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Piperaceae of Micronesia

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As here interpreted, Micronesia includes those islands in the western Pacific Ocean comprising the Mariana Islands from about 20 degrees north latitude and southward and westward to the Palau Islands of the Carolines, thence eastward through the Caroline and Marshall Islands.

The first Micronesian Piperaceae to be recognized appear to have been *Piper potamogetonifolium* and *P. marianum* described by Opiz in 1830 (Presl, Reliq. Haenk. **1**: 156, 159). For 50 years Casimir de Candolle was the recognized authority on the Piperaceae. To him were sent collections made in various parts of the world, including occasional ones from Micronesia, for study and naming. In 1869 [Prodromus **16** (1): 235-471] he described as new *Peperomia mariannensis, Piper guahamense,* and *P. betle* var. *marianum.* In 1914 (Philippine Jour. Sci. **9**: 72) he added *Peperomia guamana* and *P. saipana.* Later, in 1921 (Engler Bot. Jahrb. **56**: 502-506), he described nine additional species—*Peperomia breviramula, P. gibbonsii, P. hoeferi, P. kraemeri, P. palauensis, P. ponapensis, P. volkensii, P. yapensis,* and *Piper ponapense*—from specimens collected during the German occupation of the islands. In 1915 Koidzumi (Bot. Mag. Tokyo **29**: 248) described *Peperomia pellucida* var. *obtusifolia.* Following World War I, and while the islands were under Japanese mandate, a number of Japanese botanists made extensive collections in the islands. Among the more prominent of these collectors were T. Hosokawa and R. Kanehira. Between 1935 and 1942 Hosokawa (Nat. Hist. Formosa, Trans. **25**: 117-121, 1935; **28**: 153, 1938; **32**: 287, 1942; Jour. Jap. Bot. **13**: 200, 1937) described a number of novelties based on his collections: *Peper-*

omia kusaiensis, P. mariannensis, P. pacifica, P. tiniannensis, Piper carolinense, P. decumanum var. *palauense, P. kusaiense, P. micronesiacum,* and *P. palauense.* In 1938 I tried to bring together the various species of *Peperomia* and to evaluate them, although the amount of material then available for study was limited [B. P. Bishop Mus., Occ. Papers **14** (2) : 7-25, figs. 1-9, 1938]. One new species, *Peperomia trukensis,* was described.

In addition to the species named above, described from collections made in Micronesia, various authors have credited several extra-Micronesian species to the islands, namely, *Peperomia bilineata* Miquel, *P. leptostachya* Hooker and Arnott, *P. membranacea* Hooker and Arnott, *P. pallida* A. Dietrich, *P. pellucida* Humboldt, Bonpland, and Kunth, *P. pellucidopunctulata* C. de Candolle, *Piper betle* Linnaeus, *P. fragile* Bentham, *P. latifolium* Linnaeus f., *P. macgillivrayi* C. de Candolle, *P. majusculum* Blume, *P. methysticum* Forster f., and *P. nigrum* Linnaeus.

Since World War II, American collectors have been active in conducting botanical surveys, especially in the Caroline and Marshall Islands, with the result that a considerable amount of herbarium material is now available for study. In the present paper the attempt is made to evaluate the species and varieties which grow in the Micronesian area, and to devise keys by means of which they may be identified. Six species and three varieties of *Piper* and 10 species and one variety of *Peperomia* are believed to be valid entities, of which one variety of *Piper* (*P. guahamense* var. *glabrum*) and one species of *Peperomia* (*P. glassmanii*) are here described as new to science.

It is difficult to key several of the species, especially those of *Peperomia.* The Micronesian members of this genus have not as yet developed strong contrasting characters and obvious differences. With the exception of *P. pellucida,* an introduced American species, all appear to belong to the subgenus *Sphaerocarpidium.* Leaf arrangement, usually a good key character, is variable. In shape and size of the leaves, too, there are not the contrasts commonly found elsewhere. So far as I know, with the exception of the American *Peperomia pellucida,* all species of *Peperomia* included in this treatment are indigenous.

F. R. Fosberg of the Pacific Vegetation Project was able to obtain the loan of the collections in the herbaria of the University of Tokyo (TOKYO) and Kyushu University (KYUSHU). This material, together with the collections in the herbaria of Arnold Arboretum (AA),

Bishop Museum (BISHOP), New York Botanical Garden (NY), and U. S. National Museum (US), are the basis of the present study. The herbaria in which the collections are stored are indicated in the locality citations as shown parenthetically above. Dr. Fosberg supplied copies of the original descriptions of certain species in obscure and not readily available Japanese publications, and proferred his wide experience and knowledge of the islands. Both Dr. Fosberg and E. H. Bryan, Jr. assisted in the spelling of many difficult place names. For this assistance I am grateful.

Key to Genera

Plants more or less woody, shrublike or scandent vines.....**Piper**
Plants herbaceous, small.....**Peperomia**

Key to Species of Piper

Spikes axillary, solitary; leaves round-ovate, acuminate, base strongly cordate, palmately 9-11-nerved, petiole vaginate-winged below middle; spikes unisexual, up to 15 cm. or more long, peduncle as long as petiole or shorter, floral bracts rounded, peltate, ovary and fruit globose-ovoid, subapiculate.....**1. P. guahamense**
Lower surface of blade, especially nerves and also usually petioles, peduncles, and young stems hirtellous.....var. **guahamense**
All parts glabrous.....var. **glabrum**

Spikes leaf-opposed, solitary
Leaves large, usually 15 cm. or more long, base strongly cordate.
Leaves round-ovate, 11-15-nerved, nerves distinct to base, or innermost pair of lateral nerves coalescing with midrib within lowermost 1 cm., puberulent along nerves beneath, base deeply cordate, lobes equal, rounded; spikes short (mostly 5-8 cm. long), floral bracts rounded, peltate, pedicel hirsute.....
.....**2. P. methysticum**
Leaves oblong-ovate or broadly ovate, base inequilaterally cordate-auriculate, or lobes subequal, rounded, glabrous, 9-13-nerved, nerves distinct to base or less frequently innermost pair of lateral nerves coalescing with midrib within lowermost 1-2 cm.; spikes 15 cm. or more long, floral bracts rounded, peltate, pedicel hirsute, fruit oblong, apiculate, reddish.....
.....**3. P. decumanum** var. **palauense**
Leaves smaller, or if large, base not cordate
Midrib usually with lateral branches 1-2 cm. or more above base.
Fruit globose, free; leaf blades commonly narrowing downward.....**4. P. nigrum**
Fruit coalescing and embedded in rachis tissue; leaf blades ovate, commonly cordate.....**5. P. betle**
All parts glabrous.....var. **betle**
Lower blade surface and petioles puberulent.....var. **densum**

Lateral nerves free to base or at most coalescent only in lowermost 5 mm.

Peduncle slender, commonly shorter than petiole; female spikes 1.5-2.5 cm. long, the staminate spikes up to about 6 cm. long, the floral bracts round, peltate, fruit globose, coalescent to above middle; leaves elliptic- to round-ovate, shortly acute or acuminate, base acute, obtuse, truncate, or larger leaves sometimes shallowly cordate, occasionally subpeltate or peltate, 5-nerved, petioles slender, 1-2 (-3) cm. long.....**6. P. fragile**

Peduncle commonly longer than petiole, spikes mostly much longer, floral bracts round, peltate, fruit oblong, angular, rachis fimbriate; leaves narrowly lanceolate to ovate, acuminate, base rounded, obtuse or acutish, one side cordulate, the other side usually longer and minutely auriculate, large leaves cordate, mostly 5-7 nerved, nerves prominent .....**7. P. ponapense**

1. **Piper guahamense** C. de Candolle, IN DC. Prodromus **16** (1): 336, 1869.

Piper guahamense C. de Candolle var. *guahamense*.

Piper micronesiacum Hosokawa, Nat. Hist. Soc. Formosa, Trans. **32**: 287, 1942.

Leaves and young stems more or less hirtellous.

Distribution: Mariana Islands and Kusaie (Caroline Islands).

