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POMETIA (SAPINDACEAE), A STUDY IN VARIABILITY

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SUMMARY

A monograph of *Pometia*, which extends from Ceylon throughout Malaysia to Samoa, with a few stations in SE. Asia and Formosa. Two species are recognized: *P. ridleyi* and *P. pinnata*, the latter having a particular pattern of alternating nerves. *Pometia pinnata* is extremely variable and clearly still in process of differentiation. From the wealth of forms, 8 formae have been selected for taxonomic recognition, 1 of them is newly described, 7 are new combinations; characters are found in the leaves and the inflorescence. Besides, a number of unnamed paramorphs have been described. The distribution of the variability has been sketched for each region. Details about ecology etc. are given. Specimens are cited where appropriate and a general Identification List is given at the end.

INTRODUCTION, PURPOSE

Pometia has caused much trouble to botanists, which is bad, and still more trouble to persons who wanted to use their publications, which is worse. That is one of the reasons why this study was undertaken. The other reason is that there are some economic prospects for the genus in the eastern part of its area.

Presuming that it would be a good thing to start bearing in mind the famous words of Julian Huxley: "Fundamentally, the problem of systematics is that of detecting evolution at work" we soon found ourselves in a good deal of embarrassment. For there is no doubt that evolution is well at work in *Pometia;* hybridization and variability are obviously in full swing, producing hosts of forms which defy all attempts to classify them, that means: to detect any structure in the net of reticulate affinities. Such genera, where evolution is really busy, are actually the despair of taxonomists, because they must abandon the hope that they ever will attain a satisfactory result. So it must be said that the results of the evolution's work in *Pometia*, notably the production of well-separable

*) Rijksherbarium, Leyden.

taxa, are thusfar very meagre. And the best that a taxonomist can hope is that he never will "detect evolution at work", for this means that he is entirely at a loss to find any characters reliable for classification. Though a taxonomist may hope to detect some of the ways by which differentiation and selective survival might have developed, as a matter of fact, the genera where evolution is still at work, like *Rhododendron*, *Rubus*, *Salix*, *Hieracium*, inspire to a somewhat different view, which could be worded, for instance "the hopeless problems of systematics are there, where evolution is at work".

Two comprehensive studies of the genus have been made. The first, by Blume, Rumphia 3: 113—117. 1847, where the genus is named *Irina*, is an admirable piece of early descriptive work. The second, by Radlkofer, *in* Pflanzenreich, Heft 98: 924—936. 1933, leaves the picture as it had been growing in the course of time essentially unaltered. Radlkofer's subdivision of the genus is largely good, but he maintained all these groups in the rank of species, and the application of floral characters for their distinction forms an effective bar to the merits of his revision.

We have investigated how far the characters used by Radlkofer to make segregations in *Pometia* held good, but failed to find a single one which did. We have, however, refrained from filling a couple of pages with graphs and statistics in order to make this failure more convincing. Besides, the fact that virtually all the differences between Radlkofer's supposed species were found to break down, does not mean that the taxa he recognized are non-existent. Only, they are embedded in a swarm of intermediate and deviating forms, which in the beginning bedazzle the botanist, and which account, with good reason, for the reputation of difficulty that the genus enjoys.

It has been the first purpose of this study to draw lines of demarcation round those groups of individuals in which certain combinations of characters are apparent, outcrystallized, as it were, from the pot of boiling mother-lye of genetic material, under which Evolution keeps the fire nicely burning. The second, to deal effectively with the remaining stuff. The first objective has been pursued in the taxonomic chapter, the second in the chapter on the Distribution of the Variability.

CHARACTERS AND THEIR VALUE

Correlation of characters, which is essential for every distinction, can in *Pometia*, as in most other arboreous genera, potentially be found within or between four parts of the plant: leaves, inflorescences, flowers,

fruits. As for the flowers, a great number of analyses disclosed that in vegetatively identical plants the floral parts may have very different shapes, sizes, and mutual proportions. We have, however, detected a correlation between leaves and inflorescences, and as a consequence, have based our distinctions on this point. As floral characters do not fit into this correlation we consider them worthless for the distinction of infraspecific taxa. As for the fruits, these cannot serve our purpose because the number of collections with ripe fruits is far too small to be of any taxonomic use. There are indications that the fruits are subject to great variation in shape, size, and colour, but we have succeeded only to a very small extent in approaching their relation with other characters.

About other potential characters we have still less certainty. No correlation was found between forma and tree habit, and about ecological claims we have found mere indications. The great variability displayed by the genus is certainly not randomly distributed, as we have tried to sketch in the relative chapter.

The overwhelming majority of the material belongs to *Pometia pinnata*, which is easy to recognize by the nerve-pattern. The nerves are all of the same thickness and run neatly parallel towards the margin. There one nerve, say nerve a, ends in a hydathode which is sometimes developed to a marginal tooth, while the next one, nerve a + 1, bends within the margin towards the leaf top; the then next one, nerve a + 2, ends again in a hydathode, and so on. As a consequence, the leaf margin is never absolutely entire.

The first botanist, as far as we could trace, who recognized the singular nervation in *Pometia,* was Thwaites in his excellent description of *Eccremanthus* in 1855. Hiern mentioned it in the Flora of British India in 1875. Then the character disappears completely from phytography, until Endert mentioned it again in his Geslachtstabellen of 1928, apparently after having found it on his own accord. Facts like these corroborate the impression that the value of macroscopical vegetative characters for taxonomic distinction has been somewhat neglected in favour of reproductive characters. This may well be due to the tremendous influence of Linnaeus's Sexual System. Authors seldom fail to dwell, for instance, upon details of the ovule and of the embryo.

It is noteworthy that also the S. American genus *Paullinia* possesses a similar nervation, provided that the leaves are dentate, in all the about 25 spp. we could examine. The intermediate nerve (a + 1) is then often forked.

In *Pometia ridleyi* all nerves curve upwards without reaching the margin, which is perfectly entire. As the particular nerve-pattern of *P. pinnata* is the only qualitative character within the genus, this means (I) that this is also the only character on which, with good reason, a specific distinction can be based, (II) that all other, formerly employed, specific distinctions, have to be given up.

FORMAE AND PARAMORPHS

Whereas *P. ridleyi* is known as a small homogeneous population, in *P. pinnata* many intergrading specimens cast doubt on the supposed genetic constancy of the here distinguished infraspecific taxa, and this means that even variety must be considered too high a rank for them; hence they have been given the rank of forma.

In *P. pinnata*, besides the formae *), we have distinguished a number of paramorphs. While forma is used in the taxonomic sense, the term paramorph is here used not in its original meaning of general infraspecific taxon, but in a particular way to denote a deviating part of the population which is for some reason not (yet) taxonomically recognized. The reason may be (I) not sufficient material is thusfar available, (II) the differences between the paramorph and a recognized forma are too slight. It is, however, quite possible that future work will lead to a taxonomic recognition of some paramorphs.

From the foregoing it is apparent that, in subdividing *P. pinnata* by describing a number of formae, we have not attempted to cover by this procedure the whole variability of that species. Philosophically spoken, another forma could and should be distinguished to embrace the whole of the remaining variability. In this case, there is certainly no point in doing so, for two reasons: (I) The distinction and naming of such a forma would involve the appointment of a type specimen. Future studies probably will result in segregation of more formae from the 'melting pot' and the conception of a forma as intended above will have to be emended by necessity again and again. (II) The denomination of such a forma would be of no distinctive value whatever, as it simply embraces all the material that cannot be classified, because, for instance, of its being inadequate. This would affect the idea of homogeneity on which all the other formae have been based.

Some elucidation must be given on the point that 'not sufficient' material available is a reason to deny it a taxonomic recognition. This is another philosophical point.

*) If a forma is cited without a specific name, it must be understood to belong under *P. pinnata*.

One collection of an odd specimen is, of course, not enough to recognize it as a forma. There must be several collections, and from more than one locality. The minimum number seems a matter of personal judgment. In fact, it is not; we merely substitute an arbitrary decision there where we have not enough knowledge of relevant facts. On this occasion we have fixed the number of specimens at four.

CITATION OF LITERATURE

In Radlkofer's monograph all sorts of wrong interpretations and misspellings have been corrected. Hence we feel justified not to repeat all this matter, but to give just the complete synonymy. However universally spread the custom is, to cite all synonyms in a chronological sequence, it has the obvious disadvantage that the intrinsical relation of the names that have been based on the same type specimen is obscured proportionally to the intricacy of the synonymy. Therefore, in more or less difficult genera like this it is definitely advisable to keep all names together that have been based on one type specimen.

We believe to have seen most of the literature dealing with the genus. Only those contributions considered of any importance have been cited here. Publications without taxonomic significance, but important for the knowledge of ecology, anatomy, etc., have been cited under these headings.

EAST AND WEST

As one can see in the Distribution of the Variability, in *Pometia pinnata* a distinction can be made between the population on the ancient Sunda Shelf, and the population in the area East and Northeast of it. Ecological behaviour seems to be somewhat different in either part. In the literature, the data are mostly given in general, irrespective of the (infraspecific) taxa. As the data, however, nearly always apply to one of the halves of the area only, which means that they do not apply to the formae in the other half, we have in some cases split the here compiled data, and have marked them 'East' and 'West' so that they fit more closely.

CITATION OF SPECIMENS

Thanks to the cooperation, here gratefully acknowledged, of the Directors of the herbaria of the British Museum (BM), Cambridge (CGE), Kew (K), Kepong (KEP), Leyden (L), Paris (P), Munich (M), Manila

(PNH), Sandakan (SAN), Kuching (SAR), and Singapore (SING), we could examine well over 1000 sheets. Except for the type specimens, which have been cited anyway, only those sheets have been cited which bore a collector's or series name, plus a number. With this restriction, specimens classified under *P. ridleyi* and the formae of *P. pinnata* have all been cited in the List at the end, which gives about 550 collections.

Under the descriptions only those specimens have been cited which are important for the determination of the distribution. If 1, 2, or 3 collections are known from an island or country, we have cited all of them; if there are more than 3, we have just stated that there are several or many.

As for the specimens not to be found in the List, those reckoned to a paramorph have been cited there in the chapter on Distribution of the Variability. Of the unclassified specimens, those which are somehow important have been cited in the same chapter. The residue, consisting of intermediate, inadequate, or juvenile specimens, have not been cited whatsoever. They have been labelled *'Pometia pinnata'*; the number of collections is about 100 — 150.

POMETIA Forst.

Pometia J. R. & G. Forster, Char. Gen. 109, *t. 85*. 1776; G. Forst., Prod. 74. 1786; B. & H., Gen. Pl. 1: 407. 1862; Radlk. *in* E. & P., Pflanzenfam. III 5: 332. 1896; in Pflanzenreich, Heft 98: 924. 1933; Corner, Wayside Trees 594. 1940. — *Irina* Noronha *ex* Blume, Bijdr. 229. 1825; Rumphia 3: 113. 1847. — *Eccremanthus* Thwaites in Hook., J. Bot. and Kew Gard. Misc. 7: 272, *t. 9*. 1855. — Species of *Aporetica, Euphoria, Nephelium, Sapindus, Schmidelia;* see Radlk. 1933 and under the species. — Type species: *P. pinnata* Forst.

