







No. 28.—JULY, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

I. THE POLYPODIACEAE OF THE  
PHILIPPINE ISLANDS

II. NEW SPECIES OF EDIBLE  
PHILIPPINE FUNGI

BY

EDWIN BINGHAM COPELAND, PH. D.

SYSTEMATIC BOTANIST

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(Continued on third page of cover.)







Photo by Martin.

PLATYCERIUM BIFORME (SW.) BLUME. (IN CULTIVATION IN MANILA.)

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## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,  
*Manila, P. I., December 21, 1904.*

SIR: I have the honor to transmit herewith and to recommend for publication articles entitled "I. The Polypodiaceæ of the Philippine Islands," and "II. New Species of Edible Philippine Fungi," by Edwin Bingham Copeland, Ph. D., Systematic Botanist.

Very respectfully,

RICHARD P. STRONG,  
*Director Biological Laboratory,  
Acting Superintendent Government Laboratories.*

Hon. DEAN C. WORCESTER,  
*Secretary of the Interior.*





## I. THE POLYPODIACEÆ OF THE PHILIPPINE ISLANDS.

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### INTRODUCTION.

The *Polypodiaceæ* are distinguished from the other orders of true ferns by the character of the sporangium, which is usually stalked and provided with a longitudinal annulus interrupted by the stalk, and opening by a stomium at right angles to the annulus. In the field, and without the use of the microscope, they can be distinguished as a rule from other ferns by the following characteristics:

They are rarely tree ferns, as are *Marattiaceæ* and *Cyatheaceæ*.

They are not filmy in texture, as are *Hymenophyllaceæ*.

They are not dichotomously compound, like most of our *Gleicheniaceæ*.

They do not have climbing fronds, as do most of our *Schizaceæ*.

In the Philippines, as elsewhere in the world, the *Polypodiaceæ* are several times more numerous than are all other ferns combined, and, therefore, a treatment of the order does not fall far short of being an entire fern flora.

My attempt has been to collect and publish descriptions of all the ferns known to have been found in these Islands. It is likely that I have fallen considerably short of this goal, for in some groups the discrepancy between my number of species and the larger one given by Underwood<sup>1</sup> is far greater than can be explained by any difference in our interpretation of specific limits. A history of the work on the ferns of these Islands would be superfluous, since the subject has been well handled within the past two years by both Merrill<sup>2</sup> and Underwood.

While I was engaged on this work practically no ferns collected before the American occupation were available for study in Manila.

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<sup>1</sup> Underwood, L. M.: A Summary of Our Present Knowledge of the Ferns of the Philippines. Contr. Bot. Dept., Columbia Univ., No. 206, 1903.

<sup>2</sup> Merrill, E. D.: Botanical Work in the Philippines. Bull. (Philippine) Bureau of Agr. No. 4, 1903.

I am not personally acquainted with a large part of those ferns still known here only from earlier collections and have compiled their descriptions from various sources, especially from the Synopsis Filicum. Of the collections most frequently cited, those of Cuming, Baranda, Steere, Warburg, and Loher are given on the authority of other botanists; while I have at my disposition the collections of Merrill, Elmer, Whitford, Barnes, other collectors employed by the Bureau of Forestry and the Exposition Board, and my own.

Ferns have been among the plants most ill favored by the imposition of plural names, and therefore, in these days of chaos in nomenclature, they present the best of material for jugglery. Not caring to take any part in the strife between the advocates of the different "rules" of nomenclature, I have made it my chief principle to form no new combination of names for any plant which already had, in its proper genus, a name valid under *any* rules. Pending a general agreement among competent botanists, it seems to me that current usage should be the chief criterion in deciding a choice between names. Because their adoption would have compelled me to make new combinations for many species, rather than from any preference for these generic names themselves, I have retained the ones in common use, rather than those taken up by Underwood, for *Gymnopteris*, *Nephrodium*, *Hymenolepis*, and *Niphobolus*. Chiefly for the same reason, but in part too because I can not see that the multiplication of genera adds a particle to the naturalness of the presentation, I have maintained as very large genera *Nephrodium*, *Aspidium*, *Asplenium*, and *Polypodium*.

It may not be superfluous to add that this Bureau will be very glad to undertake the determination of any ferns which may be sent to it. It is to encourage the interest in our ferns, and in response to very numerous requests for a guide in the determination of the local plants that this paper, our first systematic treatment of any part of the Philippine flora, is published. I take the liberty of copying literally, from Professor Underwood's already mentioned paper, the following directions for the profitable collection of fern specimens:

(1) In all ferns not over 2 feet high an entire plant should be secured, but in plants growing in dense crowns the rootstock may well be split lengthwise and several of the leaves removed before drying.

(2) In all ferns not over 4 feet high an entire leaf should be secured if possible attached to the rootstock or to some portion of it. In case of

very wide leaves the lower pinnae on one side may be cut away to prevent the too great massing of foliage when the leaf is doubled on itself to make a manageable specimen.

(3) In tree ferns the basal portion of the petiole should always be secured, if possible, attached to the lower pinnules. Where possible the top of the caudex should also be taken. Notes on the character of the leaf scars should always be made.

(4) If the specimen taken does not show whether the leaves are scattered or caespitose this should always be included in the notes.

(5) In ferns, of whatever size, invariably secure some portion of the rootstock, for it nearly always possesses diagnostic characters.

(6) In large leaves note whether the lowermost pinnae are larger than the others or are reduced in size and if their laminæ stand in the same plane as the rest of the leaf or are set obliquely.



## POLYPODIACEÆ.

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Chiefly perennial plants, rarely annual, and rarely arborescent; leaves (called fronds) with the tissues of flowering plants—epidermal, fibro-vascular, and fundamental; spores borne in stalked sporangia with incomplete longitudinal annulus and transverse stomium.

### *Families of the Polypodiaceæ.*

Stipe not articulate to the rhizome; sorus dorsal on its vein; indusium fastened beneath the sorus on all sides, rupturing irregularly over it (p. 14).....	I. WOODSIEÆ
Fronds not articulate to the rhizome; sori dorsal or terminal on their veins, usually round, exceptionally extending along the veins or over the parenchyma; indusia fixed by the center or at the top of a basal sinus, frequently wanting (p. 15).....	II. ASPIDIEÆ
Stipe articulate to the rhizome, or not; sori, except in <i>Oleandra</i> , terminal on the veins, often on the margin of the frond, and the margin modified in connection with them; indusium opening toward the margin or obliquely, wanting in <i>Monachosorum</i> (p. 45).....	III. DAVALLIEÆ
Stipe, except in <i>Stenochlæna</i> , not articulate to the rhizome; sori superficial, springing from the sides of the fertile veins; indusium opening on the side away from the vein or irregularly in <i>Allantodia</i> or wanting (p. 66).....	IV. ASPLENIEÆ
Stipe not articulate to the rhizome; sori near the margin, on the ends of the veins or a strand connecting their ends, protected, except in <i>Nothochlæna</i> , by the inflexed and modified margin of the frond (p. 92).....	V. PTERIDEÆ
Fronds simple and entire, not articulate to the rhizome; sori marginal or dorsal, linear, usually immersed (p. 106).....	VI. VITTARIEÆ
Stipes articulate to the rhizome; sori terminal or dorsal on the veins, usually of definite form and size, without indusia (p. 110).....	VII. POLYPODIEÆ
Fronds articulate to the rhizome or not; sporangia covering the fertile surface, without being collected into sori; indusia therefore wanting (p. 136).....	VIII. ACHROSTICHEÆ

### *Artificial key to the families and erratic genera.*

1. Sori indefinite, covering the dorsal surface, indusium wanting (*Achrostichum* L.).
2. Fertile region restricted to specialized apex of simple frond ..... (49) *Hymenolepis*

2. Fertile region not so restricted.
3. Fronds articulate to rhizome.
4. Fronds pinnate ..... (32) *Stenochlæna*
4. Fronds simple, dichotomous..... (62) *Platynerium*
3. Fronds not articulate to rhizome.
4. Fertile and sterile fronds alike.
5. Fronds simple ..... (59) *Elaphoglossum*
5. Fronds pinnate ..... (60) *Achrostichum*
4. Fronds dimorphous.
5. Veins free ..... (7) *Polybotrya*
5. Veins forming areolæ along main veins ..... (8) *Stenosemia*
5. Veins anastomosing copiously.
6. Sterile frond 2-pronged (61) *Cheiropleuria*
6. Fronds pinnate in plan (9) *Gymnopteris*
1. Sporangia gathered into sori, which are sometimes contiguous, or somewhat indefinite.
2. Sori elongate, not marginal nor sunken.
3. Indusium wanting.
4. Fertile veins oblique to costa.
5. Veins free throughout ..... (23) *Coniogramme*
5. Veins free except near margin ..... (26) *Syngramme*
5. Veins anastomosing copiously.
6. Sori anastomosing ..... (24) *Hemionitis*
6. Sori simple.
7. Stipe not articulate ..... (25) *Loxogramme*
7. Stipe articulate to rhizome ..... (54) *Selliguea*
4. Fertile veins connecting main veins ..... (5) *Meniscium*
4. Sori parallel to costa, one on each side.
5. Frond pinnate ..... (50) *Tænitis*
5. Frond tripartite ..... (51) *Christopteris*
5. Frond simple and entire..... (52) *Drymoglossum*
3. Indusium present ..... ASPLENIEÆ
2. Sori elongate, sunken, fronds simple and entire ..... { VITTARIEÆ  
  *Polypodium elongatum*
2. Sori marginal or submarginal, protected by the inflexed margin of the frond..... PTERIDEÆ
2. Sori marginal or submarginal, apical on their veins, indusium opening toward margin..... DAVALLIÆ
2. Sori dorsal on the fronds, round or nearly so.
3. Stipe articulate to rhizome, indusium absent ..... POLYPODIEÆ
3. Stipe articulate to rhizome, indusium present ..... DAVALLIÆ
3. Stipe not articulate to rhizome.
4. Indusium fastened on all sides, rupturing in middle ..... (1) *Diacalpe*
4. Indusium, when present, not fastened on all sides.
5. Veins all free, sori terminal.
6. Pinnæ articulate to rachis ..... (12) *Nephrolepis*



- 6. Pinnæ not articulate to rachis.
  - 7. Indusium attached by base and sides .....
    - (17) *Microlepia*
    - (15) *Saccoloma*
  - 7. Indusium fixed by base only, or wanting ..... ASPIDIÆ
- 5. Veins free, sori subterminal or dorsal.
  - 6. Frond quadripinnate, sorus naked ..... (20) *Monachosorum*
  - 6. Less compound, or with indusium ..... ASPIDIÆ
- 5. Veins anastomosing ..... ASPIDIÆ

## I. WOODSIEÆ.

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Stipe not articulate to the rhizome; sorus dorsal on its vein; indusium fastened beneath the sorus on all sides, rupturing irregularly over it.

