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**Pteridophytes of Guam**

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INTRODUCTION

Guam is the southernmost of the Marianas Islands, which extend about 500 statute miles through the western Pacific Ocean from latitudes  $20^{\circ} 30' N.$  to  $13^{\circ} 40' N.$ , and from  $143^{\circ} 46' E.$  to  $146^{\circ} 31' E.$ , in Micronesia. Guam is 29 miles long and four to nine miles wide with an area of 225 square miles, almost equal to the total area of the remaining islands in the group, 247 square miles.

The northern Marianas Islands are still actively volcanic, but Saipan, Tinian, Rota, and Guam have no active volcanoes. On Guam, the mountains are volcanic in origin and are in the southern part of the island, except for Mount Santa Rosa in the north. The highest altitude is 1,540 feet. Most of the northern part of the island is a raised limestone plateau. Originally the entire island was covered with forest, but now the only continuous and ancient forest areas are those of the limestone plateau. The southern part of Guam has much grassland or savannah, except for the forested localities in ravines and along rivers. The climate is tropical, with an average temperature of  $80^{\circ} F.$ , with a rain shower at least two out of every three days of the year, and with occasional typhoons.

The natural history of Guam is still not entirely known, though since the discovery of the Marianas by Magellan in 1521 it has been important both strategically and commercially. The Guam flora is, in general, small in number of species, with the known total of higher plants, both native and introduced, less than 600. The pteridophytes make up approximately one-eleventh of this number, but if native plants alone are considered, the percentage is nearly one-fifth. The ferns form an interesting and conspicuous element of its vegetation.

Numerous published lists contain accounts of the pteridophytes of Guam, but various errors have crept into the literature. Our own field experience on the island, combined with a study of our collections and a critical examination of the literature, has enabled us more accurately to evaluate previous questionable records. The results recorded here are intended to offer an introduction to tropical fern study in Guam and to indicate what to look for to add to the knowledge about pteridophytes. All of the pteridophytes definitely known from Guam are included here and briefly keyed and described. Erroneous records, doubtful but possible records, and species known elsewhere from the Marianas are all mentioned for the sake of completeness and clarification of the record.

The fieldwork upon which these notes are based was done while we were serving in Naval Air Transport. We each visited Guam 25 times, from December 1944 to June 1946, and were able during layovers there to make numerous collections in, and notes on, various parts of the island. We were exceedingly fortunate to have the guidance and instruction of Dr. Edwin B. Copeland, who kindly advised us on all aspects of our fieldwork. Later, when we assembled these notes at the University of California, he offered us every assistance in the way of sympathetic criticism and encouragement. We also acknowledge the help given us by many others who have shown interest in the course of this work.

Many famous collectors visited Guam in the early days. We shall only list them briefly as both Safford and Merrill have discussed them in detail. Starting in 1792 there were Haenke, Née, Chamisso, Gaudichaud, Lesson, Hombron, and Marche. Of these, Gaudichaud was outstanding, and, although he had the misfortune of losing much of his material when shipwrecked, his botanical notes are very valuable. In modern times, W. E. Safford, Alvin Seale, J. B. Thompson, Mrs. J. Clemens, R. C. McGregor, Joaquin L. Guerrero, and Peter Nelson made botanical collections during the years 1900 through 1930. In 1936, E. H. Bryan, Jr., of Bishop Museum, made a collection of about 250 numbers of plants in Guam, which are notable for the careful habitat data.

During World War II, a group of men in the United States Military and Naval services made collections during their spare time. Represented were the Army Engineers, Marines, Naval Construction Battalions, Naval Medical Corps, Army Air Corps, and Naval Air Trans-

port. So active were some of these servicemen-naturalists that they organized the Guam Society of Natural Sciences, which met weekly in the town of Agaña. The Botany Group was led by Mr. Russell L. Steere, pilot of a P-38 Photo Reconnaissance plane. Mr. Steere's personal collection contained several rare and interesting ferns. Joaquin Guerrero of the Military Government and a native of Guam who had collected there 30 years earlier, was also a member of the Society. A radioman with Naval Air Transport, Mr. John T. Conover, specialized in ferns and fern allies in his free hours in addition to his work with algae. His most unusual find was *Pteris ensiformis*, a species not previously reported from the island. The Naval Medical Research Unit No. 2, in the course of official investigations, made some collections of plants, including ferns. Mr. W. L. Necker, the collector, obtained interesting records on the island of Rota. Other servicemen-collectors included Messrs. N. W. Gilbert, W. F. Gilbert, Albert Vatter, Robert Rodin, George C. Moore, W. C. Sturtevant, and ourselves. The collections have been deposited, for the most part, in the U. S. National Herbarium (U.S.N.H.), the Bernice P. Bishop Museum (B.M.), the E. B. Copeland Herbarium (E.B.C.), and the herbarium of the University of California at Berkeley (U.C.); all of our numbers being deposited, unless otherwise indicated, at the University of California herbarium. The letters in parentheses are used as symbols of the herbaria throughout the paper.

Of the many publications containing lists of ferns and fern allies of Guam only the more important can be mentioned here. Cavanilles' "Descripción de las Plantas" (4)<sup>1</sup> credited 31 species of ferns to the Marianas, but some of these are known only from South America. As the Malaspina Expedition collected also in the Philippines, some of Née's specimens were mistakenly credited by Cavanilles to the Marianas, leaving us to conjecture whether these records might have been correct. Of his 31 species, only 11 are here considered valid in the light of present evidence. Kaulfuss (21) credited to Guam 11 species from Chamisso's collection, two of them apparently erroneously. Presl in 1825 published "Reliquae Haenkeanae" (28) with 21 pteridophytes credited to the Marianas; of these, 18 are here considered dependable. His most surprising error was *Polystichum rhizophyllum*, known today only from the West Indies. Probably the most

<sup>1</sup> Numbers in parentheses refer to Literature Cited, page 98.

valuable notes in the available literature are those of Gaudichaud in Freycinet's "Voyage autour du Monde" (16). All of his records were based on his personal collecting experience, though the plants are mostly known today by different names. According to modern ideas of classification he reported 31 species of ferns and fern allies from Guam, Rota, and Tinian.

In his informative work, "The useful plants of Guam" W. E. Safford (29) listed 29 ferns and "fern allies." Of these, we know 24 from Guam, the remaining names being synonyms or probable errors. He noted that no selaginellas or filmy-ferns had at that time been collected in Guam. Merrill (22, 23) enumerated 47 pteridophytes from Guam, including *Selaginella* and two wrongly identified filmy-ferns. We have been able to verify 40 of the pteridophytes on his list by actual specimens. "An enumeration of Micronesian plants" by Ryôzô Kanehira appeared in 1935 (20), and "The plants of Guam" by E. H. Bryan, Jr., was published in the newspaper *Guam Recorder* from November 1936 to June 1941. Both of these papers compiled previous records, including some earlier mistakes and omitting some records herein validated. In late 1935 and 1936, Takehide Hosokawa published "Materials of the botanical research towards the flora of Micronesia" (19). This contained many of the previous records, including some synonyms and earlier errors. It also listed from other Marianas Islands four species which we have since discovered in Guam, or for which we have found reliable evidence of occurring there. Hosokawa also gives 10 species from other islands in the group which have not yet been found in Guam.

Our total list of pteridophytes includes 10 families, 36 genera, 57 species, and one hybrid, all definitely known from Guam. Ten of our species have never before been reported from Guam, and three have not been reported for over a century, although the older literature reports a total of nearly 100 species from this island. We have been critical of all such records in order that the perpetuation of errors may cease. Carl Christensen corrected many of them in his "Revision of the genera and species of ferns described by A. J. Cavanilles" (9). We hope that this report of all definite records known to us will clear the way to a thorough knowledge of the fern flora of this small island.

Merrill (22) found that 58 percent of the vascular plants known to him were introduced by man. However, the situation is quite different for ferns, only *Pityrogramma calomelanos* being obviously an intro-



duced species. About one-sixth of the pteridophytes in Guam are pantropical in range. These are: *Ophioglossum nudicaule*, *Dicranopteris linearis*, *Cyclosorus goggilodus*, *C. dentatus*, *Acrostichum aureum*, *Adiantum philippense*, *Nephrolepis hirsutula*, *N. biserrata*, *Lycopodium cernuum*, and *Psilotum nudum*.

The remaining species are limited to the Old World tropics, the majority occurring also on the continent of Asia, some as far away as Africa. The following species extend as far west as Africa or its eastern islands: *Gonocormus minutus*, *Schizaea dichotoma*, *Lygodium scandens*, *Lastrea Torresiana*, *Ctenitis dissecta*, *Asplenium nidus*, *A. pellucidum*, *A. falcatum*, *A. unilaterale*, *Sphenomeris chusana*, *Microlepia speluncae*, *Lindsaea ensifolia*, *Pteris tripartita*, *Nephrolepis acutifolia*, *Microsorium scolopendria*, *M. punctatum*, *Vittaria elongata*, and *Lycopodium phlegmaria*.

The following extend as far west as tropical Asia: *Ophioglossum pendulum*, *Cyclosorus interruptus*, *C. unitus*, *C. parasiticus*, *Ctenitis subglandulosa*, *Tectaria crenata*, *Blechnum orientale*, *Asplenium laserpitiiifolium*, *Lindsaea Macraeana*, *Pteris ensiformis*, *Cheilanthes tenuifolia*, *Humata heterophylla*, *Davallia solida*, *Belvisia mucronata*, *Goniophlebium percussum*, *Antrophyum plantagineum*, *Pyrrhosia adnascens*, and *Selaginella ciliaris*.

Remaining Guam species have narrower ranges: *Crepidomanes brevipes*, also known from the Philippines, Borneo, and New Guinea; *Stenosemia pinnata*, Philippines and Sumatra; *Lygodium semihastatum*, Philippines; and *Cyclosorus Warburgii*, known elsewhere only in New Guinea. Species that are limited to the oceanic islands of the Pacific are *Angiopteris Durvilleana*, *Cephalomanes Boryanum*, *Pteris spinescens*, and *Cyathea lunulata*. Two species, *Cyclosorus maemonensis* and *Ceratopteris Gaudichaudii*, are apparently confined to Guam; but several others have somewhat distinctive local forms. The pteridophytes of Guam undoubtedly had their origin primarily in the Old World continental land masses and arrived perhaps by way of the Philippines and the Carolines.

A few of the ferns and "fern allies" occur in a wide variety of habitats on the island. *Psilotum nudum*, *Microsorium scolopendria*, *Nephrolepis hirsutula*, and *Cyclosorus interruptus* are examples, the first three occurring both epiphytically and terrestrially. Most of the local species, however, are more specialized in habitat. From the standpoint of environment the savannah ferns are especially interest-

ing. The areas in which these occur have been described by Safford as grassy upland regions almost devoid of trees and shrubs, characterized by red claylike soil and lack of drainage. Most of the savannahs are in the hills of southern Guam, but there is a savannah area also around Mount Santa Rosa in the northeastern part of the island. Ferns that live there are xerophytes and can tolerate considerable exposure to sunlight and dryness. They are the "sun ferns" (18) and those occurring in Guam are as follows: *Ophioglossum nudicaule*, *Lygodium scandens*, *Dicranopteris linearis*, *Cyclosorus unitus*, *Blechnum orientale*, *Sphenomeris chusana*, *Lindsaea ensifolia*, *Cheilanthes tenuifolia*, and *Lycopodium cernuum*. Some of these species grow in open marshes also; and three other species—*Cyclosorus goggilodus*, *Ceratopteris Gaudichaudii*, and *Acrostichum aureum*—grow only in the marshes. The last of these is found even more commonly in the coastal salt marshes, and our only find of *Ceratopteris Gaudichaudii* was a floating colony along the Talofofu River.

Species that occur most commonly in open grassy areas may also occur in the wooded ravines cutting through the savannahs, and may develop lax growth forms of greatly different aspect, such as the shade forms of *Cyclosorus unitus*, *Blechnum orientale*, and *Lindsaea ensifolia*. Species characteristic of the wooded ravines themselves and the forests that border the rivers of southern Guam are the following: *Angiopteris Durvilleana*, *Schizaea dichotoma*, *Lygodium semihastatum*, *Cyathea lunulata*, *Cyclosorus maemonensis*, *C. dentatus*, *C. parasiticus*, *Lastrea Torresiana*, *Tectaria crenata*, *Stenosemia pinnata*, *Asplenium unilaterale*, *Lindsaea Macraeana*, *Pteris spinescens*, *P. ensiformis*, *Adiantum philippense*, and *Selaginella ciliaris*.

Two others, *Cyclosorus Warburgii* and *Cephalomanes brevipes*, are "riverside ferns" in Guam, occurring only on shaded banks of streams, close to the water. All of the species listed above are also found on river banks. Some terrestrial species, like *Nephrolepis biserrata*, will be found in forests either in the hilly volcanic areas or in limestone places. There are a few that prefer limestone soils altogether. Those found by us in limestone soils were *Tectaria crenata*, *Asplenium falcatum*, and *Pteris tripartita*.

Some of the species, like the two *Lygodium* species and *Lindsaea Macraeana*, have a climbing habit, but the most conspicuous climber of the deep woods is *Humata heterophylla*. The epiphytic ferns include some of the most conspicuous airplants in the forest trees of Guam.

Two of them—*Asplenium nidus* and *Microsorium punctatum*—are “nest epiphytes,” characterized by the accumulation of large masses of rich black humus at the bases of the plants among the stipes and roots. Growing in these masses often are gardens of other epiphytic ferns, of which the most notable is *Ophioglossum pendulum*.

Some of the epiphytes can withstand a large degree of exposure. Outstanding examples are *Davallia solida* and *Pyrrosia adnascens*, plants with leathery, xerophytically adapted leaves. They are to be seen especially on the trunks of coconut palms (33). The opposite extreme is shown by two of the filmy-ferns, *Crepidomanes brevipes* and *Gonocormus minutus*, and also *Antrophyum plantagineum*, which are “low-level epiphytes,” found in the moist air near the bases of trees in rich forest. *Antrophyum* grows frequently also on shaded limestone rocks in dark humid places. Other normally epiphytic pteridophytes in Guam are *Asplenium pellucidum*, *A. laserpitiiifolium*, *Belvisia mucronata*, *Goniophlebium percussum*, *Vittaria elongata*, and *Lycopodium phlegmaria*.

Most of the ferns and fern allies are common to various parts of the island. Others are rare or confined to a small locality. Changes wrought by man have probably contributed to the scarcity of some of them, whereas such changes have helped others by providing suitable grasslands and second-growth brushy places. Destruction or depletion of the uncommon species is regrettable and should by all means be avoided. Following is a list of especially rare or local ferns: *Schizaea dichotoma*, *Ophioglossum nudicaule*, *Cyathea lunulata*, *Cyclosorus Warburgii*, *Lastrea Torresiana*, *Ctenitis dissecta*, *Stenosemia pinnata*, *Lindsaea Macraeana*, *Pteris ensiformis*, *Adiantum philippense*, *Goniophlebium percussum*.

In the list of species which follows we have endeavored to adopt the most accurate names according to the latest usage. Synonymies, with very few exceptions, are confined only to names applied to the plants in the Marianas. In the taxonomic interpretation of these we were fortunate to be traveling by air and thus able to collect ferns in many different islands of the Pacific and to observe their variation, due in part to isolation by enormous spaces of water over many thousands of years. In Hawaii, for example, the epiphytic adder's-tongue (*Ophioglossum pendulum* Linnaeus), is represented by a form so distinctive that it has merited subspecific treatment: *O. pendulum* ssp. *falcatum* (Presl) Clausen. Compared with the Guam representative,

this Hawaiian variant averages much smaller and is considerably more leathery. Differences of plants in widely separated island groups may be so trivial that they have never received special designation. On the other hand, some populations of a given plant in different islands are unique enough to have been separated specifically by some authorities. The Hawaiian form of *O. pendulum*, for instance, has also been construed as a different species, *O. falcatum* (Presl) Fowler.

#### PTERIDOPHYTE FLORA OF GUAM

The ferns and so-called fern allies collectively make up the phylum Pteridophyta. No flowers or seeds are produced. There are two independent generations: gametophyte and sporophyte. The familiar plant is the sporophyte, the gametophyte being small and inconspicuous. The spore-producing plant or sporophyte is usually made up of root, stem, and leaf, and has conductive tissues. In ferns, the stems are called rhizomes or rootstocks, and the leaves of ferns are usually called fronds. The spores are formed and released by the sporophyte, and germinate in appropriate places, producing the gametophytes, or prothallia, which are sexual and bear male and female organs (antheridia and archegonia respectively). When the egg cell is penetrated by the spermatozoid another sporophyte is produced. Pteridophytes are generally classified by spore-producing organs or sporangia which can be seen with a strong magnifying glass.

#### KEY TO FAMILIES

- I. Sporangia borne on fronds or in spikes. Ferns.
  - A. Sporangia large, with walls many cells thick, lacking an elastic ring (annulus), opening instead by slits or pores. Eusporangiatae.
    1. Sporangia in distinct spike; developing fronds erect or folded over before extending. Adder's-tongues.....1. OPHIOGLOSSACEAE
    2. Sporangia in groups on the underside of the frond; the developing frond curled or circinnate. Giant fern.....2. MARATTIACEAE
  - B. Sporangia small with walls only one cell thick, usually in clusters on the fronds, opening by means of the annulus. Leptosporangiatae.
    1. Sporangia without stalks or with short stalks; the annulus not interrupted by the stalk.
      - a. Sori not marginal on specialized free ends of veins; fronds many cells thick.
        - (1) Sporangia in spikes at the tip of the frond, or along the margins or pinnules; annulus transverse, just below the apex of sporangium..... 4. SCHIZAEACEAE
        - (2) Sporangia in groups (sori) on the underside of frond; annulus oblique.

- Sorus with few sporangia; savannah fern.....5. GLEICHENIACEAE  
 Sorus with many sporangia; tree fern.....6. CYATHEACEAE  
 b. Sori marginal on free ends of veins (receptacles) with tubular or two-  
 lipped indusia (involucres); leaves filmy, usually one cell thick. Filmy-  
 ferns.....3. HYMENOPHYLLACEAE  
 2. Sporangia long-stalked; the annulus interrupted by the stalk.....  
 .....7. POLYPODIACEAE  
 II. Sporangia borne in axils of scale-like leaves. "Fern Allies."  
 A. Only one kind of spore produced; plants usually tough, of moderate size.  
 1. Stems with numerous small stiff leaves; sporangia flat, with two valves.  
 Club-mosses.....8. LYCOPODIACEAE  
 2. Stems almost naked, with few tiny scale-like leaves; sporangia globose,  
 with three valves.....9. PSILOTACEAE  
 B. Two kinds of spores produced; plants weak and mosslike.....10. SELAGINELLACEAE

## I. OPHIOGLOSSACEAE

The Ophioglossaceae and Marattiaceae constitute the eusporangiate ferns, characterized by the formation of large sporangia from subepidermal cells. Sporophytes of the Ophioglossaceae are mostly small, terrestrial, or epiphytic with short erect rhizomes and fleshy or fibrous roots, and one or several leaves, the sporangia borne on specialized fertile spikes arising from a common stalk or from the sterile segment. The subterranean gametophyte depends apparently on endophytic fungi for nourishment. A small, worldwide family of primitive pteridophytes; of the three distinct genera, only *Ophioglossum* is known from Guam.

1. Genus *Ophioglossum* Linnaeus

Fronds usually simple, from short, unbranched rootstock with thick fleshy to fibrous roots. Venation reticulate. Fertile segment a slender spike. A cosmopolitan genus of 25 or 30 species occurring in varied habitats; two species in Guam.

- Terrestrial, plants 2-8 cm. high.....1. *O. nudicaule*  
 Epiphytic, plants pendent, up to 195 cm. long.....2. *O. pendulum*

1. *Ophioglossum nudicaule* Linnaeus fil., Suppl. pl., 443, 1781.

Plant perennial with sub-bulbous rootstock bearing fibrous roots and one to several leaves; common stalk 0.2-1.5 cm. long; blade ovate, apiculate at tip, 0.3-1.3 cm. long; fertile spike 1.5-6.0 cm. long; venation reticulate with primary set of veins including some free veinlets.

Along road, about 1 mile north-northeast of Mt. Tenjo, *Wagner 3700*; upland swamp on Ylig-Sigua Ridge, very rare, *Rodin 640*.

Pantropical.

This species has not previously been reported from the Marianas. A large colony was discovered on July 27, 1945, in savannahs near Mt. Tenjo, growing in reddish soil among tufts of grass with *Cheilanthes tenuifolia* and *Lindsaea ensifolia*. A later visit, on August 20, revealed that the plants had become yellow and ragged. The species, therefore, may appear only seasonally. Rodin found only two specimens at his locality. R. T. Clausen identified our material as *Ophioglossum nudicaule* var. *tenerum* (Mettenius) Clausen, but pointed out that the named varieties of this variable adder's-tongue probably have little significance.

2. ***Ophioglossum pendulum*** Linnaeus, Sp. pl., ed. 2, 2: 1518, 1763; Gaudichaud, Freyc. Voy. Bot., 73, 290, 1827; and later authors. *Ophioderma pendula* (Linnaeus) Presl; Safford, Contr. U. S. Nat. Herb. 9: 274, 1905.