Trees, sometimes attaining big size, often with prominent buttresses up to 1½ m height. Bark peeling off in flakes. Innovations with bright reddish or purplish tinge, hirsute, leaf buds plicative involute. Juvenile shoots and suckers densely patent brown-fulvous hairy, with large thin leaves. Branchlets thick to slender, shallowly grooved to smooth. *Leaves* paripinnate, the rachis up to 1 m or longer, on either side 4 — 13 leaflets subsessile jointed, the lower pairs of leaflets decreasing. Leaflets coriaceous to firmly herbaceous, often asymmetrical, the acroscopical half being wider and more extended at the base, in the apical leaves the base mostly narrowed; an orbicular gland mostly present underneath at the base on the basiscopical side and sometimes on the acroscopical side, too; largest leaflets averagely 12 — 30 by 4 — 10 cm or sometimes even larger, midrib above flat but with a narrow keel triangular on section, venation open, nerves very neatly parallel under an angle of ± 60° with the midrib, veins distinct and fairly regular; surfaces smooth. *Inflorescence* a ter-

minal or rarely axillary thyrse, stiff or pendent, ± 15—60 cm long and little less wide, main branches simple or with secondary branches, subtended by a reduced leaf (see Note 2); flowers with 6—12 in cluster-like cincinnae a few mm peduncled and bearing some minute bracts in two rows on the acroscopical side and subtended by a small linear bract; pedicels 2—5 mm, filiform. *Flowers* actinomorphic, calyx dish-shaped to shallowly cup-shaped, 2—3 mm in diameter, lobes 5, slightly imbricate in bud, more or less triangular, acutish to blunt or rounded. Petals 5, exceptionally wanting, shorter to longer than the calyx, very variable in shape but mostly truncate, ½—1½ mm long and ½—1 mm wide, without scales or a basal gland. Disk annular, ± 1—1½ mm diameter and ½ mm high, with 5 pits for the stamens, sometimes obscurely 5-lobed, nearly always glabrous. Stamens 5, the filaments filiform, shorter in the ♀ flowers, anthers ¾—1 mm long, minutely papillose. Ovary 2-lobed, obcordate, ± 1—1½ mm wide and ½—1 mm high, densely brown-pubescent, locules 2 with 1 ovule in each, basally attached; style undivided, ± 1—2 mm, with obtuse top, after anthesis stretching to 3—6 mm with a clockwise torsion, lateral parts of the apex receptive and glabrous V-shaped, the other part sparsely hairy to glabrous. *Fruit* mostly simple by abortion, with the scar of the style near its base, indehiscent, smooth, ellipsoid, up to 3½ by 3 cm, pericarp leathery, mesocarp hard-fleshy; seed covered by an arillode for ± $^1/_5$ adnate to its base, the micropyle halfway up; cotyledons straight. For germination, see below.

DISTRIBUTION. — Ceylon, Andamans, throughout Malaysia to Samoa. A few scattered stations in N. Siam, S. Yunnan, Indo-China, and Formosa.

ECOLOGY. — Typically a tropical rain forest genus of low altitude (generally below 500 m, rarely to 1000 m, highest record 1700 m, in Atjeh), on limestone, clayey, sandy, or loamy soil. In West Malaysia never dominant in the forest, in Malaya mainly riverine (see Ecology under *P. pinnata*), in Borneo and Sumatra occasionally in fresh water swamp forests, otherwise everywhere in dryland forests, in New Guinea not seldom dominant in forests, partly under human influence (see Ecology under *P. pinnata*). Not able to stand a severe seasonal climate. Evergreen or shortly deciduous. Typical witches'-broom occur (see below).

There seems to be a fixed flowering period and a fruiting season 2—5 months later, but the time varies with the region, without an apparent correlation with climatic seasons.

VERNACULAR NAMES. — West. Malay: *kasai* (also for *Aglaia* spp.; Corner); Sundanese: *langsir*, with variants; Javanese: (*kaju*) *sapi*. East. For the Philippines, see Merrill, En. Philip. 2: 506. 1923. In Ambon: *dawan* (Rumphius). In West New Guinea: *matoa*, *kottij*, and *ihi*, which has a variant *igi* in the Solomons; in Papua: *ohabu* (Womersley & McAdam); in T.N.G.: *taun* (the trade name of the wood; Walker); in the Solomons: *tauna* (Walker); in Fiji: *dawa* (Seemann). Many more local names of doubtful value.

DISPERSAL. — The fruits show such features as to make it probable that they are dispersed by bats. Van der Pijl *in* Acta Bot. Neerl. 6: 300. 1957, gives 7 characteristics of bat-dispersed fruits. Five of these apply to *Pometia,* notably: fruit comparatively large, dull-coloured, with tough skin, edible part moderately hard, and fruit hanging down more or less exposed outside the foliage. About the other two points: fruit of unpleasant odour and fruit attached to the tree till after maturity, we have no facts. Although *Pometia* is not mentioned in his paper, Dr. Van der Pijl informed us of his opinion that *Pometia* fruits are indeed dispersed by bats. This is strongly supported by the fact that the limits of the area of *Pometia* and of fruit-eating *Pteropinae* (the latter instructively mapped by Van der Pijl, *l.c.* p. 292) in the Pacific are exactly the same, with the exception that the bat does and *Pometia* does not occur in New Caledonia.

GERMINATION, SEEDLINGS. — The germination could be studied in the Leyden Botanic Garden on seeds sent from New Guinea. The germination begins immediately after maturity and is epigeic, the hypocotyle c. 6 cm long, the first internode c. 3½ cm. The cotyledons are slightly sagittate with a pair of basal lobes of 2 mm. The first pair of leaves is subopposite, the rachis c. 1½ cm long, the leaflets 5 in number, one of which is terminal; the orbicular gland underneath the leaf base is already present in the basal pair of leaflets. The leaflets are glabrous, distinctly serrate, and already possess their particular pattern of alternating nerves. The transition to paripinnate begins to take place in the third and the fourth leaf. Instead of a terminal leaflet, these produce a nerve-tip c. 13 mm long.

The only dried seedlings we have seen, *FMS 30948 Abdul Hamid* from Kepong in Malaya, is suggestive of f. *alnifolia.* Hypocotyle 8—9 cm, epicotyle 6—7 cm, first leaves opposite, rachis c. 2 cm, leaflets 5, the first (basal) pair 1—1½ by ¾—1 cm and subfalcate, the second pair to 8 by 2½ cm, the terminal one to 9½ by 3 cm; 1—2 basal glands underneath in the paired leaflets and sometimes 2 in the terminal one, short patent light-brown hairs on the epicotyle, rachis, and midrib above; nerves to c. 12 pairs in the typical *pinnata*-pattern, margin distinctly serrate.

WITCHES'-BROOMS. — *Pometia* is well known for its witches'-brooms, which occur in all taxa and often render the trees recognizable from far. These structures are approximately globose, measuring c. 15 cm to nearly 1 m in diameter, and consist of dense masses of small irregularly dissected leaves several cm wide in all colours between green and brown, or frequently there are only hairy twig-like formations. Sometimes they are still recognizable as parts of a leaf. After some time on the tree they are shed as a whole and can be found on the ground, sometimes in considerable quantities.

Several scientists have paid attention to them. A. Braun *in* Amtl. Ber. deut. Naturf. u. Aertzte Königsb. 35: 310—314. 1861, wrote a paper under the title "Abnorme Blattbildung von *Irina glabra* im Vergleich mit analogen Vorkommnissen bei andern Pflanzen", which we have not seen.

A careful examination for parasites by W. Magnus *in* Ann. Jard. Bot. Buit. Suppl. 3: 807—814, *t. 32.* 1910, failed to reveal any action by fungi or insects. He took a bud-variation for the cause of the practically infinite abnormal growth of the leaves, and supposed that only lack of water supply made them stop growing. He gave a fine photograph of several specimens.

L. Bos *in* Meded. Landbouwhog. Wagen. 57 (1): 1—79. 1957, gave on p. 39—40, *f. 20,* a description and a figure of a witches'-broom originated from a leaflet. He said not to know the cause of the phenomenon, but remarked in general that this sort of malformation is mostly caused by viruses, which disturb the plant's balance between vegetative and reproductive development.

None of these authors mention the fact which we could observe in the Bogor Botanic Gardens, that not only leaves, but also parts of the inflorescences may grow rank. The same thing appears from e.g. *Van der Leden BW 5368* from New Guinea. Here the inflorescence has kept approximately its original shape, is ± 40 cm long, bears several fruits while about half of it is deformed to bunches of small pinnatifid leaflets with strongly hairy main nerves. It is typical for all these witches'-brooms that they are abundantly hairy, even in *P. ridleyi.*

Magnus in 1910 adopted the name *P. pinnata* f. *dissecta* (Miq.) Radlk. for these malformations, without reference to a basionym. Radlkofer himself *in* Nova Guinea 8^4: 617. 1912, used the same name, but correctly referred to *Irina glabra* var. *dissecta* Bl. as the basionym, noting that a specimen partly belonged to this form. From this remark alone it is obvious that the form was based on a monstrosity, and according to Art. 67 of the Paris Code has no taxonomic status.

GALLS. — Docters van Leeuwen, Zoocecidia 337, 338. 1926, described three kinds of galls on *Pometia* leaves. One more sort of malformation occurs in most or all taxa, where regularly some ovaries are deformed to brown-hairy balls 5—8 mm diameter. They contain a chamber 2—4 mm in diameter with a tough wall and inside a pale yellow legless larva c. 1 mm long, which we suppose to be of a gall-midge.

WOOD ANATOMY. — Burgerstein *in* Rechinger, Bot. u. Zool. Ergebn. Samoa- u. Salom. 2: 112. 1908, and Browne, For. Trees of Sarawak and Brunei 319. 1955, give anatomical descriptions of the wood. See also the paper by Mrs. Koning-Vrolijk, c.s. 'Properties of New Guinea Woods' *in* Nova Guinea 1962, in the press.

RELATIONSHIPS. — *Pometia* belongs to the tribe of the *Nephelieae,* among the genera with non-dehiscent fruits, viz *Euphoria, Otonephelium, Pseudonephelium, Litchi, Cubilia, Xerospermum, Nephelium,* and *Paranephelium.* In this tribe it is the genus with the most-jugate leaves, and the only genus with entirely smooth fruits and with a curved embryo; hence its position is comparatively isolated. Vegetatively there is a resemblance with *Litchi philippinensis* Radlk.; the structure of the inflorescence and of the flower comes perhaps nearest that of *Nephelium.*

Within the genus, *P. pinnata* f. *macrocarpa* seems to represent the point where *P. pinnata* and *P. ridleyi* are connected.

As for the formae of *P. pinnata*, not much can be said about their mutual connection. The widespread f. *glabra* seems closest related to f. *pinnata* and f. *repanda* in the eastern half of the area, and to f. *tomentosa* in the western half. The f. *tomentosa*, in turn, seems closer related to f. *alnifolia* with which the f. *macrocarpa* and f. *acuminata* are associated. The f. *cuspidata* of the Lesser Sunda Islands could have been derived from f. *pinnata*.

NOTES. — 1. The description of *Pometia* as it is given above, does not contain family characters of the *Sapindaceae*. It will be sufficiently known that in this family the leaves are generally exstipulate, paripinnate, the flowers unisexual although the ♀ flowers look as if they were bisexual, but the anthers do not open. The disk is annular and extrastaminal. The ♂ flowers open first and exceed the ♀ ones far in number.

2. The leaf which subtends the primary branches of the inflorescence is very variably reduced. Sometimes no more of it is left than a pinnate bract of 5 mm long. In many cases, however, it is reduced save for the first (basal) pair of leaflets. These generally agree in size and shape with the corresponding pair of the normal leaves. In f. *glabra*, this pair is peculiar in that the leaflets are not falcate but rounded and clasping the stem in the way stipules sometimes do, both in the inflorescence and in the normal leaves. In a few cases there are two pairs of them. Such leaflets are here termed auricles. Rarely the leaves subtending the lower primary branches of the inflorescences are hardly reduced at all; then we have a leafy thyrse.

3. The particulars discussed under the headings Ecology, Uses, etc. have been inserted under those taxa to which the reference seemed certain. In cases of general application, or where the proper taxon could not be traced, the data are given under the genus or under *P. pinnata*, where mostly a difference could be made between the western and the eastern half of the area.

