1831) 13; Monogr. Gen. Potent. Suppl. 1 (1835) 11, t. 5; Rev. Potent. (1856) 53; Klotzsch & Garcke, Bot. Ergebn. Reise Pr. Waldemar (1862) 155, t. 9; Wolf, Bibl. Bot., Heft 71 (1908) 143. — Type: *Wallich 1026* from Gossain Than, holotype in K, isotype in CGE.

P. mooniana Wight, Ic. 1 (1840) t. 233, text p. xlv; Lehm., Rev. Potent. (1856) 54; Hook. *f.*, Fl. Brit. Ind. 2 (1878) 349; Van Steenis, De Trop. Nat. 21 (1932) 101, fig. 3—4; Bull. Jard. Bot. Btzg III, 13 (1934) 243; Back. & Bakh., Fl. Java 1 (1963) 518; Murata in Hara, Fl. East. Himal. (1966) 124. — Type: *Wight* specimen from Nuwara Eliya, Ceylon, not seen.

P. polyphylla Wall. *ex* Lehm. var. *barbata* [Wall., Cat. (1829) nr. 1030, *nomen* '*P. barbata*'] Lehm., Rev. Potent. (1856) 54; Wolf, Bibl. Bot., Heft 71 (1908) 145. — Type: *Wallich 1030* from West Bengal, holotype in K, isotype in CGE.

P. sordida Klotzsch *ex* Klotzsch & Garcke, Bot. Ergebn. Reise Pr. Waldemar (1862) 155, *in syn.*, *nomen nudum.*

P. mooniana Wight var. *kinabaluensis* Stapf, Trans. Linn. Soc. Lond. II, 4^2 (1894) 146; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 243. — Type: *Haviland 1056*, holotype in K, isotype in SING.

Rosette herb with prolonged leafy flowering stems. *Rosette leaves* pinnate, 9—35 cm long, *petiole* 1½—10 cm, petiole and rachis hairy. *Stipules* of rosette leaves and lower cauline leaves up to *c.* 1½ cm adnate and *c.* 1½ cm free, membranous, with entire margin, hairy on outer surface, those from the upper part of the flowering stems herbaceous and with serrate margins. *Leaflets* 10—20 pairs, elliptic, up to 10—30 by 5—12 mm, gradually smaller towards base of leaf, the basal ones sometimes less than 2 mm long, base rounded to acute, apex rounded, margin pinnatisect to serrate with (5—)7—12 pairs of incisions, sparsely long-hairy on both surfaces, somewhat denser on the midrib below, the Java specimen more hairy than the Kinabalu specimens; intermediary leaflets present. *Flowering stems* several per rosette, ascending to prostrate, longer than the rosette leaves, 14—45 cm long, with some leaves which become smaller towards the top, stems and pedicels hairy; thyrsus with a terminal flower and some lateral monochasia, total number of flowers per main stem 4—10, flower-bearing part of stem (measured from uppermost empty leaf) 5—17 cm long, half of which is peduncle. *Flowers* 5-merous, rarely 6-merous. *Floral cup* 3½—5 mm diam., sparsely long-hairy outside. *Epicalyx leaves* about elliptic, 3—4(—5) by 2—4(—5) mm, growing after anthesis and up to 6 mm long under the fruit, usually with 1—4 incisions which go about halfway or deeper, sparsely long-hairy outside. *Sepals* triangular, about equal to the epicalyx or slightly longer, 3—4½(—5) by 2—4 mm, acute, entire, indumentum like in epicalyx. *Petals* obovate to suborbicular, 5½—6 by 5—6 mm, entire, glabrous, yellow. *Stamens* 19—24, filaments up to 2 mm, anthers ½—¾ mm long. *Torus* elevated, cone-shaped, hairy as is the disc. *Pistils* many, ovary glabrous, on hairy stalk, style inserted in the middle of the ovary, narrowed at base, more or less narrowed at apex. *Achenes c.* 1½ × 1 mm, smooth, brown.

Remarks. The material from Mt Kinabalu is not very different from, and certainly conspecific with the specimens from Ceylon and the Himalayan region. In accordance with Stapf's opinion the two groups are treated here as varieties. The specimen (only one collection) from Mt Papandajan in West Java does not belong to the Bornean variety, but to the continental Asian one. It may be expected to occur also in Sumatra. The description given here, was drawn from the Malesian material only.

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. . . . . **a. var. polyphylla**

Leaflets pinnatisect, incised to 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. . . . . **b. var. kinabaluensis**

a. var. **polyphylla**

JAVA. Mt. Papandajan, Tegal Aloen Aloen: *Van Steenis 4802.*

Distribution outside Malesia: India (W. Bengal, Assam), Nepal, Sikkim, Ceylon.

Collectors' notes. The continental Asian specimens seen come from altitudes between 1500 and 3660 m, the only Javanese specimen from 2475 m.

b. var. **kinabaluensis** (Stapf) Kalkm., *comb. nov.* — *P. mooniana* var. *kinabaluensis* Stapf, Trans. Linn. Soc. Lond. II, 4^2 (1894) 146.

BORNEO. Sabah. Mt Kinabalu, different localities: *Clemens 28937, 32335, 51521, Collenette 21514* (mixed with *parvula*), *Enriquez SF 18178, Fuchs 21084, Haviland 1056, Jacobs 5749,*

Collectors' notes. The plants were collected between *c.* 3300 and *c.* 4000 m altitude, in sheltered places, variously described as peaty, swampy, wet, or damp.

Remarks. For a comparison of the Bornean *P. polyphylla* with *P. parvula*, see under the latter species, remark 3.

6. Potentilla hooglandii Kalkm., *spec. nov.* — **Fig. 1.** — Type: *Hoogland & Schodde 7245*, holotype in L, isotype seen from CANB, also distributed to A, B, BISH, BM, BRI, LAE, PNH, US, Z.

Herba caulescens, caulibus prostratis foliosis ramos florigeros emittentibus. Folia pinnata, 5½—21 cm longa, foliolis 11—16-jugis. Petiolus atque rachis dense molliter ac patenter pilosa, foliolis subtus dense sericeis. Caules florigeri procumbentes, 4—27 cm longi, flore terminali floribus singulis vel paucis in axillis foliorum supremis vel eis bractearum positis adiutis. Hypanthium 3—4 mm diam. Epicalycis foliola 3—6½ × 1½—3½ mm, in parte superiore incisionibus 2—4, extus dense sericea. Sepala 3—4½ × 2—3 mm, integra. Petala 5—6 × 4—5 mm, integra, lutea. Stamina 10—12(—c. 20). Pistilla numerosa, toro piloso inserta. Achenia c. 1 × ¾ mm, laevia.