### (1) **DIACALPE** Blume.

Rhizome erect; fronds large, tripinnate; veins free; sorus usually one to each segment, on the lowest acropetal veinlet; indusium spherical. Two terrestrial ferns, in this part of the world.

(1) **D. aspidioides** Blume. Stipes clustered, erect, 40 cm. high, scaly at the base; frond 25 to 50 cm. high, triangular-ovate; pinnules oblong-cuneate, lobed and more or less decurrent, submembranaceous, glabrescent, or sparsely chaffy on the veins, disposed to blacken in drying.

Mountains of Benguet and Lepanto, not below 2,000 m., *Loher*.  
India, southern China, and Malaya.

## II. ASPIDIEÆ.

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Fronds not articulate to the rhizome; sori terminal or dorsal on their veins, usually round, exceptionally extending along the veins or over the parenchyma; indusia fixed by the center or at the top of a basal sinus, never elongate, frequently wanting.

Because the presence or absence of the indusium varies within the larger genera, and even in some of their species, no classification and arrangement of the *Aspidieæ* is everywhere easy to use. But, for this reason, any arrangement which tries to define its genera primarily by this character is eminently artificial and impractical.

This is the largest group in our fern flora, and, except for the genera whose sporangia cover the dorsal surface, it is a very natural one, distinguished from the *Polypodieæ* by the nonarticulate stipe and the usually present indusium, from *Asplenieæ* by the round sorus and indusium, and from *Davallieæ* by the latter's mode of attachment.

1. Frond pinnate or pinnately veined.
  2. Sori definite, confined to the veins, fertile fronds or segments not sharply differentiated.
    3. Veins free.
      4. Indusium oval, attached by its axis..... (2) *Didymochlaena*
      4. Indusium orbicular, attached by its center.. (3) *Polystichum*
      4. Indusium cordate-reniform or wanting..... (4) *Lastraca*
    3. Lowest veinlets of neighboring veins uniting to form regular triangular areolæ, usually with a series of regular areolæ outside.
      4. Sori round ..... (4) *Nephrodium*
      4. Sori elongate along the cross-veinlets..... (5) *Meniscium*
    3. Veins anastomosing copiously ..... (6) *Aspidium*
  2. Fronds or their segments dimorphous, sori covering the parenchyma.
    3. Veins free ..... (7) *Polybotrya*
    3. Veins anastomosing.
      4. Veins free toward the margin..... (8) *Stenosemia*
      4. Veins anastomosing throughout ..... (9) *Gymnopteris*
1. Frond and venation dichotomous ..... (10) *Dipteris*

### (2) DIDYMOCHLAENA Desvaux.

Fronds at least bipinnate, the basiscopic half of the ultimate divisions almost suppressed; veins free, branched; sori terminal on them but not marginal, somewhat elongate; indusium the shape of the sorus, fixed along the middle, opening on all sides. A single variable species, terrestrial in most tropical countries, resembling a *Lindsaya* more than any of its relatives in *Aspidieæ*.

(1) *D. lunulata* Desv. Rhizome erect, rising above the ground or not; stipes clustered, fronds 1 to 2 m. high, commonly bipinnate; pinnules almost dimidiate, trapezoidal, the lower margin almost straight, the upper slightly rounded, entire, glabrous, herbaceous; sori 4 to 6 to a pinnule, large, partly immersed.

Luzon, *Cuming* 142, *Steere*; Mount Apo, *DeVore* and *Hoover* 345, common at about 4,500 feet.

Pantropic.

### (3) POLYSTICHUM Roth.

Fronds at least pinnate, usually tough or rigid, with toothed and spinulose margins and the basiscopic half the less developed; veins free, or in one species anastomosing sparsely and irregularly; sori round, usually dorsal; indusium normally peltate, exceptionally reniform. A reasonably natural genus, but difficult to define because of the many directions in which single species or groups vary; related to both *Nephrodium* and *Aspidium*. Mostly terrestrial.

- |   |                           |
|---|---------------------------|
| 1. Pinnæ articulate to rachis ( <i>Cyclopeltis</i> ) .....                    | (1) <i>P. preslianum</i>  |
| 1. Pinnæ not articulate, veins free ( <i>Eupolystichum</i> ) .....            |                           |
| 2. Simply pinnate .....   | (2) <i>P. auriculatum</i> |
| 2. Lower pinnæ pinnate, sori costal or medial.                                |                           |
| 3. Teeth aristate .....   | (3) <i>P. aculeatum</i>   |
| 3. Teeth blunt or mucronate .....   | (4) <i>P. obtusum</i>     |
| 2. Lower pinnæ pinnate, sori submarginal.....                                 | (5) <i>P. amabile</i>     |
| 2. Lower pinnæ at least bipinnate.  |                           |
| 3. Teeth mucronate or awned.  |                           |
| 4. Lower pinnæ lanceolate-deltoid.  |                           |
| 5. Rhizome creeping .....   | (6) <i>P. aristatum</i>   |
| 5. Rhizome erect .....  | (7) <i>P. conifolium</i>  |
| 4. Pinnæ linear .....   | (8) <i>P. horizontale</i> |
| 3. Teeth awnless .....  | (9) <i>P. varium</i>      |
| 1. Pinnæ not articulate, veins inclined to anastomose toward the margin ..... | (10) <i>P. falcatum</i>   |

(1) *P. preslianum* (J. Sm.) Moore. Rhizome creeping or oblique, short, densely fibrillose; stipes clustered, 3 to 10 cm. high, naked or nearly so; frond 20 to 40 cm. high, 8 to 10 cm. broad, simply pinnate; pinnæ jointed to the rhizome, broadly lanceolate, obscurely crenate, almost horizontal, acute, cordate on the lower and truncate on the upper side at the base, coriaceous, glabrous; veins forked about three times, the lower branches falling short of the margin; sori in 1 to 3 rows on each side of the costa, the costal row the most constantly complete.

Masbate and Catanduanes, *Baranda*; Tayabas, *Merrill* 3351.

Malaya.

A species very near this, but with thinner foliage and the pinnæ not articulate to the rachis, occurs in Luzon and Mindanao, and probably throughout the Archipelago; the two are decidedly too alike for me to separate them generically, by recognizing J. Smith's *Cyclopeltis*.

(2) *P. auriculatum* (Sw.) Presl, var *nervosum* (Fee) Christ. Stipes fasciculate, decumbent, 10 to 15 cm. long, scaly below or throughout; frond about 30 cm. long, 5 cm. broad; pinnæ numerous, subsessile, crenate,

without awns, falcate, acute, auricled on the upper side, subcoriaceous; sori minute, scattered, indusia almost wanting.

Mount Mariveles, 1,400 m., *Loher*.

India to Formosa (the type).

(3) *P. aculeatum* (Sw.) Roth. Stipes tufted, 15 cm. and upward in height, more or less clothed with ovate-lanceolate and fibrillose pale brown scales; frond 30 to 60 cm. high, 20 cm. broad, bipinnate below or almost throughout; pinnae close, horizontal, lanceolate; pinnules ovate-rhomboidal, oblique, auricled on the acroscopic side at base, aristate-serrate, subcoriaceous, almost glabrous; rachises fibrillose or scaly; sori principally in rows, nearer the midrib than the margin. An exceedingly variable species, or type of a large group of closely related species, of which our material is not sufficient to determine which are distinct enough to be profitably named. Beside fairly typical specimens the following varieties are reported:

*Hastatum* Ten., Davao, *Warburg* 14150.

*Subamœnum* Christ, Davao, *Warburg* 14124, 14136.

*Batjanense* Christ, which is almost tripinnate, *Benguet*, *Loher*.

Luzon, *Steere*; Davao, *Warburg* 14149, *Copeland* 1031.

Cosmopolitan.

(4) *P. obtusum* (Mett.) Presl. Stipes tufted, 10 to 15 cm. high, densely clothed with large, ovate-acuminate, bright brown scales; frond 30 cm. or more high, 10 to 15 cm. broad, lanceolate; pinnae numerous, distant, linear-lanceolate, the lower ones 6 to 10 cm. long; pinnules distinct, oblong-rhomboidal, the obscure teeth blunt or mucronate, subcoriaceous, glabrous; rachis densely fibrillose; sori in rows midway between the midrib and margin.

Luzon, *Cuming* 234, *Lobb*; Mount Arayat, *Loher*; *Bagnio*, *Topping* 179.

Not very distinct from *P. aculeatum*.

(5) *P. amabile* (Bl.) Presl. Rhizome creeping, scaly; stipes scattered, about 30 cm. high, slender, stramineous, scaly toward the base; frond 30 cm. or more high, 20 to 25 cm. broad, with a lanceolate, acuminate, terminal pinna, and 3 to 6 similar lateral ones on each side; pinnules rhomboidal, with at least half of the lower side cut away, 10 to 15 mm. long, over half as broad, the upper side and outer half of the lower lobed and sharply spinulose-serrate, subcoriaceous, glabrous; sori submarginal, small.

*Benguet*, *Loher*; Davao, *Copeland* 1114.

India to Formosa and Java.

(6) *P. aristatum* (Sw.) Presl. Rhizome creeping; stipes scattered, 30 to 50 cm. high, clothed at least toward the base with linear or fibrillose scales; frond 30 to 60 cm. high, 20 to 30 cm. broad, ovate-deltoid, tri- or quadripinnatifid; lower pinnae largest, 15 to 25 cm. long, subdeltoid; lowest pinnules much largest, lanceolate-deltoid, 5 to 10 cm. long, with subdeltoid lower segments; teeth copious, aristate; texture subcoriaceous; glabrous, rachis nearly so; sori small, principally in rows near the midrib; indusium sometimes reniform.