4. The bright reddish tinge of the young foliage, which persists until the leaves have attained their full size, inspired De Noronha to give it the name *Irina*, after the celestial rainbow (*in* Verh. Batav. Gen. 5: 2. 1790, *n.v.; ibid.* ed. 2: 65. 1827, name only). De Noronha gave no description, referred only to the vernacular name lengsar. From the various *Sapindaceae* with coloured innovations this name is applied to, Blume chose this genus for description.

5. According to Corner, Wayside Trees, the inflorescences are scentless, and the branches of the drooping panicles toss in the wind like catkins.

KEY TO ALL TAXA

The purpose of the key, as far as *P. pinnata* is concerned, is to save the reader the time of going through all the descriptions rather than to enable him to identify

any specimen. Since part of the specimens cannot be classified into a forma on account of their being intermediate or deviating, a specimen which does not entirely concur with any description must remain unclassified. In that case it may tally with one of the paramorphs already known from the same island; this can be found in the chapter 'Distribution of the Variability'.

1. Every other nerve ending in a hydathode or tooth, the intermediate nerves bending upwards without reaching the margin. Calyx hairy, and often the innovations and inflorescences so . . . . . *2. P. pinnata*
2. Leaflets above hairy on the midrib.
3. Inflorescence stiff, dense, fulvous-brown puberulous. Leaflets ovate, nerves reddish-tinged . . . . . *2a.* f. *pinnata*
3. Inflorescences more or less hanging.
4. Inflorescence branches simple.
5. Leaflets subentire, to 19 cm, olive-greenish when dry, glossy above . . . . . *2e.* f. *alnifolia*
5. Leaflets dentate, to 16 cm, greenish-grey when dry, dull . . . . . *2h.* f. *cuspidata*
4. Inflorescence repeatedly branched, densely rusty-brown hairy. Leaflets brownish when dry, to 30 cm, with distinct teeth . . . *2g.* f. *tomentosa*
2. Leaflets above glabrous on the midrib.
6. Inflorescence stiff.
7. Inflorescence with auricles, to 60 cm long, leaflets coarse, to 30 cm or longer, the basal pair auricle-shaped (see Note 2) . . . . . *2b.* f. *glabra*
7. Inflorescence mostly without auricles, to 30 cm long.
8. Inflorescence glabrous or practically so.
9. Leaflets subentire . . . . . *2f.* f. *macrocarpa*
9. Leaflets repand . . . . . *2c.* f. *repanda*
8. Inflorescence short fulvous-brown puberulous. Leaflets ovate, nerves reddish-tinged . . . . . *2a.* f. *pinnata*
6. Inflorescence hanging. Leaflets to 25 cm or longer, 2—4 cm acuminate, markedly dentate but the teeth far apart . . . . . *2d.* f. *acuminata*

1. All nerves equal, bending upwards without reaching the margin which is perfectly entire. Plant completely glabrous, only the ovary and sometimes the petals hairy. . . . . *1. P. ridleyi*

1. POMETIA RIDLEYI King *emend.* Radlk.

Pometia ridleyi King *in* J. As. Soc. Beng. 65 ii: 443. 1896; emend. Radlk. *in* Pflanzenreich, Heft 98: 927. 1933; Corner, Wayside Trees 595. 1940. — Type specimen: *Goodenough 1899* (CAL, holotype; K! M, fragm.! SING!), Malaya, Malacca, Bukit Tampin, fl. V. 1894.

Vegetative parts completely glabrous, only the very youngest innovations hirsute; material often dark-coloured in the herbarium. Branchlets some 5 mm thick, shallowly grooved, sometimes like the base of the

rachis with a faint covering of wax. *Leaf* rachis fairly slender, ± 17–2 cm, with 6—8 pairs of leaflets often opposite. Leaflets coriaceous, th first (basal) pair about 1 cm, falcate, the next 1—2 pairs somewhat large the other leaflets more or less equal, often overlapping one another, abou 2½—3½ times as long as wide, widest about the middle or slightly belo the largest ones ± 12½—15 by (4—5½) cm; the acroscopical half some times being the wider and then covering the rachis; base oblique, rounde to subcordate, mostly without a gland, top more or less gradually acumi nate, the tip up to 1 cm, blunt; midrib often reddish tinged, nerves 11—15 pairs, none of them ending in a hydathode but all bending towar the top without reaching the margin; upper surface sometimes very glos sy, lower surface less so, margin quite entire. *Inflorescence* stiff, ± 17–2 cm long and wide, glabrous, rather dense, repeatedly branches higher u as well as at the base, primary branches subtended by reduced falcat leaflets. Flowers with a glabrous dish-shaped calyx split to $^1/_4$—$^1/_3$, th lobes triangular acutish, exceeding the petals; petals irregularly obverse triangular to roundish ± $^2/_3$ by 1 mm, glabrous or very sparsely hairy; disk 1¼ mm diameter $^1/_2$ mm high; stamens in the ♂ flower 4 mm, in the ♀ flower 2 mm; ovary brown-pubescent like its vestige in the ♂ flower; style 1 mm glabrous. *Fruit* unknown.

DISTRIBUTION. — Sumatra, East Coast, a few localities, also Simalur; fairly common in Malaya, but not from Singapore.

ECOLOGY. — Primary forest up to 200 m alt.

NOTES. — 6. King deliberately refrained from describing *P. ridleyi*, for want of complete material, but merely gave a few characters. Radlkofer entered it as a species and extended the description.

7. From Wyatt-Smith's field notes to *FMS 66544* (a specimen with normal, entire leaflets) we extract the following particulars: the leaflet of the seedling has serrate margins and is hairy on the midrib above and on rachis, midrib, and nerves beneath. The seedling looks in fact very much like *P. pinnata* f. *alnifolia*, but no mature trees of that were found in the neighbourhood, only *P. ridleyi*.

8. Witches'-brooms may bear an indumentum.

2. POMETIA PINNATA Forst.

Pometia pinnata J. R. & G. Forster, Char. Gen. 110, *t. 55*. 1776; G. Forster, Prod. Fl. Ins. Austr. 74. 1786; Seem., Fl. Vitiensis 48, *t. 10*. 1865; Radlk., Sapind. Holl.-Ind. 30. 1877; King *in* J. As. Soc. Beng. 65 ii: 441. 1896; Valeton *in* Bull. Inst. Bot. Buit. no 15: 8. 1902; Radlk. *in* Nova Guinea 8[4]: 617. 1912; *in* Bot. Jahrb. 58: 271. 1920; Ridley, Fl. Mal. Pen. 1: 504. 1922; Merr., En. Philip. 2: 505. 1923; Lane-Poole, For. Res. Papua & New Guinea 109. 1925; Radlk. *in* Pflanzenreich, Heft 98: 929. 1933; Corner, Wayside Trees 595. 1940; F.S. Walker, For. Br. Solomon Is. 167. 1948; Adelb.

in Backer, Bekn. Fl. Java (em. ed.) 7A: fam. 149, *p. 18.* 1948. — *Euphoria pometia* Poiret *in* Dict. Sci. Nat. 27: 59. 1823. — *Aporetica pinnata* DC., Prod. 1: 610. 1824. — *Schmidelia pinnata* Spreng., Syst. Veg. 2: 223. 1825. — *Nephelium pinnatum* Cambess. *in* Mém. Mus. Hist. Nat. 18: 30. 1829. — *Dabanus pinnatus* O.K., Revis. Gen. 1: 143. 1891. — Type specimen: *Forster s.n.* (BM!), New Hebrides, Namoka, c. 1774 (not that from Tonga).

Sapindus sp. Turcz. *in* Bull. Soc. Nat. Moscou 31[1]: 404. 1858 (see Note 11).

Other synonyms under the formae.

Trees up to 47 by 1.40 m. Inner bark with abundant thin red gum. Branchlets, rachis, leaflets underneath and inflorescences more or less glabrescent to glabrous. *Leaf* rachis slender to very vigorous; leaflets firmly herbaceous to coriaceous, fairly symmetrical, oblong to mostly lanceolate, mostly with parallel sides but sometimes ovate, the 1st pair mostly suborbicular to elliptic 3 cm or shorter and often clasping the branch like stipules; base variable, top subacuminate to acuminate with a tip up to 1½ cm; nerves 11—25 pairs, every other nerve ending in a marginal hydathode or tooth, the intermediate nerves bending upwards without reaching the margin which is c. 3 mm deep dentate or repand to subentire with small hydathodes; surfaces generally glabrous. Filaments 3—6 mm, in the ♀ flowers sometimes reduced to $^1/_2$ mm, densely to sparsely hairy towards the base. *Inflorescence* variable; see under the formae. *Fruit* not completely known in all its variability (see Note 13 and Uses), c. 1½—3½ by 1—3 cm, round to elliptic in section, pericarp coloured in variations of yellow, red, purple, or brownish, 2—7 mm thick, the thickest at the top; arillode to 4 mm thick, the thinnest at the top; seed nearly half to over three quarters the size of the whole fruit, measured in all directions.

DISTRIBUTION. — The same as that of the genus.

ECOLOGY. — West. From Malaya and Java *Pometia* is recorded to be bound to the proximity of rivers; from other islands there are no such indications.

East. According to Ir. J. F. U. Zieck in an internal report (1959) on the forestry in the neighbourhood of Manokwari, NE on the Vogelkop peninsula, New Guinea, *Pometia* is predominant in primary forest on different kinds of soil. On well drained limestone those *Pometias* occur which are here named *P. pinnata* f. *pinnata* and f. *repanda*. With equally large *Intsia*, they form a rather closed canopy; associated with them are *Meliaceae, Palaquium, Planchonella, Pterygota, Haplolobus, Diospyros, Calophyllum, Mastixiodendron, Koordersiodendron, Neonauclea, Elaeocarpus*, scarcer are *Pimeleodendron, Dracontomelum, Alstonia*. In these forests *Pometia* (Manikiong name for both formae: *kottij*) shows a considerable regeneration, and perhaps depletion of the forest will lead to a complete domination of *Pometia*. On the bottom of valleys, in the alluvial plain forests, another form of *Pometia* dominates, notably f. *glabra*

(Manikiong name: *ihi*) in the 2nd storey, under a broken canopy of *Intsia palembanica, Octomeles, Ficus, Alstonia;* associated are *Homalium foetidum, Celtis, Teysmanniodendron, Artocarpus, Inocarpus, Pterocarpus*. Although the heartwood is not seldom rot, *Pometia* is the main timber crop in that area.

Womersley & McAdam, For. Terr. Papua and N.G. 22. 1957, described a *Pometia pinnata* type of lowland rain forest from E. New Guinea and the Bismarck Archipelago. They considered this to be subclimax representing a late seral stage from cleared land to the true climax which is relatively poor in *Pometia*. Also F.S. Walker on p. 168 remarks that the species (*P. pinnata*) is well apt to recover clearings.

According to F. S. Walker, For. Brit. Solomon Is. 1948, *Pometia* makes up a high percentage of the total number of trees in a sample plot in the Solomons, from 10 to often 50, rarely to 60%. Pure stands never seem to occur.

Beversluis *in* Klein, Nieuw Guinea 2: 293. 1954, said that of the c. 100 cub. m exploitable timber occurring on a hectare, 5—34, once even 86 cub. m consists of *Pometia*.

USES. — West. According to Burkill, Dict. 1797. 1935, some value is attributed to the wood as timber, occasionally used for construction. The fruits may be eaten, and also the oily seeds after roasting.

East. Apart from some minor medicinal applications, the wood and the fruit have a certain limited economic importance.

1. The sapwood is pinkish, not always well distinguished from the heartwood, which is light to dark redbrown, often with lighter concentric zones; tolerably fine-grained. The wood is liable to cracking during the drying process and after, when applied in a climate where the humidity of the air is very variable. It is easy to bend, but often breaks immediately after the maximum charge is reached. The sapwood is well-impregnable, the heartwood not. If it is perfectly dried and selected, it can be used as timber under roof, for ship construction and furniture; in the soil it rots away. There is quite a variation in weight and quality. In the 5-class scales of durability and strength adopted by the former Netherlands Indies Forestry Service, *Pometia* comes into durability class 3, strength class 2. This is not very splendid, but the wood is available in big sizes and in large quantities. The above is from a compilation made by Mr C. Kalkman in an internal report, 1959. For more data, see Womersley & Mc Adam, For. Terr. Papua and New G. 55. 1957.