Rosette plant, forming prostrate, not-rooting, often long runners which bear leaves and flowering lateral shoots, sometimes also sterile laterals; taproot stout. *Rosette leaves* pinnate, 5½—21 cm long, *petiole* ¾—4 cm long, petiole and rachis densely clothed with long, soft, patent hairs. *Stipules* 6—8 mm adnate, 8—12 mm free, entire, membranous, sericeous outside except the margins, glabrous inside. Leaves and stipules of runners about equal to those of rosettes, but smaller. *Leaflets* 11—16 pairs, lower alternate, upper (sub)opposite, ± elliptic, sessile, basal ones 3—6 by 1½—3 mm, gradually larger towards tip, up to (8—)10—24 by (4—)6—11 mm, base rounded to acute, apex obtuse to rounded, margin pinnatifid to pinnatisect, with 6—12 pairs of incisions, densely

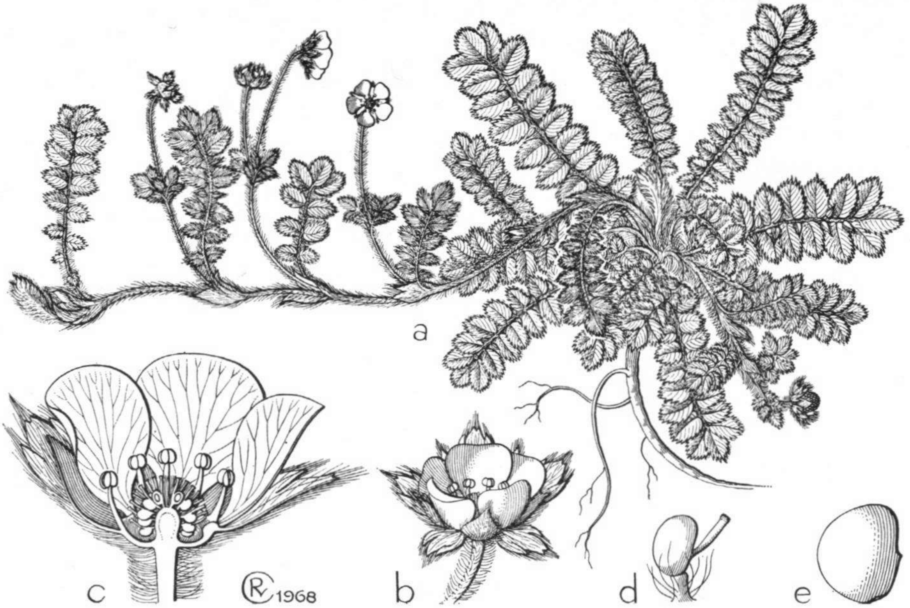

Fig. 1 — *Potentilla hooglandii* Kalkm. a. Plant with prostrate flower-bearing runner, × 2/3; b. flower, × 2; c. flower in length section, × 4; d. ovary, × 12; e. fruit, × 12. (a. *Hoogland 9693*; b, c, d. *Kalkman 4874*; e. *Kalkman 4745*).

sericeous below, less densely so above; intermediary leaflets usually present, small or large. *Flowering stems* procumbent, in axils of rosette- and runner-leaves, 4—27 cm long, with some leaves or (the smaller ones) with only 2 leaf-like bracteoles under the terminal flower, except for the latter only 1 or few flowers in the axils of upper leaves; all stems including runners and pedicels patently silky. *Flowers* 5- or 6-merous. *Floral cup* 3—4 mm diam., densely sericeous outside. *Epicalyx leaves* elliptic to ovate, 3—6½ by 1½—3½ mm, serrate in upper part, but often with only 2, rarely with more than 4 incisions, densely sericeous outside, less densely so inside. *Sepals* (broadly) triangular to ovate, 3—4½ by 2—3 mm, entire, rarely with an incision, indumentum as in epicalyx, inside sometimes glabrous. *Petals* (sub)orbicular to obovate, 5—6 by 4—5 mm, entire, glabrous, yellow. *Stamens* 10—12(—*c.* 20), filaments 1—1¼ mm, anthers *c.* ½ mm long. *Torus* thin to thick, hairy as is the disc. *Pistils* very many, on short stalks with some hairs, ovary glabrous, style inserted below the middle of the ovary, narrowed at base. *Achenes c.* 1 by ¾ mm, brown to dark purplish, smooth, with a lighter coloured dorsal line.

NEW GUINEA. Terr. New Guinea. Western Highl. Dist., Laiagam, different localities: *Hoogland & Schodde 7245, Walker ANU 910, Womersley NGF 15212*. Eastern Highl. Dist., Goroka Subdist., Kerigomma: *Hoogland & Pullen 5514*. Morobe Dist., Saruwaged Range: *Clemens 5263, Hartley 11129, Hoogland 9693*. — Terr. Papua. South. Highl. Dist., Mt Giluwe: *Schodde 2059*; Mt Kerewa: *Kalkman 4745*; Pass Mt Ne — Mt Kerewa: *Kalkman 4874*; Mt Ambua: *Kalkman 5058, 5060* (see remark 2).

Collectors' notes. Collected between 2440 and 3560 m altitude, in open grassy places, also on trails.

Remarks. 1. Superficially this species looks like *P. papuana*, because it also has the lower surface of the leaflets white-sericeous. It differs, however, from *papuana* in having runners, and in having patent — not appressed — hairs on stems, petioles, and rachises.

2. On Mt Ambua I found growing together typical *P. hooglandii* (*Kalkman 5058*), typical *P. parvula* (*5059*), and some specimens showing introgressions from *parvula* into *hooglandii*. The three most typical intermediates were collected as number *5060* (in L). That they are in fact hybrids, is also made probable by the high proportion of sterile pollen.

7. **Potentilla foersteriana** Laut., Fedde Rep. 13 (1914) 240; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 242. — Type: *Keysser 309*, holotype destroyed in B, isotype seen from WRSL.

P. foersteriana Laut. var. *keysseri* Diels, Bot. Jahrb. 62 (1929) 480; Merr. & Perry, J. Arn. Arb. 21 (1940) 189, *pro min. parte.* — Type: *Keysser 32*, not seen.

P. archboldiana Merr. & Perry, J. Arn. Arb. 21 (1940) 185. — Type: *Brass & Meijer Drees 10133*, holotype in A, isotype in L; paratype: *Brass & Meijer Drees 9839*, seen from A, BO, L.

P. brassii Merr. & Perry, J. Arn. Arb. 21 (1940) 185. — Type: *Brass & Meijer Drees 10156*, holotype in A, isotype in L; paratypes: *Brass 9427* (A, L), *Brass & Meijer Drees 10390* (BO, L).

? *P. simulans* Merr. & Perry, J. Arn. Arb. 21 (1940) 187. — Type: *Brass 9594A*, holotype in A, no duplicates. See remark 3.

Rosette forming herb, in higher altitudes becoming a very small and compact solitary or cushionplant, not rarely the stem branched and bearing several rosettes; taproot stout. *Rosette leaves* pinnate, ½—10 cm long; *petiole* from less than ½ mm to *c.* 1 cm long, petiole and rachis long-hairy, usually rather densely so, the hairs appressed or patent. *Stipules* up to *c.* 1 cm long, usually over more than half of their length adnate, up to 5 mm wide, membranous, hairy on the outside. *Leaflets* 2—18 pairs, elliptic or ovate to oblong, basal ones smallest, gradually larger towards tip and largest ones up to 2—13 by 1—6 mm, base usually rounded or cordate, sometimes more acute, apex rounded to acute, margin pinnatisect to pinnatipartite with 1—5 pairs of incisions, sometimes the leaflets bipartite with the segments separated from the base; upper surface with some hairs or glabrous, lower surface from very sparsely hairy to more or less densely sericeous; intermediary leaflets generally absent. *Flowering stems* one or several per rosette, short and the flowers consequently not elevated above the rosette, the peduncle always distinctly shorter than the leaves, in the smaller rosettes up to 1 cm, only in the most luxurious plants from lower altitudes up to 3(—5) cm long; peduncle without leaves but with bracts, bearing 1 or 2, rarely more (—4) flowers; stems and pedicels densely long-hairy. *Flowers* usually 5-merous, rarely 4- or 6-merous. *Floral cup* 3—5 mm diam., hairy outside. *Epicalyx leaves* elliptic to ovate, sometimes spathulate, 1¼—4½(—6½) by ½—3 mm, entire or notched at apex, rarely with 1—3 deeper incisions, (sparsely) hairy outside, glabrous or with few hairs inside. *Sepals* triangular, 1¼—4(—5) by 1—3 mm, acute, entire, hairy to glabrous outside, glabrous or with some hairs near apex inside; epicalyx as well as calyx often distinctly growing after anthesis. *Petals* elliptic to obovate, 2—8½ by 1½—5½ mm, entire, glabrous, yellow. *Stamens* 5—12, usually the same number as petals, more rarely twice as many; filaments up to 1½ mm, anthers ½—¾ mm long. *Torus* low, hairy, as is the disc. *Pistils* few to many; ovary glabrous, on short hairy stalk, style inserted at about the middle of the ovary, slightly thinner at base. *Achenes c.* 1½ by 1 mm, brown.