Luzon, *Steere*; Benguet and Arayat, *Loher*; Camarines, *Baranda*.

Africa to Japan and Polynesia.

(7) **P. conifolium** (Wall.) Presl. Rhizome erect; stipes clustered, 20 to 50 cm. high, clothed at the base with narrow black scales, stramineous; frond 30 to 50 cm. high, deltoid; pinnæ deltoid, the lowest 10 to 15 cm. long, with its lowest basipetal pinnule largest, usually falcate, 6 to 8 cm. long, its pinnules of the second order stalked and toothed or lobed, spinulose, subcoriaceous, glabrous; sori mostly in rows along the midribs.

Luzon, *Cuming* 262; Benguet, *Loher*, *Topping* 192; Arayat, *Merrill* 3815; Mount Mariveles, *Copeland*, *Barnes* 136, 142; *Whitford* 136.

Africa to Polynesia.

(8) **P. horizontale** Presl., in *Epim. Bot.*, p. 57. Stipes clothed with short, ovate, and long, linear acuminate scales; frond about 1 m. high, ovate, tripinnate; pinnæ subopposite, short stalked, linear, very acute, the lower ones horizontal; primary pinnules subsessile, oblong-lanceolate, acute; secondary pinnules sessile, rhomboidal, obtuse, mucronate-dentate, coriaceous, the veins beneath bearing scattered, minute scales; sori rather large, with coriaceous, persistent indusium.

Luzon, *Cuming*.

(9) **P. varium** (L.) Presl. Rhizome short, creeping; stipe 30 to 60 cm. high, densely fibrillose toward the base; frond 30 to 50 cm. high, about 30 cm. broad; lower pinnæ the largest, 15 cm. long, subdeltoid, with the lowest basipetal pinnules elongate, 8 cm. long, and divided into distinct, linear-oblong, falcate secondary pinnules; the rest of the frond only bipinnate, teeth rather obscure, not spinulose; coriaceous, glabrous, but rachis and midribs fibrillose; sori medial; indusia reniform or peltate.

Baguio, *Elmer* 6489; Arayat, *Loher*.

Japan and China.

(10) **P. falcatum** (L.) Diels. Stipes tufted, 15 to 30 cm. high, beset at the base with large, dark scales; frond 30 to 60 cm. high, ovate-lanceolate, simply pinnate; pinnæ numerous, the lower ones stalked, ovate-acuminate, falcate, 10 to 15 cm. long, 2 to 5 cm. broad, entire or slightly undulate, contracted suddenly on the upper side and often auricled; rounded or obliquely truncate on the lower, coriaceous, glabrous, glossy above; veins as a rule anastomosing toward the margin; sori small, copious, scattered.

Mount Data, 2,250 m., *Loher*.

Natal across India to Hawaii.

#### (4) **NEPHRODIUM** Richard.

Fertile and sterile fronds or parts of the frond not differentiated, or but slightly so; veins free, or the branches of adjacent veins anastomosing to form regular areolæ, triangular next the costa, trapezoidal farther out; sori round, the indusium cordate-reniform or wanting. Mostly terrestrial ferns, of medium or large size, thin or moderately firm, but not very coriaceous, compound. Related through *Pleocnemia* to *Aspidium*. A very large genus, so natural that even the separation of the two great

subgenera leaves several species in an equivocal position. In spite of this homogeneity it includes a large number of genera proposed at different times.

*Lastræ: Veins free.*

1. Simply pinnate, pinnæ not incised beyond the middle..... (1) *N. hirtipes*
1. Simply pinnate, pinnæ incised beyond the middle.
  2. Lowest pinnæ not reduced conspicuously.
    3. Lowest pinnæ considerably longer than others.
      4. Frond over 30 cm. high..... (2) *N. distans*
      4. Frond under 10 cm. high ..... (3) *N. grammitoides*
    3. Lowest pinnæ not longer than others.
      4. Segments of pinnæ at right angle to costa.
        5. Segments obtuse ..... (4) *N. crassifolium*
        5. Segments acute ..... (5) *N. Fauriei* clatius  
(6) *N. attenuatum*
      4. Segments of pinnæ forming acute angles.
        5. Veinlets less than 10 on a side.
          6. Lower surface villous..... (7) *N. calcaratum*
          6. Lower surface granular .... (8) *N. viscosum*
          6. Lower surface glabrous ..... (15) *N. sagenoides*
        5. Veinlets more than 10 on a side.
          6. Sori submarginal, texture thin ..... (9) *N. immersum*
          6. Sori marginal, subcoriaceous (10) *N. ligulatum*
    2. Lowest pinnæ reduced, veinlets simple.
      3. Pinnæ not lobed nearly to their midrib..... (11) *N. exiguum*
      3. Pinnæ lobed nearly or quite to their rachis.
        4. Veinlets 4 or 5 on a side..... (12) *N. Beddomei*
        4. Veinlets 8 to 12 on a side..... (13) *N. Luersseni*  
(14) *N. oxydon*
  2. Lowest pinnæ reduced, veinlets forked.
    3. Lobes of pinnæ entire.
      4. Sori subterminal, indusium absent..... (16) *N. obscurum*
      4. Sori subterminal, indusium present ..... (17) *N. symmaticum*
    3. Lobes of pinnæ toothed or pinnatifid.
      4. Surfaces glabrous, young indusium red. (18) *N. erythrorum*
      4. Surfaces glabrous, indusium never red.... (19) *N. Preslii*
      4. Lower surface villous..... (20) *N. flaccidum*
1. Decomound (except *N. dissectum*).
  2. Small or middle sized ferns with erect rhizome.
    3. Frond ovate-lanceolate, glabrous ..... (21) *N. sparsum*
    3. Frond deltoid, pubescent beneath..... (22) *N. crenatum*
  2. Small or middle sized ferns, rhizome creeping.
    3. Sori marginal ..... (23) *N. recedens*
    3. Sori medial ..... (24) *N. hirtum*
2. Large ferns, indusium usually inconspicuous.
  3. Bipinnatifid ..... (25) *N. dissectum*
  3. Bipinnate.
    4. Lamina glabrous ..... (26) *N. intermedium*
    4. Both surfaces villous ..... (27) *N. asperulum*
  3. Tripinnate.
    4. Indusium present.
      5. Frond not glabrous ..... (28) *N. setigerum*
      5. Glabrous throughout ..... (29) *N. divisum*
    4. Indusium wanting.
      5. Rhizome erect ..... (30) *N. ornatum*
      5. Rhizome creeping ..... (31) *N. rugulosum*
  3. Quadripinnate ..... (32) *N. megaphyllum*



*Goniopteris*: *Veinlets from neighboring veins anastomosing regularly.*

1. Terminal pinna much exceeding the lateral, lobes uniform.
  2. Sori small, lamina not villous ..... (33) *N. simplicifolium*
  2. Sori large, lamina villous.
    3. Frond obtuse ..... (34) *N. Bakeri*
    3. Frond acuminate ..... (35) *N. canescens*
1. Terminal pinna exceeding lateral or not, lobes of pinnae very unequal ..... (36) *N. diversilobum*
1. Terminal pinna hardly exceeding lateral, lobes uniform.
  2. Rhizome creeping.
    3. Lower pinnae hardly, if at all, reduced.
      4. Pinnae entire ..... (37) *N. rubidum*
      4. Segments of pinnae entire.
        5. Sori marginal in the lobes ..... (38) *N. pteroides*
        5. Sori not confined to lobes, pinnae not lobed over half way to costa.
          6. Indusium hairy ..... (39) *N. unitum*
          6. Indusium absent, sori indefinite ..... (40) *N. aoristisorum*
          6. Indusium absent, sori definite.
            7. Proliferous ..... (41) *N. proliferum*
            7. Not proliferous ..... (42) *N. urophyllum*
          6. Indusium present, not hairy (43) *N. moulmeincense*
        5. Sori not confined to lobes, pinnae lobed two-thirds of way to costa. (44) *N. extensum*
      4. Segments of pinnae sharp toothed. .... (45) *N. Otaria*
    3. Lower pinnae shorter than the succeeding.
      4. Glabrous ..... (46) *N. aridum*
      4. Not glabrous beneath.
        5. Rachis nearly naked ..... (47) *N. cucullatum*
        5. Rachis villous, sori marginal ..... (48) *N. loherianum*
        5. Rachis villous, sori medial.
          6. Pinnae 15 cm. long, villous beneath ..... (49) *N. invisum*
          6. Pinnae 25 cm. long, glandular ..... (50) *N. hirsutum*
  2. Rhizome erect.
    3. Pinnae entire, or not lobed one-third of distance to midrib.
      4. Lowest pinnae not much reduced.
        5. Pinnae under 10 cm. long ..... (51) *N. glandulosum*
        5. Pinnae over 20 cm. long ..... (52) *N. philippinense*
      4. Lowest pinnae reduced.
        5. Rachis and lower surface glabrous (53) *N. latipinna*
        5. Rachis and lower surface not glabrous.
          6. Lower pinnae gradually smaller and deflexed ..... (54) *N. amboinense*
          6. Lower pinnae very abruptly reduced.
            7. Veinlets 3 to 4 on a side ..... (55) *N. Arbuscula*
            7. Veinlets 6 to 9 on a side ..... (56) *N. pennigerum*
    3. Pinnae incised one-third or two-thirds of distance to midrib.

4. Lower pinnae abruptly reduced to auricles ..... (57) *N. hispidulum*
4. Lower pinnae not abruptly reduced to auricles.
  5. Stipe black fibrillose, later rough.. (58) *N. ferox*
  5. Stipe naked or villous.
    6. Frond about 40 cm. high, sori medial ..... (59) *N. parasiticum*
    6. Frond about 1 m. high, sori close to veins ..... (60) *N. truncatum*

(1) **N. hirtipes** (Bl.) Hooker. Stipes tufted, 30 cm. or more high, densely clothed with long, blackish, fibrillose scales; frond 60 to 100 cm. high, 20 to 40 cm. broad; pinnae 10 to 20 cm. long, 2 to 3 cm. broad, cleft about one-third of the way to the midrib into obtuse lobes, herbaceous, glabrous, the lower ones not reduced; rachis fibrillose like the stipe; veinlets 4 or 5 on each side; sori medial, indusium sometimes wanting.