The bark, wood, and fruits have been described by Lane-Poole, *l.c.*; the bark and wood by F.S. Walker, *l.c.* Rappard, *in* Nieuw Guinea Studiën 5: 1—9. 1961, predicts considerable prospects for the wood, as soon as a method is invented to impregnate it against damage by termites, since it is one of the best-exploitable timbers of New Guinea.

2. The fruit is edible, and for this purpose the tree is occasionally cut down in the forest, and fairly commonly cultivated near Lake Sentani in North New Guinea.

Lane-Poole described the fruit as a pear-shaped drupe 3¾ by 2½ cm, apple red and green with a similar surface, epicarp of egg-shell thickness and brittle, endocarp a white pulp, arillode 3 mm thick at the sides 1½ mm at apex, much eaten by natives, birds, and fruit bats. Nut 2 by 1½ cm, shiny brown.

Rappard stated that the ripe fruit is dull yellow, velvety, the arillode whitish, half-translucent. The form with the skin purplish tinged is valued most. The Papuas protect them in a primitive sort of orchards.

Dr. P. van Royen, while in the field in New Guinea near Hollandia, communicated some data which he had kindly gathered on our request. In that region there are three races. As we have not yet seen material, it cannot be said whether they concur with our distinctions. 1. *Kalinsa* (Sentani language) or *matoa utan*, which is exclusively wild, often along rivers, and sometimes colonizes open ground. The wood is hard and useful. Flowers cream-white in May and June, fruits from June to August, green, 2 by 1½ cm, skin thick, flesh thin, without scent or taste, worthless, dispersed by birds and bats. 2. *Kablauw* (Sentani language), only cultivated, propagated through seeds. First yield after 15 years, when the tree is well cared of, after 10 years. The wood is soft and only used for fuel, rarely for boats. Fertility in the same period, flowers light brownish, fruits yellow, c. 2½—3 by 2½ by 3 cm, skin soft, glossy, flesh thick, sweet, tasting like rambutan, only eaten fresh. This one belongs probably to f. *glabra*. 3. *Iwa* (Sentani language). Much like the foregoing, but fruits oblong or obovoid, c. 2½—4 by 2—3 cm and purple-red. Dr. Van Royen agrees with Rappard's view that as soon as superior West-Malaysian fruit trees are widely introduced, *Pometia* will be quickly supplanted.

NOTES. — 9. East. By Rumphius, Herb. Amboin. 3: 31, *t. 16, 17.* 1743, *Pometia* is extensively described under the name *Dabanus*, latinization of the Amboinese vernacular name *Dawan*. He distinguishes three kinds: *dawan batu, dawan mera,* and *dawan puti*, which are all described with distinctly dentate leaflets, and hence cannot belong to our f. *pinnata;* the leaflets seem too large or too wide for our f. *repanda* either, so we conclude that Rumphius must have had material of the f. *glabra* or of one of the many unnamed paramorphs; no more can be said about the identity. He said that in Ambon it is one of the commonest forest trees, never on the beach, but in the hills, preferably in rocky places, and that it is universally applied as a timber for constructions of minor importance. It is easy to work, Rumphius said, but it should not be applied fresh as it is very liable to warping, nor should the trees be cut at the moment when the flush is coming out, as such wood is of inferior quality.

Rumphius mentioned under his description plates 16 and 17. Merrill, Int. Rumph. 339. 1917, assumed that both represent *Pometias* and this

might have been the intention, but plate 16 is not to be recognized as could represent another *Sapindacea* as well.

Blume, Rumphia 3: 114. 1847, revived under *Irina glabra* Rumphius' kinds of *Dabanus* by basing 3 of his 5 varieties on Rumphian names, viz var. *solida* on *dawan batu*, var. *rubra* on *dawan mera*, var. *alba* on *dawan puti;* the other two being var. α and var. *dissecta*, which represents a monstrosity. Only the type of Blume's var. *rubra* comes from Ambon.

10. I. H. Burkill *in* J. Linn. Soc. 35 Bot.: 32. 1901, recorded the species from New Caledonia, without mentioning specimens or references. Actually, the occurrence of *Pometia* in New Caledonia has never been confirmed.

11. West. *'Sapindus e Java aut Sumatra'* Turcz., *l.c.*, was based on *Goering II 38*, probably from Java. Radlkofer *in* Pflanzenreich, Heft 98: 934. 1933, who apparently saw this specimen, placed it under *P. tomentosa.*

2a. forma PINNATA.

Type specimen: *Forster s.n.* (BM! W), New Hebrides, Namoka, c. 1774 (not that from Tonga, see Note 12).

Irina diplocardia Blume, Rumphia 3: 115. 1847; Miq., Fl. Ind. Bat. I^2: 557. 1858. — *Nephelium diplocardia* F. v. M., Notes Papuan Pl. 2: 21. 1876. — Type specimen: *Zipelius 145/d* (L!), New Guinea.

Pometia coriacea Radlk. *in* Bot. Jahrb. 50^1: 75. 1913; *in* Pflanzenreich, Heft 98: 928. 1933. — Type specimen: *Schlechter 16138* († ? B, from descr.; not seen), New Guinea, VI. 1907.

Tree 10—40 by 0.35—0.75 m. Branchlets not or shallowly grooved, golden brown pubescent when young. *Leaf* rachis fairly vigorous, late glabrescent, ± 18—28 cm, with ± 6—8 leaflets on either side. Leaflets subcoriaceous; the first (basal) pair up to 2 cm long and elliptic, subfalcate, auricle-like, the larger leaflets asymmetrical and often overlapping, up to 12—19½(—22) by 4—6½(—10) cm, widest below the middle or sometimes about, base oblique, shallowly cordate, the acroscopical half often covering the rachis, top gradually tapering to a bluntish tip; nerves 13—16 pairs often reddish tinged like the midrib; lower surface sometimes sparsely pubescent as is sometimes the midrib above; margin mostly subentire to rarely shallowly repand. *Inflorescence* stiff, densely golden-brown puberulous, ± 18—30 cm long, rather dense, branches stiffish, mostly not subtended by reduced leaflets. *Fruit* as far as known subglobose ± 2½ by 2 cm.

DISTRIBUTION. — Philippines to Samoa.

SPECIMENS. — PHILIPPINES. Batanes: *Estrada PNH 37294.* Camiguin: *Edaño BS 79195.* Luzon: *Ramos BS 76820.* Mindoro: *Merritt FB 6800; Rosenbluth FB 12709.* Samar: *Ramos BS 1702.* CELEBES. Minahasa: *bb 28736;*

Koorders 18826. Muna: *Ham B3.* MOLUCCAS. Sula Is: *bb 23832.* Ceram: *bb 26810; Buwalda 5604; Kuswata & Soepadmo 133.* Ambon: *bb 26004.* Tanimbar Is: *bb 24273.* NEW GUINEA (incl. Japen, Noemfoor, Meos Waar): many. PACIFIC. Solomons: several. New Hebrides: *Baker 215, 325; Forster s.n.* (type); *Kajewski 19.* Santa Cruz Is: *F.S. Walker 221.* Fiji: several. Tonga: *Crosby 34.* Samoa: several.

NOTES. — 12. In the BM there are two collections by Forster. The one from Namoka was found to have been designated as the type; hence that from Tonga does not belong to the type collection.

13. Seemann stated that in Fiji the fruit can attain the size of a pomegranate, which would mean 8 cm at least; this is utterly incredible. He noted that in Fiji there are several varieties; the season of the fruits is January-February; the fruit is glutinous, with a taste like honey. Seemann also tried to introduce it in Australia, New South Wales; no results are known to us.

2b. forma **glabra** (Bl.) Jacobs, *stat. nov.*

Irina glabra Blume, Bijdr. 230. 1825; Rumphia 3: 113. 1847; Miq., Fl. Ind. Bat. I²: 558. 1859. — *Pometia glabra* T. & B., Cat. Hort. Bog. 214. 1866. — *Pometia pinnata* var. *javanica* K. & V., Bijdr. 9: 196, 198. 1903; Backer, Schoolfl. 267. 1911; Koord., Atlas 1: *t. 89.* 1913. — Type specimen: *Blume 738* (L!), W. Java, Mt Salak.

Irina glabra var. *ß solida* Blume, Rumphia 3: 114. 1847; Miq., *l.c.* — Type specimen: *Korthals* (? see Note 17) *s.n.* (L!), Sumatra.

Irina glabra var. *γ rubra* Blume, Rumphia 3: 114. 1847; Miq., *l.c.* — Type specimen: *Forsten* (*?48*) (L!), Amboina, in the forests, 15. V. 1842.

Irina glabra var. *δ alba* Blume, Rumphia 3: 114. 1847; Miq., *l.c.* — Type specimen: *Korthals s.n.* (L!), Sumatra; paratype: *Reinwardt* (*?*) *s.n.* (L!), Celebes, 1821.

Irina glabra var. *ε dissecta* Blume, Rumphia 3: 114. 1847, illegitimate name (see under Witches'-brooms); Miq., *l.c.* — Forma *dissecta* Radlk. *in* Nova Guinea 8⁴: 617. 1912. — Based on *Korthals s.n.* (L!), Sumatra.

Tree 17—40 by 0.60 m. Branchlets ± 6—10 mm thick, grooved, when young brown-puberulous. *Leaf* rachis some 30—80 cm (or perhaps longer), sometimes sparsely puberulous, with some 8—12 leaflets on either side. Leaflets coriaceous, to 4 mm stalked; the first (basal) pair like auricles, up to 3 cm long and suborbicular to elliptic, persistent; the largest ± 25—32 by 8(—13) cm, parallel-sided; base subcordate to sometimes blunt, top subacuminate; midrib and nerves always glabrous above, often sparsely puberulous underneath, nerves 18—25 pairs; marginal teeth minute to sometimes coarse. *Inflorescence* stiff and rather lax, ± 30—60 cm long, rather densely brown-pubescent, the main branches subtended by 1—2 pairs of reduced suborbicular leaflets like auricles, repeatedly branched. *Fruit* ± 3½ by 2½—3 cm.

DISTRIBUTION. — Andamans; all over Malaysia, but in Java only West of long. c. 110° and not in the Lesser Sunda Islands.

SPECIMENS. — ANDAMANS: *Prain's Coll. 10*; *Sen Gupta 6051*. SUMATRA (incl. Simalur): many. Enggano: *Lütjeharms 4071*. MALAYA: many. JAVA. West: *Blume 46, 738*; *Junghuhn 369, 372, 373*; see also Koorders, *l.c.* BORNEO: many. Banguey I.: *Wood & Charington SAN 16411*. Pulau Laut: *bb 12226*. PHILIPPINES. Basilan: *Santos 4252*. Luzon: *Elmer 17609*; *Lagrimas PNH 40889*. Mindanao: many. Mindoro: *Ramos BS 40987*. Palawan: *Celestino & Ramos PNH 23073*; *Sulit PNH 12554*. CELEBES: several. Muna: *bb 21112*. MOLUCCAS. Ambon: *C.B. Robinson Pl. Rumph. 2, 3*; *Teysmann 14254*. Buru: several. Ceram: *bb 25853*; *Kornassi* (*exp. Rutten*) *1226*; *Rutten 1874*. Morotai: *bb 33858, 33912*. Sula Is: *Atje* (*exp. Hulstijn*) *365*. Talaud: *Lam 2852*. NEW GUINEA (incl. Japen, Meos Waar, Salawati): many. NEW BRITAIN (?): *Waterhouse 930*.

