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Diospyros ferrea (Ebenaceae) in Hawaii

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INTRODUCTION

Diospyros, the Hawaiian *lama,* is represented in the Hawaiian islands by two species long known as *Maba sandwicensis* and *Maba Hillebrandii.* The genus *Maba,* though originally seeming to be distinct, has, through recent botanical exploration of the Asiatic and American tropics, been found to be more and more indistinguishable from *Diospyros*[1].

Resting originally on the characteristic trimerous flower and 3-or 6-celled ovary, as opposed to 2-, 4-, or 5-merous flower and 2-, 4-5-, 7-20-celled ovary in *Diospyros, Maba* always has seemed a rather artificial genus. Why pick out the plants with a three-parted flower as a separate genus any more than those with any other number? Recent explorations have revealed species in which the flower is not on the plan of three, though the perianth or some other one set of parts is. In this study, careful scrutiny of a number of specimens, not different in any other way, shows that 4-merous flowers are not at all uncommon in typically 3-merous Hawaiian plants. Together with the absolute lack of distinct geographic ranges, these facts leave little excuse except inertia for maintaining two genera.

In order to refer to the Hawaiian plants under *Diospyros,* in 1936 I transferred both species to that genus.

Recurring reference to *Maba sandwicensis* from Fiji and other

[1] See R. C. Bakhuizen van den Brink, Gard. Bull., Straits Settlem., 7: 161, 1933, and P. C. Standley, Carnegie Inst. Washington, Pub. 461: 79-80, 1935.

western Polynesian localities led me to study the specimens of this genus available in the herbaria of Bishop Museum and the New York Botanical Garden. Certain plants were found which greatly resemble the Hawaiian ones. Some of these had been referred also to *Maba buxifolia (Diospyros ferrea)*. A large series of the latter species and its close relatives, extending from India and Ceylon to Australia, Micronesia, Melanesia, and Fiji is available in the New York herbarium. The necessity to resort to the most minute of characters to separate *Diospyros sandwicensis* from this mass of material was soon apparent. It became a choice of a great number of very poorly distinguished species or a large and variable single species extending over a wide geographic range. The Hawaiian plants differ far more among themselves than some do from much of the material of *D. ferrea.* To maintain the Hawaiian plants as distinct would necessitate the description, even in the Hawaiian islands, of a number of poorly separable species. The range of fruit size of Hawaiian specimens would include all but the smallest in *D. ferrea.* In leaf shape, most of the types are represented in Hawaii, as are all but the extremes in amount of pubescence. The flowers which are rarely present on the specimens, are variable but offer few definite differences. The calyces of the Hawaiian and the western Pacific forms range from cupulate to practically flat, though in Hawaii the flatness never reaches an extreme type with the lobes reflexed.

Before these observations had even been put on paper, a revision of the Malayan Ebenaceae by R. C. Bakhuizen van den Brink appeared (Bull. Jard. Bot. Buitenzorg, III, 15, 1936) in which he set forth practically the same conclusions. Bakhuizen reduces most of the species in Hiern's section *Ferreola* to two widespread and variable species: *D. ferrea* including those with sessile or almost sessile inflorescences, and *D. ellipticifolia* including those with pedunculate inflorescences. He even makes *D. Hillebrandii* a variety of *D. ferrea. Maba sandwicensis* is reduced to *D. ferrea* var. *sandwicensis,* and to it is referred *Maba nandarivatensis* Gillespie from Fiji. He makes no attempt to segregate forms within var. *sandwicensis* or to divide it in any way. Skottsberg's *Maba sandwicensis* var. *pubescens* is reduced to var. *sandwicensis* without comment.

Though I am glad to be relieved of the responsibility of reducing *D. sandwicensis* to a variety of *D. ferrea,* and willing to follow

Bakhuizen in this, I think it impossible to consider *D. Hillebrandii* as a part of this species. It seems to be a distinct species. Nor can I include the Fijian forms in var. *sandwicensis*; I believe they are related, but distinct varieties.