Guam: 1918, *P. Nelson 5* (BISHOP, NY, US); *J. B. Thompson* [Guam Experiment Station] *387* (US), this number in Bishop Museum is var. *glabrum*; Mt. Lamlam, Oct. 28, 1949, *D. Anderson 318* (BISHOP, US); Mt. Lamlam, summit, alt. 400 m., Sept. 4, 1949, *Anderson 144* (BISHOP, US); near Talisay, 2.5 km., 15 degrees southeast of Apra Heights, alt. 150 m., Dec. 20, 1953 [female], *F. R. Fosberg 35263* (BISHOP, US); same locality and date [male], *Fosberg 35264* (BISHOP, US); Barrigada Point area, alt. 400-600 ft., Nov. 17, 1945, *G. C. Moore 7* (US); Ritidian Point, on limestone, in forest, alt. 400 ft., July 1, 1946, *E. Y. Hosaka 3089* (BISHOP, US), 1.5 km. inland, Sept. 13, 1945, *W. L. Necker 159* (US); headwaters of Ylig River, Aug. 12, 1945, *R. Rodin 613* (US); Mogfog, alt. 400 ft., Aug. 8, 1945, *J. L. Gressitt and H. Hurlbut 2007* (US); Canada, in open scrub forest, Apr. 6, 1936, *E. H. Bryan, Jr. 1074* (BISHOP, NY, US); Maguan, under shrub in limestone country, low forest, alt. 150 m., Mar. 31, 1936, *Bryan 1036* (BISHOP, NY, US); one mile south of Taguac, on north plateau, common in undergrowth, alt. 110 m., Jan. 18, 1954, *Fosberg 35478* (BISHOP, US); southwest of Anao

Point, occasional on plateau in undergrowth, alt. 200 m., Mar. 3, 1950, *Fosberg 31938* (BISHOP, US); Anigua, in secondary thicket on limestone talus, alt. 4 m., Jan. 24, 1950, *Fosberg 31214* (BISHOP, US); Agana, June 18, 1900, *A. Seale* (BISHOP); north of northwest air strip, in dense wet wood, Feb. 24, 1945, *J. T. Conover and W. H. Wagner, Jr. 563* (BISHOP); Anderson Air Force Base, dense vegetation, July 18, 1954, *R. Moran 4404* (BISHOP, US); Mataguac, July 21, 1954, *Moran 4438* (BISHOP, US); Tailalo, shrubby forest on rough limestone, Aug. 7, 1954, *Moran 4581* (BISHOP, US).

Kusaie: Mt. Keies, Mallens, Aug. 23, 1938, *Hosokawa 9498* (AA, US), type number of *P. micronesiacum*.

Piper guahamense C. de Candolle var. **glabrum** Yuncker, n. var.

Omnino glabra.

Distribution: Mariana Islands.

Agrigan: Aug. 1, 1934, *Hosokawa 8011* (BISHOP); canyon east side of island, common on bottom of upper part of gorge, on volcanic ash soil and lava rocks, Feb. 17, 1950, *Fosberg 31620* (BISHOP, US).

Tinian: *S. Ohotani 136* (KYUSHU).

Rota: July 10, 1934, *Hosokawa 7568* (AA, BISHOP); July 27, 1946, *D. F. Grether 4425* (US); 1945, *Necker R113* (US); Aug. 11, 1935, *R. Kanehira 3619* (KYUSHU); Sabana, alt. 1,300 ft., June 24, 1953, *Y. Kondo* (BISHOP); northwest coast of west end of main part of island, between Rota and Tatacho Point, June 20, 1946, *Fosberg 25013* (BISHOP, US); second main terrace from top, occasional in undergrowth in thick tangled woods on rough coral limestone, alt. 320 m., Feb. 25-27, 1950, *Fosberg 31855* (BISHOP, US); Shinaparu, in forest, alt. 150 ft., June 25, 1946, *Hosaka 3045* (BISHOP, US); three-fourths mile east of Sabana, second terrace from top of island, common in undergrowth, alt. 420-450 m., June 21-23, 1946, *Fosberg 25036* (BISHOP, type; US); July 1932, *Kanchira 1741, 1753* (NY).

Guam: *J. B. Thompson* [Guam Experiment Station] *387* (BISHOP).

Native names: *pupúlon anite* (Rota), root used to cure gonorrhea; *pupúlu ito* (Guam); *pupúlo aniti* (Guam); *pupúlo aneti* (Guam). The parts have an anise-like fragrance when crushed.

The species, for the most part, is restricted to the Mariana Islands. The type of Hosokawa's *P. micronesiacum* from Kusaie Island in the Carolines (Hosokawa 9848, in the Taihoku Herbarium) has not been

examined. Specimens with the same collection data are in the herbaria of the Arnold Arboretum and the United States National Museum. These specimens, which agree with Hosokawa's description, I believe to be duplicates of the type collection. The pubescence on these specimens may be slightly less abundant, the hairs less crisp, and the secondary nerves and nervules somewhat more prominent than is common for specimens from Guam. These very minor differences, even when considered collectively, are scarcely significant, and the Kusaie plant is believed to represent *P. guahamense* var. *guahamense* despite the disjunctive distribution.

P. guahamense is the only species of *Piper* of the section *Macropiper*, characterized by axillary spikes, known from Micronesia. The plants are characteristically dioecious; but an occasional one may be monoecious or, rarely, the spikes may be bisexual. One of its closest relatives appears to be *P. puberulum* (Bentham) Bentham of Tonga, Samoa, and Fiji. It differs from that species, however, in its more strongly cordate leaves, in having petioles vaginate scarcely to the middle, in 9-11-nerved leaves, and in usually longer spikes. *P. puberulum* has leaves mostly 7- or, less frequently, 9-nerved, and the petioles are usually vaginate to the middle or above. *P. macgillivrayi* C. de Candolle, reported from the Marianas by Prowazek (Deutches Marianen, 115, 1913) is considered to be a synonym of *P. puberulum*. No material representing *P. puberulum* has been seen from Micronesia, and Prowazek's report was probably based on a specimen of *P. guahamense*. *P. guahamense* bears some resemblance to *P. latifolium* Linnaeus f. of the Society Islands, That species, however, usually has more broadly rounded, abruptly short-acuminate leaves, with shorter spikes which are usually multiple in the leaf axils. In *P. guahamense* the spikes are usually solitary or, very infrequently, multiple.

2. **Piper methysticum** Forster f., Pl. Esculent. Ins. Oc. Austr., 76, 1786.

Distribution: Caroline Islands.

Palau Islands: Babelthuap, Marukyoku, July 18, 1929, *Kanehira 453* (KYUSHU).

Ponape: Matalanim, Aug. 15, 1929, *Kanehira 835* (BISHOP, KYUSHU); Colonia, planted in house garden, Aug. 9, 1929, *Kanehira 671* (KYUSHU, NY); south base of Tolenot Peak, peninsula east of Tawenjokola River, cultivated in yard, Aug. 10, 1946, *Fosberg*

26318 (BISHOP, US); Mt. Asama, alt. 200-500 m., Sept. 8, 1940, *T. Hosokawa 9601* (AA); Mt. Seletereh, alt. 500 ft., tree 15 ft. high, July 28, 1949, *S. F. Glassman 2725* (BISHOP, US); Kuporujo [Kupwuriso?], cultivated, Mar. 13, 1936, *M. Takamatsu 676* (BISHOP); Tolomail, cultivated, Feb. 11, 1936, *Takamatsu 970* (BISHOP); Anapeng-pa, "liana, climbing on trees" [?], Feb. 6, 1936, *Takamatsu 708* (BISHOP). Specimen 708 is sterile, but it agrees well with *P. methysticum* in its vegetative characters.

Native names: *kava* (Polynesia), *yangona* (Fiji), *sakau* (Ponape).

This species is ordinarily a shrub. It is widely distributed through the islands of the Pacific, always, as far as I know, as a cultivated plant. Its origin is problematical. A watery infusion of the pulverized root is a widely used beverage.

3. **Piper decumanum** Linnaeus var. **palauense** Hosokawa, Nat. Hist. Soc. Formosa, Trans. **28**: 153, 1938.

Distribution: Palau Islands.

Palau Islands: Angaur, July-Aug. 1929, *Kanehira 568* (KYUSHU, NY); Todaiyama, an elevated coral island, Apr. 4, 1938, *Kanehira and S. Hatusima 4646* (KYUSHU); same locality, Aug. 1932, *Kanehira 2027* (KYUSHU, NY); Marukyoku, July-Aug. 1929, *Kanehira 392* (KYUSHU, NY); Peleliu, Apr. 7, 1938, *Hatusima 4742* (KYUSHU); climbing along tree trunks in forest, May 8, 1936, *Takamatsu 1748* (BISHOP); same locality and same date, *Takamatsu 1763* (BISHOP); same locality, Sept. 9, 1937, *Hosokawa 9226* (AA, BISHOP, believed to represent duplicates of the type collection); Babelthuap, Airai, common in forest, Apr. 20, 1936, *Takamatsu 1163* (BISHOP); Akoru-kaigan [coast], Cocos rin oyobi kôhôrin, Sept. 21, 1933, *Hosokawa 7098* (AA, BISHOP).