Benguet and Arayat, *Loher*.

India and Malaya.

(2) **N. distans** (Don) Diels. Rhizome more or less creeping; stipes 30 to 45 cm. high, slender, glossy, stramineous or chestnut; frond 40 to 100 cm. high, 20 to 30 cm. or more broad; lowest pinnae rather the largest, 15 to 20 cm. long, 4 cm. broad, cut down nearly or quite to the rachis into deeply pinnatifid pinnules 6 mm. broad, with obtuse or acute, toothed or subentire lobes, herbaceous, slightly pubescent beneath; rachis naked; veinlets slightly pinnate in the lower lobes, pellucid; sori scattered, copious, exindusiate.

Benguet, *Loher*.

India to Celebes.

(3) **N. grammitoides** (Christ, Bull. Herb. Boiss. 6:193). Rhizome short creeping, scaly; stipes weak, 3 to 4 cm. high, stramineous, clothed, like the entire plant, with short, stiff, whitish hairs; frond 5 to 7 cm. long, 15 to 20 mm. broad, caudate-attenuate, broadest at the base, bipinnatifid; free pinnae about 6 pairs, remote, alternate, sessile, triangular-deltoid, acuminate, incised below to the costa into acute, triangular, crenate lobes 4 mm. long; veins pinnate in the lobes; sori minute, round, 3 or 4 on each side of the vein; indusium minute and pilose, or wanting.

Mount Mariveles, 1,400 m., *Loher*.

(4) **N. crassifolium** Hooker. Stipes tufted, 30 cm. or more high, glossy, slightly villous; frond 40 to 60 cm. high, 20 to 30 cm. broad; pinnae 10 to 15 cm. long, 2 to 4 cm. broad, their lobes obtuse, falcate, 4 to 6 mm. broad, reaching from half to two-thirds down to the midrib, subcoriaceous, glossy but the midribs finely villous, lower pinnae distinctly stalked; veinlets 10 to 12 on each side, with the sori nearer the midrib than the margin; indusium small, evanescent.

Philippines, *Loher*; Negros, *Copeland* 93.

Malaya.

(5) **N. Fauriei** (Christ) var. **elatus** (Christ) probably belongs here. It is a small fern, with very narrow fronds, and consequently short pinnae,

and large sori; in the Philippine form the pinnæ are incised at the base to the rachis, or nearly so.

Mount Tonglon, 2,250 m., *Loher*.

Japan.

(6) *N. attenuatum* (J. Sm.) Baker. Stipes 30 cm. or more high, firm, glossy, naked; frond about 100 cm. high, 60 cm. broad; pinnæ 20 to 30 cm. long, 2 to 3 cm. broad, long-acuminate, incised three-fourths of the way to the costa into spreading, entire, obtuse lobes 2 mm. broad, the basal lobes much reduced, subcoriaceous, glandular beneath, lowest pinnæ slightly stalked; veinlets 12 to 16 on each side; sori in a close row, indusiate.

Samar, *Cuming* 327; Rizal, *Loher*.

(7) *N. calcaratum* (Bl.) Hooker. Rhizome short, erect; stipes densely tufted, stramineous, 20 cm. high; frond 30 to 40 cm. high, 10 to 15 cm. broad; pinnæ spreading, 4 to 10 cm. long, 1 to 2 cm. broad, cut down two-thirds or more of the way to the midrib into oblique, subfalcate, linear-oblong, acute or obtuse lobes, the lowest acroscopic the longest, herbaceous or subcoriaceous, dark green, more or less villous beneath; veinlets 3 to 6 on each side; sori medial, indusium glabrous, persistent.

Philippines.

India and Malaya.

(8) *N. viscosum* Baker. Stipe 15 cm. or more high, firm, erect, reddish brown, slightly scaly, finely villous; frond 20 to 30 cm. high, about 10 cm. broad, oblong-lanceolate; pinnæ close, 5 to 8 cm. long, 1 cm. broad, cut down nearly to the midrib into close, spreading, linear-oblong lobes, herbaceous, dark green, densely glandular beneath; veinlets 5 to 6 on a side; sori medial, indusiate.

Philippines, *Lobb*.

Malacca and Borneo.

(9) *N. immersum* Hooker. Stipes tufted, 60 cm. or more high, stramineous, scaly at base, naked above, or sparsely pubescent at top; frond 100 to 200 cm. high, 40 to 60 cm. broad; pinnæ 20 to 30 cm. long, 20 to 35 mm. broad, almost horizontal, acuminate, cut down almost to the midrib into close, spreading, subacute, linear lobes 2.5 mm. broad, papyraceo-herbaceous, pubescent with stiff white hairs nearly 1 mm. long; veinlets 10 to 15 on each side; sori nearer the margin than the vein, immersed so as to be prominent on the upper side; indusium peltate.

Southern Luzon, *Baranda*; Davao, *Copeland* 695. Our plant is atypical in the close lobes and more pubescent fronds.

Assam to New Caledonia.

(10) *N. ligulatum* Hooker. Stipes gray, glossy, naked; frond about 100 cm. high, 30 to 50 cm. broad; pinnæ 15 to 25 cm. long, 2 to 3 cm. broad, cut down very nearly to the midrib into linear, obtuse, entire, erecto-patent lobes 2 mm. broad with more than their own space between them, subcoriaceous, finely pubescent beneath, as is the rachis; veinlets 10 to 12 on a side; sori quite marginal, indusiate.

Luzon, *Cuming* 94; Cagayan-Luzon, *Warburg* 12216; Cebu, *Cuming* 343.

(11) **N. exiguum** Hooker. Stipes tufted, 15 to 25 cm. high, slender, gray, naked; frond 20 to 25 cm. high, 3 to 5 cm. broad; pinnae 2 to 3 cm. long, 1 cm. broad, cut down half way to the midrib or more into close, obtuse lobes, papyraceo-herbaceous; rachis villous; veinlets obscure, 2 to 3 on each side; sori near the veins.

Luzon, *Cuming* 251, 272.

(12) **N. Beddomei** Baker. Rhizome slender wide-creeping; stipe 15 to 25 cm. high, slender, glossy; frond 15 to 50 cm. high, 5 to 10 cm. broad, lanceolate; central pinnae the largest, 3 to 5 cm. long, lanceolate, cut down to their rachis into close, rather acute, entire lobes, glabrous except for the veins, firm; lower pinnae distant and dwindling down very gradually; veinlets 4 to 5 on a side; sori close to the incurved margin, indusiate.

Benguet, *Loher*, *Topping* 331, *Elmer* 6491.

India, Java, southern China.

(13) **N. Luersseni** Harrington, *Journ. Linn. Soc.* 16:29. Stipes clustered, firm, shining, light purplish; frond 45 to 75 cm. high, 15 to 25 cm. broad, oblong, tapering abruptly to the base; pinnae 10 to 20 cm. long, 2 to 4 cm. broad, lanceolate, acuminate, jointed at the base, cut down almost or quite to the rachis into numerous linear or oblanceolate lobes 2 to 4 cm. long, membranaceous, glabrous, lowest pinnae very small; veinlets 8 to 12 on a side, distant; sori marginal, indusiate. Near *N. prolixum* Baker.

Baluku Island, growing on the margin of a pond, *Stecere*.

(14) **N. oxydon** (Baker in *Journ. of Bot.*, 1879, p. 66, sub *Polypodio*) should probably be inserted here.

Jolo Archipelago, *Burbidge*.

(15) **N. sagenoides** (Mett.) Baker. Stipes tufted, slender, 15 to 50 cm. high, almost black, polished, scaly at the base; frond 30 to 60 cm. high, half as broad; pinnae 10 to 15 cm. long, 3 to 4 cm. broad, narrowed gradually from the base to the apex, cut down nearly to the midrib into linear-oblong, obtuse, crenate or entire lobes, papyraceo-herbaceous, glabrous; veinlets 6 to 10 on a side, forked; sori terminal on the acropetal branch, nearer the margin than the vein, indusiate.

Davao, *Warburg* 14122, *Copeland* 1238.

Malaya.

(16) **N. obscurum** (Fee) Diels. Stipes tufted, 30 cm. high, black, glossy, naked; frond 20 to 40 cm. high, deltoid-oblong, acuminate; pinnae about 10 cm. long, 2 to 3 cm. broad, cut three-fourths of the way to the midrib into close, obtuse lobes 5 mm. broad, thin-papyraceous; veinlets 6 to 8 on a side, forked; sori subterminal on the acropetal branches, medial.

Philippines, *Cuming* 302; Rizal, *Loher*, a small form.

Tavoy?

(17) **N. syrmaticum** (Willd.) Baker. Rhizome erect; stipes tufted, 30 to 60 cm. high, stramineous; frond 100 cm., more or less, high, less than half as broad; pinnae 15 to 25 cm. long, about 4 cm. broad, cut down

almost to the midrib into slightly toothed lobes 5 mm. broad, subcoriaceous, glabrous, the lowest stalked, not much reduced; veinlets 8 to 12, sometimes more than once forked; sori subterminal on the branches, as near the margin as the midrib, indusium small but evident. Near *N. crassifolium*.

Luzon, *Cuming* 13, 14, 154; Sorsogon and Catanduanes, *Baranda*; Bohol, *Cuming* 354; Davao, *Copeland* 669, 928, 953, small forms; Zamboanga, *Copeland* 736.

India, Malacca.

(18) *N. erythrosorum* Hooker. Stipes tufted, 15 to 25 cm. high, more or less densely clothed with long lanceolate and linear scales; frond 30 to 50 cm. high, 20 to 30 cm. broad, ovate-lanceolate; pinnae lanceolate, the lowest the largest, 10 to 15 cm. long, cut quite down to the rachis below into oblong-obtuse pinnules which are slightly, sometimes spinosely, toothed, herbaceous but firm, glabrous; sori in rows of 6 to 9, near the veins; indusium 1 mm. broad, flat, bright red when young.