Diospyros ferrea var. *sandwicensis,* even in Hawaii, is not a homogeneous group. Everyone who has studied the plants in the field realizes this. Hillebrand recognized a var. β, also recognized by Rock, and named by Skottsberg. St. John has remarked, in conversation, on the necessity for a revision of the group, and Degener urged me to work over his material, pointing out several forms he considers distinct.

Here are presented the results of an attempt to work out the entities present in the Hawaiian branch of *Diospyros ferrea. D. Hillebrandii* is well separated by its glabrous calyx with acute lobes, and its peculiar, large, comparatively thin, oblong, strikingly reticulate leaves, and need not be mentioned further. It has so far been found only on Oahu and Kauai. No one who has seen it growing would include it in *D. ferrea.* My notes on the western Polynesian plants previously grouped with the Hawaiian ones have been presented previously (Bull. Torr. Bot. Club **65**(9) : 607, 1938).

I wish to express my appreciation to the Bishop Museum authorities and to Otto Degener for loans of many specimens, to the authorities of the New York Botanical Garden for the use of their extensive *Diospyros* collection, and to E. Y. Hosaka of Honolulu, for collecting specimens at my request. In citations of specimens below, those in Degener's herbarium are indicated by (D); those not so indicated are in Bishop Museum. Duplicates of many of the collections cited are in the herbaria of the New York Botanical Garden and the University of Pennsylvania.

Diospyros ferrea (Willd.) Bakhuizen, Gard. Bull. Straits Settlem., **7**: 162, 1932.

Maba buxifolia (Rottb.) A. L. Juss., Ann. Mus. Hist. Nat. **5**: 418, 1824. Not *Diospyros buxifolia* Hiern.

Ehretia ferrea Willd., Phytogr., **1**: 4, 1794.

Highly variable shrubs or trees with mostly ovate, oblong, or elliptical leaves, usually more or less strigose or hirsute, often glabrate; flowers single or in groups, sessile or very shortly peduncled, pistillate larger and more often solitary; calyx strigose or hirsute, usually three parted, lobes acute, becoming more or less accrescent in fruit, the lobes becoming obtuse, rounded or obscure;

corolla ovoid, silky outside except the margins of the rounded lobes; stamens variable in number, 3-18 or more; ovary hirsute; fruit cylindrical to globose, 1-2.5 cm. long, yellow, orange, red, or purple, with thin sweetish flesh and one or two hard seeds.

Range: India and Ceylon to the Hawaiian islands. Not known from southeastern Polynesia.

Though Hawaiian forms differ conspicuously among themselves, there is little doubt that they are phylogenetically more closely related to each other than to any of the extra-Hawaiian varieties within the species. They have several characteristics in common, and there is much intergradation among all of them. Together they may be conveniently regarded as forming an endemic Hawaiian subspecies.

Diospyros ferrea subsp. **sandwicensis** (A. DC.) Fosberg, n. subsp.

Maba sandwicensis A. DC., DC. Prodr., **8**: 242, 1844.

Ebenus sandwicensis O. Ktze., Rev. gen. pl., **2**: 408, 1891.

Diospyros sandwicensis (A. D.C.) Fosberg, B. P. Bishop Mus., Occ. Papers, **12**(15): 8, 1936.

Diospyros ferrea var. *sandwicensis* (A. DC.) Bakh., Bull. Jard. Bot. Buitenzorg, III, **15**: 58, 1937 (excl. syn. *M. nandarivatensis*).

Arbores, rami nigro-verrucosi, ramuli et folia aureo-strigosa glabrata, folia coriacea, flores sessiles vel subsessiles, lobae calycorum in fructubus non reflexae.