A large epiphytic plant with short rhizome bearing one or more, usually several, pendent strap-shaped fronds often one- to three-forked toward the tips, 35-195 cm. long with membranous texture and rippled appearance in nature. Venation reticulate. Fertile spike 10-25 cm. long, hanging on slender stalk inserted medially some distance from base of sterile segment.

Upi, growing downward from forks of trees in limestone forest, alt. 175 m., *Bryan 1270* (B.M.); near Agaña Airfield, growing from roots of *Asplenium nidus*, *Wagner 3301*; 4 miles south of Northwest Airfield, *Wagner and Conover 3441*; woods just north of Northwest Airfield, *Conover 598*; forest trees near Santa Rosa, *Safford and Seale 1055* (U.S.N.H.); hanging from root mass of *Microsorium punctatum*, Mt. Santa Rosa, *Wagner 3892*; epiphyte attached to base of *Asplenium nidus*, 5 miles south of Northwest Airfield, *Conover 524*; on trunk of fallen *Artocarpus* tree, north of Northwest Airfield, *Conover 598*; northern plateau, *Rodin 585*.

Tropical Asia to Polynesia.

This curious plant is frequent in the forests of Guam, occurring especially in the root masses of bird's-nest ferns, where luxuriant plants occasionally form spectacular hanging sprays of long wavy fronds. The prevalent plant in Guam is *O. pendulum* ssp. *typicum* Clausen, with lax membranous fronds. *Safford and Seale 1055* in part was cited by Clausen as the subspecies *falcatum* (Presl) Clausen, which is mainly Hawaiian and differs in its more rigid texture and smaller size. The specimen cited appears merely to be a small frond of



the typical form. It has been collected at Sabaana, Rota, by the U. S. Naval Medical Research Unit No. 2 (*Necker R520*), and Hosokawa (19, vol. 26, pp. 45-46) has reported it from Shinapal, Rota, and from the summit of Mt. Tappoty, Saipan. The native name is *leston*.

## II. MARATTIACEAE

Sporophytes terrestrial with coarse, often enormous, fronds, bearing "stipules" at base of stipe. Venation circinnate. Sporangia separate or grouped into "synangia" which open by pores or slits. A tropical family of eusporangiate ferns; of the six genera only *Angiopteris* is known from Guam.

### 1. Genus *Angiopteris* Hoffman

Ferns with massive erect rootstocks and huge bipinnate fronds. The bases of the stipes and pinnae with swellings (pulvini). Sori made up of double rows of sporangia. Gametophytes flat and green.

An Old World genus made up of numerous, very similar species.

#### 1. *Angiopteris Durvilleana* de Vriese, Mon. Maratt., 17, 1853 (fig. 1).

*Angiopteris evecta* of Swartz, Syn. Fil., 166, 395, 1806; Willdenow, Sp. pl. 5: 69, 1810; and later authors; not (Forster) Hoffman 1796.

? *Angiopteris Beecheyana* of Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 44, 1936; not de Vriese 1853.

A huge plant with fronds 3-4 or more m. in height. Rootstock large; stipe bases with brown succulent stipules. Pinnae 80-120 cm. long, 2 cm. wide, the bases cuneate-truncate, the tip dentate-caudate, 1 cm. long; texture thinly herbaceous; glabrous except for a few squamulae along costa. Recurrent or false veins running only 3-6 mm. from margin, between forked or simple veins. Sori 1-2 mm. from margin, with 6-10 sporangia.

Sigua River valley, *Grether 3721*; ravine, Mt. Santa Rosa, *Wagner 3894*; Aguada River valley, *Conover 542*; small gulch on northeast side of Mt. Tenjo, surrounded by sword-grass, alt. 320 m., *Bryan 1247* (B.M.); headwaters of the Ylig River, *Rodin 602*; wooded bank, Tolijuice River, Maemon Valley, *Grether 4423*.

Rota, alt. 1,500 feet, *Grether 4478*; Sabaana, *Necker s. n.*

Marianas, ?Tahiti, ?Philippines.

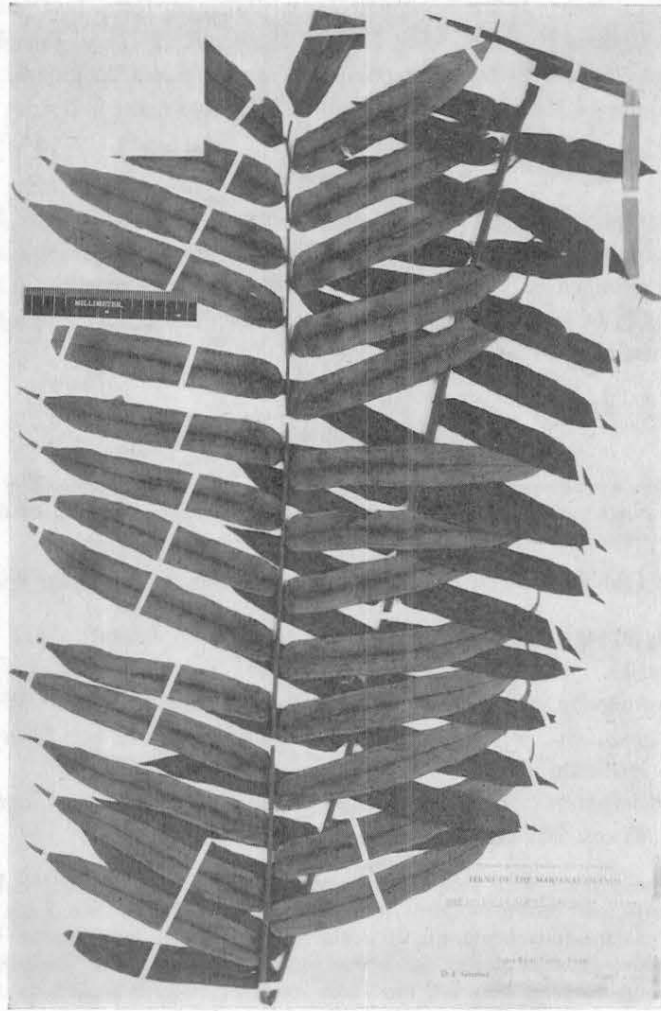


FIGURE 1.—*Angiopteris Durvilleana*, pinna.

The type locality of *Clementea palmiformis* Cavanilles was given as "Palapa, que es una de las Islas Marianas" (4, p. 554), but Née, the collector, visited only Guam and Tinian there (Safford, 29, p. 26). Therefore, there is little doubt that the type was actually collected at Palapa near Point Espiritu Santu on Samar, where the Malaspina Expedition went from Guam. It differs from the Guam plant in the

narrower pinnae with false veins running close to the costa and in the much longer caudate tips, and it is common in the Philippines. Christensen's reduction of *A. Durvilleana* de Vriese *pro parte* to *A. palmiformis* was, therefore, in error. Our material from Guam agrees with de Vriese's description and figure of *A. Durvilleana*, collected by Gaudichaud in the Marianas, in herbaceous texture, short false veins, and number of sporangia. Occasional specimens (*Rodin 602, Grether 4423*) have a thicker texture but agree otherwise with *A. Durvilleana*. It has not been reported recently either from Tahiti or the Philippines. *A. evecta* Hoffman is a similar plant but specimens from Tahiti have thicker leaf tissue with false veins extending close to the costa, and 10-15 sporangia. *A. Beecheyana* de Vriese, reported by Hosokawa from Sarigan and Alamagan and, with a question mark, from Guam, was described from the Carolines as having pinnae a foot or more in length, 9-10-11 sporangia, and the recurrent veins extending almost to the costa. All of these species are similar and, construed broadly, have been placed with *A. evecta*.

Called the "giant fern" in Guam, this plant frequents shaded ravines and woods, in some places forming stands of primeval grandeur as in the damp ravine on the northeast side of Mount Tenjo. Gaudichaud reported it in the mountains along the Humatac River.

### III. HYMENOPHYLLACEAE

Small plants called filmy-ferns because of their thin leaf tissue. Sori in funnel-shaped or valvate indusia or involucre. Gametophytes green, mostly filamentous. Terrestrial or epiphytic plants of damp shady places. A large mainly tropical family with 33 genera, three known in Guam but apparently not recorded elsewhere in the Marianas.

- |   |                        |
|---|------------------------|
| Terrestrial; fronds rigid and bristly.....          | 1. <b>Cephalomanes</b> |
| Epiphytic; fronds membranaceous.                    |                        |
| Fronds 3-10 cm. long, pinnate, not proliferous..... | 2. <b>Crepidomanes</b> |
| Fronds 1-2 cm. long, palmate, proliferous.....      | 3. <b>Gonocormus</b>   |

#### 1. Genus **Cephalomanes** Presl

Terrestrial ferns with erect rhizomes; leaves rigid and simply pinnate. Involucre cylindrical (rarely obconic); stipes and rachis setose.

Nine species of tropical Asia through Polynesia.

1. **Cephalomanes Boryanum** (Kunze) van den Bosch, Syn. Hym., 11, 1859; Copeland, Philippine Jour. Sci. 67: 1, 68, 1938.

*Trichomanes Boryanum* Kunze; Copeland, Philippine Jour. Sci. 51: 2, 254, pl. 52, fig. 4, 1933.

*Trichomanes javanicum* of Merrill, Philippine Jour. Sci. 9 (C): 1, 41, 1914; and later authors; not Blume 1828.

Fronds linear-oblong, 8-25 cm. long, 1-2 cm. wide, on stipes 2-8 cm. long. Stipes, unfolding fronds covered with dark hairs. Rootstock erect, with prop roots. Sori borne on upper side of upper pairs of pinnae. Involucres 2 mm. long with somewhat dilated mouths, and bristle-like receptacles, 4-5 mm. long.

Guam Experimental Station 27, collected by J. B. Thompson (B.M.); stream banks, 200 yards east of Talisai River bridge, Maemon Valley, *Wagner 3597*; close to waterfall, headwaters of Ylig River, *Rodin 616*; Ylig Canyon, *Rodin 692*; muddy bank, Maemon Valley, *Grether 4408*; small stream about 3 miles south of Agat, *Grether 4381*; muddy bank, Geus River, *Grether 4379*.

Micronesia and Polynesia.

The Guam plant varies toward *Cephalomanes atrovirens* Presl in the not greatly dilated mouth of the involucre (Copeland, 14, p. 255). It occurs frequently but locally in wooded valleys on damp stream banks in the volcanic areas of the island but not in the limestone woods.

## 2. Genus **Crepidomanes** Presl

Small epiphytic ferns with thin creeping rhizomes. Fronds pinnately dissected, with false veins, and the midrib alate. Sori axillary, the involucres obconic, usually, with bilabiate mouths.

Twelve species in the Old World tropics; one in Guam.

1. **Crepidomanes brevipes** (Presl) Copeland, Philippine Jour. Sci. 67: 1, 60, 1938.

*Trichomanes brevipes* Presl; Copeland, Philippine Jour. Sci. 51: 2, 182-183, pl. 20, 1933.

*Trichomanes humile* of Merrill, Philippine Jour. Sci. 9 (C): 41, 1914; and later authors; not Forster 1786.

Fronds 4-9 cm. long, 2 cm. wide, the segments usually less than 1 mm. wide. False veinlets present, the submarginal ones interrupted. Rootstocks widely creeping, 0.5 mm. thick, clothed with short dark-brown hairs. Involucre with distinctly valvate lips.

Near North Airfield, *Grether 3583*; epiphytic in wet woods, hilly country, Lonfit River valley, *Grether 3719*; on trees, Upi Road and Yigo, *Guam Experiment Station 208* (B.M.); trunks of trees in moist limestone forest, alt. 110 m., *Bryan 1193* (B.M.); *McGregor 398* (E.B.C.); epiphytic, Geus River, *Grether 4372*.

Philippines, Guam, Borneo, and New Guinea.

Both of the specimens reported by Merrill as *Trichomanes humile* are this species. It is apparently the commonest filmy-fern in Guam. It is most frequent in the damp limestone forests of northern Guam, where it occurs locally in mats at the bases of tree trunks, but it is found also in the southern part of the island.

### 3. Genus *Gonocormus* van den Bosch

Tiny epiphytic ferns with delicate wiry creeping rootstocks clothed with dark hairs. Fronds with flabellate venation, deeply incised; stipes proliferous, bearing additional fronds. Sori immersed in the tips of the segments. Involucre tubiform-campanulate or dilated.

A genus of one species, or many very closely related ones.

#### 1. *Gonocormus minutus* (Blume) van den Bosch, *Hymen. Javan.*, 7, pl. 3, 1861.

Recognizable by the characters of the genus. Fronds of Guam specimens 0.8 to 1.4 cm. long.

Growing on trunk of coconut, shady wooded base of cliff along Beach Road, about 1 mile northeast of Agaña, *Wagner 3765*.

Africa to Polynesia and Japan.

New to Guam. This mosslike plant is probably more common in Guam than its one collection would indicate; it is small enough to escape easy detection. Our specimens grew mixed with mosses on a coconut trunk in association with *Pyrrisia*, *Davallia*, and *Antrophyum*, from the bole of the trunk to about 15 feet above the ground.

## IV. SCHIZAEACEAE

Ferns with terrestrial rhizomes and erect or twining fronds; characterized by the transverse annulus at or just below the tip of the sporangium. Gametophytes simple or branched, flattish. Six genera, almost exclusively tropical; two in Guam.

Fronds erect, wiry, dichotomously branched, small and rushlike....1. *Schizaea*  
Fronds climbing, pinnate, lobed, long and vinelike.....2. *Lygodium*

1. Genus **Schizaea** Smith

Small grasslike ferns; fronds usually narrow, triquetrous or flattish. Sporangia borne in narrow divisions at the tips of the branches. About 30 species, all except one tropical; one local species.

1. **Schizaea dichotoma** (Linnaeus) Smith, Acad. Turin, Mem. 5: 422, pl. 9, fig. 9, 1793; Merrill, Philippine Jour. Sci. 15: 6, 539, 1919; and later authors.

An odd shiny-green plant with short horizontal rootstock and several fronds, 15-25 cm. long, with flattened wirelike stipes, branching at the top in fanlike narrow segments. Sporangia in brown pinnately arranged divisions, 2-3 mm. long, at tips of segments.

Wet ravine, Mt. Tenjo, *Grether 4320*; rotten log on bank of stream, 10 ft. from water's edge in dense shade, 200-300 ft. alt., Ylig Valley, *Steere 51, Rodin 621*; on ground in moist dense woods, *Moore 375*; on rotten tree stump, near wet-wooded stream, 3 miles south of Agat, *Grether s. n.* (B. M.).

Madagascar and tropical Asia through Polynesia and Melanesia.

First discovered in Guam in 1918 by Peter Nelson on tree trunks at Cotot, associated with *Psilotum nudum*, this plant is apparently rare in Guam. Its small size and usual occurrence in deep-shaded woods make it difficult to see. Four of the known stations for this plant in Guam were on tree trunks or logs.

2. Genus **Lygodium** Swartz

Plants called "climbing ferns" because of their scandent fronds, with wiry climbing rachises, the pinnae aborting after producing two pinnules. Rhizomes subterranean.

Mostly tropical ferns with about 30 species, of which two occur in Guam.

Pinnae palmate; segments long-oblong.....1. **L. semihastatum**  
Pinnae pinnate; segments short and oval.....2. **L. scandens**

1. **Lygodium semihastatum** (Cavanilles) Desvaux, Prodr., in Soc. Linn. Paris, Mem. 6: 203, 1827; Hooker, Syn. Fil., 436, 1868; Merrill, Philippine Jour. Sci. 9 (C): 1, 46, 1914.

*Ugena semihastata* Cavanilles, Icones 6: 74, pl. 594, fig. 1, 1801.

*Lygodium circinnatum* of Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; not (Burmans) Swartz 1806.



Climbing fern with palmate pinnules, the primary petioles of the pinnae nearly obsolete, the secondary petioles 1-2 cm. long. Segments large, 6-15 cm. long, 1-1.5 cm. wide. Sporangia borne in spikes along the margins.

Along stream, Maemon Valley, about 3 miles east of Agat, *Wagner 3837*; wet bank in deep shade, 2 miles up Aguada River valley, *Conover 541*; wet ravine, Mt. Santa Rosa, *Wagner 3887*; Lonfit River valley, dryish base of hillside on cane, *Grether 3707*; wet banks of Sigua River, *Grether 3816*; headwaters of Ylig River, *Rodin 606*; edge of woods 1 mile east of Mt. Tenjo, *Moore 292*; semi-savannah, Maemon Valley, *Grether 4420*.

Philippines and Guam.

Safford (29, p. 314) stated that *L. dichotomum* Swartz and *L. longifolium* Swartz were recorded from Guam, but these are now considered to be synonymous with *L. circinnatum* (Burm.) Swartz (C. Christensen, 7, pp. 411-412). Merrill pointed out that the records of *L. circinnatum* in Guam were probably based on the present species, which is distinguished by the semihastate bases of the segments, lacking in *L. circinnatum*. The two species are, however, similar in general appearance. We made an intensive effort to find *L. circinnatum* in Guam, with no success, and we agree with Merrill that *L. circinnatum* was credited to Guam probably because of confusion with *L. semihastatum*. The latter is locally abundant in Guam, usually in woods and thickets along streams. The twining fronds climb 10 or 15 or more feet above the ground.

2. ***Lygodium scandens*** (Linnaeus) Swartz, Schrad. Jour. Bot. 2: 106, 1801; Gaudichaud, Freyc. Voy. Bot., 75, 297, 1827; and later authors.

*Hydroglossum scandens* (Linnaeus) Willdenow, Sp. pl. 5:77, 1810.

*Lygodium microphyllum* R. Brown; Presl, Rel. Haenk. 1:72, 1825.

Climbing fern with pinnate pinnae, the small pinnules rounded, wider at the bases, 0.5-1.5 cm. wide, 0.5-3.5 cm. long, on stalks 2-3 mm. long, primary petioles of the pinnae 1-3 mm. long.

Along stream, 1 mile southwest of Agaña, *Wagner 3310*; edges of savannahs, Lonfit River valley, *Grether 3714*; on cane near stream, Masso River valley, *Grether 3430*; Agaña marshes, *Wagner 3763*; Sigua River valley, *Grether 3725*; climbing on *Nephrolepis hirsutula*, edge of savannah, half a mile west of Mt. Santa Rosa, *Wagner 3873*;

Merizo, north of village, climbing on sword-grass, alt. 80 m., *Bryan 1238* (B. M.); edge of small pond, half a mile northeast of Mt. Tenjo, *Moore 302*; savannah, Maemon Valley, *Grether 4397*.

Old World Tropics.

As Gaudichaud said, "Cette Fougère est très-polymorphe." The commonest form has small pinnules averaging about 0.7 mm. wide, and 1.8 cm. long, and occurs abundantly in damp open savannah areas. *Lygodium scandens* var. *microphyllum* (R. Brown) Schumann and Lauterbach is this form. In damper and shadier places, however, forms of this plant may be found with very much larger pinnules. The species was collected by the U. S. Naval Medical Research Unit No. 2 also at Sabaana, Rota (*Necker RS28*) and is reported by Hosokawa from Saipan (19, vol. 25, p. 438). The local name is *alambrillo*, according to Safford.

#### V. GLEICHENIACEAE

Ferns characterized by dorsal sori with the few sporangia opening by longitudinal slits, the annulus transverse across the middle of the sporangium. Terrestrial plants, in many species with fronds of indefinite growth. Six tropical genera, only one in Guam.

##### 1. Genus *Dicranopteris* Bernhardt

Rootstocks usually branched and long-creeping. The fronds of indefinite growth, pinnate but aborting above the first pair of pinnae, each of which divides similarly, and so on, in some places producing dense tangles of fronds. Plants bearing hairs rather than scales. The veinlets forked more than once. Sporangia 8-10 in a sorus. Foliate "stipules" at bases of pinnae.

Represented in the Marianas by one common species.

1. *Dicranopteris linearis* (Burm.) Underwood, Torr. Bot. Club, Bull. 34: 249, 1907.

*Gleichenia linearis* (Burm.) Clarke; Merrill, Philippine Jour. Sci. 9 (C): 1, 46, 1916.

*Mertensia dichotoma* (Thunberg) Hooker; Gaudichaud, Freyc. Voy. Bot., 301, 1827.

*Gleichenia dichotoma* (Thunberg) Hooker; Safford, Contr. U. S. Nat. Herb. 9: 283, 1905.

*Dicranopteris dichotoma* (Thunberg) Bernhardt; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 25: 424, 1935.

Pinnae pectinate, 25-40 cm. long, pale green, glaucous beneath usually, with leaflike "stipules" at their bases, 7-15 cm. long.

Rocky cliffs near Masso River, *Grether 3433*; wet ravine, Mt. Tenjo, *Wagner 3745*; savannah, Lonfit River valley, *Grether 3716*; edge of savannah, half a mile west of Mt. Santa Rosa, *Wagner 3876*; savannah, Maemon Valley, *Grether 4403*, *Grether 4390*.

Rota: alt. 1,500 ft., *Grether 4474*.

Pantropical.

Of this common Guam plant, Safford wrote that "In places where the sabanas have been burned over the stiff erect stipes project a few inches over the surface, and often cause wounds in the feet of the natives even when the latter are protected by leather sandals." The native name for it is *mana*. It is also called "savannah fern" because of its abundance in the dry grassy areas. In steep, shaded valleys, as Mt. Tenjo, it sometimes forms dense stands of large plants. Gaudichaud reported it in the volcanic mountains around Humatac. We have not found this plant in the limestone areas of the island. It is reported from Alamagan by Hosokawa, and probably occurs throughout most of the Marianas.