Remarks. 1. Normally, this species is well distinct from *P. parvula* which has the inflorescence longer than the leaves. Not every poor or immature specimen will, however, be identifiable.

2. The species varies distinctly with the altitude, mainly in vegetative characters.

Three groups can be distinguished, groups which I have given varietal rank. Each of the groups is fairly homogeneous and the greater part of the specimens falls without doubt into one or other of the varieties. Because of the obvious relation to the altitude-linked climatic factors, and because of the not 100 % sharp delimiting possibilities, the rank of variety seemed to be most appropriate.

3. Merrill and Perry described *P. simulans* from one plant taken from a *P. habbemana* collection made by Brass. The plant bears one flower. The leaves have bipartite leaflets of the same kind as often met in *P. foersteriana* var. *brassii*. The plant in question, which of course should never have been made the type of a new species, may well be a hybrid of *P. foersteriana* and '*habbemana*' (see p. 349).

4. According to Diels' description, var. *keysseri* differs only in a few very minor characters from typical *foersteriana* ('*etwas grössere Blätter und gestielte Blüten*'). I did not see the type specimen but it seems certain to me that it does not deserve a separate status. The majority of the specimens that Merrill & Perry (1940) identified as var. *keysseri*, belong to *P. parvula*.

KEY TO THE VARIETIES

1. Leaflets 13—18 pairs. Stamens 5—12, often more than petals. 2200—3350 m altitude (once at 4450 m) . . . . **b. var. ima**
1. Laeflets up to 11 pairs. Stamens always isomerous. From 3200 m upwards.
    2. Open rosettes with the leaves at least 1½ cm long and with 5—11 pairs of leaflets, sparsely or more distinctly hairy.. . . . . **a. var. foersteriana**
    2. Compact plants, usually forming cushions, with almost glabrous, small leaves (not more than 1 cm long not counting the stipule) with few (2—8) pairs of leaflets.. . . . . . **c. var. brassii**

a. var. **foersteriana**. — *P. foersteriana* Laut. *incl.* var. *keysseri* Diels.

NEW GUINEA. West New Guinea. Mt Carstensz, different localities: *Kloss s.n.* (*BM*), *Wissel 13, 52, 71, 102, 127*; Mt Wilhelmina: *Brass & Meijer Drees 10131, 10383*; Lake Habbema: *Brass 9149, 9542, 9594A*; Waterval Bivouac: *Versteeg 2480*. — Terr. New Guinea. Western Highl. Dist., Mt Sugarloaf: *Hoogland & Schodde 7130*. Madang Dist., Finisterre Range: *Keysser 309*. Eastern Highl. Dist., Mt Wilhelm, different localities: *Van Balgooy 239, Millar & Sayers NGF 19870, Van Royen NGF 15174, Walker ANU 5112*; Morobe Dist., Saruwaged Range, different localities: *Clemens 5765, Hoogland 9813, 9870, 9889*. — Papua. South. Highl. Dist., Mt Giluwe: *Schodde 1783, 1921*; Mt Ambua: *Kalkman 5107*. Centr. Dist., Mt Albert Edward: *Brass 4419/4419a*.

Collectors' notes. Collected in grassland and other open vegetation types, most often in moist (boggy, peaty, marshy) conditions. The lowest collections are from 3225 m altitude, the highest ones were made on Mt Carstensz, at altitudes above 4000 m, at the same altitudes as the cushion-forming var. *brassii*. About the differences in habitat in these high altitudes nothing is known.

b. var. **ima** Kalkm., *var. nov.* — Type: *Kalkman 4642*, holotype in L. isotypes will be distributed to CANB, LAE, and other herbaria.

A varietate typica differt foliolorum jugis magis numerosis atque vulgo staminibus plus quam 5.

NEW GUINEA. Terr. New Guinea. Western Highl. Dist., Mt Sugarloaf: *Hoogland & Schodde 7021*; Eastern Highl. Dist., Goroka Subdist., Marafunga: *Millar & Garay NGF 18742*; near Kerigomma: *Hoogland & Pullen 5513*; Chimbu Subdist., Mt Wilhelm: *Van Balgooy 47*; Pombameri — Mirima track: *Robbins 778*. Morobe Dist., Saruwaged Range: *Hoogland 9692*. — Papua. South. Highl. Dist., Ibiwara (Tari subdist.): *Kalkman 4642, 4925*; Pass Mt Ne — Mt Kerewa: *Kalkman 4842*; Lamende Range, N.W. of Mt Giluwe: *Shaw Mayer s.n.* (BM, two collections). Milne Bay Dist., Maneau Range: *Brass 22885*.

Collectors' notes. All specimens but one were collected between 2230 and 3350 m altitude, in open grasslands, sometimes described as peaty. From not less than 4450 m altitude, however, comes *Van Balgooy 47*, collected in sheltered places between rocks. Despite its deviating altitude it must be relegated to var. *ima* because of its large number of leaflets (up to 22 pairs even!).

c. var. **brassii** (Merr. & Perry) Kalkm., *comb. nov.* — *P. brassii* Merr. & Perry, J. Arn. Arb. 21 (1940) 185. — *P. archboldiana* Merr. & Perry.

NEW GUINEA. West New Guinea. Mt Carstensz, different localities: *Wissel 38, 62, 79*; Mt Wilhelmina: *Brass 9427, Brass & Meijer Drees 9839, 10133, 10156, 10390.* — Terr. Papua. Southern Highl. Dist., Mt Giluwe: *Wade & McVean 7792.*

Collectors' notes. Collected between 3440 and *c.* 4600 m altitude, in alpine bogs. Usually described as a cushionplant or as 'hard flat hummocks of 20—35 cm diam.' (*Wade & McVean 7792*), but sometimes growing solitary ('every plant forming a distinct green rosette *c.* 1½ cm in diam.', *Brass 9427*).

8. Potentilla sundaica (Bl.) O.K., Rev. Gen. 1 (1891) 219; Backer, Schoolfl. Java (1911) 459; Van Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 243; Back. & Bakh., Fl. Java 1 (1963) 518. — *Fragaria sundaica* Bl., Bijdr. 17 (1826/27) 1106. — *Duchesnea sundaica* Miq., Fl. Ind. Bat. 1, 1 (1855) 372, t. 6. — *Type*: Blume mentioned with the original description '*in humidis altioribus montis Gede*'. Sheet 909.111-40 in L is an original collection with a label written by Blume, it is considered to be the type.

P. wallichiana Delile [in Wall., Cat. (1829) nr. 1022, *nomen*] *ex* Lehm., Nov. et Min. Cogn. Stirp. Pug. 3 (1831) 30, *nom. illeg.*; Rev. Potent. (1854) 80, t. 34; Wolf, Bibl. Bot., Heft 71 (1908) 411; *non* Seringe in DC, Prodr. 2 (1825) 574. — Type: *Wallich 1022*, seen from CGE.