Usually trees, with blackish verrucose branches, young growth strigose or substrigose with, usually, golden stiff hairs, more or less glabrate; leaves more or less rugulose above, or reticulate, venose beneath when dry; calyx strigose or substrigose outside, lobes strigose inside, united portion glabrous inside, accrescent in fruit, more or less cupulate, lobes seldom or never reflexed, fruit orange to red when ripe, sparsely strigose or glabrate, 1.5-2.5 cm. long, cylindrical or ovoid to obovoid or almost globose, usually obtuse but shortly tipped with the persistent style; seeds usually two, very hard, plano-convex, usually unequal in size.

Range: found on Hawaii, Oahu, Kauai, Maui, Lanai, and Molokai.

Probably most closely related to the several Fijian varieties of this species.

Working out the entities within this group has been extremely difficult. While it is quite obvious that there is a number of distinct varieties, with fairly good geographic ranges, several factors obscure their delimitation. The plants vary greatly with the maturation of each year's growth. Pubescence becomes much less, leaves become stiffer, the flowers last only a short time and are not often collected, and it is hard to ascertain the state of maturity of the fruits after

they are dried. When they are neither too young nor fully mature they hold their shape well. There is considerable fluctuating variation, as shown by the different sizes and shapes of leaves found even on the same plant. Hybridization, which undoubtedly takes place, is not easily detected as varietal differences are not clear.

It seems, from the distribution of some of the forms, that interisland transportation of seeds must have taken place. Rock (Indigenous trees of the Hawaiian islands, p. 395, Honolulu, 1913) mentions that the fruits are eaten by birds, but it is unlikely that any of the native land birds, perhaps with the exception of the crow, swallowed the large seeds of this tree.

The type of classification presented here—a broad species concept, with several ranks of subdivisions of the species—is often objected to on the basis of clumsiness in everyday use. Were it necessary to use the whole series of names applying to a given form, the criticism would be justified. The simplest system, one often recommended, is a binomial for each discernible form. The criticism of this method is the number of binomials that must be learned and the impossibility of field determination and the fact that it permits no expression of degree of difference or evolutionary relationship.

The other extreme is to recognize only broad species and to ignore subdivisions entirely. This is, of course, quite permissible under the system here used. The simple binomial, *Diospyros ferrea,* will satisfy the needs of the average worker. If trinomials are desired, the International Rules for Nomenclature permit the use of any one of the subspecific categories in addition to the binomial.

I feel that the taxonomist's task does not end with the recognition of the obvious, broad species. Recent developments in genetics, such as the scatter effect, and the genetics of small inbreeding populations, based on sound mathematical and experimental data, show that in insular populations, such large numbers of slightly differing forms and varieties are to be expected.

It seems that these forms are of sufficient importance in evolutionary and phytogeographic considerations and in the relationship of botany to paleogeography, that they must be recognized and made usable to students. It also seems desirable to indicate degree of difference or relationship of these forms by a graduated series of categories as is provided by the rules of nomenclature, even though

their exact phylogenetic significance may not be certain. If carefully worked out they are likely to be just as significant in this sense as any taxonomy not on an experimental basis. Such a system seems to me to come nearer to satisfying the demands, both of the professional botanist and of the amateur, than any other.

Construction of a key to the plants here treated is unsatisfactory because of the nature of the characters available for classification and the necessity for using vegetative characters. A key based on flowers or mature fruits, or both, would most frequently be useless and merely a source of annoyance. The existence of probable hybrids does not increase the usefulness of any key. However, an attempt is presented here, and it may be discarded if it does not prove useful.