#### VI. CYATHEACEAE

A large family of arborescent plants is that comprising the tree ferns. The rhizome (trunk) is ascending or erect, 1-15 meters high. Fronds in a crown, 1-4-pinnate, usually very large. Sori with or without indusia, globose. Sporangia numerous with oblique annuli. Over 800 tropical species, many very similar, in about eight genera, growing in humid areas. One species in Guam, and another in the northern Marianas Islands.

##### 1. Genus *Cyathea* J. E. Smith

Trunk erect, the leaves usually ovate, pinnately compound, in an arching or drooping crown. Stipes usually spiny or muricate, the bases clothed with scales. Veins free. Sporangia with or without indusia, the annuli not interrupted by the pedicel of the sporangium.

##### 1. *Cyathea lunulata* (Forster) Copeland, B. P. Bishop Mus., Bull. 59: 37, 1929 (fig. 2).

*Alsophila haenkei* Presl, Rel. Haenk. 1: 68, 1825; Safford, Contr. U. S. Nat. Herb. 9: 390, 1905.

*Cyathea haenkei* (Presl) Merrill, Philippine Jour. Sci. 15: 6, 540, 1919; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 49, 1936.



FIGURE 2.—*Cyathea lunulata*, pinna and portions of stipe; inset: pinnule, and scale from stipe base.

*Alsophila marianna* Gaudichaud, Freyc. Voy. Bot., 73, 365-366, 1827.

*Alsophila extensa* of Merrill, Philippine Jour. Sci. 9 (C):41, 1914; Kanehira, Dept. Agr. Kyushu Imp. University, Jour. 4:6, 246, 1935; not C. Christensen, 1906.

Trunk 3-5 or more meters in height, surmounted by a crown of eight to 12 or more ovate-oblong fronds two meters in length, tripinnate, the ultimate segments adnate, 2-2.5 mm. wide, 6-10 mm. long. Scales at base of muricate stipe pale straw color with marginal dark setae that break off easily, averaging about  $3 \times 12$  mm. and curved-lanceolate. Stipes of large fronds 25-30 cm. long, 1.7 cm. in diameter 10 cm. from base. Sori submedial with membranous indusia, about eight pairs on each side of costule, the last pair of sori usually 1.5 or 2 mm. from pinnule-tip. Costae of pinnules with numerous articulate pale hairs 1 mm. in length, mixed with a few white squamules, 0.1-0.2 mm. wide at base, with irregular divisions, and 0.2-0.7 mm. in length; these squamules are especially abundant at the bases of the costules of the segments, and are here also mixed with hairs. Juvenile plants conspicuously clothed with long pale hairs.

Wet ravine, Mt. Tenjo, *Wagner 3742, Gilbert s. n., Rodin 754.*

Polynesia and Micronesia.

Specimens of *Cyathea lunulata* from Fiji, Samoa, Palau, and Guam show that the scales and hairs vary from one population to another. Thus the pale straw-colored scales of the stipe-bases in the Guam plant are similar to those from Fiji, but the latter usually have narrow dark margins. In Samoa the fronds are glabrous beneath, but with some small ovate, pale, subullate entire scales, sometimes also on veins which have a few appressed, articulated hairs (10, p. 29), and two specimens examined (*Setchell 73* and *U. S. South Pacific Exp. s. n.*) reveal the described scales conspicuously at the basal third to half of the segments. Plants from Fiji are almost glabrous but the hairs may be found on the tips of some pinnae, and scales may occasionally be found (*H. St. John 18098*). One Fiji specimen, *Gillespie 4215*, shows small dark-brown scales on the costules of some pinnae. Palau specimens seem to lack both the hairs and the scales on the minor rachises beneath, and show only tiny brown chaffy scales. Frond shapes and habits of the plants of the different islands appear to be the same, judging from photographs of living plants. Pinnae of plants from each locality are the same in shape, except that Palau specimens are more sharply dentate at the pinna-tips. The Palau plant is the most distinctive, but is still close to the others.

This is a rare fern in Guam, confined to one or two of the steep shaded valleys in the southern, volcanic part of the island. It grows with *Angiopteris Durvilleana*. In the one locality where we know it, there were several fully developed trees, some decaying trunks of old ones, and a few juvenile plants. It may be nearing extinction here.

An additional tree fern, *Cyathea aramaganensis* Kanehira is found in the northern Marianas, on Aramagan and Sarigan Islands (Hosokawa 19, vol. 26, p. 50). It differs from *Cyathea lunulata* in the short-spiny stipe and rachis, the scurfiness of the axes, many amorphous squamules, and in the branched trunk.

#### VII. POLYPODIACEAE

These ferns are the most advanced in evolution, made up of plants of many different habits, and with rhizomes and fronds of a wide variety of forms. The sporangia are long-stalked with a vertical annulus, and are borne on specialized fronds or entirely covering the underside of fertile blades or arranged in lines or clusters (sori) on the undersides or edges of the unmodified blades. Indusia are present in many forms, or lacking. Gametophytes are flat and green. By far the largest family of ferns, cosmopolitan in distribution, including 25 of the fern genera known in Guam. Recent pteridologists divide this large assemblage into more natural, smaller groups.

- Sporangia covering underside of fertile frond, or not in definite sori.
- Sporangia in contracted tip; frond simple.....20. **Belvisia**
  - Sporangia not in specialized tip; frond compound.
    - Large leathery fern of marshes; rachis green; pinnae entire.....
    - .....14. **Acrostichum**
    - Medium-sized\* herbaceous fern of woods; rachis purple; pinnae pin-  
natifid .....5. **Stenosemia**
  - Sporangia grouped into definite sori.
    - Sori marginal or submarginal.
      - Fronds linear, grasslike.....24. **Vittaria**
      - Fronds elliptic, not linear, dimorphic, the sterile simple.....18. **Humata**
      - Fronds pinnate or further dissected.
        - Sori continuous in long or short lines.
          - Indusium not formed from or by the margin, but opening toward it.
            - Plant chaffy, epiphytic; pinnae articulate.....17. **Nephrolepis**
            - Plant almost glabrous, terrestrial or climbing; pinnae not  
articulate .....10. **Lindsaea**
          - Indusium formed from or by the margin.
            - Pinnae dimidiate: sori strongly curved.....16. **Adiantum**
            - Pinnae more symmetrical, not dimidiate, sori not strongly curved.

\* Medium-sized ferns as used here average from 40-90 cm. tall.



- Veins free.....15. *Cheilanthes*  
 Veins anastomosing, or connected by marginal soriferous veinlets.  
 Soft, fleshy, aquatic plant, fronds usually strongly dimorphic .....13. *Ceratopteris*  
 Herbaceous terrestrial plants, fronds not strongly dimorphic  
 (uniform, except in *P. ensiformis*).....12. *Pteris*  
 Indusium absent, veins anastomosing copiously.....5. *Stenosemia*  
 Sori short and wide, not linear.  
 Indusium reniform, pinnae articulate, deciduous.....17. *Nephrolepis*  
 Indusium square, oblong, or half-cup shaped, pinnae not articulate.  
 Fronds coriaceous, glabrous.  
 Indusium longer than wide, epiphyte.....19. *Davallia*  
 Indusium as wide as or wider than long, terrestrial plant.....  
 .....8. *Sphenomeris*  
 Fronds herbaceous, hairy.....9. *Microlepia*  
 Sori dorsal, not marginal.  
 Sori linear.  
 Sori borne one on each side of costa.....6. *Blechnum*  
 Sori more numerous, not on side of costa.  
 Veins parallel, free.....7. *Asplenium*  
 Veins anastomosing.....25. *Antrophyum*  
 Sori orbicular or elliptic, not linear.  
 Veins free.  
 Underside of frond covered with pale wax glands.....11. *Pityrogramma*  
 Fronds without whitish wax glands.  
 Fronds simply pinnate, pinnae articulate and deciduous.....  
 .....17. *Nephrolepis*  
 Fronds more compound, pinnae not articulate.  
 Fronds 2-3-pinnate, hairs blunt, with frequent tannin-filled cells,  
 sori indusiate .....3. *Ctenitis*  
 Fronds 3-pinnate, hairs needle-shaped, with all cells clear, sori  
 apparently exindusiate .....2. *Lastrea*  
 Veins anastomosing.  
 Sori with indusium; plants usually terrestrial.  
 Veins anastomosing only between segments (along costa in *C.*  
*Warburgii*).....1. *Cyclosorus*  
 Veins anastomosing elsewhere.....4. *Tectaria*  
 Sori without indusium; plants usually epiphytic.  
 Lamina with stellate scales.....23. *Pyrrhosia*  
 Lamina without stellate scales.  
 Fronds simple or pinnatifid.....22. *Microsorium*  
 Fronds pinnate, the pinnae articulate.....21. *Goniophlebium*

### 1. Genus *Cyclosorus* Link

Usually medium-sized ferns with pinnate fronds, the pinnae in most species lobed. Veinlets simple and one or more pairs joined to a secondary veinlet which runs out to the bottom of the sinus. Sori usually round; indusium present or not. The majority of species are paleotropical. The New World genus *Goniopteris*, which differs in

possessing branched hairs, is very similar, and the pantropical genus *Lastrea*, which is separated by its entirely free veins, is also very close. Seven species of *Cyclosorus* occur in Guam, several of them very similar.

- Plants always small; pinnae not lobed.....1. *C. Warburgii*  
 Plants usually of medium size; pinnae lobed.  
 Basal pinnae (2-18 pairs) reduced into auricles or abortive.  
 Texture thick; 2 or more pairs of veins united.....4. *C. unitus*  
 Texture thin; 1-1.5 pairs of veins united.....5. *C. maemonensis*  
 Basal pinnae not reduced, or only slightly smaller.  
 Sori confined to lobes, leaving a wide sterile space along costa.  
 Texture herbaceous; scales lacking from costa beneath; many habits but not a marsh fern.....3. *C. interruptus*  
 Texture almost leathery; scales borne on costa beneath; a fern strictly of marshes .....2. *C. goggilodus*  
 Sori not confined to lobes, thus leaving no sterile space.  
 Fronds only sparsely hairy; indusium with very short hairs; segments closest to rachis usually not enlarged.....6. *C. dentatus*  
 Fronds hairy; indusium with numerous long hairs; lobes of basal pinnae closest to rachis usually enlarged.....7. *C. parasiticus*

1. *Cyclosorus Warburgii* (Kuhn et Christ), new combination (fig. 3).  
*Aspidium Warburgii* Kuhn et Christ; Warburg, *Monsunia* 1: 81, 1899-1900.

*Dryopteris depauperata* Copeland, in Merrill, *Philippine Jour. Sci.* 9 (C): 44, 1914; and all later authors.

Rootstock erect, 2-5 cm. tall, with numerous pinnate fronds 12-30 (41) cm. long, tapering in both directions. The very short stipe, rachis, and costae are downy with short, pale-brown hairs, and scattered hairs are borne on lamina. Veins anastomosing along costa. Pinnae entire or slightly wavy, alternate, ascending, 15-25 pairs. Sori round, medial, confined to the lowest veinlets.

Near Tolijuice, along stream banks, 200 yards east of Talisai River bridge, Maemon Valley, 3 miles east of Agat, *Wagner* 3598; on rocks in midstream, half a mile from Tolijuice, Maemon Valley, *Wagner* 3833; growing with *Asplenium unilaterale* on rocks, Tolijuice River, Maemon Valley, *Grether* 4424.

New Guinea and Guam.

The New Guinea plant first given this specific name by Kuhn and Christ has since been construed as *Phegopteris debilis* Mettenius (25, p. 223), described from Amboina, but this reduction does not appear to be correct. The present plant differs in having evident indusia, uniseriate sori, and nearly or quite entire pinnae. Mettenius' figure (25, pl. 6, fig. 1) is unlike our plant. *Aspidium Warburgii* var. *reti-*

*culatum* Kuhn and Christ is apparently the more normal form of our species, with reticulate venation, while the form described as typical represents the reduced condition with free veins. Comparison of the Guam plant with *Clemens* 6522 from the Monge River in Morobe,



FIGURE 3.—*Cyclosorus Warburgii*.

New Guinea, and a specimen from the Rosenstock Herbarium collected by Bamler at Sattelburg (U. C.) reveals a close resemblance. The Guam plant averages somewhat larger. *Grether* 4424 contains a set of unusually luxuriant specimens, the largest 41 cm. tall.

This notable little plant grows along streams locally in the Maemon Valley in southern Guam. It occurs on the banks just above the water's edge, and may also be found growing on rocks in midstream. For leading us to Tolijuice ("natural bridge" in Chamorro), we are grateful to Felix Carbullido of Agat.

2. *Cyclosorus goggilodus* (Schkuhr) Link, Hort. Berol. 2: 128, 1833. (Spelling emended from *C. gongylodes*. See St. John, Torr. Bot. Club, Bull. 72: 1, 22-23, 1945.)

*Dryopteris gongylodes* (Schkuhr) O. Kuntze; Merrill, Philippine Jour. Sci. 9 (C): 43, 1914; and later authors.

*Polystichum serrulatum* (Willdenow) Gaudichaud, Freyc. Voy. Bot., 325, 1827.

Rootstock long-creeping, producing fronds at intervals of 0.5-2.0 cm. Fronds almost leathery, 60-100 cm. long, pinnate, the basal pinnae not reduced. Stipe and rachis glabrous. Pinnae rather distant, 5-12 cm. long, shallowly pinnatifid with pointed segments, 2-3 mm. long. Sori marginal on the segments. Upperside glabrous, the underside hairy with sparse pale-brown scales along the midribs of pinnae.

Northeast end of Agaña marshes, *Wagner 3610*; rice marsh on hillside above road, north side of Mt. Alifan, *Wagner 3840*.

Pantropical.

This fern occurs only in marshes, and is most abundant in Guam in the marshes east of Agaña. It grows in deep grass, frequently in company with *Acrostichum aureum*. Where it is most luxuriant, the fertile fronds are uncommon. Gaudichaud found this plant also in Rota and Tinian.

3. *Cyclosorus interruptus* (Willdenow) Ching, Fan Inst. Biol., Bot. Bull. 8: 4, 184, 1938.

*Aspidium opulentum* Kaulfuss, Enum. Fil., 238, 1824.

*Dryopteris extensa* (Blume) O. Kuntze; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 75, 1936.

Rootstock creeping. Fronds herbaceous, 40-200 cm. long, pinnate, the pinnae 8-25 cm. long, 0.8-2.0 cm. wide, lobed, the segments rounded or somewhat pointed, 2-6 mm. long. The lowest pair of pinnae occasionally reduced, the lower 4-5 pairs with attenuate bases, the remainder with oblique truncate bases. Underside of pinnae setose or nearly glabrous and with or without sparse or copious yellow globular glands on veinlets. Sori marginal, on segments only, sometimes restricted to tips of segments. 1-2 pairs of veins anastomosing.

Near Northwest Airfield, *Grether 3651*; in savannah, Lonfit River valley, *Grether 3710A*; in shaded ravine, Lonfit River valley, *Grether 3710B*; brushy meadow, half a mile west of Mt. Santa Rosa, *Wagner 3868*; wet ravine near junction of Lonfit and Sigua Rivers, *Grether 3817*; in woods in the Agaña marshes, *Wagner 3762*; Sigua River valley, *Grether 3768*; beneath coconuts and open forest, Yigo, alt. 180 m., *Bryan 1139*; Mt. Santa Rosa, *Glassman 172*; Agaña Spring, 1.5 miles northeast of Agaña, *Glassman 129*; Oca Point, in jungle, *Glassman 22*; terrestrial, Maemon Valley, *Grether 4399*.

Rota: alt. 50 ft., *Grether 4490*; alt. 800 ft., *Grether 4470*; alt. 1,000 ft., *Grether 4484*.

Tropical Asia, the Philippines, Micronesia, and Melanesia.

Of *Cyclosorus interruptus*, Ching (6, p. 185) wrote, "Very near *C. extensus* (Bl.), the species differs in narrower and less deeply cut pinnae with short deltoid segments, much broader sterile space along costa and regularly anastomosing veins, which are either naked or only sparsely glandular underneath." Large series of specimens from many localities, however, reveal that there are no constant differences between these types. Of *C. extensus*, Ching (6, p. 183) describes the underside as glabrous except for the copious yellow glands. Yet New World material from Trinidad and Tobago, where it has been introduced, though especially referable to *C. extensus* because of its deep lobes and glandularity, shows the presence of numerous hairs. Specimens from Guam, on the other hand, which have been referred to *C. interruptus* on the basis of shallow lobes and consequent development of more anastomosing veinlets below the sinus, show an extensive development of yellow glands (U.S.N.H.: *Safford and Seale 1086, 1087*). The number of paired veins, used to separate these plants, depends upon the varying depth of the lobes; some with very deep lobes having but one pair of connected veinlets, some with none, thereby fulfilling the free-vein feature of *Lastrea*. There are no visible differences in the stipes. Specimens which curled in drying give an illusion of having longer lobes than if they were pressed flat. *C. interruptus* and *C. extensus* have various intermediate forms, and represent, apparently, mere varieties of one species that may be quite distinct in some places but not in Guam.

Locally, *C. interruptus* is the commonest *Cyclosorus* and is one of the most numerous ferns on the island. It occurs in a wide variety of

habitats: in woods, wet ravines, edges of fields, and even on limestone rocks.

4. *Cyclosorus unitus* (Linnaeus) Ching, Fan Inst. Biol., Bot. Bull. 8: 4, 192, 1938 (fig. 4).

*Polystichum unitum* (Linnaeus) Gaudichaud, Freyc. Voy. Bot., 325, 1827.

*Dryopteris unita* O. Kuntze; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 77, 1936.

*Tectaria serrata* Cavanilles, Descr. pl., 251, 1802.

*Aspidium serratum* Swartz, Syn. Fil., 246, 1806.

*Nephrodium Haenkeanum* Presl, Epim. Bot., 46, 1849.

*Dryopteris Haenkeana* (Presl) O. Kuntze, Rev. gen. pl. 2: 812, 1891; Merrill, Philippine Jour. Sci. 9 (C): 43, 1914; and later authors.

*Dryopteris cucullata* (Blume) Christ; Merrill, Philippine Jour. Sci. 9 (C): 43, 1914.

? *Dryopteris sophoroides* of Kanehira, Dept. Agr. Kyushu Imp. University 4: 6, 251, 1935; not (Thunberg) O. Kuntze 1891.

*Nephrodium multilineatum* of Schumann and Lauterbach, Flora der deutschen Schutzgebiete in der Südsee, 113, 1901; not Presl 1836.

Rootstock creeping. Fronds pinnate, their texture leathery, 20-100 cm. long, abruptly reduced at base into 1-11 reduced or completely abortive pinnae. Stipe and rachis pubescent. Normal pinnae 2-16 cm. long, 0.3-1.5 cm. wide, lobed, the segments shallow and sharp-pointed. Veinlets impressed above, raised below, several pairs joined into an excurrent veinlet. Upper side nearly glabrous, and dark green, shiny; underside paler and hairy. Sori formed on all veinlets down to midrib, no sterile space remaining.

In damp ravine, Sigua River valley, *Grether 3731*; ravine at junction of Sigua and Lonfit Rivers, *Grether 3818*; on exposed bank in hilly savannah, 2.5 miles southwest of Agaña, *Wagner 3699*; along streams in wet, wooded valleys near Agaña, *Wagner 3303*; dry hill, Masso River valley, *Grether 3438*; banks in marshes at Agaña, *Wagner 3761*, *Grether 3822*; Mt. Tenjo, alt. 320 m., *Bryan 1099* (B. M.); muddy stream bank, Maemon Valley, *Grether 4417*.

Rota: alt. 50 ft., *Grether 4489*; alt. 500 ft., *Grether 4480*.

Tropical Asia, Philippines, Micronesia, Melanesia, and Polynesia.