CEYLON: *de Silva 110* cultivated in Peradeniya Garden, origin unknown.

ECOLOGY. — West. In his Wayside Trees, Corner devoted a fine passage to the occurrence of *Pometia* in Malaya along "the rocky streams which cascade in waterfalls down the hillsides and which flow in tunnels through the forest. They are the small tributaries and the headwaters of our rivers unless their sources be at the greatest altitudes. We call them *Saraca*-streams because they are bordered by *Saraca* trees". In this association, characteristic for the banks of these rivers, which also contains *Tristania sumatrana, Dillenia indica, Podocarpus neriifolius, Cynometra, Schoutenia, Radermachera, Neonauclea, Ixora,* and *Ficus* spp., *Pometia* is always well-represented.

Koorders & Valeton, *l.c.*, gave details for Java. See also under the species.

USES. — West. According to Heyne, Nutt. Pl. 999. 1950, the wood is used locally for timber. The bark is used for healing wounds in W. Java, and the arillode is sometimes eaten, like the roasted oily seeds in S. Sumatra.

NOTES. — 14. The commonest and most widely-spread forma. Throughout the archipelago specimens occur which we believed to represent a sort of depauperated form; they are described in the Distribution of the Variability under Borneo.

15. Somtimes specimens are found with hairs on the midrib above, but otherwise agreeing with this forma. Such specimens, however, are not admissible to f. *glabra*. Besides the combination of a glabrous upper leaf surface, the presence of auricles at the leaf base and in the inflorescence is essential for this forma.

16. Ants often use the auricles for shelter and making their nests. Corner, Wayside Trees p. 33, placed *Pometia* with a few others under a special category of 'ant-trees'.

17. The type material of *Irina glabra* var. *solida* Bl. consists of 3 sheets that bear the above name though not in Blume's handwriting. The first sheet has no collector's name, is labelled 'Sumatra', the second is labelled 'Sumatra, Korthals', the third is labelled 'Sumatra, Praetorius' with the number 49 on a different, probably more recent label. The three collections, which match so closely that they could be very well from one tree, belong here.

18. The type material of *Irina glabra* var. *alba* Bl. consists of 4 sheets that bear the above name though not in Blume's handwriting. The first and second sheet have the inscription 'Sumatra, Korthals' and on another, probably more recent label the number 47. We regard this as the type. The third sheet bears an original label by Reinwardt, who collected it in NE. Celebes at Butongale, Pagowat. The fourth sheet bears 2 labels, one from Sumatra, the other from Celebes. All the material belongs here.

2c. forma **repanda** Jacobs, *f. nova.*

Rami foliaque mox glaberrimi; foliola remota lanceolata utrinque attenuata ± 12—18½ cm longa margine repanda vel dentata. Inflorescentia pubescens, ramis sine foliolis pseudostipularibus.

TYPUS. — *E. Canicosa PNH 9627* (L, holotypus; PNH!), in monte Makiling in insula Luzon d.d. 28. VII. 1949 collectus.

Tree ± 23—35 by 0.40—0.75 m. Innovations long glossy-brown pubescent, very early glabrescent. Branchlets not or shallowly grooved, ± 5 mm thick. *Leaf* rachis slender, ± 13—27 cm (—60 cm: *Brass 8181*), with 6—8 leaflets on either side. Leaflets subcoriaceous, the first (basal) pair up to ± 1 cm long and falcate, the next 1—2 pairs somewhat longer but generally the lower leaflets caducous, the other leaflets mostly not overlapping one another, the largest ± 12—18½ by 4—5(—7) cm, mostly narrowed to both ends or sometimes parallel-sided; base acutish to rarely subcordate, top gradually acuminate; nerves 13—17 pairs, reddish tinged; marginal incisions 1—2½ mm deep, rather repand than dentate; surfaces glabrous all over. *Inflorescence* stiff, more or less sparsely woolly pubescent, 15—30 cm long, rather densely branched, the branches fairly short, not subtended by reduced leaflets. *Fruit* 2—2½ by 1½—1¾ cm.

DISTRIBUTION. — Philippines to New Guinea and Aru Islands.

SPECIMENS. — PHILIPPINES. Camiguin: *Fenix BS 4081.* Luzon: several. Mindanao: *Elmer 14003.* Palawan: *Elmer 13108.* Ticao: *Clark FB 1066.* CELEBES: several. MOLUCCAS. Talaud: *Lam 3128.* Batjan: *bb 16463.* Aru Is: *bb 25321, 25332.* NEW GUINEA: many.

NOTES. — 19. In New Guinea known as *Pometia acuminata*, the type of which, however, belongs to f. *acuminata*, endemic in Borneo.

2d. forma **acuminata** (Hook. f.) Jacobs, *stat. nov.*

Nephelium acuminatum Hook. f. *in* Trans. Linn. Soc. 23: 164. 1860. — *Pometia acuminata* Radlk., Sapind. Holl.-Ind. 9. 1877; *in* Pflanzenreich, Heft 98: 993. 1933. — *Dabanus acuminatus* O.K., Rev. Gen. 1: 143. 1891. — Type specimen: *Low, wood n. 34* (K!), Borneo.

Pometia annamica Gagn. *in* Not. Syst. 13: 66. 1947; *in* Fl. Gén. I.-C. Suppl. 1: 977, f. 124. 1950. Provisional synonym! See Note 20. — Type specimen: *Poilane 7682* (P!), Indo-China, Annam.

Trees 10—20 m. Branchlets slender, often cinder-grey. *Leaf* rachis slender, ± 20—45 cm, often somewhat pubescent above, with 5—7 leaflets on either side. Leaflets subcoriaceous, in the herbarium generally brownish sometimes with an olive-green tinge, the first (basal) pair falcate, acute, 3½ by 2 cm, mostly caducous, the other leaflets very symmetrical and not overlapping, ± 3 times as long as wide, the largest leaflets 20—25(—32) by 6—8½(—10) cm, sometimes obovate with tapering base but mostly parallel-sided with acutish base, top rounded and abruptly acuminate, the tip narrow, 2—4 cm long, acute; midrib often darkish-coloured, with a few hairs underneath and mostly none above, nerves ± 12—15 pairs; teeth sharp but soft, distinctly protruding from the margin especially towards the top, ± 2½ cm or more apart; upper surface glabrous, lower surface sometimes with a few hairs. *Inflorescence* hanging, slender, 35—60 cm, laxly soft fulvous pubescent to mostly brown-velvety, branches few, long, simple, mostly not subtended by reduced leaflets, but if so, by 1—2 pairs often ovate acuminate 2 cm long on a short velvety rachis 1 cm; bracts ± 5 mm long, peduncles approximately clavate by bearing the flowers at the top. Fruits elongate, 3—4 by 1½—2 cm, red.

DISTRIBUTION. — Borneo, only seen from Sarawak and North Borneo; several specimens.

ECOLOGY. — The few specimens that have been annotated, are from mixed swamp forest, and seem to be not buttressed.

NOTES. — 20. Of the paramorph described as *Pometia annamica* only the type collection is known. Its closest affinity is no doubt with f. *acuminata*, but as its largest leaflets do not attain more than 12½—15 by 3¾—4 cm, we feel that we must exclude it from that forma to keep it here as a provisional synonym until more decisive material comes in.

21. The paramorph known in New Guinea as *Pometia acuminata*, is actually *P. pinnata* f. *repanda*.

2e. forma **alnifolia** (Bl.) Jacobs, *stat. nov.*

Irina alnifolia Blume, Rumphia 3: 117. 1847. — *Irina tomentosa* var. *alnifolia* Miq., Fl. Ind. Bat. I²: 558. 1859. — *Pometia alnifolia* Radlk., Sapind. Holl.-Ind. 30. 1877; King *in* J. As. Soc. Beng. 65 ii: 442. 1896; Ridley, Fl. Mal. Pen. 1: 504. 1922; Radlk. *in* Pflanzenreich, Heft 98: 928. 1933; Corner, Wayside Trees 595. 1940. — Type specimen: *Korthals s.n.* (K! L!, holotype), Central Sumatra, in bud.

Pometia gracilis King *in* J. As. Soc. Beng. 65 ii: 441. 1896. Radlk. *in* Pflanzenreich, Heft 98: 928. 1933. — Type specimen: *King's Coll. 3607* (CAL, BM! K! L!), Malaya, Perak, Larut, 3500 ft, fl. Nov. 1882. See Note 22.

Tree (6—)8—15(—25) by 0.15—0.60 m. Branchlets grooved, when young brown-pubescent sometimes velvety. *Leaf* rachis slender, ± 10—23 cm, hairy at least on the upper side, with 4—8 leaflets on either side. Leaflets firmly herbaceous to subcoriaceous, mostly markedly decreasing in size towards the base; the first (basal) pair sometimes caducous, up to 1 cm long and falcate often with mucronate hairy top, the other leaflets not overlapping, about 3 times as long as wide, the largest ± 11—19 (—23) by 3—6½ cm, parallel-sided or obovate; base narrowed subcordate or rounded to acute, top rather abruptly acuminate with ½—1½ cm long tip; midrib and often the nerves hairy on both sides, nerves 11—19 pairs; margin subentire with hydathodes up to 1 mm. *Inflorescence* more or less hanging, brown-hairy, ± 15—70 cm long, the branches long and slender, simple, not subtended by reduced leaflets. Petals approximately rectangular to inversely trapeziform, mostly long-hairy inside in the upper half. Filaments in the ♂ flowers 5—6 mm, sparsely hairy towards the base. *Fruit* ± 1½ by 1 cm.

DISTRIBUTION. — Sumatra; Malaya; in Borneo North of the line Pontianak-Balikpapan.

SPECIMENS. — SUMATRA. West Coast: *Korthals s.n.* (type). Palembang: *Grashoff 1021*; *Castillo & Valderrama 11*, and others. MALAYA: *Corner SF 29302*; *Wyatt-Smith KEP 66545*, and others. BORNEO: *Kadir A 664*; *Puasa BNB 1910*, and others.

ECOLOGY. — According to Corner, Wayside Trees 594. 1940, in Malaya in swampy forest. In Borneo it is also known from that habitat, but from dryland forest, too.

USES. — According to Heyne, Nutt. Pl. 999. 1950, the wood is in Sumatra used for construction. Corner recommended it as a roadside tree.

NOTES. — 22. King himself cited many numbers under his description. The number cited above is the one which was found in Kew marked as the type.

23. *Pickles S 3617* from Sarawak has a leaf rachis of 70 cm with on either side 15 leaflets c. 20 by 4½ cm. It is from a tree of 10 m height in rain forest, and probably represents a juvenile stage.

24. Of all formae, this is the most difficult one to define. The number of leaflets vary, their shape; the base is wide or tapering, and in the herbarium their colour varies between brown and olive-green. The inflorescence tends to repeated branching. Critical collecting is desired.

2f. forma **macrocarpa** (Kurz) Jacobs, *stat. nov.*

Pometia macrocarpa Kurz *in* J. As. Soc. Beng. 44 ii: 205. 1875; King *in* J. As. Soc. Beng. 65 ii: 440. 1896; Ridley, Fl. Mal. Pen. 1: 503. 1922; Radlk. *in* Pflanzenreich, Heft 98: 927. 1933. — Type specimen: *Maingay 463* (CAL, holotype; BM! K! L!), Malaya, Malacca.

Leaf rachis 30—50 cm, slender, glabrescent, often darkish coloured, with 8—9 leaflets on either side. Leaflets coriaceous, the first (basal) pair falcate, c. 1½ by 1 cm, the other not overlapping, very symmetrical, parallel-sided, the largest c. 3½ times as long as wide, 13—21½ by 4—6 cm, base rounded, top rounded and abruptly subacuminate; midrib glabrous or sparsely hairy beneath, nerves c. 17—22 pairs; margin subentire with minute hydathodes or teeth; surfaces glabrous, glossy above, dull below. *Inflorescence* probably stiff, c. 15—20 (or more?) cm long and wide, soon glabrescent, branches simple or with a few basal secondary branches, not or hardly subtended by reduced leaflets. *Fruits* ovoid, glabrous, 4—5 cm long (King).