A. Young growth lightly strigose, early glabrate (var. *sandwicensis*).
  B. Leaves obtuse or rounded at apex, under 5 cm. long.....f. **obtusa**
  BB. Leaves acute or over 6 cm. long.
    C. Petioles persistently hairy.....f. **wailauensis**
    CC. Petioles early glabrate.
      D. Leaves subcoriaceous.
        E. Leaves under 5 cm. long.....f. **ovata**
        EE. Leaves over 5 cm. long.....f. **subcoriacea**
      DD. Leaves coriaceous.....f. **sandwicensis**
AA. Young growth densely strigose and only tardily glabrate.
  B. Leaves foveolate-reticulate above.....var. **Toppingii**
  BB. Leaves only minutely rugulose above.
    C. Leaves lanceolate, ovate-lanceolate, elliptic-lanceolate, or oblong-lanceolate, or if broader, then 2-4.5 cm. long, base rounded or obtuse, rarely acute.
      D. Leaves mostly at least 10 cm. long.....var. **kauaiensis** f. **Wiebkei**
      DD. Leaves not usually over 7 cm. long (var. *pubescens*).
        E. Leaves strongly stiff coriaceous, 2-4 cm. long.....f. **sclerophylla**
        EE. Leaves merely coriaceous, mostly 5-7 cm. long.....f. **pubescens**
    CC. Leaves ovate, oblong, or oval, well over 4 cm. long, base obtuse, rounded, or cordate, stiff-coriaceous.
      D. Leaves ovate-cordate, about 10 cm. long, apex acute.....var. **kauaiensis** f. **kauaiensis**
      DD. Leaves oblong or oval, seldom over 8 cm. long, apex obtuse or rounded (var. *Degeneri*).
        E. Plant strigose, hairs closely appressed.....f. **lanaiensis**
        EE. Plant densely substrigose, hairs not closely appressed, those on calyx, especially, almost spreading.....f. **Degeneri**

Diospyros ferrea var. **sandwicensis** (A. DC.) Bakh., Bull. Jard. Bot. Buitenzorg, III, **15**: 58, 1937, pro parte (excl. syn. *Maba nandarivatensis, Maba sandwicensis* var. *pubescens*).

Branchlets slender, plant sparsely strigose on young parts but early glabrate, leaves ovate-lanceolate, elliptic-lanceolate, narrowly oblong, lanceolate, or elliptic, up to 10 cm. long and 4 cm. wide, but ordinarily much smaller, base acute to rounded, usually obtuse, apex acute to rounded, usually acute, usually coriaceous but not extremely so; fruit cylindrical to obovoid, rarely almost spherical, 1-2 cm. long, 1-1.2 cm. wide, usually early glabrate.

Range: the common variety on Oahu, more rare on the other islands. Evidently hybridizes occasionally with other varieties.

Five forms are here separated. More might be recognized, but the lines between them would have to be purely arbitrary, so they are left in f. *sandwicensis,* but mentioned in the citations.

There is a distinct tendency, in a dry locality, for the upper surface of the leaves to become reticulate. A specimen from Oahu, Waianae Mountains, Mauna Kapu, *Degener 12005* (D), is so reticulate that it seems to be an intergrade, perhaps a hybrid, with var. *Toppingii,* from the same general region, although it is not as hairy as variety *Toppingii.*

Another collection from Oahu, head of Makua Valley, Waianae Mountains, *Degener and Nitta 11992* (D), with broad, heavy leaves, often subcordate, seems to be a hybrid with var. *kauaiensis,* which has been collected in the Waianae Mountains.

Diospyros ferrea var. **sandwicensis** f. **sandwicensis** (A. DC.) Fosberg, n. f.

Maba sandwicensis A. DC., in DC. Prodr. **8**: 242, 1844.

Folia coriacea ad apicem acuta, petiola glabrata.

Leaves coriaceous, apex ordinarily acute, petiole early glabrate.