P. kleiniana Wight & Arnott in Wight, Ill. Ind. Bot. 1 (1831) t. 85; Wight & Arnott, Prodr. 1 (1834) 300; Lehm., Rev. Potent. (1854) 79; Hook. *f.*, Fl. Brit. Ind. 2 (1878) 359; Vidal, Fl. Camb., Laos & Vietn. 6 (1968) 124. — Type: *Wight 914*, holotype in K, isotypes seen from L, NY.

P. anemonefolia Lehm., Add. Ind. Sem. Hort. Hamb. (1853) 9, *non vidi*; Lehm., Hamb. Gartenz. 9 (1853) 505, *non vidi*; Lehm., Rev. Potent. (1854) 80, t. 63. — Type from Japan, no further information available, not seen.

Duchesnea sundaica (Bl.) Miq. var. *hirsuta* Miq., Fl. Ind. Bat. I, 1 (1855) 373. — Type: *Junghuhn s.n.* in U.

Herb with leaves in a loose rosette and with erect to prostrate, often rooting, flowering stems. *Stolons* (prostrate stems without normally developed leaves) sometimes present? *Rosette leaves* palmately (pedately) 5-foliolate; *petiole* variable, 6—40 cm long, sparsely to more densely patently to more or less appressedly soft-hairy; *stipules* —4 cm long, adnate over *c.* ¾ of their length, the free lobes acute, membranous, with a few long hairs on outer surface; *leaflets* obovate, terminal one 2—4½ by 1—2½ cm, lateral ones smaller, base acute, apex rounded, the apical leaflet more or less distinctly, shortly petioluled, margin coarsely serrate, pinninerved, sparsely appressedly soft-hairy below, mainly so on the nerves, sparsely hairy to glabrous above. *Cauline leaves* smaller than rosette leaves, with shorter petioles (up to 5 cm long) and with smaller and more herbaceous stipules, rarely trifoliolate. *Stems* variable in length and habit according to the habitat, up to 45(—60?) cm long, erect to prostrate, often rooting on the nodes and developing axillary daughter plants, the first leaves of which are smaller than the rosette leaves and the lowermost ones sometimes only trifoliolate; all stems and pedicels sparsely to more densely, patently soft-hairy. *Inflorescence* terminal (and sometimes smaller ones in the axils of the uppermost cauline leaves), a compound dichasium with under the terminal flower two (sub)opposite dichasial to monochasial branches, the whole inflorescence up to 5—10 cm long. *Bracts and bracteoles* leaf-like but much smaller and with a diminished number of leaflets, the upper ones usually only unifoliolate. *Flowers* 5-merous, aberrations apparently rare. *Floral cup* 2—3 mm diam., sparsely pilose outside. *Epicalyx leaves* ± oblong, 2—3 mm long, slightly growing after anthesis, entire or (less often) apically incised and bifid, the lobes up to 1 mm wide, apex obtuse, sparsely pilose outside, glabrous inside. *Sepals* triangular, 2—3 by 1—2 mm, about equal to or slightly longer than the epicalyx leaves, under the fruit growing to *c.* 4 mm, acute, entire, indumentum as in epicalyx. *Petals* developing late and falling early, full-grown ones only little longer than sepals, obovate, 3—3½ by 2—3 mm, apex rounded or shallowly retuse, glabrous, yellow. *Stamens* 20 or few missing, filaments *c.* 1 mm, anthers *c.* ½ mm long. *Torus* high and thin in anthesis, distinctly thicker under the ripe fruits, with few long hairs; disc with a ring of long hairs. *Pistils* many; ovary glabrous, on a short stalk which may be glabrous or have a few long hairs, style terminal to subapical, rather short and thick, lighter in colour than the ovary. *Achenes* 0.7—1 by 0.5—0.6 mm, style-remnant close under the apex, pericarpium redbrown to brown, rugose when quite ripe with oblique, elevated, lightercoloured lines.

SUMATRA. Atjeh, Laut Pupandji: *Van Steenis 6391*; Laut Tawar: *Honing s.n.* (BO). Gajo and Alas Lands, Kung: *Pringo Atmodjo 337*.

JAVA. Prov. Preanger, several collections from different localities, i.a. Mt Papandajan, Mt Djaja, Mt Patuha, Mt Tangkubanprahu. Prov. Pekalongan, Josoredjo: *Backer 16082*. Prov. Banjumas, Diëng Plateau, many collections from different localities.

Distribution outside Malesia: India (Punjab, United Prov., Assam, and localities in the Himalayan region), Ceylon, China (Yunnan, Kiangsu), N. Vietnam, Laos, Japan, Korea (no specimens seen).

Collectors' notes. In Java the altitude ranges from 1500 to 2300 m; from Sumatra two records are available: 1200 and 1950 m; on the continent the plant also grows at lower altitude, viz. 800 (Tonkin) or 900 (Punjab) m. It seems to be a species from often damp to marshy places, banks of brooks and lakes, but also growing in villages and along roadsides.

Remark. The above description was drawn from the Malesian material only.

9. **Potentilla indica** (Andr.) Wolf in Asch. & Graebn., Syn. Mitt.-Eur. Fl. 6, 1 (1904) 661; Wolf, Bibl. Bot., Heft 71 (1908) 664. — *Fragaria indica* Andrews, Bot. Repos. 7 (1807) t. 479; Hook. *f.*, Fl. Brit. Ind. 2 (1878) 343; Backer, Schoolfl. Java (1911) 458; v. Steenis, Bull. Jard. Bot. Btzg III, 13 (1934) 241; Back. & Bakh., Fl. Java 1 (1963) 517. — *Duchesnea fragiformis* J. E. Smith, Trans. Linn. Soc. 10 (1811) 373, *nom. illeg.* — *Duchesnea indica* Focke in Engl. & Prantl, Natürl. Pfl.-fam. 3, 3 (1888) 33; Hara & Kurosawa, J. Jap. Bot. 34 (1959) 165; Vidal, Fl. Camb., Laos & Vietn. 6 (1968) 111. — Type: According to Vidal no specimen is present in K or BM, so the plate by Andrews must be considered the type.

Fragaria chrysantha Zoll. & Mor., Syst. Verz. (1846) 7. — *Duchesnea chrysantha* Miq., Fl. Ind. Bat. 1 (1855) 372; Hara & Kurosawa, J. Jap. Bot. 34 (1959) 165. — Type: *Zollinger 1987* from Java (Tangkuban Prahu), according to Hara and Kurosawa present in Z, not seen.