Japan and China.

Benguet, *Loher*.

(19) *N. Preslii* Baker. Stipes 15 to 25 cm. high, slender, deciduously fibrillose; frond 15 to 25 cm. high, 10 to 15 cm. broad, lanceolate-deltoid; upper pinnae lanceolate, close; lowest pair deltoid, the upper pinnules 4 mm. broad, obtuse, entire, the lower ones pinnatifid with similar lobes and broad uncut center, subcoriaceous, glabrous; rachis fibrillose; sori about 6 to the lower lobes, dorsal on the veins, nearer the vein than the margin.

Luzon, *Cuming* 255.

(20) *N. flaccidum* Hooker. Stipes tufted, 30 cm. or more high, slender, stramineous, naked; frond 30 to 50 cm. long, 15 to 20 cm. broad; pinnae 7 to 10 cm. long, 2 to 3 cm. broad, cut down to a rachis with a narrow, distinct wing into oblong lobes 4 mm. broad, cut about half way down in turn, herbaceous, villous beneath, like the rachis; lower pinnae distant, shorter than the others and deflexed; veinlets forked, or in the lower lobes subpinnate; sori about midway between the vein and margin.

Benguet, *Loher*.

Himalayas to Java.

(21) *N. sparsum* Don. Stipes tufted, 15 to 30 cm. high, scaly near the base, stramineous and glossy above; frond 30 to 60 cm. high, 20 to 30 cm. broad, ovate-lanceolate; lowest pinnae the largest, 10 to 15 cm. long, 3 to 5 cm. broad; lowest pinnule sometimes compound, the others lanceolate, unequal sided, pinnatifid with oblong, obtuse lobes, herbaceous but firm, glabrous, pale green; sori usually one to each lobe, near the vein; indusium flat, naked, 2 mm. broad.

Benguet, *Loher*, *Topping* 282.

Mauritius to Malaya and China.

(22) *N. crenatum* (Forsk.) Baker. Stipes 25 to 50 cm. high, stramineous, glossy, densely clothed at the base with a tuft of lanceolate, bright brown scales; frond 20 to 40 cm. high, deltoid; lowest pinnae much the largest, deltoid, 15 to 25 cm. long, 6 to 10 cm. broad; pinnules lanceolate,



often imbricate, with ovate or oblong pinnatifid segments with rounded lobes, herbaceous, pale green, pubescent beneath as is the rachis; sori copious; indusium large, pale, villous.

Cagayan-Luzon, *Warburg* 12205; Benguet, *Loher*, *Elmer* 6480, 6595; Arayat, *Loher*.

Cape Verde Islands to China.

(23) **N. recedens** (J. Sm.) Hooker. Rhizome wide-creeping; stipe about 30 cm. high, erect, villous, soft, clothed at the base with squarrose, linear scales; frond 40 to 60 cm. high, 30 cm. or more broad, deltoid; lower pinna much the largest, 15 to 30 cm. long, 10 to 15 cm. broad; pinnules of the lower side the largest, sometimes 15 cm. long, 5 cm. broad, with distinct, one-sided lanceolate segments with close, slightly toothed linear-oblong lobes, firm, nearly glabrous; rachises villous; sori small, 6 to 8 around the margin of the larger lobes.

Luzon, *Cuming* 96.

Ceylon and southern India.

(24) **N. hirtum** (Presl.), non Hooker. Frond deltoid, decompose, 30 cm. long; rachises clothed with copious appressed, linear, brown paleae; lower pinnae the largest, deltoid, the lower side the more developed; central pinnae oblong-lanceolate; final segments oblong, entire, 2 mm. broad, moderately firm, glabrous; veinlets few, erecto-patent; sori medial.

"Philippines," *Haenke*.

(25) **N. dissectum** (Forst.) Desv. Stipes tufted, 30 cm. or more high, rather slender, glossy, clothed toward the base with linear, dark brown scales; frond 30 to 150 cm. high, 30 to 100 cm. broad, deltoid; lower pinnae varying from simply pinnatifid, with broad obtuse lobes, to 30 cm. long, with similar pinnatifid pinnules, the center usually uncut for a breadth of 1 cm., and the uncut obtuse or acute ultimate divisions equally broad, papyraceo-herbaceous, bright green, nearly glabrous; sori copious, generally submarginal; indusium flat, 1 mm. or more broad.

Luzon, *Cuming* 36, 249.

Madagascar to Polynesia.

(26) **N. intermedium** (Bl.) Baker. Stipe 30 to 60 cm. high, stout, erect, densely clothed at the base with long, bright brown, silky fibrils; frond 60 to 100 cm. high, 30 to 50 cm. broad, subdeltoid; lower pinna lanceolate, often 30 cm. long, 10 cm. broad; pinnules close, lanceolate, with distinct oblong-lanceolate segments with ligulate, subentire lobes about 2 mm. broad, herbaceous, firm, glabrous or slightly scaly on the midribs; sori small, copious, nearer the veins than the margin; indusium thin, fugacious.

Benguet and Rizal, *Loher*.

Ceylon to Japan.

(27) **N. asperulum** (J. Sm.). Stipe firm, terete, brownish, pubescent; frond 40 to 60 cm. high, 30 cm. or more broad; lower pinnae 15 to 25 cm. long, 5 to 8 cm. broad; pinnules lanceolate, 1 cm. broad, oblique, cut down to the rachis below into oblique, oblong, pinnatifid segments, sub

coriaceous, villous on both surfaces; veinlets immersed; sori copious, one to each ultimate segment.

Luzon, *Cuming* 63; Albay, *Baranda*.

(28) *N. setigerum* (Bl.) Baker. Rhizome creeping; stipe 30 to 50 cm. high, scaly at the base, naked in the middle, villous at the top, stramineous; frond 40 to 100 cm. high; lowest pinnae the largest, 20 to 30 cm. long, half as broad; pinnules close, linear-lanceolate, reaching a length of 10 cm. their segments pinnatifid more than half way to the midrib, herbaceous, glabrous or sparingly hirsute; sori minute, numerous; indusium fugacious.

Cagayan-Luzon, *Warburg* 12207; Benguet, *Topping* 178; Rizal, *Guerero* 1.

India across Polynesia.

(29) *N. divisum* Hooker. Stipes 60 to 100 cm. high, brownish, glabrescent; fronds 2 to 3 m. high, spreading; lower pinnae 30 to 50 cm. long, 20 to 25 cm. broad; pinnules lanceolate, acuminate, their rachis very slightly winged, their rather obtuse segments cut down over half way to the midrib into sharp teeth or toothed lobes, papyraceous, glabrous, deep green; sori nearer the midrib than the margin, usually one to each tooth or lobe, indusiate.

Mount Apo, *Copeland* 1138.

India, Bourbon, Java.

(30) *N. ornatum* (Wall.) Baker. Rhizome erect; stipe densely chaffy at the base and more or less so throughout, 50 to 100 cm. high; fronds 1 m. high and upward, ovate, at least tripinnate, exceedingly variable, villous beneath, herbaceous; sori often sheltered by the incurved margin, exindusiate. This is rather doubtfully distinct from *N. setigerum*.

Luzon, *Cuming* 1, 75, 412; Rizal, *Loher*; Davao, *DeVore* and *Hoover* 360, 361, *Copeland* 611.

India to Celebes.

(31) *N. rugulosum* (Labill.). Rhizome wide-creeping, rather hairy than scaly; stipe 30 to 50 cm. high, puberulous and glandular; frond 30 to 120 cm. high, deltoid; lower pinnae the largest, themselves less broadly deltoid, their pinnules with distinct, obtuse, more or less deeply crenate segments 1 cm. long, 3 mm. broad, firm-papyraceous, viscid-puberulous, very sparsely so above, pale green, especially beneath; sori copious, or one at the base of each tooth, on the upper side, exindusiate. This is probably a form of *N. punctatum* Diels; but that name is invalidated under the Berlin rules by *Acrostichum punetatum* L., and under the Kew rules by *Nephrodium punetatum* Parish. Strikingly like *Hypolepis*.

Baguio, *Topping* 252.

All warm countries except Africa.

(32) *N. megaphyllum* Baker. An enormous fern, several meters high; stipe 15 mm. or more thick, rough, clothed with appressed, subulate scales, as is the rachis; frond ample, quadripinnate; pinnae 75 cm. long, 15 cm. broad, stalked, acuminate; pinnules almost sessile, remote, alternate, ovate-oblong; pinnules of the third order 3 cm. long, almost sessile, broadly



triangular-ovate, their rachis narrowly winged; segments of the fourth order ovate, incised into coarse truncate-obtuse teeth, furfuraceous; sori single at the base of the ultimate lobes; indusium reniform.

Baguio, *Loher*.

Borneo.

(33) **N. simplicifolium** Hook. Rhizome creeping; stipes tufted, strong, villous upward, about 10 cm. high; frond 15 to 30 cm. high, with a lanceolate-acuminate, entire apex about 3 cm. broad, and at its base 1 to 6 small blunt, spreading, entire, distinct pinnae, subcoriaceous; midrib hispid beneath, and the prominent veins slightly so, main veins 3 mm. apart, all the veinlets anastomosing; sori minute, indusium wanting.

Leyte, *Cuming* 315.

Fiji.

(34) **N. Bakeri** Harrington. Rhizome erect (?); stipes clustered, light brown, villous or sealy, 4 to 10 cm. high; frond oblong-oblanccolate, 10 to 15 cm. high, 2 to 3 cm. broad, obtuse, coarsely crenate or lobed one-third the distance to the costa, with usually 2 to 4 distinct oblong-obovate sessile pinnae at the base hardly as large as the lobes, papyraceous, villous; veinlets 6 to 8 pairs, the majority of them anastomosing; sori small, midway on the veinlets, the indusium hairy, often absent.

Panay, terrestrial in the mountains, *Steere*.