Oahu, Koolau Range: Punaluu, alt. 1,900 ft., *St. John 10079*; Castle Trail, Punaluu Valley, alt. 500 m., *Fosberg 13745*; Wahiawa, north fork Kaukonahua Gulch, *Rock and Hosmer 8717;* Waikane-Schofield Trail, alt. 1,400 ft., Oct. 16, 1932, *Hanson*; north ridge, Kahaluu Valley, alt. 350 m., *Fosberg 12190*; Kipapa Gulch, alt. 1,750 ft., *Bryan 779*; Halawa Ridge, alt. 450 m., *Fosberg 13851*; Honolulu, Kapalama Heights, Kamehameha Girls' School, March 21, 1932, *A. F. Judd*; Nuuanu-Lanihuli Trail, *Garber 275*; ridge east of Hillebrands Glen, *Forbes 1045.O*; Nuuanu Valley, *Rock and Kauka 1912*; northeast of Nuuanu Pali, *Degener 12004, Degener and Nitta 12007*

(D); Manoa Cliff Trail, alt. 600 m., *Fosberg 12216*; same locality, alt. 425 m., *Fosberg 9689*; same locality, *Garber 371*; Palolo, *Shaw (Rock's) 10032, 10021*; Wailupe Valley, *Rock 12942*; middle ridge of Niu Valley, *Degener and others 11994* (D).

Oahu, Waianae Mountains: Kaala, *Faurie 674*; head of Makua Valley, alt. 480 m., *Fosberg 9063*; Makua Valley, *Topping 2819*; southeast corner of Makua Valley, *Degener and Judd 11996* (D); Keeau Valley, *Degener and Nitta 11995* (D) (leaves very stiff).

Oahu: without locality, *Mann and Brigham 124; Degener 11872* (D); *Hillebrand and Lydgate* (not labeled Oahu, but plants look like those from Oahu).

Maui, west: Olowalu Valley, *Forbes 2480.M.*

Hawaii: Pohoiki, *St. John and others 11245*; Puna, *Forbes and Thurston 1046.H*; forest between Waiakea and Olaa, *Forbes 564.H*; Pololu Valley, *Degener and Wiebke 3227* (D) (perhaps a hybrid with var. *pubescens* or a more glabrate form of it).

Lanai: Maunalei Mauka, Feb. 4, 1914, *Munro*; Paomai, March 19, 1914, *Munro.* These two collections must be hybrids with var. *Degeneri,* or more probably only very glabrate forms of it, as they seem intermediate.

The following 5 collections from the Koolau Range, Oahu, have very narrow lanceolate or elliptic-lanceolate leaves, and might constitute a distinct form, but there is no distinct break between these and other plants of the same region, with slightly broader leaves: Wahiawa, Head-gate trail, *Forbes 2219.O*; Moanalua Camp ridge, April 15, 1909, *Forbes*; Moanalua Valley, *Forbes 1290*; Manoa Valley, Jan. 1920, *Rock*; Olympus trail, ridge up from Woodlawn, Manoa Valley, alt. 400 m., *Fosberg 13846.*

The following collections have leaves much larger than the majority of the specimens of this form. This group also might be separated, but as the line would have to be arbitrary, it is left in f. *sandwicensis.* These plants are usually found in dry regions:

Oahu, Koolau Range: Niu Valley, center ridge, Dec. 3, 1933, *Topping and Bush* (D); Niu Ridge, *Bush and Topping 3700.*

Oahu: Waianae Mountains, head of Makua Valley, alt. 500 m., *Fosberg and Duker 9047* (fruits almost spherical); Kuaokala, Haili Gulch, alt. 420 m., *Fosberg 12880*; Mokuleia, Pahole (Kukuiula) Gulch, alt. 420 m., *Fosberg 13023*; Kaumuku Gulch, Puuiki, *Degener*

and others 11562 (D); central Lualualei, below Kanehoa, "forested ridge between valleys 2 and 3," alt. 450 m., *Christophersen 3681*; Lualualei, Halona Valley, alt. 660 m., *Fosberg 9497*; Puuiki Gulch, *Degener 11993* (D); gulch north of middle ridge between Puu Kamaohanui and Puu Pane, *Degener 11876* (D).

Maui, east: Ulupalakua, alt. 1,600 ft., *Hosaka 1480.*

Although I have not seen the specimen from De Candolle's herbarium, there can be little doubt that it is one of the lanceolate-leaved plants from Oahu. The description exactly fits no other form.