Christensen examined Cavanilles' type of *Tectaria serrata*, which is identical with Presl's type of *Nephrodium Haenkeanum*, the speci-



mens collected by Haenke at Umatac in Guam; the only difference found between *N. Haenkeanum* and *Cyclosorus unitus* was the presence of one pair of abortive pinnae rather than several. He considered this character "scarcely of specific value" (9, p. 16). Our specimens vary considerably in the number of reduced pinnae, the minimum number of pairs being two. On old fronds the abortive pinnae are frequently lost by breaking off. The most remarkable feature of this fern in Guam is the degree of variation in size in different environments;

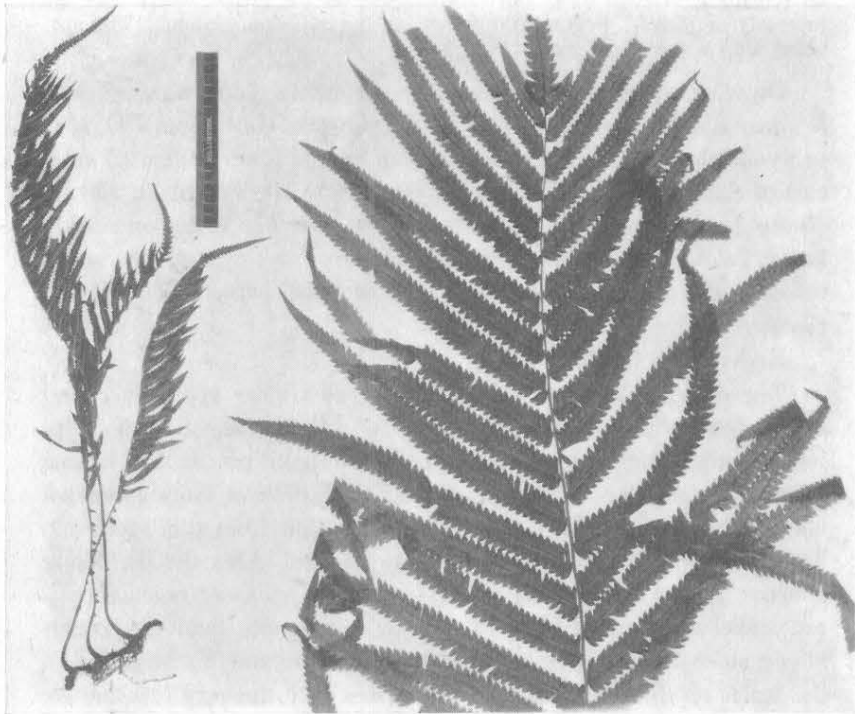


FIGURE 4.—*Cyclosorus unitus*: on left, small form, exposed bank in savannah, 1 mile north northeast Mt. Tenjo, Wagner 3699; on right, large form, dark ravine, Sigua River valley Grether 3731.

in dry savannahs occur leathery midget plants one-fifth as large as the giant thinner ones of damp ravines [*Cyclosorus Haenkeanus* (Presl) Ching, 6, p. 194]. The species is common in Guam, and is recorded by Gaudichaud also from Rota and Tinian; it is reported from the northern Marianas Islands by Hosokawa.

**5. *Cyclosorus maemonensis*, new species (fig. 5).**

*Cyclosorus* *C. parasitico*, *C. dentato*, *C. adenophoro* et *C. heterocarpo* affinis, rhizomate repente, pinnis basalibus reductis vel abortivis pluribus, et lamina utraque facie glandulis minutis ornata distinctus.

Rootstock creeping. Fronds 70-120 (195) cm. in length, lanceolate, with 16-20 pairs of normal pinnae and 17 (11-18) pairs of reduced pinnae, the basal ones very small, reaching to within 4-8 cm. of the stipe base. Middle pinnae pinnatifid, 5-12 (18) cm. long, 1.0-1.7 (2.1) cm. broad, 1-1.5 pairs of veinlets anastomosing, with copious yellow glands below, and fewer above, hirsute on both surfaces. Rachis and stipe densely hirsute. Dark brown ciliate scales on rootstock, at stipe base, and rarely above on the rachis, where they are promptly deciduous. Sori medial, indusiate, the indusium glandular and provided with a few short hairs.

Growing abundantly in damp ravine below the old dam, Mt. Tenjo, *Wagner 3746* (type, in University of California Herbarium 700521); in woods along stream, 200 yards east of Talisai River bridge (3 miles east of Agat), Maemon Valley, *Wagner 3595*; Mt. Tenjo, alt. 300 m., *Bryan 1250*; wet ravine, Mt. Santa Rosa, *Grether 4323*; on muddy bank, Talofoto River, *Grether 4329*; muddy bank of small stream, 3 miles south of Agat, *Grether 4383*; wooded banks, Geus River, *Grether 4374*.

Endemic to Guam.

The present species is one of a group of similar appearance, and differs from other members of the group in the combination of creeping rootstock, numerous reduced to abortive basal pinnae, and lamina generally glandular on both surfaces. *Polystichum consanguineum* Gaudichaud (16, p. 331) differs in description from this species in having fasciculate fronds and stipitate pinnae. Also the dwindling abortive pinnae at the base of the frond of *Cyclosorus maemonensis* are sufficiently conspicuous to warrant more note than the gradually smaller inferior pinnae of his description; and his stressing of the scales on the stipe and rachis disagrees with the very few that we find on our material. With only the description of his Guam plant at hand it is not possible to identify the present plant with it.

The Saipan plant referred to by Kanehira (20, p. 250), as *Dryopteris adenophora* C. Christensen may be the plant described here. True *Cyclosorus adenophorus* (C. Christensen) Copeland differs in the erect rootstock and in the large disciform protuberances at the bases of the lower pinnae, which are much less developed in the present plant. The latter is immediately separable from *C. dentatus* and *C. parasiticus*, which often grow with it in Guam, by the usually larger

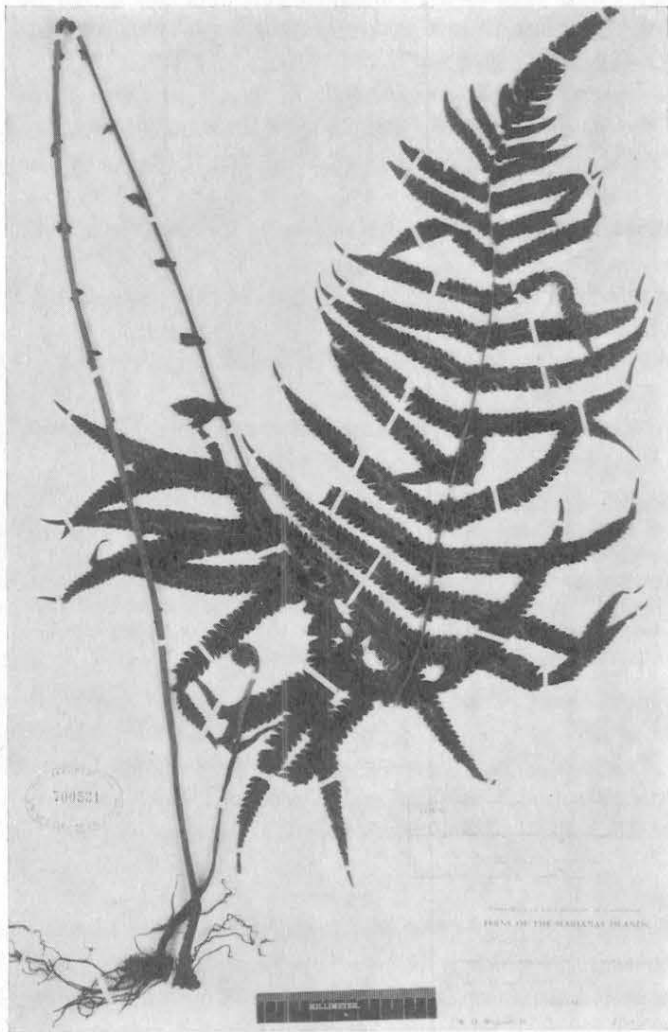


FIGURE 5.—*Cyclosorus macmonensis*, type.

size, and the presence of the 11 to 18 pairs of earlike, progressively distant, reduced pinnae in the lower part of the frond. *C. heterocarpus* (Blume) Ching resembles *C. adenophorus*, and, like it, has an erect rootstock; it differs from *C. maemonensis* in this respect and in the presence of glands below only.

This new species is characteristic of woods in damp stream valleys in the southern half of Guam, and in the wooded ravines on Mt. Santa Rosa in the north. It is very local, but it is usually abundant where it does occur.

6. *Cyclosorus dentatus* (Forskål) Ching, Fan Mem. Inst. Biol., Bot. Bull. 8: 206, 1938.

*Dryopteris dentata* (Forskål) C. Christensen, Kgl. Danske Vid. Selsk. Skr. VIII, 6: 24, 1920.

*Polystichum molle* (Willdenow) Gaudichaud, Freyc. Voy. Bot., 326, 1827.

*Dryopteris mollis* (Willdenow) Hieronymus; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 78, 1936.

Rootstock usually horizontal and creeping. Frond 40-90 cm. long, the lower 1-3 pairs of pinnae somewhat shorter and deflexed. Lower pinnae usually without extended basal segments. Middle pinnae 9-11 (15) cm. long, 1.5-2.0 cm. broad, cut just less than one-half the way down into rounded segments (except in very luxuriant plants). Excurrent veinlet joined by basal pair of veinlets and one or two more veinlets. Pinnae sparsely short-hairy. Indusium with very short hairs. Easily confused with *C. parasiticus*.

Common along Fonte River, 1 mile southwest of Agaña, *Wagner 3307*, *Wagner and Conover 3393*; Mt. Tenjo, *Grether 4321*; muddy banks, Talofoto River, *Grether 4328*, muddy bank, Geus River, *Grether 4376*; muddy bank of small stream, 3 miles south of Agat, *Grether 4382, 4384, 4385*; semi-savannah, Maemon Valley, *Grether 4418*.

Pantropical.

This species is locally frequent but apparently not as common as *C. parasiticus*, to which it is very similar and closely related. It is found especially in damp bamboo thickets and on muddy banks along streams. A series of unusually luxuriant plants, *Grether 4382, 4384, and 4385*, presents an appearance quite different from the usually smaller Guam form of this species. The pinnae of the largest of these specimens are 15 cm. long, 2 cm. broad, and are cut two-thirds of the way to the costa. Gaudichaud reported this species also in Rota and Tinian.

7. *Cyclosorus parasiticus* (Linnaeus) Farwell, Am. Midl. Nat. 12: 259, 1931.

*Dryopteris parasitica* (Linnaeus) O. Kuntze; Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; and later authors.

Rootstock horizontal, creeping. Fronds 40-150 cm. long, the lower pinnae of the same size as those above. The anterior basal segment of the lower pinnae extended and larger than the other segments. Middle pinnae 12-15 cm. long, 1.3-1.8 cm. wide, cut half-way down into somewhat pointed segments. Excurrent veinlet joined usually only by basal pair of veinlets. Pinnae usually copiously hairy. Sori in partly fruiting fronds very often only a pair at the base of each segment, the indusia with numerous long hairs.

Brushy meadow, half a mile west of Mt. Santa Rosa, *Wagner 3869*; wet ravine, Lonfit River valley, *Grether 3708*; wet ravine below dam, Mt. Tenjo, *Wagner 3747*; dry place near edge of woods, North Guam, *Grether 4312*; near Merizo, *Grether 4317*, *Grether 4318*; Mt. Tenjo, *Grether 4319*, *Grether 4322*; Anao Point, *Grether 4331*; Maemon Valley, *Grether 4389*; wooded bank along small stream, about 3 miles south of Agat, *Grether 4387*; Mt. Santa Rosa, *Sturtevant 34*.

Range more limited than that of *C. dentatus*; tropical Asia, Japan, Formosa, Korea, and the Pacific islands.

This plant is generally common in Guam, occurring in a variety of habitats, but especially in shaded damp ravines and brushy places in meadows. Most of the specimens are without glands, as are forms in South China and elsewhere. An unusually large rhizome, 28 cm. long, is shown by *Grether 4214*. The two collections from Merizo comprise plants of very different appearance: *Grether 4318* is the usual hairy form, but *4317* is more nearly glabrous, the lower pinnae are a little reduced, as in *C. dentatus*, yet the anterior basal lobes of the lower pinnae are much enlarged, as is characteristic of *C. parasiticus*, and are coarsely dentate. Except for the reduced pinnae *4317* resembles *Wagner 3869*, which in the field had a rather different appearance from typical *C. parasiticus*. With these exceptions, however, the present plant is quite constant and can readily be separated from *C. dentatus* in Guam.

Also known from the Marianas is *Cyclosorus truncatus* (Poiret) Farwell. Collected in Rota by Hosokawa and by Grether (alt. 500 ft., *Grether 4495*), it differs from species definitely known in Guam by its erect woody rhizome, tall tufted and almost naked fronds, truncate segments, and naked sporangia. *Polystichum consanguineum* Gaudichaud, mentioned before under *Cyclosorus maemonensis* Wagner and

Grether, may be a form of *C. truncatus*. *Aspidium meniscioides* (Willdenow) Kaulfuss was credited by Kaulfuss (21, p. 231) to Guam, but it is otherwise known only from tropical America.

## 2. Genus *Lastrea* Bory

Moderate-sized ferns with once to several times pinnate fronds. Veinlets free. Sori round, indusiate or not. A cosmopolitan genus of many species of terrestrial habitats; only one known in Guam.

### 1. *Lastrea Torresiana* (Gaudichaud) Moore, Ind. Fil., 106, 1858. *Polystichum Torresianum* Gaudichaud, Freyc. Voy. Bot., 33, 1827.

Rootstock short, erect. Fronds pale green, tripinnate, and covered with sparse hyaline needle-like hairs of one to several cells, 50-100 cm. tall, triangular, the middle pinnae up to 22 cm. long. Stipe and rachis pale straw-colored and practically bare. Stipe base with ciliate dark scales which leave rough spots after falling. Sori apparently without indusia.

Tributary of Fonte River, 1 mile southwest of Agaña, *Wagner 3391, Conover 510*; wooded ravine, Mt. Santa Rosa, *Wagner 3885*.

Old World tropics.

This plant has not been reported here since Gaudichaud's description of *Polystichum Torresianum* from the Marianas. From characters of cutting, sori, articulate hairs, ciliate paleae, fibrous hairy roots, and others, there is little doubt that he was dealing with the present species. The description of the hairs: "Les poils de la surface inférieure sont blancs, rares, alongés, articulés, et quelquefois rameux; ceux qu'on observe sur les rachis de la face supérieure sont de même nature, mais plus courts et plus épais," (16, p. 335) agrees with our material, except that no branching was found; where two hairs are borne close together, however, they appear on casual examination to be branched. Above on the costae the hairs are dense and numerous but below they are more remotely scattered and fewer. They are more conspicuous, however, below because of their much greater length. Of the indusium Gaudichaud said, (16, p. 334), "J'ai eu beaucoup de peine à trouver les tégumens, qui sont réniformes, grisâtres, mais tellement petits." We were unable to find any indusia at all on our material. The scales were described as "longues de 6 à 10 lignes, brun-clair, velues et ciliées, laissent sur les pétioles, après leur chute, des impressions proéminentes, rugueuses, brunes." Dark spots left by these scales along the stipe above the atrocaneous stipe base are conspicuous, especially on larger fronds.



*Lastrea Torresiana* (Gaudichaud) Moore is apparently the plant that has generally been called *Dryopteris setigera* (Blume) O. Kuntze (*Cheilanthes setigera* Blume 1828). We have found only two stations for this fern in Guam, both in shaded woods. From Alamagan, Sariapan, and Anatahan, Hosokawa (19, vol. 26, p. 233) reports *Phegopteris ornata* Fée. It is very possible that his records were of *Lastrea Torresiana*, as the plants are closely similar.

The plant described from the Marianas by Mettenius as *Aspidium stipitatum* (24, p. 344) has been placed in the genus *Lastrea* by Moore (27, p. 105). The description suggests, however, that the plant may actually have been a species of *Humata*. Unusual for the genus *Lastrea* are the stipes longer than the lamina which is deltoid and coriaceous. (See also *Humata*.)

### 3. Genus *Ctenitis* Christensen

Terrestrial, mainly tropical ferns, usually of moderate size. Rhizome usually ascending or erect, scaly. Fronds bipinnatifid or more dissected, with pluricellular jointed hairs on lamina, and scales commonly on rachis and costae beneath. Veins free. Sori round, usually indusiate.

Fronds bipinnate, rachis with few or no scales, ultimate segments fewer, 6-9 mm. broad.....1. *C. dissecta*  
Fronds tripinnate, rachis distinctly scaly, ultimate segments very numerous, 3 mm. broad.....2. *C. subglandulosa*

#### 1. *Ctenitis dissecta* (Forster) Copeland, Gen. Fil., 124, 1947.

*Dryopteris dissecta* (Forster) O. Kuntze; Safford, Contr. U. S. Nat. Herb. 9: 273, 1915; and later authors.

Rootstock erect, with sparse very dark brown scales, 0.5-0.9 cm. long. Frond deltoid, bipinnate, 30-80 cm. long, almost glabrous, herbaceous. Stipe and rachis brown, finely hirsute, scales only at stipe-base. Pinnae deeply pinnatifid, the lobes rounded, the basal pinnae pinnate. Veins forked but not anastomosing. Sori rather small, supra-medial.

Old World tropics.

We did not succeed in finding this plant in Guam, but two collections, which we have not seen, *Safford 1003* and *Safford and Seale 1088*, were cited by Merrill (22, p. 43). On the island of Samar in the Philippines we have found this species to be abundant in shaded limestone woods. It should be sought in similar places in Guam, but it is evidently rare on the island.

2. *Ctenitis subglandulosa* (Hance) Ching, Fan Inst. Biol., Bot. Bull. 8: 5, 302, 1938.

Rootstock erect, it and the stipe bases covered with tufted castaneous narrowly lanceolate scales, 1-3 cm. long. Fronds 0.9-1.3 m. tall, broadly lanceolate, 3-4-pinnate at base, the lamina herbaceous and nearly glabrous; segments oblique, oblong-lanceolate, and numerous. Stipe above base, rachis, and costae with numerous ovate pale-brown clathrate scales, 1-2 mm. long, and jointed hairs. Sori small and medial.

In sword-grass, savannah near the river, Geus River, *Grether* 4375.

Philippines, Bonins, Ryukyus, and Japan.

This fern has not previously been recorded from the Marianas. The plant is large and conspicuous but it is apparently rare in Guam. The presence of numerous scales on stipes, rachis, and costae, and the densely tufted long scales of the rootstock and stipe base serve to distinguish *C. subglandulosa* readily from *Lastrea Torresiana*, which is somewhat similar in habit.

#### 4. Genus *Tectaria* Cavanilles

Mostly medium-sized or large ferns characterized by anastomosing veins, usually with included free veinlets. Sori round, often rather large, the indusia peltate, orbicular, or wanting. A very large tropical genus represented by one species in the Marianas.

1. *Tectaria crenata* Cavanilles, Descr. pl. 250, 1802; Merrill, Philippine Jour. Sci. 9 (C): 45, 1914; and later authors.

*Sagenia crenata* (Cavanilles) Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 72, 1936.

*Aspidium Haenkei* Presl, Rel. Haenk. 1: 30, 1825.

*Aspidium longifolium* ? Desvaux; Gaudichaud, Freyc. Voy. Bot., 342, 1827.

Rootstock erect. Fronds large and coarse, over a meter tall when well developed, pinnate, the pinnae 20-30 cm. long, 3-6 cm. wide, glabrous, with entire to wavy margins. Stipe and rachis glabrous. Sori numerous, large, with orbicular indusia, arranged in two rows between the parallel main veins.

Near bank of Fonte River, 1 mile southwest of Agaña, *Conover* 564; coral-limestone soil, Agaña, *Grether* 3358; on tree-trunks and bases of coconut palms, limestone slope, Ritidian Point, alt. 50-150 m., *Bryan* 1152 (B.M.); Sigua River valley, *Grether* 3729; bank of Lonfit River, *Grether* 3705; on wooded limestone outcrops, wooded

ravine, Mt. Santa Rosa, *Wagner 3882*; headwaters of Ylig River, *Rodin 617*; muddy bank, Maemon Valley, *Grether 4422*.

Rota: alt. 800 ft., *Grether 4469*; alt. 50 ft., *Grether 4491*.

Malaya to Melanesia.

Examination of photographs from Prague of Presl's type of *Aspidium Haenkei* from the Marianas shows that it is identical with *Tectaria crenata* Cavanilles. The plant from Fiji referred to this species is different. Gaudichaud doubtfully called the Guam plant *Aspidium longifolium*, which is now considered a synonym of *Tectaria incisa* Cavanilles, a variable New World fern which is very close to *T. crenata*. This species is common in Guam, especially on wooded limestone slopes, and it occurs also in Rota and Saipan.

Cavanilles (4, p. 249) credited *Tectaria trifoliata* to the Marianas by mistake. It is known only in the tropics of the New World.

##### 5. Genus *Stenosemia* Presl

Medium-sized ferns with dimorphic fronds, the fertile ones being normally much contracted and covered beneath with sporangia. Venation anastomosing but without included veinlets in the areoles. Sterile fronds often proliferous with a bud or young plant developed on the rachis near the tip.

Only three paleotropical species, the genus ranging from the Solomons to Malaya.

##### 1. *Stenosemia pinnata* Copeland, Philippine Jour. Sci. 1, Suppl. 2: 146, 1906 (fig. 6).

Rootstock erect with blackish scales. Fronds bipinnatifid, 30-55 cm. long, glabrous, herbaceous. Stipe dark purple, shiny. Pinnae pinnatifid, mostly opposite. Veins anastomosing. Sori on contracted fertile frond, either covering the underside or limited to margin.

Wooded ravine, Mt. Santa Rosa, *Wagner 3883*; deep-wooded bank, Tolijuice River, Maemon Valley, *Grether 4421*.

Philippines, Sumatra, and Guam.

Not previously reported from the Marianas. This species is abundant in two places, forming large stands on damp forested slopes at Mt. Santa Rosa. The shape of the sterile fronds and the much contracted fertile fronds are very distinctive among Guam ferns.