DISTRIBUTION. — North Sumatra, Malaya.

SPECIMENS. — SUMATRA. East Coast: *Krukoff 4127, 4419* (? see Note 25). MALAYA. Pahang: *FMS 819 Yussoh*; *FMS 10662 Hamid*; *FMS 14088*; *FMS 49828 Symington*. Malacca: *Maingay 463* (type), fl. V. 1866, fr. VII. 1867.

NOTES. — 25. For two reasons, the status of this forma is tentative: 1) there are not quite enough specimens and the ones we have are mainly sterile, 2) its delimitation against f. *glabra* is not certain. Part of *Krukoff 4419* agrees quite well with the present forma, but the material shows that the plant can produce much coarser foliage than seems admissible for this forma.

26. This forma is the one of *P. pinnata* which is closest to *P. ridleyi*. Every other nerve ends here in a marginal hydathode, however small, whereas in *P. ridleyi* the nerves never reach the margin.

2g. forma **tomentosa** (Bl.) Jacobs, *stat. nov.*

Irina tomentosa Blume, Bijdr. 230. 1825; Rumphia 3: 116. 1847, quoad var. *γ*; Miq., Fl. Ind. Bat. I^2: 558. 1859. — *Pometia tomentosa* T. & B., Cat. Hort. Bog. 214. 1866; Kurz, Andam. Rep. ed. 2: 34. 1870; Hiern *in* Hook. f., Fl. Br. Ind. 1: 691. 1875; Kurz, For. Fl. Br. Burma 1: 295. 1877; Radlk., Sapind. Holl.-Ind. 30. 1877; Valeton *in* Bull. Inst. Bot. Buit. no. 15: 8. 1902; K. & V., Bijdr. 9: 199, 202. 1903; Backer,

Schoolfl. 267. 1911; Radlk. *in* Bot. Jahrb. 56: 273. 1920; Merr., En. Philip. 2: 506. 1923; Radlk. *in* Pflanzenreich, Heft 98: 934. 1933; Adelb. *in* Backer, Bekn. Fl. Java (em. ed.) 7A: fam. 149, p. 19. 1948. — Type specimen: *Blume 1489* (K! L! holotype), W. Java, Salak and Burangrang.

Eccremanthus eximius Thwaites *in* Hook., J. Bot. and Kew Gard. Misc. 7: 272, *t. 9.* 1855. — *Nephelium eximium* Thw., En. Pl. Zeyl. 57. 1858. — *Pometia eximia* Thw., En. Pl. Zeyl. (corr.) 408. 1864; Beddome, Fl. Sylv. 1: *t. 157.* 1869; Trimen, Handb. Fl. Ceyl. 1: 310. 1893. — Type specimen: *Thwaites CP 1153* (Peradenya, holotype; BM! K!), Ceylon.

Pometia tomentosa var. *ferruginea* Hiern *in* Hook. f., Fl. Br. Ind. 1: 691. 1875. — Type specimen: *Anonymous s.n.* (K!), Ceylon, Shevagherry hills, VIII. 1836.

Pometia pinnata (*non* Forst.) Brandis, Indian Trees 185. 1906.

Pometia pinnata (*non* Forst.) Lec. *in* Fl. Gén. I.-C. 1: 1045, *f. 130.* 1912. — *Pometia lecomtei* Gagn. *in* Fl. Gén. I.-C. Suppl. 1: 977. 1950; inval. publ. — Based on *Balansa 4035* (P!), Indo-China, Tonkin, Tu-phap, 1888.

Tree up to 47 m. Branchlets densely rusty-brown hairy. *Leaf* rachis generally vigorous, up to 1 m long, densely hairy, with 5—13 leaflets on either side. Leaflets subcoriaceous, brownish when dried, the first (basal) pair falcate, ± 2 by 1 cm, often caducous or reduced to a hairy appendage, the other leaflets slightly overlapping, very symmetrical, the largest ± 3 times as long as wide, at least 12—30 by 5—8 cm, margins largely parallel, base obtuse, top somewhat narrowed and 1 cm acuminate with acute tip; midrib hairy above and sometimes beneath, nerves 18—22 pairs, above hairy towards the base; teeth distinctly protruding about 1 mm; surfaces mostly glossy, except the nerves glabrous above and sometimes beneath. *Inflorescence* slender, somewhat hanging, 20—40 cm, repeatedly branched, lax, densely rusty-brown hairy, without reduced leaflets subtending the branches. *Fruit* ± 3¼ by 2 cm, in Ceylon deep red, in Java purple, aril white, semitransparent, seed red-brown.

DISTRIBUTION. — Ceylon, Indo-China (Tonkin, Laos), Simalur off N. Sumatra, Java. Also, or a closely approaching paramorph, in the Andamans.

SPECIMENS. — CEYLON: *Thwaites CP 1153*; *Anonymous s.n.*, Shevagherry hills, *) fl. VIII. 1836; *Worthington 272, 325.* ANDAMANS. S. Andaman: *Kurz s.n.*, fr. (probably here). INDO-CHINA. Tonkin: *Balansa 4035.* N. Laos: *Poilane 26430.* SUMATRA. Simalur: *Achmad 1473* (leaflets 2½ times as long as wide; pointed to both ends). JAVA. West: *Blume 1489* (type); *Hasskarl 14542; Kalshoven 37; Koorders 24416; Winckel 301ß, 1809β.* East: *Koorders 14692, 38558.* CULTIVATED: *Hortus Bogoriensis III H 25a, III K 27 & 27a*, origin Ceylon. A number *Comm. ex Herb. Hort. Bog. 14257* was probably collected by Hasskarl from one of these trees.

*) We were not able to find this locality on a map, but we suppose that is in Ceylon. There is, however, a possibility that the Shevaroy hills are meant, which are in Madras at Lat. 12°. In the Flora of British India 'Eastern Peninsula' is given under the distribution, but there is no other material to confirm this, not is there any reference in the Flora of Madras.

ECOLOGY. — In Ceylon in the upper zone of moist low country an flowering in May - June. Common in East Java to 1400 m, in evergree forest, not in teak forest. Koorders & Valeton, *l.c.*, gave detailed infor mation, also about uses.

NOTES. — 27. The type of *P. tomentosa* var. *ferruginea* has an extra ordinarily thick indumentum, but as the other known specimen fro Ceylon is also very hairy, there seems no reason to keep the former apar

28. The material from Ceylon, both wild and in Bogor cultivated and from Indo-China, is larger in its vegetative parts and its inflorescenc than the material from Java, as can also be seen from the fine descrip tions by Thwaites and by Koorders & Valeton. In Java specimens occu where the inflorescence branches are simple and largest leaflets do no attain 12 cm; these are excluded from this forma, as they come too near f. *alnifolia*, where the leaflets, however, are mostly olive-greenish tinged.

2h. forma **cuspidata** (Bl.) Jacobs, *stat. nov.*

'Irina tomentosa?' Span. *in* Linnaea 15: 180. 1841. — *Irina tomentosa* var. *β cuspidata* Bl., Rumphia 3: 116. 1847; Miq., Fl. Ind. Bat. I²: 558. 1859. — Type specimen: *Spanoghe s.n.* (L!), Timor, in the mountains, fl.

Large tree. Innovations fulvous-brown hairy, glabrescent. Branchlets slender, purplish grey-brown. *Leaf* rachis slender, c. 16—30 cm, often darkish-coloured, with 6—8 leaflets on either side, the first (basal) pair falcate 1 cm long or reduced to a hairy appendage, the second pair also falcate, 3—4½ by 1½—2 cm, often caducous, the other leaflets thinly coriaceous, somewhat asymmetrical, parallel-sided or widest about half-way, to 16 by 5¼ cm, base roundish or tapering, top acutish to 1 cm acuminate, main nerves often dark-coloured, midrib on both sides glabrous to hairy, nerves 14—18 pairs, margin distinctly dentate, teeth c. 1½ cm, surfaces remarkably dull, glabrous, above brownish, beneath green-greyish tinged. *Inflorescence* more or less hanging, slender, lax, 25—30 cm, fairly densely fulvous-brown puberulous, branches mostly simple or sometimes with a secondary branch near the base, not subtended by auricles. *Fruit* unknown.

DISTRIBUTION. — Lesser Sunda Islands.

SPECIMENS. — LESSER SUNDA ISLANDS. W. Sumbawa: Mt Batulante, *De Voogd 1919*. W. Timor: *Spanoghe s.n.* (type); Kapan, *bb 27118*. Wetar: N of Ilwaki, *bb 27193*.

ECOLOGY. — Between 700 and 900 m alt. See Note 30.

NOTES. — 29. The affinity of this forma is with f. *pinnata*, which has its outliers in the Tanimbar Is. The f. *cuspidata* is distinguished by its small dentate leaflets with their typical colours.

Although there is not quite enough material, the homogeneity of the collections and the above characters justify the recognition of a forma.

30. Docters van Leeuwen, in his Zoocecidia 338. 1926, recorded under *P. tomentosa* a collection by Dammerman in NW. Sumba at 100 m alt., April 1925, which we have not seen.

DISTRIBUTION OF THE VARIABILITY

Rather than to say that each of the paramorphs (whether or not taxonomically recognized) has a definite geographic distribution, one observes the absence of certain paramorphs in certain provinces. We thought it useful to give a summary of the main features of *Pometias* in all provinces, which will also enable us to cite some unclassified yet important specimens. The classified specimens have been listed under each forma, and if not, in the general identification list at the end.

Ceylon. Material very scarce; all wild specimens belong to f. *tomentosa*. One cultivated specimen, *De Silva 110*, belongs to f. *glabra*, but its origin is unknown.

Siam. Two collections only are known. *Kerr 7413* collected near the Malayan frontier is typically f. *glabra*. *Hosseus 611* is from Muang Fang in the very North at 1300 m; it is quite near f. *alnifolia* but the inflorescence (7 + 29 cm) has branched axes. Craib, Fl. Siam. En. 1: 331. 1926, has both under *P. tomentosa*.

China. One collection from Szemao in Yunnan at 1200 m, *A. Henry 12128;* leaflets rather coarse and hairy, inflorescence 43 cm with sparsely branched axes; hanging? Near f. *tomentosa*.

Formosa. The only collection examined is *Price 430* (K!) from Tauran, Karenko 'savage village' on the East coast. Rachis 25 cm or longer, with 12 pairs of leaflets subcoriaceous, lightish brown, the 3 basal pairs falcate ¾—2½ cm, the other asymmetrical, overlapping, to 11½ by 4 cm, base rounded, top gradually acuminate, midrib sparsely hairy above, nerves c. 14 pairs, margin subentire, surfaces glabrous, glossy above. Inflorescence erect, 23 cm long, lax, fairly densely fulvous-grey puberulous, with a few secondary branches, auricles falcate. This collection agrees almost perfectly with *Sulit PNH 3683* from Luzon, in the latter the inflorescence is denser hairy and the auricles less markedly falcate.

Kawakami & Koryashi 1522 is recorded but not described by Hayata, Mater. Fl. Formos. 64. 1911; not seen. Kanehira's reference in Formosan Trees 710. 1936, may also apply to this record.

Indo-China. Two collections from Tonkin, *Balansa 4035* and *Poilane 26430*, match f. *tomentosa* though the inflorescences are smallish. Three collections from Luang Prabang in N. Laos, probably also belong here. They are sterile and look like juvenile forms (indumentum lax, patent, long leaf rachis, leaflets thin-textured, large, elongate: *J. Vidal 2111, 2496, 2543*.