Diospyros ferrea var. **sandwicensis** f. **obtusa** Fosberg, n. f.

Folia elliptica obtusa 2-3 cm. longa 1-1.5 cm. lata.

Habit (when growing in open) unusually compact, leaves 2-3 cm. long, 1-1.5 cm. wide, elliptic, apex obtuse or rounded, coriaceous, petioles early glabrate.

Oahu, Koolau Range: Hanakaoe, Pupukea-Kahuku Trail, alt. 450 m., *Fosberg and Hosaka 14000* (type); Hauula, *Degener and Wiebke 3226* (D); east ridge of Kaipapau Valley, *Degener and Park 11875* (D); gully southeast of Kahuku entrance of Pupukea-Kahuku Trail, *Degener 12067* (D); Pupukea-Kahuku Trail, *Degener and Nitta 11997* (D); Pupukea-Kahuku region, *Degener and others 11874, 11877, 12070, Degener and Shear 11873* (all D). The last cited has rather large leaves and, in that respect, approaches f. *sandwicensis.*

This form is conspicuous along the Pukukea-Kahuku Trail, because of its dark green color and compact habit. It is rarely seen in flower or fruit which fact may account for its absence from earlier collections. Degener first called my attention to its distinctness.

Diospyros ferrea var. **sandwicensis** f. **ovata** Fosberg, n. f.

Folia subcoriacea, ovata vel lance-ovata.

Leaves subcoriaceous, ovate to ovate-lanceolate, sharply acute, 3-4 cm. long, 1-2 cm. wide.

Kauai: Hii Mountains, *Forbes 690.K* (type); Wahiawa Mountains, *Forbes 277.K.*

Maui, east: Ulupalakua, 1913, *Wilder.*

It is with some hesitation that I include the Maui collection, as the leaves are stiffer and narrower; but it resembles this form more than f. *sandwicensis* in general appearance.

Diospyros ferrea var. **sandwicensis** f. **subcoriacea** Fosberg, n. f.

Folia subcoriacea, 5-10 cm. longa.

Leaves subcoriaceous, 5-10 cm. long, rounded at base.

Kauai: Hanapepe Falls, *Degener 11133* (type), *12003* (both D).

This form seems to be related to f. *ovata* but with much larger leaves. I originally considered it a form of var. *kauaiensis,* and annotated the type collection as such, but after seeing another collection, I am convinced that it is closer to var. *sandwicensis.*

Diospyros ferrea var. **sandwicensis** f. **wailauensis** Fosberg, n. f.

Folia 3-5 cm. longa, 1-2 cm. lata, petiola strigosa tarde glabrata.

Differs from f. *sandwicensis* in being more tardily glabrate, especially the petioles, leaves 3-5 cm. long, 1-2 cm. wide.

Molokai, east: pali above peninsula west of Wailau Valley, alt. 150 m., *Fosberg 9658* (type); Wailau Valley, alt. 200 m., *Fosberg 9618*; east fork of Kawela Valley, *Degener 11880, 12001* (both D).

This form was at first regarded as a distinct variety, and some material was annotated as such, but the differences between it and var. *sandwicensis* are too slight.

The two collections from Kawela have stiffer leaves than the Wailau specimens, but otherwise seem the same. They may, perhaps, be regarded as approaching var. *pubescens* f. *sclerophylla,* the only other member of this complex found on Molokai. *Diospyros* is surprisingly rare on Molokai compared with the other islands.

Diospyros ferrea var. **pubescens** (Skottsb.) Fosberg, n. comb.

Maba sandwicensis var. β Hillebr., Fl. Haw. Is., 275, 1888 (pro parte).

Maba sandwicensis var. *pubescens* Skottsb., Medd. Göteb. Bot. Trädgård, 2: 257, 1926.