(35) **N. canescens** (Bl.) Christ. Rhizome creeping; stipe of sterile frond about 5 cm., of fertile about 20 cm. high, erect, villous above; rachis likewise villous; sterile frond 10 cm. more or less, high, ovate-lanceolate, acute, the terminal segment sometimes almost the whole length, sometimes much less than half, crenate; pinnae truncate at both ends, crenate or slightly lobed toward the broad apex, papyraceous, mostly glabrous; fertile frond similar except that the pinnae are usually narrower and occupy a relatively large part of the frond; sori near the main veins, or irregularly scattered, indusium usually absent. I follow Christ in referring this plant to Blume's *Gymnogramme canescens*, though our plants are largely glabrous. It is variable here as in Celebes (cf. Christ, *Ann. Jard. Buitenz.* 15:130).

Isabela-Luzon, *Warburg* 11608, 11611; Nueva Vizcaya, *Merrill* 162; Rizal, *Loher*; Linao, *Merrill* 3130, *Copeland* 250; Samar, *Cuming* 322; Davao, *Copeland* 503.

Java, Celebes.

(36) **N. diversilobum** Presl. Rhizome creeping or ascendent; stipe of sterile frond 10 cm., of fertile 20 cm. high; rachis very closely villous; frond 15 to 30 cm. high, lanceolate or ovate; pinnae opposite, acuminate, below their apex deeply and variously lobed, crenate near the truncate, sometimes auricled base, papyraceous, glabrous except for the costa; fertile frond the same, sori midway on the veinlets, exindusiate.

Luzon, *Cuming* 51, 102; Negros and Davao, *Copeland* 83, 698.

This and the preceding two species are very close together, and probably all very near *N. parasitium*.

(37) **N. rubidum** Hooker. Stipes firm, erect, glossy, reddish brown, naked; frond 30 to 50 cm. high, 30 cm. or more broad; pinnae numerous,

the lowest stalked, 15 to 20 cm. long, 2 cm. broad, acuminate, entire or nearly so, subcoriaceous, glabrous; veinlets obscure, 8 to 10 on a side; sori close to the main veins, exindusiate.

Luzon, *Cuming*; Camarines and Sorsogon, *Baranda*.

Java and Borneo (?).

(38) *N. pteroides* (Retz.) J. Sm. Rhizome hypogæous, creeping; stipe 30 to 60 cm. high, slender, almost naked; frond 40 to 80 cm. high, 30 to 40 cm. broad; pinnae spreading, 15 to 25 cm. long, 1 to 2 cm. broad, serrate with triangular teeth seldom one-third the depth to the midrib, papraceo-herbaceous, rachis and veins somewhat hairy beneath; veinlets 5 to 8 on each side; sori confined to the margin of the teeth, indusiate.

Rizal, *Loher*; Sorsogon, *Baranda*; Mindoro, *Merrill* 984; Cullion, *Merrill* 484, 594; Mindanao, *Cuming* 293; Davao, *Copeland* 636.

India and China to Queensland and Polynesia.

(39) *N. unitum* R. Br. Stipes 30 to 50 cm. high, brownish, naked; frond 60 cm. or more high, 15 to 20 cm. broad; pinnae 10 to 15 cm. long, 1 to 2 cm. broad, cut from a third to half way down into spreading, triangular, acute lobes, coriaceous, the lower ones not dwindling down; veinlets 6 to 8 on each side; sori nearly terminal, principally in the lobes, indusium hairy.

Luzon, *Cuming* 259.

Pantropic.

(40) *N. aoristisorum* (Harrington, in Journ. Linn. Soc. 16:30). Rhizome short and thick, with slender, brown scales; stipes clustered, 8 to 15 cm. high, slender, gray slightly pubescent above; frond 15 to 25 cm. high, 2 to 4 cm. broad, linear-lanceolate, the lower pinnae reflexed; pinnae 20 to 40 pairs, 12 to 16 mm. long, half as broad, elliptical, slightly falcate, obtuse, coarsely crenate, auricled on the upper side, sessile or nearly so, subcoriaceous, pubescent beneath, as is the rachis; veinlets 2 or 3 on each side, of which but one usually anastomoses with the opposite one of the next lobe; sori not definitely bounded, the sporangia more or less scattered.

Panay, terrestrial in mountains, *Steere*.

(41) *N. proliferum* (Presl.). Rhizome stout, creeping; stipes spreading, naked, 5 to 20 cm. high; frond 30 to 60 cm. long, 15 to 30 cm. broad, erect or decumbent, often elongate and rooting at the point and branched copiously from the axils; pinnae 10 to 15 cm. long, 1 to 2 cm. broad, broadest at the truncate or cordate base, obtuse, bluntly lobed about 2 mm. deep, subcoriaceous, naked or nearly so; veinlets 6 to 10 on a side; sori medial, oval, sometimes confluent, exindusiate.

Luzon, *Cuming* 168; Benguet, *Loher*.

Africa to Polynesia.

(42) *N. urophyllum* (Wall.) Beddome. Rhizome horizontal, short and stout; stipe 50 to 80 cm. high, erect, nearly naked; frond 60 cm. or more high, 30 to 50 cm. broad; pinnae rather few, 20 to 30 cm. long, about 5 cm. broad, acuminate, entire or crenate, sessile, papraceous,

glabrous; veinlets about 15 pairs, the sori medial on them, forming two rows, or, near the midrib, terminal and forming a single row, exindusiate.

Luzon, *Baranda, Steere*; Davao, *Warburg* 14171, *Copeland* 952.

India to Queensland and Polynesia.

(43) **N. moulmeinense** Beddome. Rhizome short, creeping; stipe 60 to 120 cm. high, erect, naked unless at the top; frond 60 to 120 cm. high, 40 to 60 cm. broad; pinnae usually more than 6 on each side, 20 to 30 cm. long, scarcely 4 cm. broad, long-acuminate, entire or crenate or more often serrate with falcate teeth 2 to 3 mm. deep, abruptly contracted to the sessile or subsessile base, subcoriaceous, glabrous or nearly so, smooth; veinlets about 15 on a side; sori medial on them, mostly with a visible indusium.

Rizal, *Loher*; Mindoro, *Merrill* 997; Zamboanga, *Copeland*; Davao, *Copeland* 1240, called "Saiop" in Bagobo.

India and Malaya.

This species differs typically from the preceding in being of firmer texture, with more numerous, narrower, and more uniformly narrow pinnae with less entire margin, more numerous main veins, and indusia; in practice, they are not very distinct.

(44) **N. extensum** (Bl.) Hooker. Stipe 30 to 60 cm. high, naked or nearly so, brownish; frond 60 to 120 cm. high, 30 to 50 cm. broad; pinnae 15 to 25 cm. long, about 2 cm. broad, cut down about two-thirds of the way to the rachis into linear-oblong lobes, papyraceo-herbaceous, naked or nearly so; veinlets 6 to 8 on each side, often only the lowest pair united; sori nearly terminal, not confined to the lobes, indusiate.

Rizal, *Loher*; Albay, *Baranda*.

India, Malacca.

(45) **N. Otaria** Baker (*Anisocampium Cumingianum* Presl.). Stipe 15 to 30 cm. high, substramineous; frond 30 cm. or more high, with a linear-oblong terminal pinna 10 to 15 cm. long, 2 to 4 cm. broad, acuminate, lobed one-fourth to one-third of the way to the midrib into finely serrate lanceolate lobes, and 3 to 6 distant, spreading, similar lateral pinnae on each side, the lower ones stalked, thinly herbaceous, glabrous; veinlets 6 to 8 on each side, the lowest uniting midway between the midrib and the edge; indusia present.

Luzon, *Cuming* 239.

India.

(46) **N. aridum** (Don) Baker. Stipe 30 cm. or more high, erect, naked; frond about 100 cm. high, 30 to 50 cm. broad; pinnae 15 to 25 cm. long, about 3 cm. broad, cut about one-third of the way down to the midrib into subtriangular, acute lobes, coriaceous, glabrous or slightly hairy; veinlets 8 to 10 on a side; sori in rows about midway between midrib and margin.

Luzon, *Cuming* 278.

India, Malaya.

(47) **N. cucullatum** (Blume) Baker. Rhizome wide-creeping; stipe 30 cm. or more high, erect, brownish, nearly naked; frond 40 to 80 cm. high, 20 to 30 cm. broad; pinnae close, 10 to 15 cm. long, 1 to 2 cm.

broad, cut down one-third of the way to the midrib into triangular, acute, subfalcate lobes, the lower ones dwindling down suddenly to mere auricles, coriaceous, lower surface, like the rachis, densely pubescent; 8 to 10 veinlets on each side; sori subterminal, indusiate.

Luzon, *Cuming* 254; Cagayan-Luzon, *Warburg* 12206, 12212; Lepanto and Rizal, *Loher*; Nueva Ecija, *Merrill* 283, 284; Benguet, *Elmer* 6486; Mindoro, *Merrill* 879; Davao, *Warburg* 14097, *Copeland* 326, 447.

India across Polynesia.

(48) *N. loherianum* (Christ, Bull. Herb. Boiss. 6:191). Rhizome creeping; stipes subtufted, 30 cm. high, sparsely scaly at the base, densely but closely strigose-pubescent above, as are the rachis and veins; frond deltoid-ovate (aside from some auricles representing the lowest pinnae), 30 cm. high, 18 to 20 cm. broad, acuminate; pinnae 10 cm. long, 2 cm. broad, horizontal, lanceolate, acuminate, sessile, cleft down to 3 mm. from the midrib into obtuse, oblong, falcate lobes 3 mm. broad, subcoriaceous, short-pilose, ash-brown; veinlets about 12 pairs, only the lowest anastomosing, and these not always; sori small, marginal, crowded, with pilose indusia.

Montalban, Rizal, *Loher*.

(49) *N. invisum* Carruth. Rhizome stout, wide-creeping; stipe 30 cm. or more high, stout, brownish, villous; frond 45 to 60 cm. high, 20 to 30 cm. broad; pinnae numerous, 10 to 15 cm. long, 1 cm. or more broad, cut about one-third of the way to the midrib into sharp, triangular, falcate lobes, subcoriaceous, the lower ones distant and dwarfed; rachis and lower surface villous; veinlets 6 to 8 on each side; sori in rows close to the midrib, indusiate; capsules setose.