*Bolbitis Quoyana* (Gaudichaud) Ching, which differs from *Stenosemia* in its longer and narrower frond with shallowly lobed pinnae and a creeping rootstock, has been reported by Hosokawa (19, p. 248)

from the northern Marianas Islands. *Polystichum rhizophyllum* (Swartz) Presl, a West Indian fern, was reported by Presl (28, vol. 1, p. 31) from the Marianas through error. *Polystichum* (*Rumohra*) *aristatum* (Forster) Presl, a medium-sized fern with

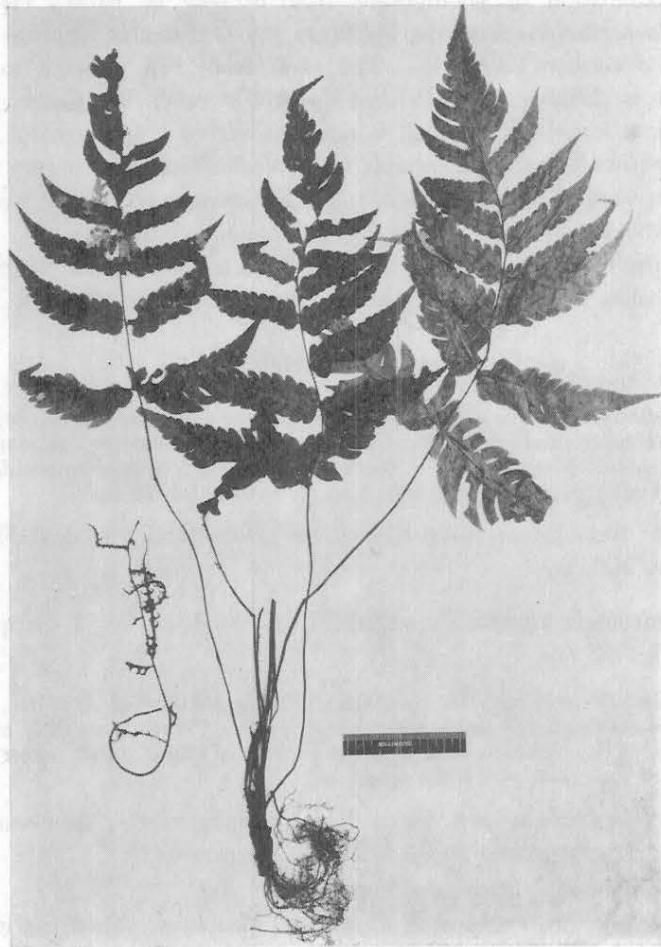


FIGURE 6.—*Stenosemia pinnata*.

tripinnate shiny dark-green fronds, was also credited by Presl to the Marianas (28, vol. 1, pp. 37, 38) but this record has not since been confirmed. The species has, however, a wide range through Japan, tropical Asia, and Polynesia, and may possibly occur in the Marianas.

*Athyrium silvaticum* (Blume) Milde (26, p. 376), a widely variable species is known to us from the Marianas by three collections from Rota: Sabaana, alt. 450 m., *Necker R530*; alt. 1,000 ft., *Grether 4486*; alt. 1,500 ft., *Grether 4472*. The Naval Medical Research Unit No. 2 material is lax and three-pinnate with remote dentate segments, 10 mm. long and 5 mm. wide. Our two collections are two-pinnate and compact, with closer pinnules. The stipes and lower rachises of all of the material are black and the stipe bases are provided with numerous black scales, about 1 cm. in length. The fronds are over 1 meter tall. Broadly construed, this species extends from eastern New Guinea to the Dutch East Indies and north to the Marianas.

*Diplazium sorzogonense* Presl has been reported from an open woodland in the middle altitudes of Alamagan Island by Hosokawa (19, p. 229). Known also as *Athyrium sorzogonense* (Presl) Milde, this is a medium-sized fern with deeply truncate-lobed pinnae and parallel asplenioid sori.

#### 6. Genus *Blechnum* Linnaeus

Moderate-sized ferns with rhizome mostly erect, sometimes creeping. Fronds simple or once-pinnate, sometimes dimorphic. Veins forked and free in sterile pinnae. Fertile pinnae with linear sori borne along the costa on a special elongate veinlet connecting the main veins. Indusium linear, opening on the costal side.

A cosmopolitan genus of terrestrial ferns with many species.

1. *Blechnum orientale* Linnaeus (Sp. pl. 2: 1077, 1753; *B. occidentale* by error) Sp. pl., ed. 2, 2: 1535, 1763; Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; and later authors.

*Blechnum longifolium* Cavanilles, Descr. pl. 263, 1802; Swartz, Syn. Fil., 114, 1806.

*Blechnum pectinatum* Presl, Rel. Haenk. 1: 51, 1825.

*Blechnum elongatum* Gaudichaud, Freyc. Voy. Bot., 394, 1827.

*Blechnum lomarioides* Gaudichaud, Freyc. Voy. Bot., 396, 1827.

Rootstock erect, with numerous narrow brown scales. Fronds when fully developed glabrous, from 30-180 cm. tall, pinnate, the pinnae 7-18 cm. long, 0.4-1.8 cm. wide. Stipe of various lengths, scaly at base, and with numerous abortive pinnae. Sori very long and usually confluent over the midrib in mature fronds.

Dry slope, Masso River valley, *Grether 3431*; wet shaded ravine, Mt. Tenjo, *Wagner 3750*; open field on dry banks in hills southeast of Agaña, alt. 900-1,000 ft., *Wagner 3746*; edge of savannah, half a

mile west of Mt. Santa Rosa, *Wagner 3872*; savannahs on hillside, Lonfit River valley, *Grether 3704*; semi-savannah, Maemon Valley, *Grether 4402*.

Rota: alt. 1,500 ft., *Grether 4473*; Sabaana, *Necker R527*.

Tropical Asia and Pacific islands east to Austral Islands.

This species is apparently limited to the volcanic areas of the island, being especially frequent in the dry savannahs. In damp shady places, however, giant forms nearly two meters high can be found, but these tend to be sterile.

*Pteris pectinata* Cavanilles (4, p. 266), described from the Marianas, and also reported by Willdenow (34, p. 366), is a synonym of *Blechnum loxense* (Kunth) Hieronymus. These reports are therefore erroneous as the species is known only from the New World (9, p. 22).

### 7. Genus *Asplenium* Linnaeus

Small to large ferns with rhizomes creeping to erect, their scales with pigmented walls. Fronds simple to 4-pinnate. Sori linear along the free veinlets, always indusiate, the indusium on one side, as long as the sorus. A cosmopolitan genus of ferns of many habitats; terrestrial, on rocks, or epiphytic. Five local species.

- Fronds simple, strap-shaped.....1. *A. nidus*  
 Fronds simply pinnate.  
 Rootstock short; pinnae partly cut away below but not dimidiate.  
 Pinnae numerous, narrow, crowded; rachis often with many dark scales; frond tapering toward base; stipe short; epiphytic.....2. *A. pellucidum*  
 Pinnae fewer, broader, distant; rachis almost glabrous; frond not tapering toward base; stipe long; terrestrial.....3. *A. falcatum*  
 Rootstock long-creeping; pinnae dimidiate.....4. *A. unilaterale*  
 Fronds 3-4-pinnate.....5. *A. laserpitiiifolium*

1. *Asplenium nidus* Linnaeus, Sp. pl. 2: 1079, 1753; Cavanilles, Descr., 254, 1802; Willdenow, Sp. pl. 5: 304, 1810; Merrill, Philippine Jour. Sci. 9 (C): 42, 1914; and later authors.

*Asplenium nidus* Linnaeus var. *guamensis* Gaudichaud, Freyc. Voy. Bot., 313, 1827.

*Neottopteris nidus* (Linnaeus) J. Smith; Safford, Contr. Nat. Herb. 9: 273, 1905.

A very distinctive epiphytic fern with ligulate fronds, 0.5-2.0 meters long, 12-20 cm. wide. Sori 2-3 cm. long, in close parallel oblique rows usually on the upper half of the blade. Base of plant full of black humus and usually forming a place for other ferns to grow.



Growing on tree at north end of island, *Grether 3349*; tree trunk, Northwest Airfield, *Grether 3641*; Ritidian Point, epiphytic on trees in moist limestone forest, alt. 50-180 m., *Bryan 1168* (B. M.); Mt. Santa Rosa, *Sturtevant 38*.

Old World tropics.

Called *galak* and airplant, the bird's-nest fern is one of the most conspicuous epiphytes in Guam. A remarkable crested form, five times divided, was collected by J. C. Thompson at the Naval Station at Guam around 1920 (B.M.). We have seen specimens of the bird's-nest fern also from Rota and Saipan, and Hosokawa reports it from Anatahan.

A somewhat similar species of the New World tropics, *Asplenium serratum* Linnaeus (synonym, *A. subsessile* Cavanilles) was erroneously credited to the Marianas by Cavanilles. Swartz considered *A. subsessile* a dubious species in 1806 (30, p. 24); he also erroneously gave (30, p. 75) the Marianas as the locality of *A. vittaeforme* Cavanilles, which Cavanilles himself had stated to be Mauban, Luzon.

2. ***Asplenium pellucidum*** Lamarck, *Encycl. méth. Bot.* 2: 305, 1786; Presl, *Rel. Haenk.* 1: 43, 1825; Hosokawa, *Nat. Hist. Soc. Formosa, Trans.* 26: 230-231, 1936.

*Asplenium hirtum* Kaulfuss, *Enum. Fil.*, 169, 1824.

*Asplenium Torresianum* Gaudichaud, *Freye. Voy. Bot.*, 317, 1827.

? *Asplenium caudatum* Forster, *Fl. ins. prodr.*, 80, 1786; Merrill, *Philippine Jour. Sci.* 9 (C): 42, 1914; Kanehira, *Dept. Agr. Kyushu Imp. University, Jour.* 4: 6, 248, 1935; Hosokawa, *Nat. Hist. Soc. Formosa, Trans.* 26: 230, 1936.

Rootstock short-creeping, scaly. Fronds 45-80 cm. long, pinnate, tapering toward the base, the pinnae 35-45 pairs, narrow, less than 1 cm. broad, attenuate (rarely blunt), obliquely crenate, with short oblique sori, 3-8 mm. long. Stipe short, often with numerous narrow dark scales which occur also on the rachis.

Along stream, epiphytic, Maemon Valley, 3 miles east of Agat, *Wagner 3838*; Northwest Airfield, epiphytic, *Grether 3645*; woods in ravine, Mt. Tenjo, *Wagner 3744*; epiphytic in woods, Lonfit River valley, *Grether 3712*; on *Cycas* trunk, Agaña Airfield, *Wagner 3663*; epiphytic in wet ravine, Mt. Santa Rosa, *Wagner 3891*; epiphytic, Talofoto River, *Grether 4330*; epiphytic, North Guam, *Grether 4311*; epiphyte, Maemon Valley, *Grether 4411*.

Rota: alt. 500 ft., *Grether 4500*.

Tropical Asia, Madagascar, Polynesia.

This is a very common epiphyte in Guam. It is known also from Rota and Saipan. Some of our specimens are nearly glabrous as was the Haenke specimen from the Marianas Islands mentioned by Presl, but the species is more usually scaly. The epiphytic habit is useful in separating this fern from the following.

3. *Asplenium falcatum* Lamarck, Encycl. méth. Bot. 2: 306, 1786; Safford, Contr. U. S. Nat. Herb. 9: 273, 1905.

*Asplenium grande* Willdenow, Sp. pl. 5: 311, 1810.

*Asplenium cultratum* Gaudichaud, Freyc. Voy. Bot., 317, 1827.

*Asplenium macrophyllum* Swartz, Schrad. Jour. Bot. 2: 52, 1801; Merrill, Philippine Jour. Sci. 9 (C): 42, 1914; Kanehira, Dept. Agr. Kyushu Imp. University, Trans. 4: 6, 248, 1935; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 231, 1936.

*Asplenium adiantoides* (Linnaeus) C. Christensen; Merrill, Philippine Jour. Sci. 9 (C): 42, 1914; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 231, 1936.

Rootstock short-creeping, scaly. Fronds 40-70 cm. long, pinnate, not tapering toward the base, the pinnae 15-20 pairs, broader, usually more than 1 cm. broad, sharply dentate, with oblique long sori, 6-15 mm. long. Stipe long, this and the rachis with but few scales.

Abundant on limestone slopes, Agaña Airfield, *Wagner 3662*; limestone rocks in wet woods, mouth of Talofofu River, *Wagner 3751*; Ritidian Point, alt. 180 m., *Bryan 1168*; along spring stream, foothills of Mt. Santa Rosa, *G. C. Moore 383*; Tumon Bay, *Sturtevant 44*.

Rota: *Necker R77*; alt. 500 ft., *Grether 4487*.

Saipan: limestone cliff, *Wagner 3231*.

Old World tropics.

A large series of specimens of *Asplenium macrophyllum* Swartz and *A. falcatum* from many different localities reveals that plants deemed typical of the two named segregates represent extremes of one variable species, and that there are numerous intermediates. The Guam population, however, is rather uniform, and does not develop the very large pinnae of some forms. The species is abundant on limestone rocks and in limestone soil in Guam and Saipan, but we have not found it growing epiphytically here as it often does in other Pacific islands.

An apparent hybrid, *Asplenium falcatum* × *pellucidum* (fig. 7), was discovered on a wooded limestone slope at Agaña Airfield (Wagner 3737). The plant was growing terrestrially with a large colony



FIGURE 7.—*Asplenium falcatum* × *pellucidum*.

of *A. falcatum*, but it stood out conspicuously. *A. pellucidum* is a common epiphyte in the near vicinity. The putative hybrid was darker green than *A. falcatum*, and its pinnae shorter-stalked than in that species, but not so shortly stalked as in *A. pellucidum*. The apparent

hybrid has an average of 25 pairs of pinnae; *A. falcatum*, fronds of equal size about 16; and *A. pellucidum*, usually 40 pairs. The basal pinnae of the intermediate fern are reduced but not so much so as in *A. pellucidum*, and the stipes are shorter than those of *A. falcatum* fronds of similar size, but not so short as *A. pellucidum*. The average length of the sori is between those of the presumed parents. The pinnae are obliquely crenate-dentate, with more lamina posteriorly at the base than in *A. falcatum*, and the pinnae are narrower than in that species.

*Asplenium macrophyllum* Cavanilles (4, p. 259) and *A. grande* Swartz (30, p. 77) are both actually *Diplazium marginatum* (Linnaeus) Diels, a species of the American Andes, not of Palapa, which is given by Cavanilles (Christensen, 9, p. 19) as a place in Guam.

4. ***Asplenium unilaterale*** Lamarck, Encycl. méth. Bot. 2: 305, 1786.

Rootstock narrow, 2-3 mm. thick, long-creeping. Fronds 8-26 cm. long, pinnate, not tapering toward base. Pinnae blunt, not caudate-tipped, dimidiate, dentate. Sori distal, 2 mm. long. Stipe dark and glabrous.

Muddy bank, Taloforo River, *Grether 4327*; rocks near water, Geus River, *Grether 4380*; rocks in stream with *Cyclosorus Warburgii*, Tolijuice River, Maemon Valley, *Grether 4419*.

Old World tropics.

A new record for Guam. The measurements given above are rather small for this plant, but the species is extremely variable in size elsewhere and probably reaches a larger size in Guam. It is apparently frequent here, and Hosokawa has reported it from three of the northern Marianas Islands (19, vol. 26, p. 232).

5. ***Asplenium laserpitiifolium*** Lamarck, Encycl. méth. Bot. 2: 310, 1786; Presl, Rel. Haenk. 1: 48, 1825; and all subsequent writers.

A large lacy fern with scaly rootstock and 3-4-pinnate dark-green fronds, 80-120 cm. long. Pinnae much dissected into cuneate dentate segments, 0.5-1.0 cm. long, with short sori, 2-4 mm. long. Veinlets raised. Stipe and rachis dull purple black.

Epiphytic in woods, Northwest Airfield, *Grether 3644*; wet woods, growing on ground, north end of island, *Grether 3348*; North Guam, *Grether 4310*; Mt. Santa Rosa, *Sturtevant 41*.

Rota: alt. 500 ft., *Grether 4492*.

Tropical Asia to Polynesia, east to Tahiti.

This is a common epiphyte in the forests of Guam, and is one of the most beautiful ferns on the island. Its specific distinction from the pantropical *Asplenium cuneatum* Lamarck may be questioned.

Another decomposed *Asplenium* in the same group, *A. nitidum* Swartz, has been repeatedly credited to Guam through a confusing series of errors. Cavanilles (4, p. 256) published a description of *A. caudatum* Cavanilles from the Port of Palapa, which is apparently in Samar, not Guam. In 1804, he published a new name, *Diplazium nitidum* Cavanilles, for the same species (5, p. 66, pl. 48). Swartz included both of Cavanilles' names, but renamed the earlier one *A. elongatum* Swartz (30, pp. 79, 92, 283); Willdenow repeated the names used by Swartz (34, pp. 318, 319, 352, 353). A century later, Safford confused the name "*Asplenium nitidum* Swartz" with Cavanilles' plant in his list of Guam ferns, giving the clue to his error by writing elsewhere in his descriptive catalogue (29, p. 263) that this was the same as *Diplazium nitidum*. Since then every published list of Marianas ferns has included *Asplenium nitidum* Swartz. Yet the plant described by Cavanilles first as *Asplenium caudatum* and later as *Diplazium nitidum*, according to Christensen (9, p. 19), on Merrill's authority, seems actually to be *Asplenium tenerum* Forster, a once-pinnate species. It is a common plant in the Philippines and elsewhere but is not reliably known from Guam, although Beddome credited it to the Marianas, citing *A. elongatum* Swartz as a synonym (1, p. 147). Either *A. nitidum* Swartz or *A. tenerum* Forster might reasonably be expected to occur in Guam, but the evident nomenclatorial confusion regarding the former and the *a priori* untrustworthiness of the locality of the latter require their present exclusion from the fern flora of Guam.

Other asplenia reported in Guam by mistake are *Asplenium monanthes* Linnaeus (*A. monanthes* L. of Cavanilles, Willdenow, and Safford), a small species of the New World tropics and Hawaiian Islands, and *A. trilobum* Cavanilles, a Chilean species reported erroneously by Cavanilles.

#### 8. Genus *Sphenomeris* Maxon

Medium-sized ferns with creeping rhizomes covered with dark-brown bristles. Fronds erect, dissected into small cuneate divisions with one or two sori on the tip of each segment. Sori indusiate, the indusia attached by the base and part of the sides. A small genus of tropical ferns represented in Guam by a single species.

1. *Sphenomeris chusana* (Linnaeus) Copeland, B. P. Bishop Mus., Bull. 59: 69, 1929.

*Davallia retusa* of Presl, Rel. Haenk. 1: 66, 67, 1825; not Cavanilles 1802.

*Davallia tenuifolia* Willdenow; Presl, Rel. Haenk. 1: 67, 1825.

*Davallia?* *ferruginea* Swartz; Gaudichaud, Freyc. Voy. Bot. 373, 1827.

*Odontosoria retusa* of Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; and later authors; not (Cavanilles) J. Smith 1857.

*Odontosoria chinensis* (Linnaeus) J. Smith; Merrill, Philippine Jour. Sci. 9 (C): 44, 1914; and later authors.

Recognizable from the generic description. Fronds 3-4-pinnate, 10-60 (averaging about 20) cm. tall, coriaceous and shiny. Stipes pale pink.

Dry hill, Masso River valley, *Grether 3437*; exposed rocks, Mt. Tenjo, *Wagner 3741*; road bank, north side of Mt. Alifan, *Wagner 3841*; dry grassy slope, half a mile west of Mt. Santa Rosa, *Wagner 3878*; in dense moist woods, north end of Tumon Bay, *Moore 393*.

This fern provides another example of the apparent confusions met with in the literature of the pteridophytes of Guam. *Davallia retusa* Cavanilles (4, p. 278), a plant closely related to the present species but much larger and with broader segments, was described from Luzon. We did not succeed in finding this species in Guam although Willdenow, perhaps in error, credited it to the Marianas in 1810 (34, p. 476). In 1825, Presl, stating that he did not know the plant except by figure, thought it to be the same as *Davallia chinensis* Linnaeus (which is *Sphenomeris chusana*), so he called his Guam specimens *Davallia retusa*. Safford accordingly named the plant he found common in the savannahs of Guam, *Odontosoria retusa* [now *Sphenomeris retusa* (Cavanilles) Maxon], and subsequent writers have followed him. Merrill identified the Guam plant correctly but included the other on Safford's authority.

*Sphenomeris chusana* is very common in the hilly volcanic areas of the island, growing usually in exposed grassy situations, and occasionally on rocks.

#### 9. Genus *Microlepia* Presl

Medium- to large-sized ferns with creeping rhizomes which are hairy or bristly. Fronds bipinnate to decompose; veins free. Sori dorsal, usually



near the margin, in the indusium half-cup shaped, attached by the base and sides.

Terrestrial ferns of about 50 species, all tropical.

1. *Microlepia speluncae* (Linnaeus) Moore, Index Filicum, xciii, 1857.

Rootstock stout and hairy. Fronds herbaceous, minutely hirsute, 95 cm. tall, triangular, 3-pinnate in large specimens, the ultimate segments oblong-deltoid and shallowly crenate. Sori small, nearly marginal.

Semi-arid brushland, Maemon Valley, Grether 4404.

Old World tropics.

This common species has evidently not been found previously in Guam, where it seems to be rare. The plant is characteristic of brushy second-growth areas. Hosokawa's report (19, vol. 26, p. 125) of the poorly known species, *Microlepia manilensis* Presl, from Rota, may actually represent an additional record for the Marianas of the polymorphic *M. speluncae*.

10. Genus *Lindsaea* Dryander

Mainly small ferns, with creeping rhizomes provided with narrow dark scales. Fronds pinnate, the pinnae dimidiate in most species, herbaceous, and glabrous. Veins free or anastomosing. Sori near the margin on the ends of free veins or on a continuous vein parallel to the margin, the indusium opening on the marginal side.