This variety is believed to differ from the species because of its somewhat smaller leaves, subpalmate nervation, and fewer nerves which are submarginally loop-connected. No significant differences can be found in the spike characters which are well illustrated by Quisumbing (Philippine Jour. Sci. **43**: 42, fig. 14, 1930). It also bears some resemblance to *P. majusculum* Blume, from which it differs because of its glabrous stems and leaves and in the character of the nervation. Kanehira (Enum., 305, 1935) listed his Palau collections as *P. majusculum*. The typical form occurs in the Moluccas and the Philippines.

4. Piper nigrum Linnaeus, Sp. Pl., 28, 1753.

According to Safford (U. S. Nat. Herb., Contrib. **9**: 355, 1905), he had introduced this species into garden cultivation in Guam sometime previous to 1905 and by the time of his report it was doing well. This species differs from *P. betle* in having more an acute than a rounded blade base, and in having the fruit free. In *P. betle* the fruit is submerged in the rachis. No specimens of *P. nigrum* have been seen in the Micronesian collections examined.

5. Piper betle Linnaeus, Sp. Pl., 28, 1753.

Piper betle var. *betle*.

[?] *Piper potamogetonifolium* Opiz, IN Presl, Reliq. Haenk. **1**: 156, 1830.

Piper marianum Opiz, IN Presl, Reliq. Haenk. **1**: 159, 1830.

[?] *Macropiper potamogetonifolium* (Opiz) Miquel, Syst. Pip., 221, 1843.

Piper betle var. *marianum* (Opiz) C. de Candolle, IN DC. Prodromus **16** (1): 360, 1869.

Entirely glabrous.

Distribution: Mariana Islands.

Agrigan: Aug. 1, 1934, *Hosokawa 8009, 8011* (AA).

Alamagan: Oct. 2, 1949, *Anderson 418* (US).

Saipan: July 17, 1933, *Hosokawa 6658* (AA); July 1930, *Kanehira 892* (BISHOP, KYUSHU, NY).

Guam: Mt. Tenjo, in head of valley on northeast slope of peak, alt. 300 m., May 3, 1936, *Bryan 1248* (BISHOP, KYUSHU, NY, US); Guam Experiment Station, *Thompson 190* (BISHOP, US).

Piper betle var. **densum** (Blume) C. de Candolle, IN DC. Prodromus **16** (1): 360, 1869.

Piper densum Blume, Bat. Genoots., Verh. **11**: 193, fig. 18, 1826.

Nerves on lower blade surface and petioles puberulent.

Distribution: Mariana and Caroline Islands.

Guam: 1918, *Nelson 49* (BISHOP, NY); Agana, June 1900, *Seale* (BISHOP); Umatac, water point, base of cliff at head of valley, alt. 100 m., Jan. 10, 1954, *Fosberg 35412* (BISHOP, US); Mt. Santa Rosa, May 6, 1945, *Glassman 149* (US).

Alamagan: around Partido village, Feb. 18-19, 1950, *Fosberg 31667* (BISHOP, US).

Palau Islands: Ogiwaru, Apr. 19, 1936, *Takamatsu 1429* (BISHOP); Angaur, east side of island, Mar. 9-10, 1950, *Fosberg 31995* (BISHOP, US).

Yap: Gorror, central plateau, alt. 100 ft., *Hosaka 3307* (BISHOP, US); Yap, Feb. 19, 1948, *C. C. Y. Wong 484* (US).

Native names: *gabui* (Yap); *pupúlo* (Guam).

Piper betle occurs naturally from India to Malaysia. It is widely planted in tropical countries, where it may become an escape. The species is variable, as indicated by the large number of synonyms and varietal names which have been accredited to it. Two forms are recognizable in the Micronesian material studied. One is entirely glabrous and is believed to represent Opiz's *P. marianum*. This was later reduced by C. de Candolle in the Prodromus to varietal status under *P. betle* where he distinguished it from the species on the basis of its much longer petioles. The petioles tend to lengthen downward and there is often considerable variation in length on the same specimen. Quisumbing (Philippine Jour. Sci. **43**: 87, 1930) in describing *P. betle* says that the petioles range from 1-2 cm. in length and up to 4 cm. in lower leaves, a length sufficient to include those of var. *marianum*. Another character he mentions is the presence of pellucid dots. In none of the material I have studied are such dots noteworthy. The other form is recognized by the nerves beneath and the puberulent petiole, and I believe it represents Blume's *P. densum*.

Natives chew a combination of fresh *P. betle* leaves, a piece of the fragrant seed of the *Areca* palm, and a pinch of quicklime. Betle-chewing has not developed to any extent in Polynesia, where the *P. methysticum* beverage called kava apparently takes its place.

It has not been possible to recognize *P. potamogetonifolium* in any of the material seen from the inadequate description by Opiz, who states that it is related to *P. carpunya* which, however, is a Peruvian species. Merrill says of it (Philippine Jour. Sci. **9**: 72, 1914): "Collected in Guam by Haenke, and known only from that island, unless the plant was erroneously localized, as many of Haenke's were." De Candolle apparently had some doubt as to its validity, as he placed it in a group of species of unsatisfactory status for which he gave only brief descriptions in his Clavis. I suspect that, if the original specimen was, in fact, collected on Guam, it may be *P. betle*.

6. **Piper fragile** Bentham, Hooker Jour. Bot. **2**: 234, 1843.
Piper carolinense Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 117, 1935.
Piper trukense Hosokawa, Jour. Jap. Bot. **13**: 200, 1937.

Distribution: Caroline Islands. Also in New Guinea, British North Borneo, and the Philippines.

Palau Islands: Peleliu, Sept. 9, 1937, *Hosokawa 9212, 9219* (AA, BISHOP); climbing on tree trunks, May 8, 1936 *Takamatsu 1789* (BISHOP); Apr. 7, 1938, *Kanehira and Hatusima 4782* (KYUSHU); Todaiyama, a coral island near Koror, Apr. 4, 1938, *Kanehira and Hatusima 4671* (KYUSHU); Todai-san (Todaiyama) Oct. 15, 1933, *Hosokawa 7505* (AA, BISHOP, type number of *P. carolinense*). The locality is given in the original description as "in a forest on the coral islet of Urktable [Urukthapel], at middle altitudes"); Korror [Koror?], in forest near village, July 12, 1929, *Kanehira 341* (KYUSHU, NY); Koror, Sept. 15, 1939, *T. Tuyama* (TOKYO); Babelthuap, Kasioru, climbing on tree trunks, rare, Apr. 11, 1936, *Takamatsu 1500* (BISHOP); Angaur, climbing along tree trunks, rare, May 10, 1936, *Takamatsu 1806* (BISHOP); Angaur, ridge on northwest corner of island, common in forest, leaves on sterile parts peltate, on flowering branches not peltate, alt. 40 m., July 26, 1946, *Fosberg 25948* (BISHOP, US).

Hall Islands: Nomwin Atoll, Nomwin Island, very abundant, vine covering ground and climbing on tree trunks, sterile, May 29, 1946, *Fosberg 24580* (BISHOP, US); Namoluk Atoll, Leor Village, Dec. 15, 1949, *Anderson 913* (BISHOP, US).

Truk Islands: Truk Island, growing over ground and climbing on *Hernandia ovigera* along seashore, Oct. 2, 1947, *Wong 170* (US); Tadiu, in a secondary forest near seashore, Aug. 11, 1936, *Hosokawa 8396* (AA, BISHOP); Melat, Aug. 21, 1936, *Hosokawa 8355* (AA); Wara Islet, Mt. Tikuman, in thicket at upper altitudes, Aug. 17, 1936, *Hosokawa 8459* (AA, BISHOP, US, believed to represent duplicates of type of *P. trukense*); Moen (Wena) Island, Moen Village, west coast of island, vine with very marked pleasant odor, even when unbroken, alt. 15 m., July 31, 1946, *Fosberg and K. J. Pelzer 26019* (BISHOP, US); Huyoto, Mar. 23, 1937, *Kanehira 4262* (KYUSHU); Trowasi Islet, Mt. Troman, in a secondary thicket at middle altitudes, Aug. 26, 1936, *Hosokawa 8500* (AA, BISHOP, US); Tol Island, Mt. Tunuital (Unibot), highest peak on island, climbing in

tree, alt. 200-460 m., May 24, 1946, *Fosberg 24451* (BISHOP, US); Natu Sima (Dublon), July 22, 1936, *Hosokawa 6521* (AA); Pis Island, on north side of Truk barrier reef, everywhere in forest covering tree trunks and on ground, alt. 1-2 m., June 3, 1946, *Fosberg 24688* (BISHOP, US), sterile but believed to be this species.