Mount Mariveles, *Warburg* 12759; Tayabas, *Warburg* 12509.

Polynesia.

(50) *N. hirsutum* J. Sm., Presl. Stipes 100 cm. more or less high, scaly at the base, closely hirsute toward the top; frond 100 to 200 cm. high, 50 cm. or more broad; pinnae 20 to 35 cm. long, narrowly linear, acuminate, incised about half way to the midrib into obtuse, falcate lobes, subcoriaceous, closely glandular beneath; rachis densely but closely hirsute, surfaces very sparsely hairy; veinlets about 8 on each side; sori medial on them.

Luzon, *Cuming* 82; San Ramon, *Copeland* 751, a form with about 13 veinlets on each side, the sori reaching most of their length.

Celebes.

(51) *N. glandulosum* J. Sm. Stipes tufted, 30 cm. or more long, naked or slightly villous; frond 30 cm. or more high, 10 to 15 cm. broad; pinnae 8 to 10 pairs, spreading, larger and closer on the sterile frond, 6 to 10 cm. long, 2 to 3 cm. broad, entire or nearly so, truncate and sometimes auricled at the base, papyraceo-herbaceous; rachis and lower surface naked or slightly villous, sometimes glandular; fertile pinnae somewhat contracted; veinlets 4 to 8 on a side, with the sori close to the midrib, indusiate. Near *N. urophyllum*.

Luzon, *Cuming* 16; Leyte, *Cuming* 298.

Malaya.

(52) *N. philippinense* Baker, in Ann. Bot. 5:327. Frond oblong-lanceolate, bipinnatifid, 60 to 90 cm. high, 30 to 45 cm. broad, glabrous throughout; pinnae lanceolate-acuminate about 20 cm. long by 3 cm. broad, cut down less than half way to the rachis into oblong, erecto-patent lobes, moderately firm, the lower ones not dwarfed; veinlets 8 to 9 pairs; sori medial, with firm, glabrous, persistent indusia. Near *N. Arbuscula*.

Luzon, *Cuming* 10, 84; Benguet and Rizal, *Loher*; Cebu, *Cuming* 338.

(53) *N. latipinna* Hooker. Stipes tufted, 10 to 15 cm. high, slender, naked; frond 20 to 30 cm. high, 8 to 12 cm. broad, the upper third or half lanceolate, pinnatifid with broad oblong lobes: below this several pinnae on each side, the largest 5 to 8 cm. long, about 2 cm. broad, cut about one-fourth of the way down into broad, oblong, subfalcate lobes, papyraceo-herbaceous, the lower ones much reduced and distant; rachis and sides glabrous; 3 to 5 distant veinlets on each side, with a sorus about the middle of each. Doubtfully distinct from *N. parasiticum*.

Isabela-Luzon, *Warburg* 11599, 11604, 11610, 11979; Manila, *Warburg* 12747.

Hongkong, Java.

(54) *N. amboinense* Presl. Stipes tufted, 15 to 20 cm. high, grayish, nearly naked; fronds 60 cm. or more high, 20 to 30 cm. broad; pinnae spreading, about 10 cm. long, 1 to 2 cm. broad, cut one-fourth of the way to the midrib into obtuse, slightly falcate lobes, papyraceo-herbaceous, the lower shorter and deflexed; rachis and lower surface slightly pubescent; veinlets 4 to 6 on a side; sori in rows close to the midrib.

Luzon, *Cuming* 83; Leyte, *Cuming* 317.

India and Malaya.

(55) *N. Arbuscula* Desv. Stipes tufted, 10 to 20 cm. high, naked or slightly pubescent; frond 30 to 50 cm. high, 15 to 20 cm. broad; pinnae close, numerous, about 10 cm. long by 1 cm. broad, cut not more than one-fourth of the way to the midrib into obtuse lobes, herbaceous, several of the lower pairs short and distant; rachis and lower side finely villous; veinlets distant, 3 or 4 on a side; sori in close rows.

"Philippines."

India to Polynesia.

(56) *N. pennigerum* (Bl.) Hooker. Stipes tufted, stout, 20 to 30 cm. high, finely villous; frond 60 to 120 cm. high, 30 to 50 cm. broad; pinnae numerous, spreading, 15 to 25 cm. long, about 3 cm. broad, acuminate, cut about one-fourth of the way to the midrib into oblong, falcate lobes, herbaceous or subcoriaceous, the lower ones dwarfed and distant; rachis and under surface finely villous; veinlets 6 to 9 on a side, the sori medial on them, indusiate; capsules setose. Near *N. moultmeincense*.

Baguio, *Loher*.

Africa, India, Malaya.

(57) *N. hispidulum* Baker. Stipes tufted, slender, 30 to 50 cm. high, grayish, villous; frond 30 to 50 cm. high, 15 cm. broad; pinnae distant, spreading, about 10 cm. long, 1 cm. broad, acuminate, cut about half



way to the midrib into oblong, slightly falcate lobes, the lower pinnae suddenly dwarfed to mere auricles; rachis and under surface finely villous; veinlets 3 to 4 on each side, with a large sorus on each near the margin, indusiate; capsules naked.

Luzon, *Cuming* 268; "Philippines," *Baranda*.

Malaya.

(58) **N. ferox** Moore. Stipe 30 to 80 cm. high, strong, densely fibrillose with black hairs which leave the stipe rough when they fall; frond 90 to 150 cm. high, 60 cm. broad; pinnae rather close, spreading, 15 to 40 cm. long, 2 to 3 cm. broad, very acuminate, cut about one-third of the way to the midrib into lanceolate-falcate lobes, subcoriaceous, glabrous and glossy; veinlets 10 to 12 on each side; sori close to the main veins.

Benguet, *Loher*, *Topping*, 162, 320, *Elmer* 6232; Albay, *Baranda*.

Malaya.

(59) **N. parasiticum** (L.) Baker. Rhizome short; stipes tufted, 30 cm. high, slender, deciduously hairy; frond 30 to 60 cm. high, 30 cm. broad; pinnae spreading, 10 to 15 cm. long, 2 cm. broad, obtuse or acuminate, cut about half way to the midrib into subfalcate obtuse lobes, truncate at the base, herbaceous, finely villous, the lower ones deflexed, usually distant and rather shorter; veinlets 6 to 8 on each side; sori medial, indusiate.

Isabela-Luzon, *Warburg* 11976; Benguet, *Topping* 319; Rizal, *Loher*; Mount Mariveles, *Copeland* 226, 1389; Albay and Masbate, *Baranda*; Culion, *Merrill* 589; Davao, *Warburg* 14096.

All warm countries.

(60) **N. truncatum** Presl. Stipes tufted, stout, erect, 60 cm. high, grayish, naked or slightly villous; frond 60 to 120 cm. high, 30 to 50 cm. broad; pinnae 15 to 25 cm. long, 2 to 3 cm. broad, very obtuse, cut down one-third of the distance to the midrib, more deeply toward the apex, into obtuse, spreading, oblong lobes, papyraceo-herbaceous, glabrous or nearly so; rachis slightly villous; veinlets 6 to 8 on each side, with a sorus near the base of each. This includes *N. caudiculatum* Sieb. and *N. abruptum* J. Sm.

Luzon, *Cuming* 120, *Steere*, *Baranda*; Leyte, *Cuming* 317.

India across Polynesia.

#### (5) **MENISCIUM** Schreber.

Fronds simple or once pinnate; veins anastomosing as in *Goniopteris*, the veinlets from adjacent veins uniting in pairs, and from the points of fusion veinlets running toward the margin parallel to the main veins; sori elongate along the cross-veinlets, exindusiate. A small genus of terrestrial ferns, very closely related to *Nephrodium*, with which it is perhaps better combined.

(1) **M. triphyllum** Swartz. Rhizome wide-creeping, the younger part scaly; stipes slender, 20 to 30 cm. high, stramineous, slightly pubescent; fronds simple, oblanceolate, 10 to 15 cm. high, 1, 5 to 2 cm. broad, acute, repand, auricled at the base; or the auricles becoming free, as distinct

pinnules, herbaceous, slightly pubescent on the veins beneath; areolæ 5 to 9 between costa and margin. The simple form is *M. simplex* Hooker.

Isabela-Luzon, Warburg 11609; Leyte, Cuming 299; Negros, Copeland 76.

India to Java and Formosa.

(2) *M. cuspidatum* Blume. Stipe 30 to 100 cm. high, brownish, naked; frond 40 to 100 cm. high, with few scattered pinnae, the terminal like the lateral; pinnae erecto-patent, about 15 cm. long by 3 cm. broad, caudate-acuminate, usually falcate at the end, nearly entire, short stalked or sessile, subcoriaceous, glabrous or nearly so, dark green above, with rows of light or reddish dots marking the excurrent veinlets. This species is very near *Nephrodium urophyllum*, but must be specifically distinct even if the genera were united.

Luzon, Cuming 178; Mount Mariveles, Whitford 272; Leyte, Cuming 314; Mindoro, Cuming 361.

Himalayas, Java.

#### (6) *ASPIDIUM* Swartz.

Fertile and sterile fronds alike or nearly so, inclined toward a triangular shape, and the pinnae toward a stronger development of the basiscopic side; texture moderately thin; veins anastomosing irregularly, usually very copiously, with or without free included veinlets; sori nearly always round, on a distinct receptacle; indusium peltate, reniform or wanting. An almost exclusively tropical genus of terrestrial ferns, whose greatest development is reached in this region; intimately related, through *Pleocnemia*, to *Nephrodium*. The most of our species seem to be of very local occurrence, and not even locally abundant; the number of species still to be discovered is therefore probably large. The arrangement of the species adopted here is probably artificial, and it is therefore undesirable to raise any of these groups (unless it be *Pleocnemia*) to generic rank.