A large tropical genus of epiphytic or terrestrial ferns.

Plant climbing, in shaded woods; pinnae dimidiate.....1. *L. Macraeana*  
Plant terrestrial, in open fields; pinnae symmetrical.....2. *L. ensifolia*

1. *Lindsaea Macraeana* (Hooker and Walker-Arnott) Copeland, B. P. Bishop Mus., Bull. 59: 70, 1929 (fig. 8).

*Lindsaya Boryana* (Presl) Brause; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 116, 1936.

Rhizome wide-creeping, 1.5 mm. thick, with mahogany-colored scales. Fronds linear, 20-35 cm. long, pinnate, the numerous pinnae dimidiate, 0.8-1.2 cm. long, crenate on the upper side. Veins free. Stipe and rachis straw-colored. Sori near margins, one on each lobe of the pinnae.

Scandent at bases of trees in deep wooded ravine, Mt. Santa Rosa, Wagner 3888; base of *Areca* palm, Talofoto River, Rodin 678.

Old World tropics exclusive of Africa and its islands.

New to Guam, where the representative of this plant resembles specimens from Kusaie and Ponape in the Caroline Islands in being smaller and more delicate than is usual over much of the rest of its



FIGURE 8.—*Lindsaea Macraeana*

range; the species is, however, extremely variable. At the one Guam locality where we have found it, the plant climbs abundantly on tree-trunks near their bases. Rodin, however, found only one plant at his locality. Hosokawa reports this species also from Sarigan Island.

2. *Lindsaea ensifolia* Swartz, Jour. Schrad. Bot. 2: 77, 1801 (fig. 9).  
*Schizoloma ensifolium* (Swartz) J. Smith; Safford, Contr. U. S.  
 Nat. Herb. 9: 77, 1905; and later authors.  
*Schizoloma Biillardieri* Gaudichaud, Freyc. Voy. Bot., 380, 1827.  
*Pteris angulata* Presl, Rel. Haenk. 1: 54, 1825.

Rootstock creeping, its scales short. Fronds pale green, 15-40 cm. long, pinnate, rarely bipinnate at base, the linear pinnae finely serrate, 2-8 cm. long, 0.5-1.5 cm. wide, with cuneate bases. Veins anastomosing. Sori continuous along the margins with long pale indusium.

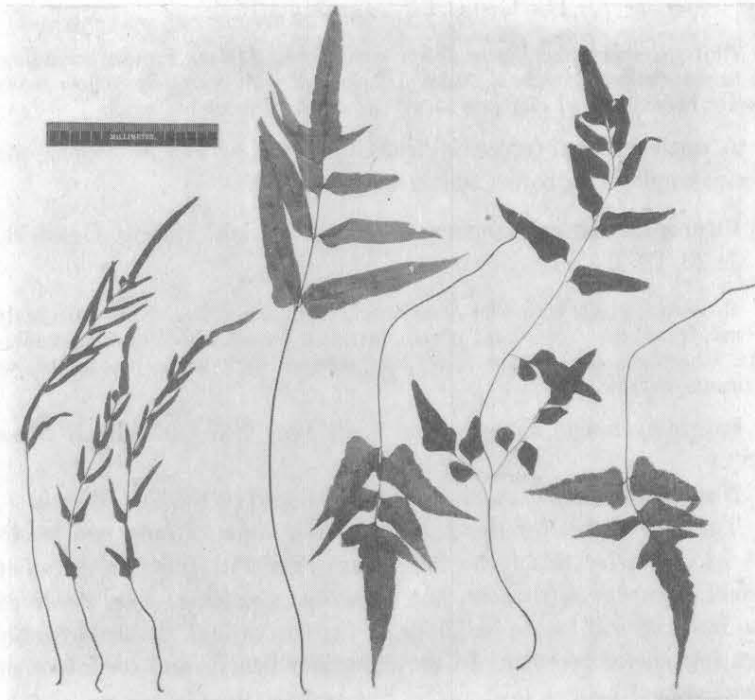


FIGURE 9.—*Lindsaea ensifolia*, the three fronds on left usual savannah form; fronds on right, from shaded damp place.

Open hilly field, south of Agaña, alt. 900-1,000 ft., *Wagner 3309*; grassy fields, Maemon Valley, *Wagner 3834*; savannah, half a mile east of Mt. Santa Rosa, *Wagner 3874*; dry fields, Masso River valley, *Grether 3434*; Sigua River valley, *Grether 3727*; rocks near water,

Masso River, Grether 3435, Grether 3821; dry roadside, Maemon Valley, Grether 4391.

Old World tropics.

A very common fern of open grassy savannahs. In damp shady places occasional plants may be found which resemble forms of *Lindsaea heterophylla* Dryander, the pinnae becoming very wide and the basal ones pinnate.

*Lindsaea ambigens* Cesati (synonym, *L. decomposita* Willdenow) has been reported from Alamagan Island by Hosokawa (19, vol. 26, p. 117).

#### 11. Genus *Pityrogramma* Link

Rhizome short-creeping or erect, with narrow scales. Fronds ascending, the stipes dark and shiny. Blades 1-3-pinnate, with white or yellow waxy powder beneath. Sori elongate along the veins, without indusia.

A small genus of terrestrial ferns, mainly New World tropical, the species common on banks and in weedy places.

##### 1. *Pityrogramma calomelanos* (Linnaeus) Link, Handb. Gewächs. 3: 20, 1833.

Rootstock erect, with very attenuate dark-brown scales. Stipe also scaly at base, it and the rachis dark purple, lustrous. Frond 30-65 cm. long, tripinnate, lanceolate, dark green above and covered with white powder below. Segments narrow, dentate.

In grassy tangle along stream bank, near Piti Junction, *Wagner* 3659.

New World tropics, and widely introduced in the Old World.

The first report for the Marianas. We know of only two localities in Guam for this fern; the station near Piti Junction is rather distant from any settlement, but numerous sporelings were observed also in damp soil beside buildings at Agaña Airfield. It has probably been introduced recently. In the Hawaiian Islands and certain other Pacific island groups this species has become abundant.

#### 12. Genus *Pteris* Linnaeus

Medium- to large-sized ferns with 1-4-pinnate fronds, the veins free or anastomosing. Sori linear, borne on a marginal vein connecting the ends of the veinlets. Indusium formed by the reflexed specialized margin.

Terrestrial ferns of 250-300 species, mainly of the tropics, represented by three species locally.

Veins anastomosing along costa; frond dull green, tripartite....1. *P. tripartita*  
 Veins free along costa; frond shiny green, pinnate in plan.

Fronds small, dimorphic; lobes of pinnae few.....2. *P. ensiformis*

Fronds of medium size, monomorphic; lobes of pinnae numerous.....

.....3. *P. spinescens*

1. *Pteris tripartita* Swartz, Jour. Schrad. Bot. 2: 67, 1801; Presl, Rel. Haenk. 1: 58, 1825; Merrill, Philippine Jour. Sci. 9 (C): 1, 45, 1914; and later authors.

*Pteris marginata* Bory; Safford, Contr. U. S. Nat. Herb. 9: 273, 1905.

Plant 0.5-2.0 m. tall. Rootstock large with deltoid or tripartite dull-green fronds. Fronds usually divided into three or five bipinnatifid parts, two of these branching off of the main rachis oppositely, and these branches frequently again divided. Veins forming areoles along the costa and elsewhere.

Shady wooded base of limestone cliff along Beach Road, about 1 mile northeast of Agaña, *Wagner 3764*; wooded ravine near summit of Mt. Santa Rosa on limestone outcrops, *Wagner 3890*; deep wet woods near Northwest Airfield, *Conover 537*; damp dense woods at foot of cliff, a quarter of a mile south of Tumon Bay, *Moore 382*; Tumon Bay, *Sturtevant 45*.

Rota: alt. 1,500 ft., *Grether 4479*.

Africa through tropical Asia to Tahiti.

A common fern in Guam, and reported also from Rota and Saipan. It is found in limestone soils and apparently does not grow in the volcanic areas. On the forested limestone plateau of northern Guam plants of very large size may be found.

2. *Pteris ensiformis* Burmanni, Fl. Ind., 230, 1786.

? *Pteris serraria* Swartz, Syn. Fil., Kiliae, 289, 1806.

A small fern with creeping rootstock. Fronds 15-40 cm. long, of two types: the fertile bipinnate with long narrow segments, 5-12 cm. long, 0.4-0.5 cm. wide, with smooth margins; the sterile smaller, bipinnate, the divisions much shorter and broad, with dentate margins.

Muddy bank, close to water's edge in deep woods, Aguada River, 2.5 miles east of Sumay, *Conover 540*, *Wagner 3626*.

This species has not been reported from Guam before, the only possible exception being Swartz' report of Née's collection of *Pteris serraria* Swartz from the Marianas. Christensen (7, p. 607) has reduced *P. serraria* to *P. cretica* Linnaeus, a similar species which may also occur in Guam. Immature or small specimens of the latter may be confused with *P. ensiformis*, but fully developed plants of *P. cretica*

have larger fronds with much longer and pointed pinnae. The single known station for *P. ensiformis* in Guam was discovered by J. T. Conover in 1945; the colony contains numerous plants and extends for more than 100 yards along the stream banks.

3. *Pteris spinescens* Presl, Rel. Haenk. 1: 56, 1825; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 338, 1936.

*Pteris quadriaurita* of Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; and all later authors; not Retzius 1791.

? *Pteris biaurita* of Safford, Contr. U. S. Nat. Herb. 9: 57, 273, 1905; and later authors; not Linnaeus 1753.

Rootstock ascending, with lustrous brown lanceolate scales, 5-10 mm. long, 1 mm. wide, and numerous twisting roots covered with velvety pale-brown root hairs. Stipe base sparsely scaly and somewhat muricate, dark brown, the dark color occasionally extending in a wide streak to the rachis; upper stipe and rachis mostly straw-colored, sulcate, and glabrous. Frond pinnate, the pinnae pectinate (cut almost to the rachis), the basal pinnae with 1-3 pectinate divisions on the lower side. Segments 1.0-1.5 cm. long, 4 mm. broad at base. Costae and costules provided with a few very short spines.

Two hundred yards east of Talisai River bridge, Maemon Valley, *Wagner 3596*; stream banks near Piti Junction, *Wagner 3658*; terrestrial in shady wooded ravine, Mt. Santa Rosa, *Wagner 3889*; Sigua River valley, *Grether 3724*; dry woods, Lonfit River valley, *Grether 3715*; on clay banks, headwaters of the Ylig River, *Rodin 609*; terrestrial, Maemon Valley, *Grether 4406, 4398*.

Rota: alt. 1,000 ft., *Grether 4485*.

Marianas and Carolines.

Described originally from Guam, *P. spinescens* is one of a pantropical aggregate of very closely related forms (*P. quadriaurita* Retz. *sensu lato*), which, if treated as one species, has many recognizable subspecies. *Pteris biaurita* has broader, more shallowly lobed pinnae, and veins anastomosing along the costa. Safford under "Ferns" included both *P. quadriaurita* and *P. biaurita*, but under "Savannahs" mentioned only *P. biaurita*. In the savannah areas of the island we found only the plant which Safford named *P. quadriaurita*; we agree, therefore, with Hosokawa that Safford's record of the other species is dubious, based perhaps on the same confusion between these plants that beset Christensen in the Index Filicum.

*Pteris spinescens* is partial to the volcanic parts of the island, occurring in the wooded damp ravines that cut through the grasslands, especially along streams. It is fairly common.



*Histiopteris incisa* (Thunberg) J. Smith has been reported by Hosokawa from Alamagan (19, vol. 26, pp. 227-228), and is represented in our collections from Rota, where it was found growing in a matchwood grove at 1,500 feet altitude (*Grether 4475*). It is a coarse, two-pinnate, dull-green fern with fronds 70-130 cm. tall, opposite pinnae, the segments long oblong with rounded shallowly lobed or undulate margins. The veins anastomose copiously; the sori are continuous along the margins; and the stipe is dull red brown. The species occurs throughout the tropics and may be expected also in Guam.

### 13. Genus *Ceratopteris* Brongniart

Plants floating or rooted in marshes. Rootstocks short and sparsely scaly. Fronds soft and herbaceous, occasionally viviparous, of two types; the fertile usually erect, decomposed, with linear segments; the sterile ascending or spreading, smaller, usually with much broader, rounded segments. Venation areolate, without included veinlets. Sori borne in lines on one or two long, anastomosing marginal veins.

A small anomalous pantropic genus, often put into a separate family, the Parkeriaceae.

1. *Ceratopteris Gaudichaudii* Brongniart, Soc. Philom. Paris, Bull. 1821: 187, 1821; Gaudichaud, Freyc. Voy., Bot., 393, 1827.

*Ellobocarpus cornutus* Kaulfuss, Enum. Fil., 148, 1824, in part.  
 ? *Ceratopteris thalictroides* of Safford, Contr. U. S. Nat. Herb. 9: 222, 273, 1906; and later authors; not (Linnaeus) Brongniart, 1821.

Sterile fronds broadly deltoid, tripinnatifid, 14-25 cm. long, 6-12 cm. wide at base, stipes 3-6 cm. long, segments 2.5 (1-4) mm. wide, the ultimate segments mostly extremely narrow, 2.5 (1-10) mm. long, 0.5 (0.25-1.5) mm. broad. Fertile fronds with divisions fewer, these linear attenuate, 1-3.5 cm. long, 1-1.5 mm. broad (size and form of fertile fronds not seen, but described as "palmares").

Floating on water, Talofofu River, *Grether 4326*; *guafak oohong*, *Nelson 203* (B. M.).

Endemic in Guam.

This identification is made on the specimens cited, and one other, so further study of the Guam plant, particularly of its seasonal variation, should be made.<sup>2</sup> The few sporangia found on *Nelson 203* have

<sup>2</sup> Since the above was written, a fragment consisting of one fertile and one sterile pinna of *C. Gaudichaudii* collected by Gaudichaud in the Marianas was kindly loaned by Monsieur J. Leandri, Museum d'Histoire Naturelle, Paris, for comparison. The fertile segments of this specimen are 0.5-1.5 cm. long, and 1 mm. broad, with constricted, extremely narrow sterile tips 0.25-1.5 mm. in length; the sterile pinna agrees closely in size and form with our Talofofu River specimens.

well-developed annuli, and spore numbers greater than 16 (those counted between 20 and 30, the total probably 32 when all spores are present). Agreement of the sterile fronds, however, with Brongniart's characterization of the lobes as setaceous, as opposed to his description of the lobes of sterile fronds of *Ceratopteris thalictroides* as ovate-lanceolate obtuse, is evidence that the Guam plant may be distinct from that species. At the Talofoto River station the plants were abundant, but all were floating, and small shrimp were found among the roots (*guafak oohong* means shrimp bed in Chamorro). It is possible that the aquatic habit may produce this frond-form, although Gaudichaud, the original collector, reported it in swampy terrain. Ordinarily, the plants called *C. thalictroides* grow rooted in muddy or wet sandy soil, often subject to flooding, and are taller plants of different aspect, the sterile fronds with much fewer, wider, and rounded ultimate segments.

According to Gaudichaud and Safford, the local name is *umug sensonyan*, and the plant is eaten in Guam as a salad. It is apparently not generally common, and it probably appears seasonally.

#### 14. Genus *Acrostichum* Linnaeus

Tall coarse ferns with erect, paleaceous, and often massive rootstocks. Fronds erect, thick-textured, glabrous, simply pinnate. Veins anastomosing, the areoles minute. Sporangia covering the undersides of the fertile pinnae, and mixed with paraphyses (tiny sterile filaments). Characteristic tropical salt-marsh ferns of few species.

1. *Acrostichum aureum* Linnaeus, Sp. pl., 1069, 1753; Presl, Rel. Haenk. 1: 16, 1825; and most later writers.

*Acrostichum inaequale* Willdenow; Gaudichaud, Freyc. Voy. Bot., 74, 305, 1827.

Recognizable from generic description. Fronds usually about 1 m. tall, but occasionally over 2 m.

Agaña marshes, *Grether 3701*; marshy spot on hillside above road, north side of Mt. Alifan, *Wagner 3839*; mouth of Pago River, *Conover 529*; swamp at headwaters of Ylig River, *Rodin 603*.

Pantropical.

The native name in Guam is *langayao* according to Safford (29, p. 174). This is a very abundant fern in brackish marshes, and occurs also in upland marshes. Juvenile plants were found on rock shelves along streams in the Maemon Valley, about three miles east of Agat.

At the Agaña marshes this fern attains a fine development; plants here reach over 2 meters in height. Gaudichaud records this species also from Rota and Tinian, and Hosokawa reports it from the northern Marianas.

#### 15. Genus *Cheilanthes* Swartz

Small ferns with erect rootstocks. Fronds pinnate to quadripinnate, with dark stipes and rachises. Veins free, the sori borne on the enlarged ends. Indusium formed by the reflexed margin.

A large cosmopolitan genus of terrestrial ferns.

1. *Cheilanthes tenuifolia* (Burmam) Swartz, Syn. Fil., 129, 332, 1806; Merrill, Philippine Jour. Sci. 9 (C):1, 1914; and later authors.

Rootstock erect, covered with linear light-brown scales. Fronds 3-4-pinnate, 10-40 cm. long, triangular, with long stipes, the stipes, rachises, and minor axes dark purple. Sporangia abundant, confluent along the margins, not covered by the slightly reflexed margins.

Open hilly field, south of Agaña, alt. 900-1,000 ft., *Wagner 3306*; Sigua River valley, *Grether 3736*; Masso River valley, *Grether 3580*; Lonfit River valley, *Grether 3717*; Mt. Tenjo, *Moore 86M*; Mt. Santa Rosa, *Sturtevant 25*.

Tropical Asia through Micronesia and Melanesia.

This is a very common and characteristic fern in the savannahs. It grows in reddish soil among grasses, and may occasionally be found growing upon rocks.

#### 16. Genus *Adiantum* Linnaeus

Ferns with erect or creeping rhizomes. Fronds pinnate to decompose, ascending or drooping, the stipes dark, usually shiny. Pinnules usually dimidiate. Sori beneath the reflexed margins, on or between the ends of the veinlets.

A very large cosmopolitan genus of terrestrial plants, the maiden-hair ferns.

1. *Adiantum philippense* Linnaeus, Sp. pl. 2: 1094, 1753.

*Adiantum lunatum* Cavanilles, Desc. pl., 272, 1802.

*Adiantum lunulatum* Burmann; Kaulfuss, Enum. Fil., 205, 1824.

*Adiantum arcuatum* Swartz, Syn. Fil., Kiliae, 272, 1806; Willdenow, Sp. pl. 5:431, 1810.

Rootstock small, ascending, with tiny narrow reddish-brown scales. Frond pinnate, sometimes drawn out to a long tip, and bearing a bud at the end. Pinnae 1.0-1.5 cm. long, on shiny hairlike stalks, dimidiate, with undulate or lobed margins. Sori strongly curved, 1-2 mm. long.

Stream banks, tributary of the Fonte River, 1 mile southwest of Agaña, *Conover 502, Wagner 3399*; ravine at entrance of stream into river, Lonfit River valley, *Grether 3718*; dense shade, on stream bank, Sigua River valley, *Steere 30, Rodin 672*.

Old World tropics and Central America.

Apparently this fern has not been reported from the Marianas since 1824. It is very local in occurrence, growing along stream banks in shady places, but where it is found it is usually abundant. The nearest other known station is Yap Island in the Carolines; it evidently has not been recorded in the other Marianas Islands.

*Adiantum caudatum* Linnaeus was reported by Cavanilles (4, p. 271) from the Marianas. It resembles *A. philippense* but is more coriaceous, with deeply lobed and smaller pinnae. Although Cavanilles may have been mistaken, this is a widespread plant and his record may be correct.

#### 17. Genus *Nephrolepis* Schott

Ferns with short scaly rootstocks and pinnate fronds, the pinnae articulate to the rachis and deciduous. Veins free. Sori indusiate, orbicular and medial or marginal, or elongate along the margin.

A pantropical genus of terrestrial or epiphytic ferns with some very ill-defined species.

- Sori elongate, marginal; epiphytic.....1. *N. acutifolia*  
 Sori round, marginal or medial; usually terrestrial.  
 Plants of medium size; sori near the margin.....2. *N. hirsutula*  
 Plants usually large; sori medial.....3. *N. biserrata*

1. *Nephrolepis acutifolia* (Desvaux) Christ, Nat. Ges. Basel, Verh. 11: 243, 1895; Merrill, Philippine Jour. Sci. 9 (C): 1, 44, 1914; and later authors.

Rootstock woody, with long twisting "stems," covered with narrow, red-brown shiny scales. Fronds pinnate, linear, usually 1 m. but occasionally over 2 m. long. Stipe base scaly. Rachis and pinnae covered with deciduous pale tomentum. The sterile pinnae rounded at tips; fertile pinnae narrower, lanceolate, and pointed, with one continuous sorus on each side, or with this broken into several sori. Indusium conspicuous, opening along the marginal side.

Epiphytic in woods, north-central Guam, *Wagner 3611*.

Africa, tropical Asia, and the Philippines to Australia.

A frequent epiphyte in Guam. The larger plants of shady forests form characteristic sprays of long pendent fronds. This sword-fern may be found in southern Guam, but it is most frequent in the limestone forest of the northern plateau.