Herb with rosettes and with long, prostrate, partly sympodial stems which bear normal leaves and flowers in the basal and reduced leaves in the apical part. *Daughter plants* usually abundantly produced, only on the nodes bearing reduced leaves, the first leaf of the plantlet allways abaxial and reduced to the '*Unterblatt*'. *Stems, pedicels* and *petioles* with long, more or less patent hairs and with usually many multicellular glandular hairs. *Leaves* trifoliolate, long-petioled, *petiole* of rosette leaves up to 12(—16) cm long, that of runner leaves usually shorter. *Stipules* of rosette leaves adnate over *c.* ½ cm, free tips narrowly triangular, acute, *c.* ½ cm long, with long hairs on outer surface and margins, glabrous inside, membranous. *Leaflets* about equal in size, sessile to distinctly (rarely more than 1 mm) petioluled, the latter especially in the apical leaflets; *apical leaflets* rhomboid to obovate, 1½—3½ by 1—2½ cm, base cuneate, apex rounded, margin entire in basal part, serrate (usually rather evenly so) in upper part; *lateral leaflets* elliptic to ovate, 1—3 by 1—2 cm, base cuneate and usually very unequal, apex rounded, margin serrate, usually evenly so, sometimes with deeper incisions and in extreme cases deeply divided and then the leaf almost becoming 5-foliolate; all leaflets with long, semi-patent hairs on lower surface, more densely on the nerves, on the larger nerves also mixed with some glandular hairs, upper surface sparsely appressed-hairy. *Flowers* solitary, terminating the prostrate stems which continue their growth from the axil of the uppermost leaf which is either normally developed or reduced to a 3-lobed structure; the flowers seemingly placed opposite the runner leaves. *Pedicels* upright, 2—8 cm long, not conspicuously growing after anthesis. *Flowers* usually 5-merous, rarely 6-merous. *Floral cup* 2—3½ mm diam., sparsely hairy outside, with a ring of hairs inside. *Epicalyx leaves* ± obovate, 3—5 by 2—3 mm during anthesis, distinctly growing afterwards and up to 8 by 5 mm under the fruits, with 2—6 incisions in the apical part, sparsely hairy on both sides. *Sepals* about equal to the epicalyx leaves, narrowly triangular, 4—6 by 2—3 mm during anthesis, also growing afterwards, acute to acuminate, with same indumentum as epicalyx but glabrous inside. *Petals* obovate, 3½—4½ by 2—3½ mm, apex rounded, entire, yellow, caducous. *Stamens* 15—20; filaments up to 2½ mm; anthers *c.* ½ mm long. *Torus* elevated, with long hairs or glabrous, distinctly enlarging after anthesis. *Pistils* many, sessile; ovary glabrous; style inserted above the middle of the ovary and in anthesis much longer than it, up to 1, rarely 1½ mm, filiform, tapering to the base. *Pseudocarps* with a soft, fleshy torus of 5—11 mm diam. (judged from herbarium specimens), red outside when ripe, epicalyx and calyx (judged from herbarium) first closed around the fruits, later spreading to reflexed. *Achenes* not placed in pits, 0.9—1.3 by 0.7—1 mm, pericarp smooth or distinctly rugose to tuberculate when quite ripe, red to brownish, near the place of attachment sometimes with a more or less distinct 'appendage' typically consisting of two white cheeks each at one side of the hilum and containing large, obviously dead and empty cells. *Chromosome number* 2n = 14, 84.

Wild specimens from Malesia:

JAVA. Prov. Preanger: many specimens from many different localities, a.o. Mt Gedeh, Mt Pangerango, Mt Patuha, Mt Papandajan, Mt Tangkubanprahu. Prov. Pekalongan, Mt Diëng: *Backer 21744, Wirjosapoetro 61*; Petung Kriana: *Backer 15739, 15896, 16036.* Prov. Semarang, Telomojo: *Koorders 28060.* Prov. Madiun, Mt Lawu: *Coert 193, Dorgelo 131*; Ngebel: *Koorders 23830.* Prov. Kediri, Wilis: *Lörzing 820.* Prov. Pasuruan, Tengger: several specimens from different localities; Mt Sangka: *Wisse 300*; Punten: *v. Steenis 2495*; Mt Kawi: *Rappard 36*; Mt Ardjuno: *Bremekamp s.n.* (BO). Prov. Besuki, Idjen: *Koorders 29359*; Jang Plateau: *v. Steenis 11043.*

PHILIPPINES. Luzon, Benguet Prov., Pauai: *Clemens 9141, Mearns BS 4291, BS 4299, Santos BS 31658*; Baguio: *Elmer 5770, 8608, McClure s.n.* (UC), *Merrill 4373, Steiner PNH 35841, Williams 1442*; Mt Santo Thomas: *Clemens s.n.*(UC); Mt Data: *Clemens 16359, 18747*; Mt Pulog: *Clemens s.n.*(UC); Barria Agawa: *Santos 5390.*

LESSER SUNDA ISLANDS. Bali, Bratan Lake: *Posthumus 3684*. — Timor, Fetin: *Bosarchitect Koepang 1*.
Cultivated, run wild, or doubtfully indigenous:
JAVA. Prov. Bogor, cult. near Bogor: *Belle s.n.* (BO); ricefield near Rarahan, Tjibodas: *Wirawan s.n.* (L).
SUMATRA. Medan, cult.: *Lörzing 16911*.
MALAYA. Johore, 'exotic': *Spare s.n.* (SING).
SINGAPORE: *Sinclair SF 38588, Nur s.n.* (SING), both naturalized.

Area outside Malesia, see below.

Collectors' notes. In Java, the Lesser Sunda Islands, and the Philippines (few notes available) the species has been collected in a wild state between *c.* 700 and *c.* 2300 m altitude, sometimes in forest but usually in disturbed habitats like road-sides, tea-, coffee-, or *Cinchona* gardens. Not rarely it has been collected in damp places (banks of rivers, brooks, ditches, and lakes). The specimen *Belle s.n.*, collected at Bogor, 250 m alt., originated — according to its label — from a culture at Djakarta, at only 5 m altitude, where it also produced flowers and fruits. It seems that medical properties are ascribed to this plant (especially by the Chinese?); according to *Belle s.n.* a decoct in arrack is rubbed in the skin against rheumatism.

Remarks. 1. The 'Indian strawberry' has been treated here as one species without any subdivision, although indications are strong indeed that in fact two taxa — of which rank they may be — exist.

Fragaria indica Andrews, afterwards *Duchesnea indica* (Andr.) Focke, later still *Potentilla indica* (Andr.) Wolf, was described from a specimen originating from West Bengal and cultivated in the garden of the London horticulturist C. F. Greville.

Zollinger and Moritzi described from Java *Fragaria chrysantha*, which later became *Duchesnea chrysantha* (Z. & M.) Miquel. Earlier, Blume had allready named the Javanese plant *Fragaria indica* Andr., and also afterwards the Javanese and the continental Asian plants were usually considered to be conspecific and they were mostly called *Duchesnea indica*, whether coming from Kashmir or from Japan, from China or Java. Also the plants which had come into cultivation in Europe and North-America as an ornamental and which had been naturalized in several places in Europe, Africa, and America were called by that name.

A karyological investigation led Hara & Kurosawa (1959) to accomodate the Japanese plants into two species. One of those, which they called *Duchesnea indica s.s.*, is dodecaploid ($2n = 84$), the other, *Duchesnea chrysantha*, being diploid ($2n = 14$). The most stable outer-morphological differentiating characters they were able to detect are in the fruiting receptacles and achenes. A third chromosome number, $2n = 49$, has been found in two plants in Japan (Hara & Kurosawa l.c.). The authors considered them to be hybrids, since they did produce neither pollen nor fruits.

Actual chromosome counts are still sparse for areas other than Japan. Hara and Kurosawa mentioned five diploid counts from different localities in Japan and these are — as far as I know — the only published records for the diploid number. The dodecaploid number has been reported more often, first for a cultivated specimen from North America, later also from other places and from cultivated plants as well as wild ones (the latter, however, only from Japan and from Eastern Himalaya, cf. Kurosawa in Hara, 1966). From Malesian material no chromosome count has been published.

To me the difficult point was to decide whether one is justified — as Hara and Kurosawa did — to extrapolate the karyologically-based subdivision of the Japanese plants to other parts of the area on the strength of morphological characters visible in dried specimens. In order to elucidate my conclusion, a survey of the morphological variability in the complex is given below.

1. Achenes. The fruits are either smooth (which word should not be taken too literally: there may be some slightly elevated lines or pustules) and shining, or they are dull and distinctly tuberculate. Doubtful cases are rare, but a practical difficulty is that the tubercles only appear when the fruits are quite ripe.