Mortlock Islands: Lukunor Atoll, Piafa Islet, Jan. 10, 1950, *Anderson 2198* (BISHOP, US); Satawan Atoll, Moch Islet, Jan. 12, 1950, *Anderson 1106* (BISHOP, US); Satawan Islet, Jan. 2, 1950, *Anderson 1104* (BISHOP, US); Etal Atoll, Etal Islet, Jan. 5, 1950, *Anderson 2063* (BISHOP, US).

Woleai Atoll, Utagal Islet, growing under and on *Eugenia* on coral sand, alt. 1-2 m., July 28, 1946, *Wong 21* (BISHOP, US).

The last five specimens, from the Mortlock Islands and Woleai Atoll, have peltate leaves.

Native names: *atukupui* (Hall Islands); *eres, ootikk* (Truk); *atopui* (Mortlock).

This species is characterized as follows: entirely glabrous; elliptic- to rounded-ovate, 5-nerved leaves; short spikes (pistillate 1.5-2.5 cm.; staminate 3-6.5 cm.), slender peduncles; and the fruit coalescent below the middle. The leaves vary widely in size, with the larger ones sometimes up to 11 × 13 cm.; and the bases of the blades vary considerably in shape. The smaller blades are commonly acute, but the larger, lower leaves are frequently obtuse to cordate or sometimes peltate. The nerves are free to the base, or the innermost pair of lateral nerves may coalesce with the midrib within the lowermost 5 or rarely 10 mm. The specific name was based on the fact that the type was fragile and broken at the nodes. Some of the specimens cited show the same character.

7. Piper ponapense C. de Candolle, IN Engler's Bot. Jahrb. **56**: 502, 1921.

Piper kusaiense Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 118, 1935.

Piper palauense Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 118, 1935.

Distribution: Caroline Islands.

Palau Islands: Babelthuap, Aimeliik (Imeliik), Sept. 22-23, 1935, *S. Okamoto 18* (KYUSHU); Aimeliik, Experiment Station, in rain forest at low altitude, July 10. 1929, *Kanehira 285* (BISHOP, KYUSHU, NY); Koror, July 6, 1929, *Kanehira 196* (KYUSHU, NY);

Aimeliik, Sept. 25, 1933, *Hosokawa 7207* (AA); Arumonogui, near Arumaten, Sept. 15, 1933, *Hosokawa 6748* (AA); Babelthuap, Kasioru, rather rare, Apr. 11, 1936, *Takamatsu 1507* (BISHOP); Kamusetsu, Apr. 26, 1936, *Takamatsu 1120* (BISHOP); Kaiguru, south end of Babelthuap, common, Apr. 15, 1936, *Takamatsu 1590* (BISHOP); Kaisyalu Island, Malukyoku, Galdok [Melekeiok, Ngardok], Oct. 1, 1933, *Hosokawa 7361* (AA, type number of *P. palauense*); Babelthuap, Ngaremeskang Colony, Almiokan River, edge of thicket on steep slope, leaves mildly acrid to taste, ripe spikes red, July 20, 1946, *Fosberg 25763* (BISHOP, US); Peleliu, Apr. 7, 1938, *Kanehira and Hatusima 4779* (KYUSHU); same locality, very common, May 8, 1936, *Takamatsu 1788* (BISHOP); Arumonogui, near Arumaten, Sept. 15, 1933, *Hosokawa 6748* (BISHOP); Arakabesan (Ngerakabesang) Island, southwest of Babelthuap, climbing on trees, abundant, May 5, 1936, *Takamatsu 1246* (BISHOP); Arakabesan, south side of west peninsula in open slopes, cleared and, in places, recently burned, surrounded by thickets and patches of forest, alt. 20-30 m., Mar. 15, 1950, *Fosberg 32132* (BISHOP, US); Ngarmalk, northwestern Auluptagel, island just south of Koror, alt. 1-10 m., Apr. 10, 1950, *Fosberg 32616* (BISHOP, US).

Truk Islands: Sept. 26, 1947, *Wong 152* (US); Akisima [Fefan], Jan. 14, 1937, *Kanehira 3872, 3877* (KYUSHU); Tol Island, July 29, 1936, *Hosokawa 8327* (AA, BISHOP); Tol Island, June 1931, *Kanehira 1288* (KYUSHU); Tol, Mt. Tumuital (Unibot), alt. 200-460 m., May 24, 1946, *Fosberg 24444* (BISHOP, US); Tol, Unibot, July 25, 1936, *Hosokawa 8269* (AA); *8292* (AA, BISHOP); Moen (Wena) Island, Aug. 1931, *Kanehira 1716* (KYUSHU); broad flat near "Baker Dock," alt. 3 m., June 5, 1946, *Fosberg 24697, 24704* (BISHOP, US); south slope of Mt. Tonaachau, Aug. 1, 1946, *Fosberg 26053* (BISHOP, US); Dublon Island, slopes, upper ridges and top of Mt. Tolomen (Tolowan), alt. 200-360 m., May 28, 1946, *Fosberg 24554* (BISHOP, US); Natu Sima (Dublon), July 22, 1936, *Hosokawa 8362* (AA, BISHOP); Tadiu, Aug. 11, 1936, *Hosokawa 8401?* (AA, BISHOP, US); Natik, Feb. 23, 1937, *Kanehira 4120* (KYUSHU).

Mortlock Islands: Lukunor Atoll, Lukunor Islet, Jan. 19, 1950, *Anderson 2167* (US), sterile; Oneop Islet, Jan. 6, 1950, *Anderson 2102* (BISHOP), specimen sterile; Satawan Atoll, Moch Islet, Jan. 12, 1950, *Anderson 1107* (BISHOP, US); Etal Atoll, Etal Islet, Jan. 5, 1950, *Anderson 2062* (BISHOP, US).

Ponape: *Ledermann 13266* (BISHOP); Nov. 15-20, 1947, *S. H. Riesenberg 40* (BISHOP); Mt. Tolotom, Feb. 15, 1936, *Takamatsu 1059* (BISHOP); Kiti, July 1931, *Kanehira 1539* (KYUSHU, NY, US); Nanipiru (Nanipil), alt. 200 ft., Aug. 10, 1946, *Hosaka 3539* (BISHOP, US); Mt. Kankauzan, July 8, 1932, *Hosokawa 5505* (AA); Kamal Nanipil, Aug. 25, 1933, *Hosokawa 6032* (AA); Parkier (Parkiel), Aug. 10, 1929, *Kanehira 706* (KYUSHU); suburb of Colonia, Aug. 9, 1929, *Kanehira 672* (BISHOP, KYUSHU, US); outlet of Tawenjokola River, on bluff, along tidal stream, July 5, 1949, *Glassman 2444* (BISHOP, US); Param, Feb. 8, 1936, *Takamatsu 633* (BISHOP).

Kusaie: in forests at medium alt., July 1931, *Kanehira 1350* (KYUSHU); Mt. Hinkorn [Fenkol?], in primary forests, alt. 300 m., July 1931, *Kanehira 1388* (KYUSHU); Hinkolu [Fenkol?], Mar. 16, 1937, *Kanehira 4193* (KYUSHU); Mt. Matante (Buache), July 29, 1933, *Hosokawa 6261* (AA), *6324* (AA, BISHOP), type number of *P. kusaiense*; Matante, Mar. 18, 1937, *Kanehira 4199* (KYUSHU); Mt. Matante, Jan. 22, 1936, *Takamatsu 496* (BISHOP); Lele (Lela) Island, Lele Harbor, around villages and ruins of ancient temple, climbing on banyan trunk, alt. 1-5 m., Aug. 19-21, 1946, *Fosberg 26543* (BISHOP, US); lowest slopes and foot of south side of Mt. Matante, north of head of Lele Harbor, alt. 1-50 m., Aug. 19, 1946, *Fosberg 26566* (BISHOP, US); Lele Islet, epiphyte on rocks, common, July 24, 1949, *Glassman 2718* (BISHOP, US); Hill 541, alt. 500 ft., Mar. 23, 1953, *J. F. G. Clarke* (US); south slopes and ridges of Mt. Tafeayat, south of Lele Harbor, very common, Aug. 21, 1946, *Fosberg 26668* (BISHOP, US); Yasibayasi-Taontakku, July 28, 1933, *Hosokawa 6215* (AA); Mt. Fenkol (Crozer), alt. 100 m., Jan. 28, 1936, *Takamatsu 385a* (BISHOP), this specimen has leaves 2-2.5 cm. wide and 8-11 cm. long and is sterile but other than the size and proportion of the leaves agrees well with this species.