Plant strigose, tardily glabrate, hairs often persisting on the petiole, leaves ovate to oblong to lanceolate, up to 6, or rarely 8 cm. long, 3, or rarely 4 cm. wide, base rounded, apex usually acute, coriaceous, fruit broadly ovoid or ellipsoid, up to 1.5 cm. long and about 1 or 1.2 cm. wide, persistently strigose.

Hillebrand included plants from Kauai and Hawaii in this variety, but when Skottsberg gave it a name he cited only Hawaii specimens. Though he did not definitely reject the inclusion of the Kauai forms, I think he typified the variety by this limitation. Workers have since generally considered that var. *pubescens* included all the more pubescent or tardily glabrate plants from all islands. Some of these seem to me more closely related to var. *sandwicensis* than to each other, so it seems best to limit var. *pubescens* to the Hawaii and Molokai forms. The variety, as here defined, is perhaps closest to var. *sandwicensis.* It is separable into two forms.

Diospyros ferrea var. **pubescens** f. **pubescens** (Skottsb.) Fosberg, n. f.

Maba sandwicensis var. *pubescens* Skottsb., Medd. Göteb. Bot. Trädgård, 2 : 257, 1926.

Folia coriacea, 5-7 cm. longa.

Leaves usually about 5-7 cm. long, coriaceous but not extremely so.

Hawaii: slopes of Mauna Kea, Waiki, *Forbes 457.H*; Hilo, *Degener and Wiebke 3229* (D); Kau Desert, *Forbes 388.H*; Kau, 25 miles west of Volcano House, *Degener and Wiebke 3230*; Kau, between Pahala and Naalehu, *Skottsberg 605b*; Volcano Road near Naalehu, alt. 200 m., *Fosberg 10141*; Punaluu, *Degener and Wiebke 3231* (D); south Kona, Kapua, *Rock*; Puuwaawaa, *Forbes 33.H*; north Kona, *Rock 3570*.

Diospyros ferrea var. **pubescens** f. **sclerophylla** Fosberg, n. f.

Folia valde coriacea, 2-4.5 cm. longa.

Leaves very stiff coriaceous, 2-4.5 cm. long, tending to be oblong.

Molokai, west: Mauna Loa, *Forbes 6.Mo* (type); Kokio Gulch, Mahana, *Rock 14004*; Waiahewahewa Gulch, *Degener 11879, 11999* (both D); near Waiahewahewa, *Degener 11998* (D); near Hauakea Pali, *Degener 12000* (D).

Hawaii: North Kona, flow of 1859, *V. O. Fosberg 42*; near Waimea, *Degener and Wiebke 3228* (D).

This form suggests var. *Toppingii* of Oahu in its leaf size, shape, and stiffness. It inhabits extremely dry regions.

Diospyros ferrea var. **Toppingii** Fosberg, n. var.

Planta valde sericeo-strigosa, folia valde coriacea lanceolata supra foveo-reticulata.

Branchlets slender, branchlets and leaves strongly and rather persistently silky-strigose, leaves ovate- or elliptic-lanceolate, up to 5 cm. long, 1.5 cm. wide, base obtuse, apex acute, upper surface conspicuously foveolate-reticulate.

Oahu, Waianae Mountains: Nanakuli, *Bush and Topping (Degener's) 11134* (D) (type).

In general appearance suggesting var. *pubescens* f. *sclerophylla* of west Molokai.

Diospyros ferrea var. **Degeneri** Fosberg, n. var.

Planta strigosa vel substrigosa, folia valde coriacea late oblonga.

Plant densely strigosely or substrigosely hirsute, tardily subglabrate, branchlets rather rigid; leaves broadly oblong, up to 8 cm. long and 5 cm. wide, but

usually much smaller, base rounded to subcordate, apex obtuse to rounded, stiff-coriaceous, young growth often densely hairy; fruits about 1.5 cm. long, 1-1.5 cm. wide, persistently strigose.

This variety, found on Maui and Lanai, seems closely allied to var. *kauaiensis,* differing in the smaller fruits and smaller, differently shaped leaves. As observed in the field, as well as in the herbarium, it is extremely variable. Two fairly well-defined forms can be separated.