2. ***Nephrolepis hirsutula*** (Forster) Presl, Tent. Pterid., 79, 1836; Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; and all later writers.

*Aspidium gibbosum* Willdenow, Sp. pl. 5: 223, 1810.

? *Nephrodium gibbosum* (Willdenow) Gaudichaud, Freyc. Voy. Bot., 338, 1827.

*Nephrodium acutum* Presl, Rel. Haenk. 1: 31, 32, 1825; Schkuhr 1806?

? *Nephrodium bidentatum* Presl, Rel. Haenk. 1: 32, 1825.

Fronds small to medium-sized, up to 1 m. or more long. Stipe and rachis chaffy. Pinnae 2-8 cm. long, pale green, with fairly numerous brown scales above and below, entire or crenate. Sori numerous, marginal with reniform indusia.

Dry slope, Masso River valley, *Grether 3439*; on rocks in weedy spot, Mt. Tenjo, *Wagner 3740*; Sigua River valley, *Grether 3730*; edge of savannah, Lonfit River valley, *Grether 3713*; exposed places on limestone hillside, Agaña Airfield, *Wagner 3661*; 1 mile west of Mt. Santa Rosa, *R. H. Baker s. n.*; headwaters of the Ylig River, *Rodin 604*; terrestrial, Maemon Valley, *Grether 4393*; dry roadside near Umatac, *Grether 4386*.

Rota: epiphytic, alt. 1,000 ft., *Grether 4498*.

Pantropical.

The commonest form of the terrestrial sword-fern in Guam is a medium-sized plant with the sori 1-2 mm. distant from the slightly crenate margin, and is abundant, especially in coconut groves and abandoned and overgrown clearings. The plants are commonly diseased, with lumpy outgrowths of the pinnae, which may be the same as those mentioned by Presl (28, vol. 1, p. 32). The report by Hosokawa (19, vol. 26, pp. 69, 70) of *Nephrolepis exaltata* (L.) Schott from Saipan, Alamagan, and Pagan may be based on one of the small, practically glabrous forms of the present plant.

3. *Nephrolepis biserrata* (Swartz) Schott, Gen. Fil., pl. 3, 1834.

? *Nephrodium biserratum* (Swartz) Gaudichaud, Freyc. Voy. Bot., 338, 1827.

*Aspidium splendens* Willdenow; Kaulfuss, Enum. Fil., 232, 1824.

*Nephrodium splendens* (Willdenow) Gaudichaud, Freyc. Voy. Bot., 337, 1827.

Fronde usually larger than in the preceding species, 1.0-2.5 or more meters long. Stipe and rachis nearly or quite glabrous. Pinnae 10-20 cm. long, dark green, lustrous, almost glabrous, with sori rather remote, medial, about 3-4 mm. from the crenate or entire margin.

Marshes at Agaña, *Wagner 3763.5*; woods at Northwest Airfield, *Grether 3652*; woods near Dededo, *Wagner 3667*; large stand in wooded ravine, Mt. Santa Rosa, *Wagner 3893*.

Rota: alt. 1,000 ft., *Grether 4482*.

Pantropical.

The specimens cited here were all found in shaded, often damp, places and are quite typical of "*N. biserrata*" as conventionally construed. This is much less common than the smaller, more scaly plant, but in Guam the intermediates suggest that both extremes are forms, perhaps environmental, of the same species; the intermediates may, however, be hybrids. Separating a large series of specimens of these plants into one species or the other is very difficult because there occur various combinations of the characters of size, cutting of the margins of the pinnae, position of sori, and indument. Gaudichaud's statement (16, p. 338) regarding *N. gibbosum*, "Ce *nephrodium* est intermédiaire entre les *n. splendens*, *biserratum*, & c. et le *nephrodium hirsutulum*," illustrates the difficulty of separating these plants into species.

18. Genus **Humata** Cavanilles

Small epiphytic ferns with creeping rhizomes. Fronds coriaceous, simple and elliptic to 2-3-pinnate and triangular, on stipes that are articulate with the rhizome. Veins free. Sori at ends of veinlets, with oblong or reniform indusia which are attached only at base.

The genus occurs in the Malay-Polynesian region, and was named by Cavanilles for the village of Humata or Umatac, Guam.



1. **Humata heterophylla** (Smith) Desvaux, *Prod.*, 323, 1827; Safford, *Contr. U. S. Nat. Herb.* 9: 295, pl. 53, 1905; and all later authors (fig. 10).

*Davallia heterophylla* Smith; Swartz, *Syn. Fil.*, 130, 1806.

? *Humata pinnatifida* Cavanilles, *Descr. pl.*, 273, 1802; Swartz, *Syn. Fil.*, 130, 1806; Willdenow, *Sp. pl.* 5: 465, 1810; Christensen, *Dansk Bot. Ark.* 9: 3, 26, 1937.

*Davallia pinnatifida* (Cavanilles) Gaudichaud, *Freye. Voy. Bot.*, 371, 1827.

Rootstock climbing widely, about 1 mm. thick, covered with red-brown spreading scales which turn darker with age, these nearly entire but some with a few tiny teeth especially toward the base, and with a long hairlike tip, the length of the scale 2-4 mm. Sterile fronds entire or very shallowly serrulate. Stipes 0.4-3.6 cm. long, the blades elliptic and attenuate at the tip, 3-11 cm. long, 0.7-3 cm. wide. Fertile fronds incised  $\frac{1}{8}$ - $\frac{7}{8}$ , usually about  $\frac{3}{4}$ ; stipes 0.4-3.0 cm. long, blades 1.8-12.0 cm. long. Sori close to the margins of the lobes, often with a tooth projecting below each one. Two forms of fronds intermediate between the fertile and sterile are frequent: (1) shaped like a narrow sterile frond, with no lobes, but with sori along the irregular margin; (2) deeply cut but without sori.

On coconut trunks, half a mile west of Mt. Santa Rosa, *Wagner 3870*; epiphyte in wooded ravine, Mt. Santa Rosa, *Wagner 3886*; 200 yards east of Talisai River bridge, Maemon Valley, about 3 miles east of Agat, *Wagner 3594*; Sigua River valley, *Grether 3723*; on fallen tree, Northwest Airfield, *Wagner 3655*; mossy tree trunks, north-central Guam, *Wagner 3352*; wet woods near Hilaan, *Conover 580*; Yigo, alt. 200 m., *Bryan 1134* (B.M.); epiphytic, north Guam, *Grether 4313*; hanging loosely from limbs of trees, headwaters of Ylig River, *Rodin 615*; edge of woods, Mt. Lamlam area, *Moore 298*; epiphyte, Maemon Valley, *Grether 4413*; epiphyte, Geus River, *Grether 4377*.

Rota: alt. 1,500 ft., *Grether 4426*.

Tropical Asia to New Guinea and Fiji.

The Guam plant differs too slightly from typical *H. heterophylla* to be maintained as a distinct species. After examining a series of *H. ophioglossa* Cavanilles from the Philippines, we believe that it is likely that Née collected his material in Samar rather than in Guam. The plant which Safford figured as *H. heterophylla* in his plate 53 was collected by him at Pago Pago Bay, Samoa, in 1888; the rhizome of this one collection (*U. S. National Herbarium 515940*) bears fronds that agree in form with both *H. ophioglossa* and *H. heterophylla*. The

rootstock scales are less spreading than those of *H. ophioglossa*, however, and the collection is intermediate between the two types. Safford's plate, unfortunately, shows only the fronds of this collection which have the subcordate to cordate bases of *H. ophioglossa*. Material from Guam, of which we have numerous specimens, agrees with *H. ophioglossa* in the spreading paleae of the rhizome, in the

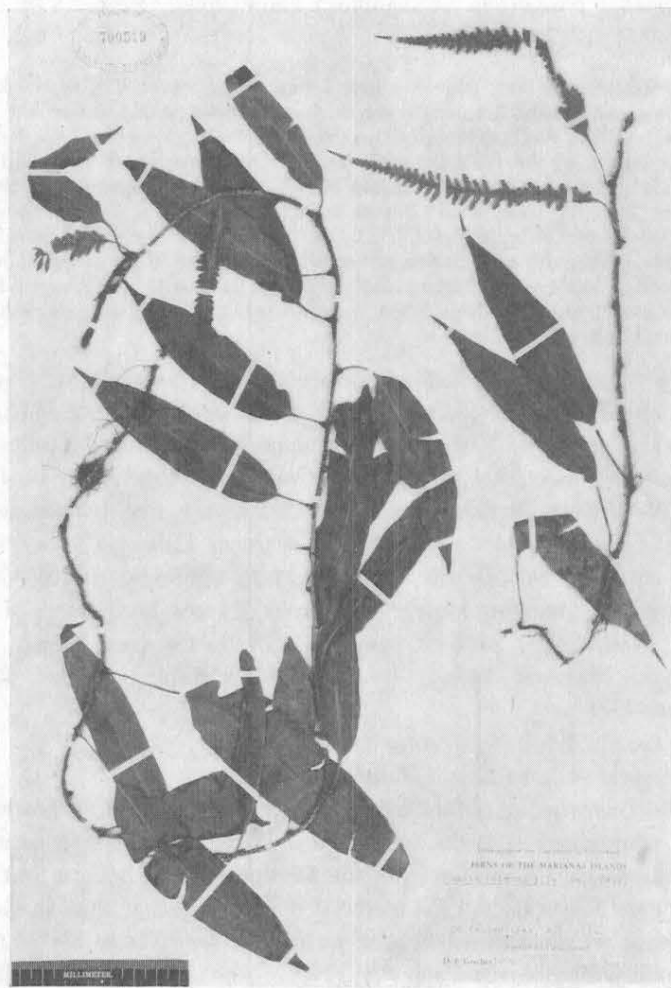


FIGURE 10.—*Humata heterophylla*, on fallen tree, Northwest Airfield, Grether 3655.

sori, and in occasionally having crenate margins, but the size and shape of the frond is that of *H. heterophylla*, which is not known from the Philippines. The type of the Philippine *H. ophioglossa* has shorter, relatively broader fronds with subcordate bases; all of the specimens from the Philippines which we have seen agree very well with Christensen's redescription of the type (9, p. 25), which is alleged to have come from Guam. However, the type of *H. pinnatifida* Cavanilles, as redescribed by Christensen, agrees, at least in part, with Guam specimens and probably came from Guam. Swartz (30, pp. 337, 338) considered *H. pinnatifida* close to *H. heterophylla* and made *H. ophioglossa* a synonym of the latter; Willdenow (34, p. 465) did the same. Gaudichaud (16, p. 371), using the name *H. pinnatifida* for the Guam plant, remarked that it is perhaps little distinct from *H. heterophylla*. The Philippine plant which agrees very well with *H. ophioglossa* may, nevertheless, be readily separated from the Guam plant, although they are very closely related. (We are indebted to Dr. W. R. Maxon for the loan of the National Herbarium material of this species.)

In the deeper forests of Guam, *Humata heterophylla* is an abundant plant, climbing trunks and branches of trees in vinelike tangles. The species is also known in Rota and probably occurs elsewhere in the Marianas.

*Humata trifoliata* Cavanilles was described from the Marianas, and was recently reported under its synonym, *H. lepida* (Presl) Moore, by Hosokawa from Alamagan (19, vol. 26, p. 121). This species and the similar *H. repens* Diels, reported as *Davallia serrata* Willdenow from the Marianas (34, p. 467), are small ferns with long-stipitate, dissected, coriaceous, triangular fronds. The description of *Aspidium stipitatum* Mettenius suggests a *Humata* also (see under *Lastrea*). With this evidence it seems probable that *H. trifoliata* actually came from Guam and that it may still exist there.

#### 19. Genus *Davallia* J. E. Smith

Ferns of medium size. Rootstock creeping, with scales that lack attenuate tips. Stipes articulate. Frond triangular, dissected, and leathery. Sori marginal, the indusia attached by the bases and sides, and opening on the marginal side.

An Old World tropical genus, represented by one common species in Guam.

1. *Davallia solida* (Forster) Swartz, Schrad. Jour. Bot. 2: 27, 1801; Gaudichaud, Freyc. Voy. Bot. 372, 1827; Safford, Contr. U. S. Nat. Herb. 9: 256, 273, pl. 3, 1905; and all later writers.

*Davallia pyxidata* of Kaulfuss, Enum. Fil., 221, 1824; not Cavanilles 1802.

*Nephrodium ? lucidulum* Presl, Rel. Haenk. 1: 39, 1825.

Rootstock 4-5 mm. in diameter, wide-creeping and branching, covered with long dark-brown scales on the young parts which leave indented scars on the old parts as they gradually fall off. Fronds glossy, pale green, 30-80 cm. long, coriaceous, deltoid, 3-4-pinnate. Sori marginal, the indusia oblong, opening at the slightly flared tip.

Epiphytic on fallen tree, Northwest Airfield, *Grether 3649*; on coconut trunk near Piti Junction, *Wagner 3657*; terrestrial in woods near Dededo, *Wagner 3668*; Sigua River valley, *Grether 3720*; epiphytic on coconut near junction of Sigua and Lonfit Rivers, *Grether 3819*; epiphytic on coconut, Maemon Valley, *Grether 4414*.

Rota: alt. 1,500 ft., *Grether 4477*.

Malaya to Fiji.

A common, conspicuous epiphytic fern in Guam (called *pugua machena*, according to Safford), this species is noticed especially on the trunks of coconut palms. We have seen it also, in Saipan, and Hosokawa records it from Rota and Alamagan. It may occasionally be found growing terrestrially. The species is extremely variable in size; occasional giant specimens are found which have fronds four times pinnate with long and narrow segments and very narrow indusia, which approach *D. fejeensis* Baker. From Rota, Hosokawa reports *D. solida* var. *Lindleyi* (Hooker) Rosenburgh, a small form with the indusium occupying the entire tip of the segment.

*Tapaenidium lineare* (Cavanilles) C. Christensen was reported by Cavanilles (4, p. 274) and by Willdenow (34, p. 483) from the Marianas but has not been reported since and this locality may have been a mistake. The species is medium-sized with bipinnate coriaceous fronds with narrow rounded segments. The sori are small, located at the ends of the veins near the margin.

## 20. Genus *Belvisia* Mirbel

Epiphytic ferns of small to medium size. Rhizome creeping, scaly. Frond simple and entire, the venation reticulate with included veinlets. Sporangia in a special apical segment with the margin reflexed over them in young fronds.

A distinctive Old World tropical genus of about 10 species, one of them in Guam.

1. **Belvisia mucronata** (Fée) Copeland, Gen. Fil., 192, 1947.

*Hymenolepis mucronata* Fée, Gen. Fil., 82, pl. 6B, fig. 1, 1852;

C. Christensen, Dansk Bot. Ark. 6: 3, 62-63, 1929.

*Hymenolepis ophioglossoides* Kaulfuss, Enum. Fil., 146, 1824.

*Acrostichum spicatum* of Cavanilles, Descr. pl., 237, 1802; not Linnaeus f. 1781.

*Belvisia spicata* of Safford, Contr. U. S. Nat. Herb. 9: 273, 1905; not (Linnaeus f.) Mirbel 1803.

*Hymenolepis spicata* of Merrill, Philippine Jour. Sci. 9 (C): 44, 1914; and subsequent writers; not (Linnaeus f.) Presl 1849.

Characterized by generic description. Fronds pale green, rather fleshy, 20-50 cm. long with fertile portion 3-5 mm. thick, 2-14 cm. long. Rootstock scales with thick blackish cell walls and marginal teeth.

Lonfit River valley, *Grether 3706*; epiphyte in wooded ravine, Mt. Santa Rosa, *Wagner 3895*; epiphyte in thick woods, Northwest Airfield, *Grether 3654*; Yigo, alt. 180 m., *Bryan 1132* (B. M.); epiphytic on tree, 2 miles east of Yigo, *Moore 258*; epiphyte, Maemon Valley, *Grether 4396*; epiphyte, Geus River, *Grether 4371*.

Rota: alt. 1,500 ft., *Grether 4476*.

Malaya, Philippines, Micronesia, New Guinea, Melanesia, and Polynesia.

*Belvisia spicata* (Linnaeus f.) Mirbel, described from the African islands, is similar to the present species, but differs from it in the distinctly raised veins, the scales without marginal teeth, and in often having a narrow, sterile tip at the base of the spike rather than a mere constriction (C. Christensen, 8, pp. 62-63). This narrow sterile strip at the base of the spike may occasionally be found in *B. mucronata* (for example, *Grether 4371*.) *B. mucronata* is a common plant in the forests of Guam, growing usually in and around the crotches of large trees. In very dark moist woods, large ruffled forms are found, the leafy liverworts often covering the upper surfaces of the fronds.

21. Genus **Goniophlebium** (Blume) Presl

Rootstock long-creeping, the stipes articulate. Fronds pinnate with articulate pinnae. Venation reticulate between the main veins, each areole with one included free veinlet. Sori round, exindusiate, borne on the free veinlets.

An Old World tropical genus of epiphytic ferns.

1. **Goniophlebium percussum** (Cavanilles), new combination.

*Cyathea percussa* Cavanilles, Descr. pl., 538, 1803.

*Polypodium percussum* (Cavanilles) Kaulfuss, Enum. Fil., 90, 1824.

*Polypodium cyathoides* Swartz, Syn. Fil., 37, 1806; Willdenow, Sp. pl. 5: 194, 1810.

*Polypodium persicifolium* Desvaux; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 26: 245, 1936.

Rota: Sabaana, *W. L. Necker s. n.* (U.S.N.H. and U.C.); alt. 300 ft., *Grether 4467*; alt. 1,000 ft., *Grether 4497*.

▼ Tropical Asia to Samoa.

Originally described by Cavanilles from a specimen collected by Née in Guam, this plant has apparently not been found there since. The specimens cited here and Hosokawa's record from the same place are the only other collections known to us from the Marianas. The fronds are commonly over 1 meter in length. The pinnae range from 1 cm. broad with the sori medial to 2 cm. broad with inframedial sori (*Grether 4497*) and in texture range correspondingly from nearly coriaceous to thinly herbaceous. In Guam the species should be sought as an epiphyte in forest trees.

*Drynaria quercifolia* (Linnaeus) J. Smith, a curious fern with oaklike humus-gathering, sterile leaves, was reported from "the Marianas Islands, especially in Palapa" by Cavanilles (4, pp. 247-248), but the specimens probably came from Samar.

22. Genus **Microsorium** Link

Rootstocks scaly, creeping. Stipes articulate. Fronds simple or pinnatifid, thick in texture, and usually naked. Veins anastomosing, the areoles including free veinlets. Sori round, without indusia.

An Old World tropical genus of mostly epiphytic ferns of numerous species, with two in Guam.

Fronds usually deeply pinnatifid; sori large, impressed.....1. **M. scolopendria**  
Fronds simple; sori small, superficial.....2. **M. punctatum**

1. **Microsorium scolopendria** (Burmam) Copeland, Univ. California Pub. Bot. 16: 112, 1929.

*Polypodium hemionitis* Cavanilles, Descr. pl., 248, 1802; Willdenow, Sp. pl. 5: 165, 1810.

*Tectaria phymatodes* (Linnaeus) Cavanilles, Descr. pl., 249, 1802.



*Polypodium phymatodes* Linnaeus; Presl, Rel. Haenk. 1: 22, 1825; Gaudichaud, Freyc. Voy. Bot., 72, 1827; Merrill, Philippine Jour. Sci. 9 (C): 45, 1914; and later writers.

*Polypodium grossum* Langsdorff et Fischer; Presl, Rel. Haenk. 1: 22, 1825.

*Phymatodes phymatodes* Maxon ex Safford, Contr. U. S. Nat. Herb. 9: 352, pl. 62, 1905.

Rootstock long-creeping, 2-4 mm. thick, bluish, with scales at the growing tip. Fronds pale green, shiny, deeply pinnatifid (sometimes simple), 5-150 cm. long, glabrous. Sori in one or two rows on each side of costa, large and round, deeply impressed, giving a warty appearance to the upper side of the frond. Extremely variable.

Terrestrial in brushy areas, Mt. Santa Rosa, *Wagner 3881*; Sigua River valley, *Grether 3726*; coconut trunks, Agaña Airfield, *Wagner 3300*; epiphytic in wet woods, Northwest Airfield, *Grether 3653*; Mt. Alifan, alt. 230 m., *Bryan 1203* (B.M.).

Rota: alt. 50 ft., *Grether 4499*.

Common and widespread in the Old World tropics.

The local name of this abundant fern is, or was, *kalaou* or *kahlau* (Gaudichaud 16, p. 72; Safford, 29, p. 352). It grows in a wide variety of habitats: on exposed coconut trunks, on forest trees, on the ground, and on rocks. Midget forms with short, simple, fertile fronds are frequent on dry coconut trunks. In rich shady situations, lax terrestrial forms become very tall, the narrow pointed lobes extending 25 or more centimeters. This is an excellent example of the effect of environment on the size and form of ferns. We have seen specimens of this species in Saipan also. *Polypodium nigrescens*, a close relative, has been reported from coastal cliffs on Anatahan Island by Hosokawa (19, vol. 26, p. 246).

2. ***Microsorium punctatum*** (Linnaeus) Copeland, B. P. Bishop Mus., Bull. 93: 73, 1932.

*Polypodium punctatum* (Linnaeus) Swartz; Merrill, Philippine Jour. Sci. 9 (C): 45, 1914; and later writers.

*Microsorium irioides* (Poiret) Fée; Safford, Contr. U. S. Nat. Herb. 9: 273, 1905.