From Annam one collection, *Poilane 7632*, suggestes quite a different affinity, notably with f. *acuminata*. The leaflets, however, are too small, 12½ by 3¾ cm. Nevertheless, this might represent another example of plant-geographical relationships between Annam and NW. Borneo.

Andamans. Though *Pometia* has been reported to be abundant, material is scarce. The plants are coarse, and more or less hairy; in the first case they are to be placed under f. *glabra*, the hairy specimens looking more like f. *tomentosa*: *Kurz s.n.* from S. Andaman, in fruit.

Prain's coll. 11 is a strange plant. Leaf rachis 22 cm, leaflets 7 pairs, to 14½ by 4½ cm, parallel-sided to ovate, midrib hairy on both sides, nerves hairy beneath, margin coarsely crenate. Inflorescence sturdy, little branched, with auricles, thinly pubescent.

Sumatra and Malaya. The southern boundary of the distributional disjunction formed by the SE. Asian monsoon area roughly coincides with the northern boundary of Malaya; see also under Siam.

Apart from Simalur (see below) which takes an extraordinary place, it seems that all paramorphs found in Sumatra and Malaya are common to both. The formae *pinnata* and *repanda* are definitely absent, and so are apparently f. *acuminata* and f. *tomentosa*. The f. *glabra* abounds, although the leaflets are generally more narrowed towards the base than in New Guinea, and it seems that some paramorphs can be derived from it by depauperation. So *Lörzing 17186* has no auricles in the inflorescence. Equally frequent is f. *alnifolia*, with several deviations and some transitions to f. *glabra*, and perhaps to f. *tomentosa*. So *Hamid FMS 4590* and *4965*, and *Abu FMS 3350*, all from Malaya, have leaflets like f. *alnifolia*, but the inflorescence is repeatedly branched like in f. *tomentosa*.

There is an important centre of differentiation from Simalur through Sumatra East Coast province to Central Malaya. Endemic in this centre are *P. ridleyi* and *P. pinnata* f. *macrocarpa* (its nearest relative), both with entire leaflets. This feature is also prominent in a paramorph allied to f. *alnifolia*, with the leaflets tinged in the same olive-green colour. The leaf rachis is 10—12 cm, the basal leaflets persistent, the other very regular in shape, the largest 10 by 4½ cm, 1 cm acuminate, with a gland

at the base. The inflorescence is small, and so seem the fruits to be. Specimens: *Thorenaar, 10 T 1 P 11* from Palembang res.; possibly *Grashoff 710* from the same region, with leaflets up to 15½ by 5½ cm, represents a sterile state of this, in which, as is well known, leaves may attain larger sizes. From Sarawak (see there) *S 3117* is very similar.

Beguin 552 from Bengkalis resembles *Grashoff 710*, the leaflets are 14½ by 4¾ cm; the inflorescence is still young with small falcate auricles. From Bangka and Belitung no *Pometias* seem to have been collected.

Simalur. Although part of the centre of differentiation which reaches into Central Malaya, in this little island, very rich in *Pometias*, development has proceeded on its own.

There is plenty of f. *glabra* but f. *alnifolia* seems absent. *Pometia ridleyi* occurs but not *P. pinnata* f. *macrocarpa*. *Achmad 1473* represents a slightly deviating paramorph of f. *tomentosa* (see there), which forma is otherwise absent from Sumatra.

Besides the forms with entire leaflets already mentioned, there is a paramorph with coarse teeth ± 2 mm protruding. *Achmad 3* has a leaf rachis of 20—21 cm with on either side 6 very glabrous leaflets up to 18½ by 8 cm, brownish when dry, with strong nerves. Panicle erect, dense, some branches axillary, repeatedly branched, without auricles, scarcely hairy, ± 16 by 10 cm. *Achmad 501* has the same sort of leaflets or still larger, and the lower inflorescence branches are similarly axillary but ± 30 cm long. *Achmad 1519*, though not a good specimen, is probably very near it; the leaflets are shallower toothed.

Java. *Pometia* is not very abundant. The limited variability allows of a fairly good distinction into two groups, f. *glabra* and f. *tomentosa*. Of both formae the type specimen is from West Java.

According to Koorders & Valeton, who deal extensively with the Java material, f. *glabra* (by them named *P. pinnata* var. *javanica*) occurs only in the western half, i.e. West of long. c. 110°, and is gradually replaced towards the East by f. (*Pometia*) *tomentosa*. Actually, f. *tomentosa* occurs in West Java as well as in East.

On account of the (generally bad) specimens available to me, I want to regard provisionally as intermediate *Koorders 4774, 7433, 7434, 11826*.

Both numbers in the series *Houtsoorten van den Gedeh, 32* and *208*, are typically juvenile forms, and probably belong to f. *tomentosa*.

No *Pometia* is known from the surrounding smaller islands.

Lesser Sunda Islands. *) No doubt the severe dry monsoo accounts for the extreme scarcity of *Pometia*. From Bali, Lombok, an Flores we have no records at all. The few collections that we have, sho that *Pometia* finds suitable conditions only in the narrow belt betwee the too dry lowlands and the too cold montane zone, i.e. between 700 an 900 m altitude. See also Note 30.

From Sumbawa, Timor, and Wetar, the material is very hom geneous and belongs to f. *cuspidata*, under which all the available spe mens have been listed.

In the Tanimbar Islands, conditions and *Pometias* are a bit differe The occurrence of *Pometia* at low altitude in these islands with yet higher annual rainfall than the above named ones, is probably explain by the slightly more even distribution of the rainfall throughout the ye We have *bb 24369* from Otimmer and *Buwalda 4563* from Jamdena; bo are sterile and agree fairly well. The young shoots are densely ferru nous-hairy, the indumentum persists on the rachis and partly on t main nerves. The leaflets are much like those in f. *cuspidata*, except th being subentire. However, another plant from Otimmer, *bb 24276*, is fra mentary but shows that the leaflets can attain 24 by 8½ cm, are ov lapping, and asymmetrical, like those of f. *pinnata*, of which forma a classified material from the Tanimbar group is known.

Borneo. The greatest wealth of paramorphs is here concentrat especially in the northern part. The f. *acuminata* is endemic. Most abu dant are f. *glabra* and f. *alnifolia*, the latter, however, apparently abs from the southern half.

The f. *repanda* is not present in the strict sense, but is approac by *SAN 16321 Wood* from North Borneo, and by *Kostermans 12661* fr East Central Borneo, with smallish, dense, subglabrous inflorescen without auricles, but differing from f. *repanda* in the too wide subent brownish leaflets. *A 1056 Cuadra* with a similar inflorescence is s further remote in the leaflets being larger, 30 by 10 cm, thus com near f. *glabra*.

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*) The Director of the Herbarium Bogoriense kindly had sent his unidenti *Pometias*, but when the material arrived, the MS. was already in the pr As an addition of essential importance, this material contained two new rec from the Lesser Sunda Islands, both falling under *Pometia pinnata* f. *cuspid* First, *bb 15148* from eastern Sumba, Langgaliru at 500 m, which comes r near *bb 27193*. Second *bb 15973* from eastern Flores, Belodua at 750 m, w comes near *bb 27118* but has densely brown-hairy innovations and a sparse br patent indumentum on the leaf rachis and on both sides of the midrib in leaflets. Both collections are sterile.

Several specimens, like *bb 29241* and *31316* look like depauperate paramorphs of f. *glabra*, with thin dark-coloured leaf rachises to 20 cm long, leaflets to c. 17 by 6¼ cm, regular in shape, no or small falcate auricles at the base of leaves and of inflorescence branches. Such specimens occur throughout the archipelago.

Borneo is the only island from which *Pometia* has been recorded from peat swamp forest, where a limited number of paramorphs are sometimes found, notably f. *acuminata*, f. *alnifolia*, and *S 3117 J.A.R. Anderson*, from Sarawak, an allied paramorph succinctly described under Sumatra. Also *S 12018 Brunig* belongs here.

Transitional specimens between two formae occur. Two examples from many are *BNB 9087 Keith* with large leaflets as f. *glabra* and an inflorescence elongate and sparsely branched as f. *alnifolia* but with auricles and some secondary branches as again in f. *glabra*, and *SAN 19234 W. Meijer*, with leaflets intermediate between f. *acuminata* and f. *alnifolia*.

Two paramorphs must be tentatively described. The first is conspicuous by its very short dense fulvous indumentum, which gives an almost pruinose appearance to the branchlets, leaf rachises, and inflorescence. Leaf rachis 20—25 cm, ± 6 leaflets on either side, the basal pair falcate sometimes caducous, the other very symmetrical, not overlapping, parallel-sided to obovate, to 18—32 by 6—12 cm, base blunt to obtuse, top rather gradually acuminate with acute tip 1¼ cm, midrib hairy on both sides, nerves 22—24 pairs, dense and regular, downy beneath, margin subentire, surfaces dull green-brownish. Inflorescence hanging, to 30 cm, lax, branches sparsely branched, subtended by abortive pinnate leaves to 1½ cm long. Fruits at least 2½ by 1¾ cm. *Kostermans 5337, 5896*, both from East Kutei on limestone rocks.

The second paramorph has densely pubescent rachises to 20 cm with c. 5 leaflets on either side, coriaceous, brittle when older, the lowest pair c. 2 by 2 cm, the other very symmetrical, to 20 by 10 cm, base rounded, top rounded with a small narrow acumen, midrib hairy above, nerves c. 18—20, very regular, margin subentire, surfaces dull, livid-brown, above glabrous, beneath densely brown hairy all over. Inflorescence 10—12 by 10—16 cm, densely ferruginous-hairy, dense, branches with secondary branches but not subtended by auricles, the rachis underdeveloped. The floral disk rather densely set with appressed hairs. Fruit unknown. Specimens all from Tanah Bumbu, Kampong Baru, in South/East Borneo, *bb 13294, 13309, 13321, 13329*.

Philippines. Although *Pometias* are fairly rare they occur throughout the archipelago to its northernmost outliers. Present are f. *glabra*, f. *repanda*, and f. *pinnata*, the last as yet not recorded from Palawan.

The affinity of the Philippine *Pometias* is definitely with the New Guinean stock. Traces of paramorphs typical for Borneo seem absent. Neither seem typical endemic paramorphs to have developed. The unclassified specimens are mainly intermediates; a few will be cited. *Merritt FB 6133* from Mindoro and *Natividad FB 25757* from Palawan seem intermediate between f. *pinnata* and f. *repanda*. *Celestino & Ramos PNH 23073* and *McGregor 298* from Mindoro have leaves like f. *glabra* and an inflorescence like f. *pinnata*. *Ramos BS 76820* from Luzon has leaves like f. *pinnata* and reduced leaves in the inflorescence more or less like f. *glabra*. *Loher BS 12486* from Luzon has leaves looking intermediate between those of f. *glabra* and f. *repanda*, but a slender lateral simple-branched inflorescence without auricles. *Edaño BS 77893* from Palawan and *Elmer 10938* from Mindanao look like f. *glabra* but the inflorescence is subglabrous and has no auricles.

Among the adequate material, two specimens are distinctly deviating. The first is *Ramos BS 1702* from Samar. The leaflets measure 19 by 9 cm or perhaps more, at the base with auricles like f. *glabra*, but the inflorescence is stiff, c. 22 by 16 cm, dense and repeatedly branched, very densely ferruginous-hairy.

The second is *Sulit PNH 3683* from Luzon. Leaf rachis to 24 cm, densely fulvous-brown hairy, with c. 11 leaflets crowded on either side, quite asymmetrical and overlapping, subcoriaceous to 14 by 4¼ cm, ovate, base rounded to subcordate, narrowed to the top, gradually acuminate with a tip 1 cm; midrib subglabrous above, sparsely hairy beneath, nerves 12—14 pairs, margin shallowly repand, surfaces glabrous, brownish, very glossy above. Inflorescence stiff, at least $^3/_4$ m long, 30—40 cm wide, branches subtended by well developed to reduced leaves, with several secondary branches, rather stiff, densely fulvous-brown hairy. The foliage and the hairy inflorescence point to an affinity with f. *pinnata*, but no more can be said. See *Price 430* from Formosa.