Native names: *eras* (Truk); *anük* (Mortlock); *ko'nok* (Ponape); *kai-fuhl* (Kusaie).

This species closely resembles *P. arborescens* Roxburgh of India and Malaysia. Typically, it has leaves scarcely more than twice as long as wide, while those of *P. arborescens* are usually about three times as long as wide. The acuminate leaves are chartaceous, vary from oblong-elliptic to broadly ovate-cordate, and range in size from 3 to 5 cm. up to 12 cm. wide and 8-15 cm. long. The base is usually subequilaterally

rounded, obtuse, or cordate in broader leaves, and minutely cordulate-auriculate at the petiole with the very small auricle slightly longer than the cordulate side. The size of the auriculation is reduced in large leaves, and in those with broadly cordate base this character may not be evident. The nerves are mostly 5 to 8 or occasionally 9, with the innermost laterals usually coalescing with the midrib within the lowermost 1-5 mm. or occasionally up to 10 mm. *P. arborescens* commonly is 5-7-nerved and with the nerves free essentially to the base. The petioles range from about 8 to 25 mm. in length, but are mostly about 10 mm. long. They are commonly vaginate near the base, but occasional long petioles may be vaginate to above the middle. The leaves and branches are typically glabrous. Occasional specimens may have one or more sides of the blade near the base, the petiole, and young branches pubescent. This character is noted most commonly on specimens from Truk. It is highly variable, however, with some specimens having both pubescent and glabrous parts on the same plant.

It has not been possible to distinguish between *P. kusaiense*, *P. palauense*, and *P. ponapense*. Hosokawa describes *P. kusaiense* as having 5-6-7-plinerved leaves and those of *P. palauense* as palmately 5-nerved. This character is so variable that it is impossible to maintain a segregation based on it.

Key to Species of Peperomia

Leaves ovate-cordate, alternate, very thin; stems branched, commonly 15-30 cm. tall; spikes slender, longer than leaves; fruit longitudinally ribbed; plants glabrous.....**1. P. pellucida**

Leaves not ovate-cordate; fruit more or less verrucose but not evidently ribbed

Stems glabrous

Leaves mostly scarcely 2 cm. long, oval-ovate, sparsely puberulent, on upper surface glabrescent, ciliolate above middle, at least near apex; plants up to 10 cm. or, rarely, more tall; spikes 3-4 cm. long.....**2. P. kraemeri**

Leaves 2-4 cm. or more long, elliptic or oval to obovate, plants commonly larger

Leaf base obtuse, apex obtusely pointed.....**3. P. mariannensis**

Leaf base acute to cuneate

Leaves mostly widest at or below middle

Leaves predominatingly alternate, mostly elliptic acute.....**4. P. guamana**

Leaves predominatingly opposite, elliptic to elliptic-obovate, mostly obtuse or subacute.....**5. P. volkensii**

Leaves mostly widest above middle, apex shortly attenuate, obtuse or acutish, margin subapically ciliolate; spikes up to 6-8 cm. long
Spikes mostly solitary.....**6. P. ponapensis**
Spikes mostly umbellate in leaf axils or as a loosely branching inflorescence, stigmas bilobulate.....**7. P. gibbonsii**

Stems hairy
Stems sparsely hairy glabrescent.....**4. P. guamana** var. **saipana**
Stems moderately to densely hairy
Leaves opposite or verticillate; stems densely hirtellous.....**8. P. leptostachya**
Leaves alternate [rarely some leaves opposite]
Rachis commonly more or less hairy with scattered hairs, at least below middle, stems rather densely subappressed crisp-puberulent.....**9. P. palauensis**
Rachis glabrous
Leaves commonly 2-3 times longer than wide, elliptic to elliptic-lanceolate, somewhat pubescent on both sides; stem very slender, rather wide-spreading and rooting from the lower nodes, crisp-pubescent; spikes mostly 1-1.5 cm. long, about equaling the slender peduncle.....**10. P. glassmanii**
Leaves mostly 1-1.5 times longer than wide
Leaves mostly 1-2 cm. wide
Stems densely subappressed hirtellous, hairs scarcely 0.25 mm. long; leaves densely ciliated.....**11. P. breviramula**
Stems loosely hirsute, hairs 0.5 mm. or more long, erect; plants mostly less than 15 cm. tall; leaves 1-2 cm. wide and 2-3.5 cm. long; spikes about as long as leaf blades.....**12. P. kusaiensis**
Leaves broadly oval, mostly 2-4 cm. wide, more or less hairy on both sides.....**13. P. trukensis**

1. **Peperomia pellucida** (Linnaeus) Humbolt, Bonpland, and Kunth, Nov. Gen. et Sp. **1**: 64, 1815.—Quisumbing, Philippine Jour. Sci. **43**: 218, fig. 117, 1930.—Trelease and Yuncker, Piperaceae of northern South America, 426, fig. 409, 1950.

Piper pellucidum Linnaeus, Sp. Pl., 30, 1753.

Peperomia pellucida var. *obtusifolia* Koidzumi, Bot. Mag. Tokyo **29**: 248, 1915.

Peperomia yapensis C. de Candolle, IN Engler's Bot. Jahrb. **56**: 504, 1921.

Distribution: Throughout Micronesia.

Guam: *H. L. W. Costenoble 1197* (US); *Thompson* [Guam Experiment Station] *234* (BERLIN, KEW, NY, US); Agana, June 5, 1900, *Seale* (BISHOP).

Yap Islands: Tomil Island, in shade and moist places in forest, alt. 100 ft., July 12, 1946, *Hosaka 3257* (BISHOP, US); Mar. 25, 1938, *Kanehira and Hatusima 4327* (KYUSHU); in moss at base of coconut tree, Jan. 9, 1900, *G. Volkens 343* (BERLIN, type of *P. yapensis*); Yap Island, on rocks and between them, Jan. 8, 1949, *Wong 318* (BISHOP, US); Dogol, Sept. 17, 1939, *Tuyama* (TOKYO); Kanif, in shaded place in forest, May 16, 1936, *Takamatsu 1910* (BISHOP); Mabo, July 23, 1937, *Hosokawa 8824* (US).

Palau Islands: Feb. 1-3, 1951, *G. Koidzumi* (TOKYO); Oct. 1933, *Kanehira and S. Nishida 3* (KYUSHU); Feb. 1925, *Y. Yamada* (TOKYO); Babelthuap, Jan. 1915, *Koidzumi* (TOKYO); Aug. 21, 28, and Sept. 2, 1937, *Tuyama* (TOKYO); Ngarsul, Sept. 13, 1937, *Tuyama* (TOKYO); Ngiwal, July 21, 1946, *Hosaka 3384* (BISHOP, US); Akoru-kaigan [coast], Sept. 21, 1933, *Hosokawa 7101* (BISHOP, AA); Arukoron-son [Ngerehelong], Konrei, Sept. 20, 1933, *Hosokawa 7082* (AA, BISHOP); Angaur, Apr. 1930, *S. Momose* (TOKYO); Feb. 1915, *Koidzumi* (TOKYO); inside of depression on northwest corner of island, alt. 25 m., July 26, 1946, *Fosberg 25910* (BISHOP, US).

Truk Islands: on rocks, Oct. 2, 1947, *Wong 78* (BISHOP, US); Tol Island, Amatang, July 26, 1936, *Hosokawa 8305* (BISHOP); Dublon Island, alt. 50 ft., May 28, 1946, *Hosaka 2758* (BISHOP, US).

Ponape: July 14, 1939, *Hatusima 10740* (KYUSHU); vicinity of Colonia, shade of banana tree, alt. 50 ft., July 20, 1949, *Glassman 2584* (BISHOP, US); Colonia, Not District, alt. 10 m., Aug. 9, 1946, *Wong 60* (BISHOP, US).

Kusaie: Lele islet, coconut grove, July 24, 1949, *Glassman 2709* (BISHOP, US); Jan. 30, 1936, *Takamatsu 332* (BISHOP); Aug. 3, 1933, *Hosokawa 6460* (AA); Lele Island, Lele Harbor, on rocks, alt. 15 m., Aug. 19, 1946, *Wong 79* (BISHOP, US); same locality, Aug. 19-21, 1946, *Fosberg 26552* (BISHOP, US).

Jaluit Island: Jan. 1915, *Koidzumi* (TOKYO), presumably represents the type of var. *obtusifolia*.