Rootstock short and usually covered with dark humus. Fronds strap-shaped, 50-120 cm. long, 3-7 cm. broad, with many small sori beneath, usually on the upper half.

Talofoto Point, alt. 90 m., *Bryan 1114*; Ritidian Point, alt. 50-180 m., *Bryan 1167* (B. M.); Sigua River valley, *Grether 3725*; epiphytic on fallen tree, Northwest Airfield, *Grether 3650*; tree branch, 12 feet from ground, east edge of Barrigada, *Moore 3M*; epiphyte in dense woods, 2 miles east of Yigo, *Moore 267*; Mt. Santa Rosa, *Sturtevant 6*.

Tropical Africa, Asia, Australia, and Pacific islands to Polynesia.

A common and conspicuous epiphyte in the forests of Guam. The humus-collecting bases of the plants provide abodes for other, smaller ferns. Hosokawa reports this species also in Rota and Saipan (19, vol. 26, p. 245).

Several species described by Cavanilles, *Polypodium percussum* (not *Cyathea percussa* Cavanilles) and *P. peltatum*, both of the New World, and *Polypodium enerve* of Malaya and the Philippines, were attributed, evidently erroneously, to the Marianas.

### 23. Genus *Pyrrosia* Mirbel

Rootstock scaly, thin, and wide-creeping. Stipes articulate. Fronds simple, coriaceous, with stellate hairs and reticulate veins. Sori round, without indusia.

Epiphytic ferns common in the Old World tropics, and represented in Guam by one very common and variable species.

1. *Pyrrosia adnascens* (Swartz) Ching, *Chin. Bot. Soc., Bull.* 1: 1, 45, 1935 (fig. 11).

*Cyclophorus adnascens* (Swartz) Desvaux; Safford, *Contr. U. S. Nat. Herb.* 9: 253-254, pl. 47, 1905; and all later writers.

Rootstock creeping, covered with very dark polished appressed scales. The leathery, gray-green, long-lanceolate, sterile and fertile fronds are slightly dimorphic (more so in forms of exposed places): the sterile fronds always shorter and broader, 0.7-3.0 cm. broad, 4.0-20.7 cm. long; the fertile fronds 0.3-1.8 cm. broad, and 10-32 cm. long. Sori reddish brown, crowded, densely covering the underside of two-thirds to one-third of the upper part of the blade.

Dead tree limb in shady woods near Agaña Airfield, *Wagner 3738*; epiphytic, Northwest Airfield, *Grether 3647*; coconut trunk, half a mile west of Mt. Santa Rosa, *Wagner 3880*; Umatac, *Grether 4315*; on trees above Togscha River, *Grether 4333*; epiphytic on tree, 6 ft. above the ground, 2 miles east of Yigo, *Moore 259*.

Rota: south part of island, alt. 800 ft., *Grether 4483*; alt. 50 ft., *Grether 4488*.

Saipan: epiphytic on breadfruit trees, *Wagner 3232*.

Tropical Asia to Polynesia.

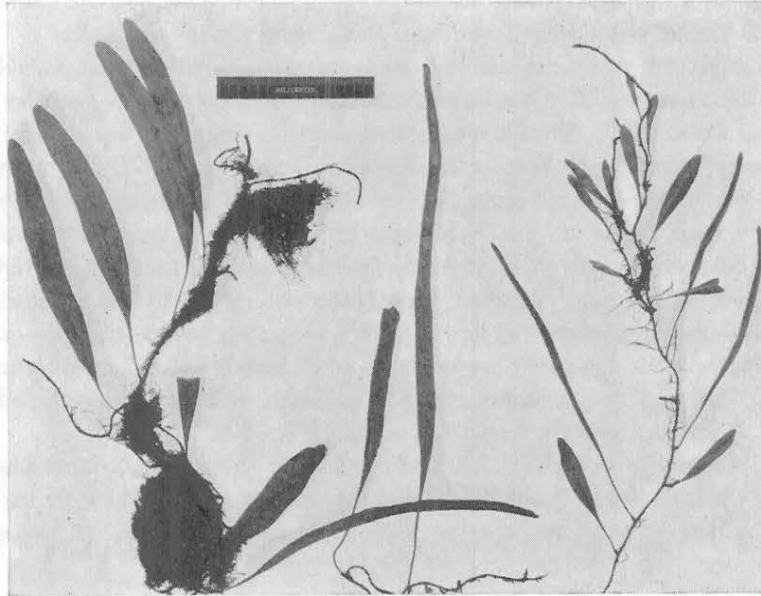


FIGURE 11.—*Pyrrhosia adnascens*: specimen on right collected on exposed coconut trunks, half a mile west of Mt. Santa Rosa, *Wagner 3880*; specimens on left from woods near Agaña Airfield, *Grether 3356*.

*Niphobolus varius* Kaulfuss was based on specimens from Guam and Manila (21, p. 125). Kaulfuss contrasted it with what he considered the present species by its linear-lanceolate, stipitate rather than ovate, sessile sterile fronds, and by the linear-lanceolate, rather than linear-elongate, fertile fronds. Gaudichaud recorded *Cyclophorus varius* (Kaulfuss) Gaudichaud from Guam, but he had earlier considered it a variety of the present species (16, p. 364). It is perhaps significant that Blume (2, p. 54) gave the habitat of *Niphobolus varius* as mossy tree trunks, especially near rivers and cataracts, and that Copeland (12, p. 14) found that *N. adnascens* occurred on the strand while *N. varius* lived in the high forest. Giesenhagen characterized the two plants mainly by a difference in the number of epidermal cells surrounding the stomata. It is our belief that this may be caused

by habitat, just as the size and the shape of the fronds apparently result from the relative humidity and exposure. Giesenhagen (17, p. 209) wrote that *N. adnascens* had 6-9, rarely 5, epidermal cells in a rosette around the stomatal cavity, while *N. varius* had only 3-5, and thus they could be quickly distinguished. Using this method, we found that one of our larger Guam specimens, from shady woods, had 5-7, averaging 6, while the smallest, from an exposed coconut trunk, had 5-10, averaging 7. Our largest material (*Grether 4315*), however, also averaged 7. Thus the largest specimens examined from Guam, the type locality in part of *N. varius*, although possessing the form of that species, do not agree in Giesenhagen's fundamental distinction of it from *N. adnascens*. Wide size differences exist between plants of deep woods and those of extremely dry, sunny situations, and all intermediates exist between these extremes. By Hooker, Clarke, Beddome, and Baker, the larger plant was made a variety of *Pyrrhosia adnascens*. It appears to us, however, to be merely an ecological form.

The plant is a common epiphyte in Guam, Rota, and Saipan, and St. John has recently reported it from Tinian (31).

Cavanilles described *Acrostichum bicolor* from the Marianas but C. Christensen (9, p. 7) wrote that this locality was probably wrong. The type included two species: *Pyrrhosia acrostichoides* and *P. samarensis*.

#### 24. Genus *Vittaria* J. E. Smith

Epiphytic ferns of small or medium size. Rootstock erect to creeping, scaly, the cells of the scales very thin, with thick dark walls (clathrate). Fronds ascending to pendent, not articulate, linear and entire. Veins reticulate. Sporangia in a line on the marginal veinlet.

A pantropical genus of 50 or more species, some of them separable only by microscopic characters.

1. *Vittaria elongata* Swartz, Syn. Fil. 109, 302, 1806; Gaudichaud, Freyc. Voy. Bot., 382, 1827; Safford, Contr. U. S. Nat. Herb. 9: 273, 398, 1905; and later writers.

*Vittaria incurvata* Cavanilles, Descr. pl., 270, 1802; Willdenow, Sp. pl. 5: 406, 1810.

*Vittaria ensiformis* of Presl, Rel. Haenk. 1: 58, 1825; not Swartz 1799.

*Vittaria anodontolepis* Fée, Hist. Vitt., 93, pl. 4, fig. 3, 1852.

Rootstocks short-creeping, clothed with long, dull-purple, clathrate, hair-tipped scales. Fronds linear, 6-75 cm. long, 2-8 mm. broad. Sori in a groove along the margin.

Epiphytic along wooded streams, Maemon Valley, 3 miles east of Agat, *Wagner* 3835; Sigua River valley, *Grether* 3732; epiphytic in wet ravine, Mt. Tenjo, *Wagner* 3748; North Airfield, *Grether* 3582; coconut trunks, half a mile west of Mt. Santa Rosa, *Wagner* 3877; on tree trunk with *Asplenium nidus* and other ferns, *Grether* 3643; epiphytic on tree on edge of woods, 1 mile east of Mt. Tenjo, *Moore* 297; epiphytic, Maemon Valley, *Grether* 4416.

Rota: *Necker R-99*; alt. 50 ft., *Grether* 4493.

Saipan: growing on breadfruit trees, *Wagner* 3234.

Tropics of the Old World.

*Vittaria incurvata* Cavanilles (syn. *V. anodontolepis* Fée) was upheld as a distinct species by C. Christensen because of the reputedly fully entire rhizome scales (9, p. 24). A long series of Guam specimens shows, however, that some scales do have short teeth (marginal extensions of the dark latticework of the scales). Elsewhere over its range, including the Carolines, *V. elongata* shows rhizome scales provided with more numerous and much longer teeth. The minor distinction of the Guam material is not here considered of sufficient value to give specific status to what is apparently only a local variant.

This is a very common epiphytic fern in Guam, growing on trees everywhere in forested areas. It is often associated with bird's-nest ferns, growing in the root masses of the larger plants.

*V. lineata* Linnaeus, a New World plant, was mistakenly credited to Guam by Cavanilles (4, p. 270). *V. isoëtifolia* Bory, an African species, was recorded from Guam by Kaulfuss (21, p. 193).

## 25. Genus *Antrophyum* Kaulfuss

Rootstocks creeping, and provided with matted water-holding roots. Fronds small to medium-sized, simple and entire, naked. Veins anastomosing, in long areoles without included veinlets. Sori linear along the veins, exindusiate.

Tropical ferns, epiphytic and occasionally on rocks, represented by one species in Guam.

1. *Antrophyum plantagineum* (Cavanilles) Kaulfuss, Enum. Fil., 197, 1824; Safford, Contr. U. S. Nat. Herb. 9:273, 1905; and later authors.

*Hemionitis plantaginea* (Cavanilles) Gaudichaud, Freyc. Voy. Bot., 309, 1827.

Rootstock creeping, covered with gray-purple narrow scales and matted roots. Frond dark green, thick, simple, ovate to linear, 12-50 cm. long including stipe, 2.0-3.5 cm. wide. Stipes variable in length, 2-13 cm. long. Midrib apparent only in lower part of leaf. Sori following the anastomosing pattern of the veins.

Sigua River valley, *Grether 3722*; wet ravine, Mt. Tenjo, *Wagner 3743*; epiphytic in damp woods near Piti Junction, *Wagner 3656*; deep woods in ravine, Lonfit River valley, *Grether 3709*; on limestone cliffs, Maemon Valley, 3 miles east of Agat, *Wagner 3836*; trees and rocks in very mossy woods, Northwest Airfield, *Grether 3648*; mossy tree trunks in wet woods, north-central Guam, *Wagner 3351*; tree trunks, headwaters of Ylig River, *Rodin 614*; epiphytic, Maemon Valley, *Grether 4415*.

India to Polynesia.

This species varies considerably, as Gaudichaud pointed out, both in the size and in the shape of the fronds. In very shady forest areas occur narrow forms that approach closely the Samoan *A. plantagineum* var. *angustatum* (Brackenridge) Hooker. It occurs frequently, both on limestone cliffs and on tree trunks (sometimes on pandan prop-roots), generally over the island, and is reported by Hosokawa also from Saipan.

#### VIII. LYCOPODIACEAE

Terrestrial or epiphytic plants, erect, trailing, or pendent. Stems usually branching repeatedly, beset with numerous small coriaceous simple leaves. Sporangia compressed, reniform to orbicular, and borne in the axils of ordinary vegetative leaves or on bractlike special leaves. Spores uniform, globose. Prothallia brown or partly green, dependent usually on endophytic fungi for nourishment. Of the two genera, only *Lycopodium* is represented here.

##### 1. Genus *Lycopodium* Linnaeus

Recognizable by family description; usually called clubmosses.

- Plant terrestrial; leaves very narrow, 2-4 mm. long; strobili short..... 1. *L. cernuum*  
 Plant epiphytic; leaves 2-3 mm. wide, 7-13 mm. long; strobili forming long tassels ..... 2. *L. Phlegmaria*



1. *Lycopodium cernuum* Linnaeus, Sp. pl., 1103, 1753; Presl, Rel. Haenk. 1: 81, 1825; and later writers.

*Lycopodium marianum* Willdenow, Sp. pl., 31, 1810.

*Lycopodium cernuum* var. *marianum* (Willdenow) Baker, Handb. Fern allies, 23, 1887.

Plant branching, 20-75 cm. tall. Main stem with several ascending branches, these 1-2 mm. in diameter, with crowded pale-green very narrow leaves, recurved in the upper half. Fertile leaves turning yellow or brown with age, in short, subpendent spikes, the leaves shorter and broader than the vegetative and with pointed tips. Spikes 2-3 mm. broad, 3-6 mm. long.

Open hilly field, alt. 900-1,000 ft., southeast of Agaña, *Wagner 3305*; dry hill, Masso River valley, *Grether 3432*; Sigua River valley, *Grether 3711*; savannah, half a mile west of Mt. Santa Rosa, *Wagner 3875*; terrestrial, Maemon Valley, *Grether 4395*.

Pantropical.

The savannah clubmoss occurs abundantly in the dry grassy areas of the southern part of Guam, and in the vicinity of Mt. Santa Rosa. If the local form is accorded subspecific recognition, it should be *L. cernuum* var. *marianum* (Willdenow) Baker. From Alamagan, Hosokawa reports *L. cernuum* var. *crassifolium* Rosenburgh, the description of which agrees quite closely with the Guam plant.

2. *Lycopodium phlegmaria* Linnaeus, Sp. pl. 2: 1100, 1753; Presl, Rel. Haenk. 1: 81, 1825; and later authors.

A large hanging plant. Roots matted in humus. Branches brownish, 2-3 mm. in diameter, branching dichotomously. Sterile leaves numerous, ascending, lanceolate, leathery, shiny dark green, averaging 1 cm. long. Fertile leaves in narrow tassels, 10-15 cm. long, the fertile leaves themselves very short, and barely covering the flat 2-valved sporangia.

Epiphytic in formerly dense woods, 4 miles south of Northwest Airfield, *Wagner and Conover 3442*; epiphytic in forest, Northwest Airfield, *Grether 3646*.

Old World tropics.

According to Safford the Spanish name in Guam was *Cordon de San Francisco*. This beautiful plant is frequent in dense forest areas, especially in northern Guam. It usually grows in the crotches of trees, 15 to 35 feet from the ground. Gaudichaud wrote in 1827 that the natives here considered it a symbol of fecundity, but in 1900 Safford found no evidence that the notion still prevailed. Today the plant is used for decoration in native houses and attached to palm trees in yards. Hosokawa reports this species also in Rota (19, vol. 25, p. 439).

IX. PSILOTACEAE

Primitive pteridophytes with stems simple and leaves in two ranks (*Tmesipteris*) or dichotomous and nearly naked, with narrow branches and a few tiny scale-like leaves. Sporangia 2-celled, or 3-celled, attached at the bases of reduced leaves. Two genera, but only *Psilotum* is found in the Marianas.

1. Genus *Psilotum* Swartz

Plants shiny-green and dichotomously divided. Branches either flat or triquetrous. Leaves few, pointed and minute. Sporangia in globose 3-lobed sporangia, borne on the ultimate branches, and falling readily from dried specimens.

Closely related to fossil species of early pteridophytes, and represented today only by two pantropical species, both of which have been recorded from the Marianas.

1. *Psilotum nudum* (Linnaeus) Grisebach, Ges. wiss. Göttingen, Abhandl. 7: 278, 1857; Merrill, Philippine Jour. Sci. 9 (C): 47, 1914; and subsequent writers (fig. 12).

*Bernhardia dichotoma* Willdenow; Gaudichaud, Freyc. Voy. Bot., 82, 290, 1827.

*Psilotum triquetrum* Swartz; Kanchira, Dept. Agr. Kyushu Imp. University, Jour. 4: 6, 258, 1936.

Branches narrow, the ultimate ones three-angled. Fully developed plants 8-45 cm. or more tall, depending upon the place of growth.

Dry exposed rocks, Mt. Tenjo, *Wagner 3749*; Sigua River valley, *Grether 3734*; near waterfall, Lonfit River valley, *Grether 3702*; on coconut boles, a half mile west of Mt. Santa Rosa, *Wagner 3871*; coconut stumps, Agaña Airfield, *Conover 525*; coconut trunks, 1 mile southeast of Piti, *Wagner 3627*; coral boulder, Talofoto Basin, *Rodin 679*; on tree in dense woods, Tumon Bay, *Moore 408*.

Rota: alt. 700 ft., *Grether 4481*.

Tropics and subtropics of both hemispheres.

This odd plant is common but inconspicuous in Guam. It grows in a variety of habitats, but most often at the bases of trees, especially on the boles of coconuts. We have found it also on old walls, on the ground, and on rocks. In dry situations, as in rocky savannahs, dwarfs may be found that have a very different aspect from the narrow,

almost sterile large forms of deep woods. Gaudichaud also reported this species on Rota Island.

*Psilotum complanatum* Swartz has been reported from Alamagan by Hosokawa (19, vol. 25, p. 443). It differs from *P. nudum* in its broad flat branches.

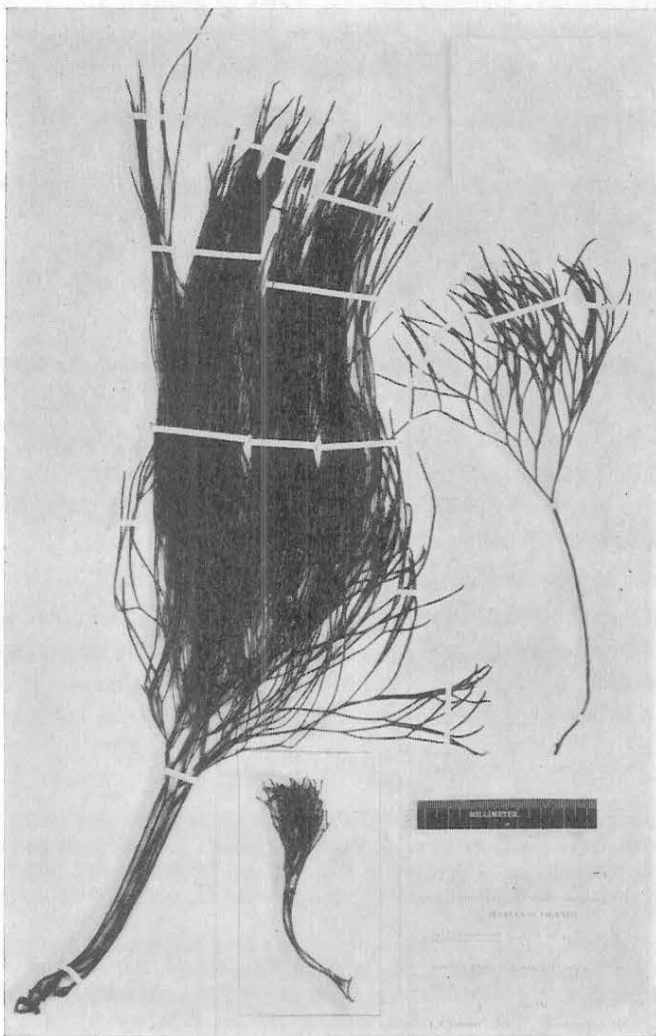


FIGURE 12.—*Psilotum nudum*; inset: dwarf form from dry exposed rocks on Mt. Tenjo, Wagner 3749.

## X. SELAGINELLACEAE

Terrestrial or epiphytic plants, usually small. Stems erect or prostrate with numerous unequal-sided leaves, usually of two kinds: the lateral leaves spreading, the superficial leaves erect. Sporangia with two valves, on special leaves arranged in a cone or spike. Spores of two kinds, megaspores and microspores. The sole genus is very large.

1. Genus *Selaginella* Beauvois

1. *Selaginella ciliaris* (Retzius) Spring, Acad. Sci. Belg., Bull. 10: 231, 1843.

*Selaginella Belangeri* (Bory) Spring; Merrill, Philippine Jour. Sci. 9 (C): 47, 1914.

*Selaginella proniflora* of Baker, Jour. Bot. 22: 156, 1885; Hosokawa, Nat. Hist. Soc. Formosa, Trans. 25: 442, 1935; not (Lamarck) 1791.

Branches decumbent to oblique, 1-4 cm. long. Sporophylls imbricated in a spike 2 mm. broad, 2-5 mm. long.

On banks in wooded ravine, Mt. Santa Rosa, *Wagner 3884*; open hilly field, southeast of Agaña, alt. 900-1,000 ft., *Wagner 3308*; stream banks, tributary of Fonte River, 1 mile southwest of Agaña, *Wagner 3400*, *Conover 501*; Pago River, *Rodin 645*.

India to northern Australia.

This plant has apparently not yet been found in the other islands of the Marianas. In Guam, however, it is frequent on damp banks in the savannah areas, usually in little gulleys along streams. It can be easily overlooked because of its small size and mosslike habit.

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