Named for Otto Degener, who early noted that the Maui form was different from *M. sandwicensis* proper.

Diospyros ferrea var. **Degeneri** f. **Degeneri** Fosberg, n. f.

Pars juvena dense substrigosa.

Young parts densely substrigose, branchlets quite rigid, leaves very stiff.

Maui, east: Auahi, alt. 3,000 ft., *Rock 8665, 8665a* (type); Laumau Forest, south slope of Haleakala, *Forbes 1937.M, 1924.M*; without locality, *Forbes 1955.M*; Ulapalakua, *Meebold (Degener's) 11132, Degener 11878, 12006* (last 3 in D); Ulupalakua, alt. 2,500 ft., *Hosaka 1733.*

In the collection from Auahi (*Rock 8665*) two of the sheets are evidently from one plant, while the third, with smaller, more cordate leaves is from a different one. This latter, the type sheet, is here designated as *8665a.*

Diospyros ferrea var. **Degeneri** f. **lanaiensis** Fosberg, n. f.

Planta strigosa.

Plant truly strigose but less densely hairy and earlier glabrate than f. *Degeneri.*

Lanai: mountains near Koele, *Forbes 7.L, 118.L* (type); Kaiholena Valley, alt. 1,800 ft., *Rock and Hammond 8077*; Kaiholena, *Munro 36, 168*; Kaa, *Munro 36*; edge of Maunalei, *Forbes 376.L*; Kahinahina, May 1, 1915, *Munro*; lee side of island, scrub forest, alt. 600 ft., *Wilder 89*; near Kanepuu, alt. 500 m., *Fosberg 12553, 12547.*

This plant is one of the principal components of the dry forest on the northern end of the plateau of the island. It appears extremely variable in the field.

Diospyros ferrea var. **kauaiensis** Fosberg, n. var.

Maba sandwicensis var. β Hillebr., Fl. Haw. Is., 275, 1888 (pro parte).

Folia magna ovato-cordata vel lanceolata valde coriacea substrigosa, fructus 2 cm. longus 1.5 cm. latus.

Branchlets rather rigid; leaves very large, usually averaging about 10 cm. long and 5-6 cm. wide, usually ovate, appearing plinerved at base, base cordate or obtuse, apex acute or obtuse, strongly coriaceous, branchlets and leaves densely substrigose pubescent, tardily glabrate; fruit broadly ovoid, obtuse, about 2 cm. long and 1.5 cm. wide, rather persistently hairy, fruiting calyx spreading pubescent.

This variety is close to var. *Degeneri* but the leaves are usually larger and more pointed, and the fruit is larger.

Two forms are distinguishable.

Diospyros ferrea var. **kauaiensis** f. **kauaiensis** Fosberg, n. f.

Folia valde coriacea ovato-cordata.
Leaves strongly coriaceous, ovate cordate.

Kauai: Milolii Gulch, upper slopes near Kopiwai forest, alt. 3,000 ft., *Rock 1502, 1501, 1685*; Waimea, Kaanamahuna Valley, alt. 2,500 ft., Oct. 31, 1929, *C. S. Judd* (type); Kaholuamanu, *Forbes 424.K.*

Oahu, Waianae Mountains: Pohakea Pass, *Judd 52.*

A specimen without data, collected by Rock, which has very large leaves with round apices seems to belong here, and probably comes from Kauai.

Although the leaves of the Oahu specimen are rather small, their shape and texture and the size of the fruit show that this is the proper disposition.

Diospyros ferrea var. **kauaiensis** f. **Wiebkei** Fosberg, n. f.

Folia lanceolata.
Leaves lanceolate, base obtuse, branchlets rather slender.

Kauai: northeast of Kipukai, *Degener and Wiebke 3234* (D) (type).

This form approaches var. *sandwicensis,* and is possibly the result of hybridization between it and var. *kauaiensis.*