Native names: *podpod lahe* (Guam); *rafung* (Yap); *pukkuson* (Truk).

This is a weedy American species which has become very widely distributed throughout Micronesia. It prefers moist shady situations. The pellucid, glabrous, branched plants, cordate-ovate leaves, and

longitudinally striate, apically pointed fruit render this species easy to recognize.

Koidzumi lists his var. *obtusifolia* without description or definite citation of a type collection. The herbarium of Tokyo Imperial University has three sheets representing a collection made by him on Jaluit Island in January 1915. I believe that they are duplicates of the same collection and represent the type of Koidzumi's variety. He gives the distribution of the variety as Micronesia and that of the species as tropical America. No significant differences have been found between the Micronesian specimens cited and those seen from America. *P. lineata* Miquel, a Java species credited to Yap by Volkens (Engler's Bot. Jahrb. **31**: 401, 1901), probably represents *P. pellucida*.

2. **Peperomia kraemeri** C. de Candolle, IN Engler's Bot. Jahrb. **56**: 503, 1921.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 12, fig. 2, 1938.

Distribution: Caroline Islands.

Palau: Koror, *Kraemer* (BERLIN, type); Ins. Baberudaob [Babelthuap], Sept. 4, 1937, *Tuyama* (TOKYO); Ins. Ngarekobasanga [Ngerakabesang], Sept. 10, 1939, *Tuyama* (TOKYO).

The comparatively small plants and small oval or oval-ovate leaves with obtuse or acutish apex and acute base characterize this species. The plants are glabrous or often the leaves bear a few scattered hairs near the base or along the nerves on the upper side of the blade.

3. **Peperomia mariannensis** C. de Candolle, IN DC. Prodromus **16** (1): 442, 1869.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 15, fig. 4, 1938. (Not Hosokawa 1935.)

I had the opportunity, in 1938, of studying the fragmentary type specimen of this species which was collected by Gaudichaud in the Mariana Islands and which was then in the Berlin herbarium. At that time I concluded that, while it resembled *P. guamana* in many respects, the oppositely arranged leaves with obtuse apex and base sufficiently distinguished it to warrant its being maintained as a distinct species. While *P. guamana* occasionally has some leaves opposite, they are acute at both ends. In the abundant material now available for study I have been unable to recognize any additional collections that could be interpreted as being this species. This fact creates the suspicion that *P. mariannensis* may represent a variant of what now passes as *P. guamana*. If this is subsequently shown to be the correct interpretation

of these two species, the name *mariannensis,* having priority, would replace *guamana.*

4. **Peperomia guamana** C. de Candolle, Philippine Jour. Sci. **9**: 72, 1914.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 13, fig. 3, 1938.

Peperomia hoeferi C. de Candolle, IN Engler's Bot. Jahrb. **55**: 505, 1921.

Peperomia mariannensis Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 120, 1935.

Peperomia tiniannensis Hosokawa, MSS., ex Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 121, 1935.

Peperomia guamana var. *guamana.*

Distribution: Mariana and Palau Islands.

Agrigan: canyon on east side of island, *Fosberg 31612* (BISHOP, US), common on vertical scoria walls, on volcanic ash soil, and lava rocks, Feb. 17, 1950.

Alamagan: July 29, 1934, *Hosokawa 7908* (BISHOP, AA); growing in deep shade on large boulder, alt. 150 m., Oct. 2, 1949, *Anderson 408* (BISHOP, US); around Partido village, epiphytic on tree trunks in forest near head of wooded lava flow, Feb. 18-19, 1950, *Fosberg 31674* (BISHOP, US); same locality and date, on rocks on wooded lava flow surface, *Fosberg 31678* (BISHOP, US).

Saligan [Sarigan]: July 5, 1933, *Kanehira 2171* (KYUSHU, NY).

Saipan: Apr. 1930, *Momose* (TOKYO); on limestone, Feb. 13, 1903, *Hoefer 38* (BERLIN, type of *P. hoeferi*); Charan-Tarhoho [Talafofo], on tree trunk, alt. 200 ft., June 21, 1946, *Hosaka 3008* (BISHOP, US); July 1930, *Kanehira 986* (KYUSHU, NY); Pagan, July 6, 1934, *Hosokawa 7987* (AA); Aug. 18, 1937, *Tuyama* (TOKYO).

Tinian: July 2, 1933, *Hosokawa 7823* (BISHOP), cited by Hosokawa as *P. kraemeri;* Sept. 19, 1937, *Tuyama* (TOKYO).

Rota: 1945, *Necker R71* (US); Mt. Kokoa, July 17, 1934, *Hosokawa 7665* (AA, BISHOP), cited by Hosokawa as representing his *P. mariannensis;* in damp places, July 1932, *Kanehira 1739* (KYUSHU); Aug. 12, 1935, *Kanehira 3636* (KYUSHU).

Guam: 1914, *Nelson 13* (US); Oct. 1911, *R. C. McGregor 629* (US, type number); *Costenoble 1196* (US); Talofofo, on a rock on

the north side of Talofofo Valley, about one-half mile from sea, alt. 10 m., Apr. 1, 1936, *Bryan 1044* (BISHOP, US); Talofofo Point, on a rock in moist lower forest, alt. 90 m., Apr. 11, 1936, *Bryan 1116* (BISHOP, NY); near Talofofo River, Sept. 31, 1945, *R. Rodin 695* (US); summit of Mt. Lamlam, growing in shade, alt. 400 m., Sept. 4, 1949, *Anderson 145* (BISHOP, US); same locality, Oct. 28, 1949, on limestone, *Anderson 334* (BISHOP, US); ridge south of Mt. Lamlam, alt. 385 m., Dec. 30, 1953, *Fosberg 35336* (US); on rock in dense moist woods, north end, Tumon Bay area, alt. 5-100 ft., Mar. 23, 1946, *Moore 395* (US); in coral shaded by trees of woodland, one mile east of Barrigada, alt. 400-600 ft., Nov. 20, 1945, *Moore 48* (US); Anao, east-northeast of Mt. Santa Rosa, common on rough limestone cliff, alt. 140 m., Jan. 22, 1954, *Fosberg 35516* (BISHOP, US); on limestone in open wood, above Anao Point, Aug. 1, 1954, *Moran 4540* (US); southwest of Anao Point, occasional on rock of cliff in patch of rather broken down forest, alt. 200 m., Mar. 3, 1950, *Fosberg 31939* (BISHOP, US); Chalandao, 1 km. southeast of Jumujong Manglo Mt., epiphytic in knothole on tree trunk in wooded ravine, alt. 320 m., Jan. 6, 1954, *Fosberg 35377* (BISHOP, US); Upi, northeast point, on rocks in moist limestone forest, alt. 175 m., May 5, 1936, *Bryan 1265* (BISHOP); Ritidian Point, in forest on limestone, alt. 400 ft., July 1, 1946, *Hosaka 3093* (BISHOP, US); Ritidian Point, on rocks on limestone slope under moist forest, alt. 50-150 m., Apr. 16, 1936, *Bryan 1156* (BISHOP); on rocks in trail to lighthouse, alt. 180 m., Apr. 16, 1936, *Bryan 1174* (BISHOP); Machanao District, on rocks and tree trunks in moist limestone forest, alt. 11 mm., Apr. 16, 1936, *Bryan 1187* (BISHOP, KYUSHU).

Agiguan: north end on limestone boulders, June 3, 1952, *Kondo* (BISHOP).

Palau Islands: middle of northeast coast of Magaiald (north arm of Urukthapel Island), southwest shore of Malakal Harbor, rock crevices and ledges just above sea, July 23, 1946, *Fosberg 25869* (BISHOP, US), slightly atypical but agrees best with this species.

Peperomia guamana var. **saipana** (C. de Candolle) Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 15, 1938.

Peperomia saipana C. de Candolle, IN Engler's Bot. Jahrb. **56**: 505, 1921.

Distribution: Endemic to the Mariana Islands.

Saipan: 1903, *Fritz* (BERLIN, type of *P. saipana*); Mar. 25,

1938, *Kanehira and Hatusima 4319* (KYUSHU); Aug. 8, 1935, *Kanehira 3569* (KYUSHU). Pagan, July 30, 1934, *Hosokawa 8023* (AA, BISHOP).