2. Torus. The elevated torus is either glabrous or long-hairy. In the latter case the hairs are usually not very abundant, but generally they may be observed also when the pseudocarps are ripe or fallen. In that state, however, a decision is sometimes difficult to make.

3. Pseudocarps. Hara & Kurosawa mention the following difference: 'fruiting receptacles bright red, glossy, 11—20 mm across, with a red neck' or 'fruiting receptacles pinkish white, not shining, 8—12 mm across, with a whitish neck'. This cannot be verified in herbarium specimens and field notes are, as usual, too scanty.

4. Leaves. There is a rather large variation in leaf-size but judged from the herbarium no limits can be drawn to distinguish two groups. The shape of the leaflets, the incisions of their margins, and the length of the petiotule also do not provide good distinctions.

5. Indumentum. The stems, pedicels, and petioles are covered with rather long, patent, 1-celled hairs. Between these, two types of glandular hairs can be observed: (1) short ones with a uniseriate stalk of 2—5 short cells and a two-celled gland-head, and: (2) much longer ones, also uniseriate but consisting of *c.* 10 cells, crowned with a smaller globular cell. The cells of the latter type soon die and then the hair is crinkled, has brown cross-walls and has lost its gland-head. In many specimens the two types of glandular hairs occur together, but one or the other may be much rarer or even virtually absent.

Two character-combinations are more often found than any other, viz.:

a. fruits tuberculate, torus hairy, glandular hairs of type 2 common, type 1 usually absent;

b. fruits smooth, torus glabrous, glandular hairs of type 2 absent or rare, type 1 usually present but sometimes rare.

The correlation, however, is not absolute: smooth achenes on a hairy torus, and tubercled fruits on a glabrous torus have both been found. The indumentum is very variable, too much so to be of much help. The latter is also true for leaf-characters. In general, plants with combination b have the larger leaves, but especially in the Philippines plants with smooth achenes and plants with tubercled achenes may be absolutely indistinguishable on vegetative characters.

From the above it appears that it is possible to distinguish two taxa, one with smooth fruits, the other with tubercled ones. Other characters are only partly correlated, or an eventual correlation cannot be detected in the herbarium. The latter refers to the shape of the pseudocarps and also to the level of ploidy.

Hara and Kurosawa established for Japan that the diploid plants have smaller pollen-grains than the dodecaploid ones. An examination¹) of the pollen-grains of eight specimens showed a large and continuous variability in dimensions. The four specimens with the averagely smaller pollen-grains, originating from India, Japan, Java, and Luzon, were specimens with tuberculate achenes and hairy torus. The four larger averages were shown by specimens with smooth fruits and glabrous torus, coming from Luzon, India, Réunion, and Europe, the latter two naturalized. I refrain from giving actual measurements since the number of observations is too small. The examination indicates the presence of different levels of ploidy also outside Japan.

It is quite possible, and to my mind even probable, that a formal distinction of the

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¹) Thanks are due to my colleague, Mr J. Muller, who kindly made this examination for me.

two taxa along the lines indicated above will appear to be justified in the future. It might also be true that we have here two species, one diploid (for which the name *P. chrysantha* cannot be used) and one dodecaploid (*P. indica s.s.*), giving sterile hybrids. On the other hand, the karyological situation and the breeding pattern may be much more complicated than that, and about the most acceptable level of the two taxa — if they be recognized — nothing of a definite nature can be said at the moment. In the light of the gaps in the factual knowledge, therefore, I have decided to treat the collectivum as one species, without any subdivision. I hope to be in a position to study more, and also living material in the years to come.

In summary, the situation is as follows:

Group a — Possibly diploid. Fruits tuberculate. The type specimen of *Fragaria chrysantha* Zoll. & Mor. (*Zollinger 1987* in Z) belongs almost certainly to this group, together with all Java plants which are undoubtedly indigenous to the island. The group is — as far as can be judged — distributed over India, China, Japan, Taiwan, Luzon, Java, Bali, Timor.

Group b — Possibly dodecaploid. Fruits smooth. The type of *Fragaria indica* Andrews (which is the plate given by Andrews, since according to Vidal, 1968, no specimen is present at K or BM) may belong to this group. Area: Afghanistan (according to Hara & Kurosawa), India, China, Laos (according to Vidal), Vietnam, Korea (Vidal), Japan, Taiwan (Vidal), Luzon. It is introduced and partly established in Europe, America, Africa, and in Malesia in Sumatra, Malaya, Singapore, and Java.

2. The synonymy given is very incomplete. A more complete survey of names and literature involved, can be found in Hara & Kurosawa's paper.

3. The description given above, was drawn from the native Malesian specimens only.

INSUFFICIENTLY KNOWN SPECIES

10. Potentilla prob. nov. spec.

Rosette plant. Leaves pinnate, 4—8 cm, *petiole* up to *c.* ½ cm long, petiole and rachis densely sericeous. *Leaflets* 12—18 pairs, stiff, folded along midrib, crowded and over a large part of the leaf ± equal in length, the middle ones up to 5—8 by 4—5 mm, long sericeous on both sides; intermediary leaflets absent. *Flowering stems* not longer than 3 cm, with a terminal flower and sometimes 1—3 lateral ones, peduncle and pedicels densely sericeous. *Epicalyx* entire or notched apically, *sepals* acute, both 2—3 mm long, sericeous outside, glabrous or slightly hairy at apex inside. *Petals* 3—3½ mm long. *Stamens* 5. *Torus* little elevated. *Pistils* many, ovary glabrous, on hairy stalk, style inserted about the middle of the ovary, rather long and thin. *Achenes c.* 1 by ¾ mm, brown, smooth.

NEW GUINEA. West New Guinea. Mt Carstensz: *Wissel 3, 57*; Mt Wilhelmina, Oranje Valley: *Versteeg 2534*.

Collectors' notes. The three specimens were collected at or above 4000 m altitude, *Wissel 57* even at 4500—4700 m.

Remarks. The three specimens certainly belong together, but it is very uncertain what status should be awarded to the group. The short peduncle places it near *P. foersteriana* of which it could be a densely sericeous high-altitude form. On the same altitude on Mt Carstensz, however, also normal forms of *P. foersteriana* were collected. On the other hand there is in the habit much that remembers of *P. adinophylla*, but the differences in inflorescence-length and number of stamens suggest convergence rather than real relationship.

I have preferred this provisional solution. More material from the western part of New Guinea is urgently needed and this case is a clear example of the fact that the mountain flora of the western half of the island is — because it has been undercollected — very poorly known in comparison to that of the eastern half: about four fifths of the ± 125 New Guinea specimens I have seen come from east of the 141st meridian!

11. **P. habbemana** Merr. & Perry, J. Arn. Arb. 21 (1940) 186. — Type: *Brass 9594*, holotype in A, isotype in L; paratypes: *Brass 9553* (BO, L), *Brass 9590* (A, BO, L).

The three specimens mentioned with the original description come from one locality: Lake Habbema in West New Guinea, alt. 3225 m. They agree very well with each other and certainly are conspecific. They are distinct in having leaflets with 3—5 incisions going to the midrib and with the resulting 4—6 lobes digitately — not pinnately — arranged. The leaves are up to 6(—12) cm long, the flowering stems shorter than the leaves and bearing normally one flower; the flowers have 5 stamens and more or less entire epicalyx leaves.