Celebes. *Pometia* is absent from the dry eastern and southeastern peninsulas; from the rest of the island we have several records of f. *glabra* and f. *repanda;* f. *pinnata* seems confined to the northeastern peninsula.

There are a few unclassified specimens, but these are bad and not worth mentioning, and mainly seems to represent depauperations of f. *glabra*.

On *Koorders 18827* from NE. Celebes, K. & V., Bijdr. 9: 197. 1903, gave a short note. The dense hairy inflorescence strongly recalls that of *Ramos BS 1702* from Samar in the P. I. and the *bb*-specimens from Tanah Bumbu in Borneo (see there). The leaflets are glabrous underneath except on the nerves and so badly preserved that no further conclusions can be based on them.

Moluccas. *Pometia* occurs scattered in most of the islands. Present are the f. *pinnata*, f. *glabra;* f. *repanda* only on Talaud and Batjan.

Much material had to remain unclassified because it is fragmentary, mostly *bb*-numbers, but nearly all of them seem to represent intermediates or depauperations of the above formae.

A specimen from Buru, *bb 24479*, has many large thin leaflets and a very dense fulvous-brown velvety indumentum; it is typically a juvenile form but it is impossible to say where it belongs.

The Tanimbar Islands have been treated under the Lesser Sunda Islands, the Aru Islands under New Guinea.

The *Pometias* in Rumphius's Herbarium Amboinense are discussed in Note 9.

New Guinea. This is the only island where *Pometia* plays a dominating role in certain vegetations. Contrary to Malaya, where *Pometia* is especially riverine, and to Borneo, where it sometimes occur in swamp forest, *Pometia* seems here preponderantly confined to dryland forest, all over the island except in the monsoon area in the South. We have indications that human influence accounts for its abundance in two ways. First, *Pometia* is known to have occupied former clearings where it forms almost pure stands. Second, *Pometias* are likely to increase in depleted forest. See also the observations under *P. pinnata*, Uses and Ecology.

Three formae occur, all in great profusion, on the mainland and on the islands in the Geelvink baai, notably f. *pinnata*, f. *glabra*, f. *repanda*. The bulk of the unclassified material consists of intermediates between the three above formae, or of occasional specimens which cannot be reckoned to f. *glabra* because the midrib is hairy above, like *BW 318*, *6813*, *9416*, and *Clemens 1092*.

There are no paramorphs typical for New Guinea. Two specimens which we will cite here represent noteworthy individual independent deviations and cannot be classified.

NGF 7444 Floyd from T.N.G., Morobe distr. at 1250 m. Rachis 22—28 cm, leaflets c. 7 on either side, with the basal pair auricle-shaped (ex coll.), the other very regular, ovate, to 20½ by 6½ cm, base rounded to subcordate, top acutish, margin subentire, nerves 18—20 pairs; rachis, midrib above, and whole surface beneath with a thin, golden-brown velvety indumentum. Inflorescence inadequate.

The other is *Carr 14679* from Papua, Boridi at 1050 m. Rachis 12—16½ cm, leaflets 5—7 pairs, basal pair small, falcate, other fairly symmetrical, to 11 by 4 cm, with broad subcordate base, subacuminate top, nerves c. 17 pairs, marginal teeth 1 mm; rachis, midrib above, and whole surface beneath densely golden brown-puberulous. Inflorescence c. 25 cm, consisting of one single hanging axis, also densely hairy.

Clemens 851 and *BW 1237* merely represent hairy juvenile forms; we guess that the former belongs to f. *repanda* and the latter to f. *glabra*.

From the Aru Islands f. *repanda* is known, and a few allied specimens: *bb 25262* and *25483*, which also approach f. *pinnata*.

From Waigeo we have so far no records. From Misool we have *bb 14376*, which seems intermediate between f. *pinnata* and f. *glabra*.

Pacific. The Pacific *Pometias* clearly represent an outlier of the New Guinea population. There are variations in the midrib, which is hairy above or glabrous, and in the marginal teeth, which are better or less developed. The ovate, overlapping leaflets and the short-hairy inflorescence with spreading branches are constant characters of the forma.

From the relatively few scattered collections we could examine, the impression was obtained that the Pacific population is sufficiently homogeneous to refer it all to f. *pinnata*. There are, however, indications that several races exist, some producing more palatable fruits than others. So *F.S. Walker 221* from Tevai in the Santa Cruz group bears a field note that the fruit is pleasant to eat and is said to be larger (4½ cm diam.) than the non-edible *Pometias* of the Solomon Islands. Seemann has also recorded that local races are selected to be cultivated for their fruit.

From the Bismarck Islands we have no certain records. We already referred to the absence of *Pometia* in New Caledonia.

Summarizing remarks. 1. *Pometia* avoids the areas with a severe dry monsoon, notably the Indo-Chinese peninsula North of Malaya and the Lesser Sunda Islands. Although not entirely absent from these areas, it is there extremely scarce and confined to a few favourable places.

2. It is apparent that the centre of differentiation in the genus is found on the ancient Sunda Land. None of the West-Malaysian paramorphs is found East of the Sunda shelf.

3. Two important secondary centres of differentiation are: a) Simalur — NE. Sumatra — Central Malaya, b) North and East Borneo.

4. The forma *glabra* is the only paramorph that is really widely distributed. Its area, stretching from the Andamans to New Guinea, covers the best part of the generic area.

5. Within the area of f. *glabra* there is an empty pocket formed by the Lesser Sunda Islands, where f. *cuspidata* occurs.

6. The population in the Philippines, NE. Celebes, the Moluccas and New Guinea is essentially homogeneous, consisting of 3 formae and remarkably few individual oddities.

7. The only record from S. Annam has its nearest relative in N. Borneo, the only examined record from Formosa has its nearest relative in the Philippines.

EXCLUDED SPECIES

Arbor palorum alba parvifolia Rumph., Herb. Amb. 3: 98, *t. 65*. 1743, excl. fig. A, was by Lamarck, Encycl. Suppl. 3: 479. 1813, placed under *Pometia*, and by Teysmann (?; quoted by Hasskarl, Neu. Schl. 55. 1866) under *Irine*. According to Merrill, Int. Rumph. 337. 1917, this is erroneous, Rumphius's plant being perhaps a *Lepisanthes* (*Sapind.*).

Irina integerrima Bl., Bijdr. 231. 1825, was by himself in Rumphia 3: 114. 1847, referred to *Meliosma nitida* Bl. (*Sabiac.*).

Pometia curtisii King *in* J. As. Soc. Beng. 65 ii: 443. 1896, was not intentionally described by King, who only wanted to provide a tentative name for *Curtis 1668* from Penang, Malaya. The specimen belongs to *Euphoria longana* Lamk (*Sapind.*).

Pometia forbesii Baker f. *in* J. Bot. 62, suppl. 26. 1924, based on *Forbes 2825* from Sumatra near Palembang; Radlk. *in* Pflanzenreich, Heft 98: 936. 1933, was identified by Mr F.H. Hildebrand as a *Paranephelium*, most probably *P. nitidum* King *in* J. As. Soc. Beng. 65 ii: 450. 1896 (*Sapind.*).

Pometia ternata (Forst.) Forst., Prod. 74, n. 393. 1786. Icon. ined. t. 280. Forster's second species in the genus, is *Schmiedelia ternata* (Forst.) Cambess. *in* Mém. Mus. 18: 24. 1829, based on *Aporetica ternata* Forst.,

Char. Gen. 132, *t. 66*. 1776 (Seemann). According to Radlkofer, *l.c.* p. 572, it is *Allophylus ternatus* (Forst.) Radlk. (*Sapind.*).

INDEX TO COLLECTORS AND NUMBERS

In this Index we have no other collections incorporated than:

A. Collections we have personally examined.

B. Collections provided with a name or series letter plus a number, and belonging to a recognized taxon. The taxa have been coded as follows:

1. *Pometia ridleyi* King emend. Radlk.
2. *Pometia pinnata* Forst.
   a. f. *pinnata*
   b. f. *glabra* (Bl.) Jacobs
   c. f. *repanda* Jacobs
   d. f. *acuminata* (Hook. f.) Jacobs
   e. f. *alnifolia* (Bl.) Jacobs
   f. f. *macrocarpa* (Kurz) Jacobs
   g. f. *tomentosa* (Bl.) Jacobs
   h. f. *cuspidata* (Bl.) Jacobs

C. Type specimens, indicated with (T). These have been cited in full under their respective names.

D. Unclassified specimens, as far as these have been discussed in the chapter on Distribution of the Variability. Such specimens are followed by the (abbreviated) name of the province under which reference to it is made.

To save space, collector's names have been omitted in institutional series.

A 664: 2e, *1056*: Born., *4954*: 2e; *Achmad 3*: Simal., *501*: Simal., *543*: 2b, *1399*: 2c, *1400*: 1, *1473*: Simal., *1519*: Simal.; *Aet* (exp. Lundqvist) *349*: 2a; *Aet & Idjan* (exp. Van Dijk) *762*: 2b; *Amdjah 931*: 2b; Ceylon *Anonymous s.n.* (T): 2g; *Atje* (exp. Hulstijn) *365*: 2b.

Baker 215: 2a, *325*: 2a; *Balansa 4035*: 2g; *bb 2089*: 2e, *12226*: 2b, *13294*: Born., *13309*: Born., *13321*: Born., *13329*: Born., *14376*: N.G., *15707*: 2b, *16014*: 2b, *16463*: 2c, *19183*: 2b, *19663*: 2b, *21112*: 2b, *21853*: 2c, *22257*: 2a, *22470*: 2b, *22992*: 2b, *23832*: 2a, *24273*: 2a, *24369*: L.S.I., *24479*: Mol., *25013*: 2b, *25036*: 2c, *25175*: 2b, *25262*: N.G., *25321*: 2c, *25332*: 2c, *25483*: N.G., *25712*: 2b, *25853*: 2b, *26004*: 2a, *26810*: 2a, *26907*: 2b, *27049*: 2b, *27118*: 2h, *27193*: 2h, *28234*: 2b, *28736*: 2a, *28845*: 2a, *28908*: 2b, *28969*: 2a, *29027*: 2b, *29241*: Born., *29500*: 1, *29745*: 2b, *30227*: 2b, *30240*: 2b, *30290*: 2b, *30567*: 2a, *30569*: 2a, *31316*: Born., *31351*: 2b, *31352*: 2b, *32098*: 2b, *32464*: 2b, *32523*: 2b, *32616*: 2b, *32627*: 2b, *32817*: 2b, *32850*: 2b, *32862*: 2b, *33117*: 2c, *33292*: 2b, *33297*: 2a, *33308*: 2a, *33326*: 2b, *33517*: 2c, *33540*: 2a, *33547*: 2c, *33684*: 2a, *33858*: 2b, *33912*: 2b, *34659*: 2b, *34734*: 2b, *Cel. V. 227*: 2b, *Cel. V. 231*: 2c, *Cel. V. 239*: 2c; *Beccari 1136*: 2d; *Beguin 552*: Sum.; *Blume 46*: 2b, *738* (T): 2b, *1489* (T): 2g; *BNB 3697*: 2b, *4910*: 2e, *9087*: Born.; *Brass 2790*: 2a, *5879*: 2c, *8181*: 2c, *8858*: 2b, *27573*: 2a, *29209*: 2a; Miss *Brooke 10211*: 2b; *BS 1702*: P.I., *4081*: 2c, *15617*: 2b, *40987*: 2b, *76820*: P.I., *77893*: P.I., *79195*: 2a; *Buwalda 4563*: L.S.I., *5604*: 2a; *BW 17*: 2b, *290*: 2b, *318*: N.G., *450*:

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