Typically, *P. guamana* is a plant scarcely more than 15 cm. tall and with leaves mostly 2 to 4 cm. in length. The stem is entirely glabrous and the leaves are glabrous with the exception of an obscure ciliolation at the extreme apex and occasionally with a few, minute, crisp hairs near the base of the blade on the upper side. The leaves are alternate or occasionally opposite. This form appears, for the most part, to be restricted to Guam. On the more northern islands of the Marianas grow plants up to 20 or 30 cm. tall and with leaves up to 6 cm. long, but they are otherwise indistinguishable from the typical form on Guam. Intermediates between the extremes are common, and it seems inadvisable to recognize this larger form with a name. It is interesting to note, however, that while the typical form appears to be mostly restricted to Guam, the larger form is scarcely at all represented on that island. Variety *saipana* differs in having sparingly hirtellous stems and leaves with slightly more ciliolation.

5. **Peperomia volkensii** C. de Candolle, IN Engler's Bot. Jahrb. **56**: 503, 1921.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 17, fig. 5, 1938.

Distribution: Endemic to Kusaie.

Kusaie: *T. Kamiya,* without date or number (TOKYO); July 28, 1933, *Hosokawa 6177* (AA); Lele Island, Lele Harbor, walls of ruined temple court, basalt blocks, alt. 1-5 m., Aug. 19-21, 1946, *Fosberg 26538* (BISHOP, US); "Auf Mauern in Lele bei Kussai," Oct. 9, 1899, *Volkens 2* (BERLIN, type); near Maarem [Malem?], epiphytic on tree trunk, alt. 200 m., Aug. 10, 1939, *Hatusima 11144* (KYUSHU), questionably referred here.

This species resembles *P. guamana* in many respects. Occasional leaves in that species are opposite, but in *P. volkensii* they are predominatingly opposite. It differs from *P. leptostachya,* also with opposite leaves, because of its lack of pubescence.

6. **Peperomia ponapensis** C. de Candolle, IN Engler's Bot. Jahrb. **56**: 504, 1921.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 17, fig. 6, 1938.

Distribution: Caroline and Marshall, and possibly Mariana, Islands.

Saligan: July 5, 1933, *Kanehira 2171* (NY).

Saipan: *Kanehira 986* (NY).

There is some question whether these two specimens, which are poorly prepared, represent this species. The disjunctive distribution would render them suspect although they appear to agree best with this species.

Ponape: Nanmatol, Kalau-Buschwald auf den Ruinen der alten Stadt, auf den Basaltblocken der Ruine, Jan. 8, 1914, *Ledermann 13984* [not 13914, as cited by de Candolle] (BERLIN, type; Kew); in strand, Aug. 16, 1929, *Kanehira 858* (KYUSHU, NY); Matalanim District, Sabera, Aug. 2, 1949, *Glassman 2760* [?, labels mixed] (US); Nanmatol Ruin, Metalanim, alt. 1 m., July 30, 1929, *Hatusima 11124* (KYUSHU); Nanmatol Islet, Matalanim District, in crevices in basalt temple wall, alt. 1-3 m., Aug. 11, 1946, *Fosberg 26379* (BISHOP; US, topotype); on coral rock fill, same locality, date, and altitude, *Fosberg 26377* (BISHOP, US); Jokazi [Jokaj, or Sokehs] Rock, on rock surface, alt. 100 m., July 24, 1939, *Hatusima 10976* (KYUSHU).

Pingelap Island: on coral stone wall in moist forest, pounded leaves used as a poultice on boils, Dec. 27, 1945, *H. St. John 21475* (BISHOP, US); same locality, July 22, 1949, on rocks, common, *Glassman 2650* (BISHOP, US).

Arno Atoll: west side of Taklebej [East Takleb] Islet, on densely shaded coarse coral rubble, June 19, 1950, *E. L. Stone 1032* (BISHOP, US); Arno Atoll, Kijbwe Islet, May 22, 1950, *Anderson 3745* (BISHOP, US); Jaluit Atoll, Imroj Islet, common at north end of islet on broken coral under coconuts, alt. 1-3 m., Aug. 23-24, 1946, *Fosberg 26734* (BISHOP, US); Lae Atoll, Lae Islet, several small colonies on boulders in east end of patch of *Barringtonia* forest on seaward boulder ridge and flat, alt. 1-3 m., *Fosberg 34027* (BISHOP, US).

Native names: *rabikiaga* (Lae Atoll); *rebijrege* (Jaluit Atoll); *drebijdreke* (Arno Atoll); *warin* (Pingelap). The plants are used medicinally.

The glabrous plants with obovate or oval-obovate, bluntly pointed leaves up to 5 cm. long and with spikes up to 6 cm. long characterize this species. The plants tend to become yellowish-green when dry. Schumann (Engler Bot. Jahrb. **9**: 198, 1888) credited *P. pallida* A. Dietrich, a Polynesian species, to Ebon Atoll in the Marshalls. So far as is known, this species does not occur in Micronesia and it is believed

that the material on which the reference was based possibly represents *P. ponapensis.*

7. **Peperomia gibbonsii** C. de Candolle, IN Engler's Bot. Jahrb. **56**: 54, 1921.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 10, fig. 1, 1938.

Distribution: Endemic to the Marshall Islands.

Ailinglapalap: in the middle of the island in shade of coco palm on basaltic rocks, spikes violet, Feb. 20, 1912, *C. Gibbons 1072* (BERLIN, type).

This species is glabrous with the exception of a few hairs on the upper surface near the base and at the tip of the elliptic-obovate leaves. The spikes are commonly multiple either as umbellate axillary clusters or in the axils of small leaflike bracts forming a loosely branching inflorescence. The arrangement of the spikes appears to be unique among Micronesian species. Bilobulate stigmas occur not infrequently among other species, but this character is especially noticeable in the type specimen of this species.

8. **Peperomia leptostachya** Hooker and Arnott, Bot. Beechey Voy., 96, 1832.—Yuncker, B. P. Bishop Mus., Bull. **112**: 57, fig. 16, 1933; B. P. Bishop Mus., Occ. Papers **14** (2): 22, 1938.

Distribution: Caroline Islands. Rather widespread in Polynesia.

Palau: on island near Koror, July 9, 1929, *Kanehira 243* (KYUSHU, NY); Todaiyama, an elevated coral island, April 1938, *Kanehira and Hatusima 4644* (KYUSHU).

This common Hawaiian species appears to be infrequent in Micronesia. The rather densely hirtellous stems and opposite or verticillate, oval or oval-obovate leaves, and comparatively long spikes characterize it. In Hawaii it is most frequent in rocky areas at low altitudes. The Micronesian collections cited above show minor variations from those from Hawaii, but it is not believed that the differences are significant.

9. **Peperomia palauensis** C. de Candolle, IN Engler's Bot. Jahrb. **56**: 505, 1921.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2): 20, fig. 7, 1938.

[?] *Peperomia pacifica* Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 119, 1935 [type not seen].

Distribution: Mariana and Caroline Islands.

Saipan: Apr. 1930, *Momose* (TOKYO).

Palau: Feb. 1-3, 1915, *Koidzumi* (TOKYO); Aurapushekaru (Ulebsehel) Island, Oct. 8, 1933, *Hosokawa 7465* (AA, BISHOP); same locality, Aug. 28, 1937, *Hosokawa 9112* (AA, BISHOP), very small, sterile plants presumably this species; Ngaiangas Island, in Yoo (Sar) Passage just west of south point of Urukthapel Island, common on rocks in shade, alt. 2-25 m., July 23-24, 1946, *Fosberg 25843* (BISHOP, US); Arumizu (Ngarmid), Aug. 26, 1937, *Hosokawa 9083* (AA); Makarakol [Malakal?], Sept. 10, 1937, *Hosokawa 9235* (AA); Gatulel-to, Ailai-son, Sept. 29, 1933, *Hosokawa 7305* (AA); Makarakaru [Malakal?], Sept. 10, 1937, *Tuyama* (TOKYO); Koro, alt. 10-100 m., Feb. 7, 1914, *Ledermann 14102* (BERLIN, type); Aug. 10, 26, 1939, *Tuyama* (TOKYO).

This species bears some superficial resemblance in the size of the plants and general shape of the leaves to *P. guamana* but differs in the strongly hairy stems and leaves and, especially, in the more or less hairy rachis. The hairs on the rachis are usually few and scattered and are more abundant in the lower half. They are usually identifiable with the aid of strong magnification, although some spikes may appear to lack hairs. The stem hairs are mostly crisp and upwardly subappressed.

10. Peperomia glassmanii, n. sp. (fig. 1).

Herba subrepens epiphytica; caule gracili crispo-pubescente, indumento sub 0.25 mm. longo; foliis alternis ellipticis vel elliptico-lanceolatis acutis vel foliis parvis inferis obovatis obtusis utrinque dissite crispo-pubescentibus, valde ciliatis, palmatim 3-5 nerviis; petiolo gracili crispe pubescente; spicis oppositifoliis terminalibusve gracili, pedunculo gracili spicam aequante, drupa globoso-ovoidea, stigmate subapicali.