From the other part of the island, the Owen Stanley Range in the Territory of Papua, come three other specimens which have the same kind of leaflets: *Brass 4765* (Mt Albert Edward, 3680 m alt), *Giulianetti s.n.* (K) (Mt Scratchley, between 3050 and 3960 m), and *van Royen NGF 30113* (Wharton Range, Murray Pass, 3050 m alt). The former two are certainly conspecific, they are small rosettes with leaves of 2—3½ cm long and with 1-flowered peduncles of about the same length as the leaves; there are 15—20 stamens, the epicalyx leaves are notched or sometimes entire. The van Royen collection, however, coming from a slightly lower altitude, consists of much larger plants with leaves up to 6 cm long and with rich inflorescences up to *c.* 12 cm long; there are 20 stamens and the epicalyx leaves are often deeply incised.

So we have three groups of plants with digitate leaflets, or rather with pseudo-digitate leaflets, because in fact they are very deeply pinnately incised with extremely reduced midrib. On the evidence available it is not possible to decide in how far the groups are conspecific. Especially the van Royen collection seems different from the others, but a decision has to be postponed till more material has become available, also from the region in between.

3. THE SPECIES OF FRAGARIA IN MALESIA

The two species of *Fragaria* of which I have seen herbarium material from Malesia, are both introduced and have both escaped from cultivation in some places. Especially the occurrence of *F. ananassa* on Mt Pangerango in Java is an interesting case.

Apart from the two species treated here, Backer (1911) mentioned two other species, viz. *F. moschata* (*F. elatior*) as 'possibly cultivated', and *F. viridis* (*F. collina*) as 'possibly found in Java'. These surmises cannot be established from the herbarium material present in Leiden or Bogor. It has to be kept in mind, however, that information about the strawberries that are or were cultivated in Malesia is extremely scanty, both in literature and in the herbarium. Heyne (1927) only cited *F. vesca*, but added that possibly still other species may be cultivated in the mountain regions of Java. Also Ochse (1927) only mentioned cultivation of *F. vesca*. Burkill (1935) said that in Malaya there have been experiments with growing '*F. chiloensis* and hybrids', evidently meaning *F. ananassa*, and recorded the flowering of those plants at Singapore. Also in the Philippines strawberries have been introduced.

Summarizing, it is quite certain that first *F. vesca*, and later *F. ananassa*, have been introduced in several places in Malesia and it is also certain that they grow quite well in many places at higher altitude. Exact data on the extent of the culture cannot be drawn, however, neither from literature nor from the herbarium.

KEY TO THE SPECIES OF FRAGARIA IN MALESIA

Flowers small: hypanthium up to 3 mm diam., epicalyx leaves and sepals up to 4 mm, petals up to 6 mm long. . . . . **1. F. vesca**

Flowers distinctly larger: hypanthium 4—6 mm diam., epicalyx leaves 5—8 mm, sepals 7—12 mm, petals 9—12 mm long. . . . . **2. F. ananassa**

1. Fragaria vesca L., Sp. Pl. (1753) 494.

Runners often present, less than 1 mm thick. *Leaves* trifoliolate; *petiole* 1—10(—12) cm long, hairy, the long soft hairs patent or reflexed, also with very short glandular hairs. *Leaflets* 15—30 by 10—25 mm, sessile or with petiolule up to 1 mm (in apical leaflets sometimes 2 mm) long, margin serrate with (3—)4—8 teeth per cm, with appressed, long, soft hairs underneath and with very short, inconspicuous glandular hairs. *Inflorescences* erect, shorter to slightly longer than the leaves, 2—14(—20) cm long, a (1—)2—4-flowered cyme with leaf-like bracts; peduncles and other axes patently hairy; *pedicels* up to 1½ cm long in anthesis, with long and soft, acropetally semi-appressed hairs, after anthesis elongated and more or less distinctly nodding. *Flowers* perfect, 5-merous. *Floral cup* 2½—3 mm in diam. *Epicalyx* leaves 3—3½ by 1—1¼ mm, acute, sometimes incised at apex, hairy outside as are hypanthium and calyx. *Sepals* about equal to epicalyx or slightly longer, 3—4 by 2—3 mm, acuminate. *Petals* orbicular to obovate, 4½—6 by 4—5½ mm, not or hardly clawed, apex rounded, margin entire, white. *Stamens* 20 or a few missing, filaments up to 2 mm long. *Disc* not distinct. *Torus* high and thin in anthesis, glabrous. *Pistils* many; ovary glabrous, style inserted below the middle, tapering to both ends. *Pseudocarps* obovoid, 8—14 by 8—10 mm (dimensions taken from herbarium specimens), with achenes also in the bottom part; fruiting calyx patent or reflexed; *achenes* not distinctly sunken, 1¼—1½ by ¾—1 mm, smooth.

SUMATRA. Agam, Brani: *Bünnemeijer 3140.*
MALAYA. Pahang, Cameron Highlands: *Johnston 82* (escape).
JAVA. Idjen Plateau: *Backer 25155* (cult.); Mt Pangerango: several collections (run wild).
PHILIPPINES. Luzon, Benguet: *Santos* BS *31870.*

Remarks. The above mentioned specimens are the only collections of this species that could be investigated. They are either cultivated plants or escapes. On Mt Pangerango the species is firmly established since it was planted there by Teysmann at about 1840 (see following species). As said in the introductory remarks, the species is probably present in many other places too, although maybe not longer as a garden plant, having largely been superseded by *F. ananassa*, as it was in Europe.

2. F. × ananassa Duch., Hist. Nat. Frais. (1766) 190. — *F. grandiflora* Ehrh., Beitr. Naturk. 7 (1792) 25. — *F. chiloensis* (L.) Duch. × *F. virginiana* Duch.

Runners scarce or absent, when present more than 1 mm thick. *Leaves* trifoliolate; *petiole* 1½—17 cm, with long, soft, acropetally semi-appressed or reflexed hairs. *Leaflets* 18—70 by 13—60 mm, shortly petioluled (petiolule of lateral leaflets up to 3 mm, that of apical one up to 9 mm) or almost sessile, margin serrate, with (2—)3—4 teeth per cm, the apical tooth smaller than the neighbouring ones or ± equal, with appressed hairs, especially on the nerves below, lower surface often distinctly glaucous. *Inflorescences* erect, shorter to slightly longer than the leaves, up to 26 cm long and with up to 16 flowers in a dichasium; primary bracts leaf-like with reduced blade, higher bracts membranous; peduncle 0—14 cm, *pedicels* up to 9 cm long, all axes with semi-appressed to patent hairs. *Flowers* functionally unisexual, 5—6-merous. *Floral cup* 4—6 mm diam. *Epicalyx* leaves 5—8 by 2½—3½ mm, acute or notched, hairy outside as are hypanthium and calyx. *Sepals* longer than epicalyx to nearly equal, 7—12 by 3—4½ mm, acute to acuminate. *Petals* (sub)orbicular, 9—12 by 9—12 mm, very shortly clawed, apex rounded, entire, white. *Stamens* 25—37, the episepalous ones longest with filaments up to 3 mm, in female flowers much reduced and sterile. *Disc* a thickened, sometimes distinctly 5- or 6-lobed ring. *Torus* high and thin, or thicker, glabrous or hairy. *Pistils* many; ovary glabrous, style at about the middle or lower to almost basal, tapering to the base; in male flowers ovaries present but not developing. *Pseudocarps* globose, obovoid or ovoid, 13—17 by 11—15 mm (dimensions taken from herbarium specimens), the neck with or without (?) achenes; fruiting calyx ± horizontally patent (?); *achenes* sunken in the swollen torus, 1¼—1½ by 1—1¼ mm, smooth.