A somewhat trailing wide-spreading epiphyte. Stems slender (about 1 mm. thick when dried), rooting from lower nodes, branching, with erect branches up to about 15 cm. tall, crisp-pubescent, the hairs less than 0.25 mm. in length. Leaves alternate, elliptic or elliptic-lanceolate, or small lower leaves obovate, acute at both ends or obovate leaves rounded at apex, palmately 3-5-nerved, the nerves very slender, when 5-nerved outermost pair of nerves scarcely reaching middle of leaf, thinly crisp-hairy on both sides especially along nerves, strongly marginally ciliate, mostly 1-1.5 cm. (0.7-2 cm.) wide and 2-4 (1.5-5 cm.) long, the petiole slender, mostly 3-5 mm. long, crisp-pubescent. Spikes leaf-opposed and terminal, slender, mostly 1-1.5 cm. long, the peduncle filiform, crisp-pubescent, about as long as the spike, the bracts round, peltate, the fruit globose-ovoid, about 0.4 mm. long, the stigma slightly below the blunt apex.

Distribution: Endemic to Ponape.

Ponape: 1913-1914, *L. Ledermann 13175* (BISHOP); Jan. 1915, *Koidzumi* (TOKYO); Mt. Kankauzan, July 8, 1933, *Hosokawa 5481* (AA, BISHOP); Nunivani, Aug. 12, 1933, *Hosokawa 5701* (AA); Tolun Nanket, mountain above Nanipil, drainage of Tawenjokola

River, Not District (above power plant), rare on tree trunks in wet mossy ridge-top forest, alt. 600 m., Aug. 13, 1946, *Fosberg 26423* (BISHOP, US); same locality and date, *Fosberg 26434* (BISHOP, US); same locality and date, *Fosberg 26456* (BISHOP, US); Mt. Troton [Tolotom?], mountain ridge, Aug. 16, 1936, *Hosokawa 9534* (AA, BISHOP), this specimen is immature and fragmentary and is included questionably; Tolomail, in palm forest, common, Feb. 11, 1936, *Takamatsu 981* (BISHOP); in forest, Feb. 11, 1936, *Takamatsu 986* (BISHOP); Mt. Tamatamansakir (Temwetemwensekir),

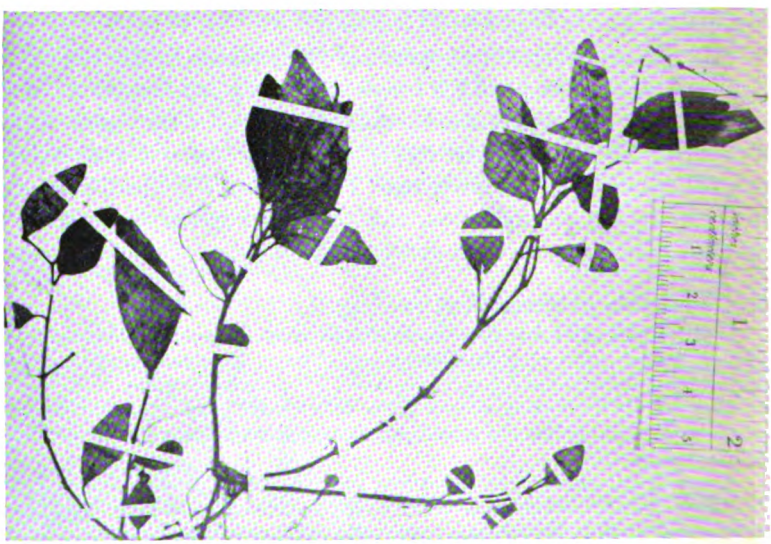

FIGURE 1.—*Peperomia glassmanii*, type specimen.

common in rain forest, alt. 1,200 ft., June 23, 1949, *Glassman 2328* (BISHOP, US); Mt. Tolotom, frequent as epiphyte, alt. 1,200 ft., Aug. 11, 1949, *Glassman 2844* (BISHOP, type; US); Mt. Tolenjiup (Tolenkiup), alt. 500 ft., July 14, 1949, *Glassman 2530* (BISHOP, US); Sankaku-yama (Dolen Eireke), in forest at low altitude, Aug. 12, 1929, *Kanehira 756* (KYUSHU, NY); Nihpit, epiphytic on tree trunk, alt. 400 m., July 19, 1939, *Hatusima 10880* (KYUSHU); Mt. Nanalaut, rain forest, alt. 2,000 ft., June 28, 1949, *Glassman 2386* (US).

This species resembles *P. huahinensis* Yuncker of the Society Islands to some extent but differs in several characters, notably the pubescence and the leaf-opposed spikes. It has been confused with both *P. breviramula* and *P. palauensis*. From *P. breviramula* it differs strongly in the shape and proportion of the leaves, though that species also has short leaf-opposed spikes and densely ciliated leaves. From the latter, with which I formerly confused it, it differs in the size and proportions of the leaves, the shorter spikes, and the absence of any rachis hairs.

11. **Peperomia breviramula** C. de Candolle, IN Engler's Bot. Jahrb. **56**: 503, 1921.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2) : 22, fig. 8, 1938.

Distribution: Endemic to Ponape.

Ponape: Paue, Montesanto, alt. 700-800 m., Dec. 14, 1913, *Ledermann 13739* (BERLIN, type; KEW); Nihpit, epiphytic on tree trunk, alt. 350 m., July 19, 1939, *Hatusima 10858* (KYUSHU), leaves larger than in the type collection.

The small plants, shape and size of the densely ciliated leaves, and short spikes characterize this species. It resembles *P. glassmanii* in the leaf ciliation and in the size of the spikes but differs strongly in the shape and the size of the leaves.

12. **Peperomia kusaiensis** Hosokawa, Nat. Hist. Soc. Formosa, Trans. **25**: 120, 1935.—Yuncker, B. P. Bishop Mus., Occ. Papers **14** (2) : 24, 1938.

Distribution: Endemic to Kusaie.

Kusaie: Mt. Buache, alt. 500 m., Aug. 11, 1939, *Hatusima 11180* (KYUSHU); same locality, in *Eugenia-Astronia* association, July 29, 1933, *Hosokawa 6278* (AA, type number); Mt. Matante, on ground, Jan. 22, 1936, *Takamatsu 566* (BISHOP); north ridge of Mt. Matante (Buache), above Tafonshak (Tafunsak) Village, north side of island, in dense primary forest of *Astronidium* and *Elaeocarpus*, with *Cyathea* above, dense undergrowth of ferns, changing below to *Hibiscus tiliaceus*, rare, on mossy tree trunks, Aug. 20, 1946, *Fosberg 26604* (BISHOP, US); Matante, Mar. 8, 1937, *Kanehira 4231* (KYUSHU).

This species is characterized by plants mostly less than 15 cm. tall, by branching stems, by elliptic leaves, mostly 1-2 cm. wide and 2-3.5 cm. long or rarely slightly larger, by spikes about as long as the leaf

blades, by the loosely hirsute stem with the hairs more or less erect and 0.5 mm. or more long, by the somewhat pubescent leaves on both sides, and by the ciliate margin. The comparatively long hairs on the stem and leaves distinguish this species from other Micronesian pubescent species which, for the most part, have shorter and usually subappressed pubescence.

13. Peperomia trukensis Yuncker, B. P. Bishop Mus., Occ. Papers **14** (*2*) : 23, fig. 9, 1938.

Distribution: Caroline Islands.

Truk Islands: Wara, Mt. Tikuman, July 17, 1936, *Hosokawa 8473* (AA, BISHOP); Natu Sima (Dublon), July 22, 1936, *Hosokawa 8360* (AA, BISHOP, US); Tol Island, Unibot, July 25, 1936, *Hosokawa 8251, 8283* (AA, BISHOP), these last two specimens are very poor and are questionably included here; Tol Island, on shaded ground or rock, Jan. 3, 1936, *Takamatsu 21* (BISHOP, type); Dublon Island, slopes, upper ridges and top of Mt. Tolomen (Tolowan), on rocks, steep wooded slopes and ridges, partially cleared and cultivated below, alt. 200-360 m., May 28, 1946, *Fosberg 24550* (BISHOP, US).

Ponape: Gyokuzi (Jokaj) Island, Aug. 26, 1933, *Hosokawa 6054* (AA, BISHOP).

The comparatively large, broadly oval, pubescent leaves, and pubescent stems characterize this species.