SUMATRA. Brastagi: *Sun Hung Fan 244.*

JAVA. Mt Tangkubanprahu: *Van der Pijl s.n.* (L, 2 collections); Mt Pangerango: many collections; several collections without exact locality.

Remarks. The above citation of specimens gives undoubtedly only a highly incomplete picture of the extent to which the Garden Strawberry is cultivated in Malesia.

It is well-known that *F. ananassa*, which is acceptedly a hybrid between the two American octaploids *F. chiloensis* and *F. virginiana*, is a very variable taxon. In Europe and America it has been subjected to back-crossings and selection, but also without that its populations are variable and may approach either of the parents or be more clearly intermediate.

According to the scanty herbarium material, the Javanese specimens belonging to *F. ananassa* fall into three groups. Two of those consist of plants under cultivation, as far as can be gathered from the labels.

Race I consists of plants with large leaves (petiole up to 17 cm, leaflets up to 7 × 6 cm) and long-petioluled leaflets (in the apical leaflet up to 9 mm). Runners were not seen. The inflorescences are equal to or longer than the leaves, they are large, up to 26 cm, and bear up to 16 flowers. The four specimens seen are all from unknown provenance.

Of *Race II* only two specimens were seen, both from Mt Tangkubanprahu, one certainly from a garden, the other presumably so. The plants are smaller, runners are scarce. The leaves have a petiole up to 7 cm, the leaflets are up to 5½ by 4½ cm and shortly petioluled. The inflorescences are shorter than the leaves, up to 6 cm long, and have only a few (up to 3?) flowers.

The two races agree in having the apical tooth of the terminal leaflet normally distinctly shorter than the neighbouring ones. This character is not present in the third and most interesting group, a population of naturalized plants on the summit of Mt Pangerango, *c.* 3000 m alt. They were planted, possibly imported from Holland, by Teysmann some time between 1839 and 1842, together with the Wood Strawberry, *F. vesca*, and several other temperate plants (cf. Docters van Leeuwen, 1933, p. 45). Both kinds of *Fragaria* have survived, at least till 1950 when the most recent collections were made.

The plants of this population make quite a different impression than the plants cultivated at lower altitudes. The rosettes are more compact, the leaves are stiff and small (petiole up to 7 cm, leaflets up to 5 by 3½ cm, almost sessile), the inflorescences are at most 18 cm long but usually shorter and do not bear more than 6 flowers. They appear to approach *F. chiloensis* more than they do *F. virginiana*.

Originally the plants were thought to belong to *F. vesca*, but this identification was about 1938 corrected by Backer, as judged from the labels in the Bogor Herbarium. Docters van Leeuwen (1933) and van Steenis (1934) speak about two forms of *F.vesca*, 'a large-flowered one which never sets fruit and the true *F. vesca* with smaller flowers which regularly fruits.' (van Steenis, l.c., p. 335).

Like its parents, *F. ananassa* is incompletely dioecious, at least it was so during the first century after it had been produced (which must have been rather soon after introduction of *F. chiloensis* in Europe). Selection, however, has produced well-bearing stocks with bisexual flowers and to those the now widely cultivated cultivars belong (Mangelsdorf, 1927).

The plants that Teysmann planted on Mt. Pangerango, or at any rate the surviving ones, were female and this accounts for the fact that in this population no fruits are formed. This recalls the events in the beginning of the 18th century, when Frezier brought five plants of *F. chiloensis* from Chile to Europe, all of which appeared to be female (quite understandably, Frezier selected some fruitbearing plants!) and which did not set fruit unless other species, especially *F. virginiana*, were planted between them. Ostensibly in this way the hybrid *F. ananassa* was produced.

In the *c.* 20 collections from Pangerango that I have seen, only one fruit was present (*Schiffner 2018*). Whether formation of this fruit was due to the (evidently very rare) presence of male or hermaphroditic flowers, or to the fecundation of a female *F. ananassa*-flower by pollen of *F. vesca* is not known. The latter seems very unlikely, since Mangelsdorf & East (1927) have shown that crossing octaploids with the diploid *F. vesca* as pollinator is not possible. (The reciproke crossing is possible, but results in very bad germination and very weak F1).

The Pangerango population does not show runners, at least not in the herbarium. It seems likely, however, that they do in fact occur, but they may be formed only after flowering and so escape being collected.

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5. IDENTIFICATION LIST OF MALESIAN SPECIMENS

As a rule only specimens with a collector's number have been entered in the list. The number behind the colon indicates the number of the species in the present paper.

Potentilla

Backer 5462: *9*; 5574: *9*; 5666: *9*; 5684: *8*; 5764: *9*; 8394: *9*; 8694: *9*; 12339: *9*; 12509: *8*; 12539: *9*; 12692: *8*; 12780: *8*; 12816: *9*; 13669: *9*; 15739: *9*; 15896: *9*; 16036: *9*; 16082: *8*; 21674: *8*; 21744: *9*; 21835: *8*; 22262: *9*; 26094: *8*; Bakhuizen van den Brink 471: *9*; 719: *9*; van Balgooy 47: *7b*; 239: *7a*; 247: *4*; 267: *2*; 743: *4*; 824a: ?*4*; 913: ?*4*. Belle s.n.: *9*. Blokhuis 65: *8*. Blume 1388: *9*. Borgmann 3: *2*; 24: *4*; 376: *2*. Bosarchitect Koepang 1: *9*. Brass 4229: *4*; 4230: *2*; 4231: *4*; 4308: *3*; 4419: *7a*; 4635: *2*; 4636: *4*; 4754: *3*; 4755: *3*; 4765: *11*; 9149: *7a*; 9394: *4*; 9427: *7c*; 9542: *7a*; 9543: *2*; 9553: *11*; 9590: *11*; 9594: *11*; 9594A: ?*7a*; 10727: *4*; 22246: *2*; 22261: *2*; 22885: *7b*; 29976: *4*; 30174: *2*. Brass & Collins 30997:*4*; 31210: *4*; 31211: *2*. Brass & Meijer Drees 9746: *2*; 9839: *7c*; 9863: *4*; 10131: *7a*; 10133: *7c*; 10156: *7c*; 10383: *7a*; 10390: *7c*; Brinkman 167: *8*; 881a: *8*. Bünnemeijer 11895: *2*; 11941: *2*; 12251: *2*; 12318: *2*. Burck 621: *9*.

Carr SF 27613: *4*, mixed with *5b*.Chew & Corner RSNB 5974: *1*. Clemens 5006: *4*; 5263: *6*; 5317: *4*; 5765: *7a*; 9141: *9*; 9378: *4*; 10580: *4*; 10652: *4*; 12374 bis: *4*; 16359: *9*; 18747: *9*; 26958: *1*; 27095 = 28937: *5b*; 29922: *4*; 32335: *5b*; 32381: *4*; 41143: *4*; 51409: *1*; 51521: *5b*. Coert 193: *9*. Collenette 21514: *5b*, mixed with *4*. Cruttwell 1065: *2*; 1345: *4*.

Danser 6708: *9*. Docters van Leeuwen — Reijnvaan 2310: *8*; 4591: *9*. Dorgelo 100: *9*; 131: *9*.

Elmer.5770: *9*; 8608: *9*. Enriquez SF 18176: *1*; SF 18178: *5b*. Everett 77: *2*. Eyma 713: *4*; 714: *2*.

Flenley ANU 2229: *2*; ANU 2420: *4*; ANU 2430: *2*. Forbes 624: *9*; 642: *9*; 878: *8* and *9* mixed. Fuchs 21084: *5b*.

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6. INDEX TO NAMES AND SYNONYMS

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