1. Veins anastomosing very copiously.

2. Indusium wanting, *Arcypteris*.

3. Fronds simple.

4. Lowest lobes entire ..... (1) *A. Bryanti*

4. Lowest lobes forked or lobed..... (2) *A. Barberi*

3. Fronds pinnate.

4. Sori in rows along main veins.

5. Pinnae mostly entire ..... (2) *A. Barberi*

5. Pinnae pinnatifid ..... (3) *A. macrodon*

4. Sori strictly marginal ..... (4) *A. Brogniartii*

4. Sori scattered.

5. Pinnae entire or once forked..... (5) *A. lamaocense*

5. Pinnae pinnately lobed.

6. Veinlets inconspicuous ..... (6) *A. difforme*

6. Veinlets very conspicuous  
above ..... (7) *A. Whitfordi*

2. Indusium reniform, *Sagenia*.

3. Sori in rows along main veins.

4. Frond not compound.

5. Rhizome erect ..... (8) *A. heterodon*

5. Rhizome creeping ..... (9) *A. decurrens*



- 4. Frond pinnate.
  - 5. Margin of pinnae nearly entire.
    - 6. Apex of frond entire ..... (10) *A. persoriferum*
    - 6. Apex pinnatifid ..... (11) *A. pachyphyllum*
    - 6. Apex trifid ..... (12) *A. grande*
  - 5. Pinnae pinnatifid.
    - 6. With free included veinlets.. (13) *A. siifolium*
    - 6. Without free included veinlets ..... (14) *A. cicutarium*
- 3. Sori scattered.
  - 4. Frond simple, pinnatifid ..... (15) *A. vastum*
  - 4. Frond pinnate.
    - 5. Terminal pinna deeply pinnatifid.. (16) *A. melanocaulon*
    - 5. Terminal pinna lobed at base..... (17) *A. irriguum*
    - 5. Terminal pinna merely sinuate.... (18) *A. Menyanthidis*
- 2. Indusium peltate, *Tectaria*.
  - 3. Lowest pinnae forked ..... (19) *A. repandum*
  - 3. Lowest pinnae pinnate ..... (20) *A. calcareum*
- 1. Veinlets forming costal areolæ, and a few others along the main veins, *Pleocnemia*.
  - 2. Caudex not subarborescent.
    - 3. Sori round.
      - 4. Indusium peltate ..... (21) *A. membranaceum*
      - 4. Indusium reniform.
        - 5. Frond bi-tripinnate ..... (22) *A. giganteum*
        - 5. Frond simple ..... (23) *A. heterophyllum*
    - 3. Sorus oblong ..... (24) *A. ambiguum*
  - 2. Caudex subarborescent ..... (25) *A. leuzeanum*

(1) **A. Bryanti** Copeland. Stipe 20 to 40 cm. high, bearing sparse horizontal scales on the back, and on each side a uniform wing 1 cm., more or less, broad, which is truncate near the base of the stipe; frond 30 to 50 cm. high, ovate, trifid with close lateral lobes or more often quinquefid with the lower lobes remote and connected by a broad wing; apical segment 20 to 30 cm. high, about 10 cm. broad, acuminate, entire or subrepand, papery, glabrous; lateral segments similar but smaller; primary veins curved, almost reaching the margin, connected by conspicuous, arched cross-veinlets, the large, regular areolæ thus formed divided into small, irregular ones with free included veinlets; sori mostly in rows along the main veins; indusium none or fugacious.

Terrestrial in forest near Gimogon River, Negros, *Copeland 82*.

(2) **A. Barberi** (Hooker). Stipes tufted, 15 to 30 cm. high, slightly scaly at the base; frond palmately 5-lobed, or more usually pinnate with a large terminal segment and 1 to 4 pairs of pinnae, the upper ones oblong-lanceolate, 10 to 15 cm. long, 2 to 3 cm. broad, nearly entire, the lowest pair with a deep lanceolate lobe at the base on the lower side, subcoriaceous, glabrous; areolæ rather large and regular, with copious free veinlets; sori copious, principally in two rows near the main veins.

Majayjay, *Loher*.

Malaya.

(3) **A. macrodon** (Reinw.) Diels. Rhizome decumbent; stipe 30 cm. or more high, slightly scaly below; frond 60 to 100 cm. high, half as broad, the apex deeply pinnatifid, below this numerous lanceolate pinnae, the lowest sometimes 30 cm. long, deltoid, cut down to a narrow wing

into pinnatifid, close, lanceolate pinnules, thin, glabrous; areolæ copious, without free veinlets; sori small, in rows near the main veins.

Luzon, *Cuming* 9, 114.

Malaya and Polynesia.

(4) **A. Brogniartii** (Bory) Diels. Rhizome short, erect, densely scaly at the top; stipe 30 cm. or more high, dark brown at the base, lighter above and glabrous; frond 50 to 100 cm. high, half as broad, apex pinnatifid into deep, repand or lobed segments; below this numerous distinct pinnæ, the lowest 15 to 20 cm. long, lanceolate-deltoid, lobed throughout into broadly lanceolate lobes of which all except the lowest basipetal one are entire or nearly so, subcoriaceous, glabrous; areolæ copious, with few or no free veinlets; sori rather small, quite confined to the margin.

Rizal, *Loher*; Albay, Camarines and Masbate, *Baranda*; Negros, *Copeland*.

Malaya.

(5) **A. lamaense** Copeland. Rhizome ascending; stipe 15 to 25 cm. high, with a few small, lanceolate scales at the base, fibrillose near the top, like the rachis; frond 15 to 25 cm. high, deltoid, usually trifoliate, with a deeply tripartite apical segment, less often with the apical segment entire, or with an extra pair of entire pinnæ intercalated; lowest pinnæ short-stalked, about 10 cm. long, furcate with the smaller, lower segment distant, herbaceous, glabrous, margin entire; areolæ with free veins; sori copious, irregularly scattered, round or elongate, exindusiate, bright, deep red.

On boulders in creek bed, Lamao Forest Reserve, Luzon, *Copeland* 223. This may not be distinct from *A. irriguum*.

(6) **A. difforme** Blume. Stipes tufted, erect; 30 cm. or more high, scaly near the base; frond 1 m., more or less, high, at least half as broad; upper pinnæ lanceolate, nearly entire or with broad obtuse or falcate lobes reaching half way to the costa; lower pinnæ often deltoid, with the lobes of the lower side prolonged and pinnatifid, subcoriaceous, glabrous; areolæ copious with few free veinlets; sori very copious, scattered.

Isabela-Luzon, *Warburg* 11589; Rizal and Laguna, *Loher*; Culion, *Merrill* 665; Davao, *Warburg* 14132.

Malaya.

(7) **A. Whitfordi** Copeland. Rhizome suberect, very short, densely scaly at the apex; stipe 20 to 30 cm. high, dark brown at the base and clothed with linear scales, lighter above and glabrous; frond 30 to 40 cm. high, deltoid, acuminate, papyraceous, glabrous, olive green, the white veins conspicuous on the upper surface; apex pinnatifid, the segments broadly crenate and obscurely serrate; below this about 6 free pinnæ on each side, erecto-patent, acuminate, lanceolate, pinnatifid more or less than half way to the rachis into oblong, obtuse, entire or serrate lobes, lower pinnæ stalked; lowest ones deltoid, with one free basiscopic pinnule resembling one of the upper pinnæ; veins laxly anastomosing, without free included veinlets; sori round or oblong, irregularly scattered but wanting near the costa, exindusiate.

Lamao Forest Reserve, near the river, Luzon, *Whitford* 201.

(8) **A. heterodon** Copeland. Rhizome short, erect, woody; stipe 15 to 20 cm. high, glabrescent, bearing on each side a wing about 5 mm. broad at the top, attenuate to the base; frond 20 to 30 cm. high, 3 or 5 partite, herbaceous, glabrous; apical segment oblanceolate, 4 to 5 cm. broad, acuminate, serrate with irregular teeth 0 to 10 mm. long; lateral lobes smaller, erecto-patent, less conspicuously serrate; primary veins reaching the margin; areolæ irregular with free included veinlets; sori large, in rows along the main veins; indusium reniform, persistent.

Terrestrial in forest near Catalonan, Davao, *Copeland* 951.

(9) **A. decurrens** Presl. Rhizome creeping; stipe with a few scattered paleæ, and on each side a wing 5 to 10 mm. broad at the top attenuate almost to the base; frond 50 to 100 cm. high, 30 cm. or more broad, cut down to a broadly winged axis into 4 to 8 pairs of usually crenate lanceolate segments 10 to 20 cm. long the lowest of which are sometimes forked, herbaceous, glabrous; main veins distinct to the margin; areolæ copious, with free included veinlets; sori large, in regular rows along the main veins; indusia reniform.

Luzon, *Cuming* 148; Rizal, *Loher*; Sorsogon and Catanduanes, *Baranda*; Mindoro, *Merrill* 1773; Davao, *Copeland* 967.

India to Polynesia.

(10) **A. persoriferum** Copeland. Rhizome short, ascending; stipe 40 to 60 cm. high, stramineous or brown, clothed at the base with lanceolate, arcuate paleæ 12 mm. long, glabrous above, like the rachis; frond 30 to 50 cm. high, ovate, pinnate, the sterile the more ample; apical part about 25 cm. high, 7 cm. broad, acuminate, entire or subrepand, subcoriaceous, glabrous; lateral pinnae about 3 pairs, sessile, erecto-patent, subarcuate, lanceolate, 15 to 20 cm. long; fertile pinnae smaller, about 10 cm. long, 2 cm. broad, obscurely crenate, the lowest stalked; main veins almost reaching the margin; areolæ irregular with free included veinlets; sori in rows along the main veins, almost covering the entire lamina; indusium reniform, very persistent.

River bank near Catalonan, Davao, *Copeland* 929.

(11) **A. pachyphyllum** Kunze. Rhizome short, apparently erect; stipe 30 cm. or more high, brownish, naked; from 60 to 100 cm. high, half as broad, with a subdecurent terminal part deeply pinnatifid at its base and entire or sinuate above, and 4 to 8 erecto-patent lateral pinnae on each side, acuminate, subcoriaceous, glabrous, the lower ones with a long fork on the lower side; main veins almost reaching the margin; free included veinlets copious; sori large, in fairly regular rows; indusium reniform. (*A. platyphyllum* Presl.)

*Cuming*, Luzon, 224; Cebu, 339 and 340; Panay (?) 356 in part; Mindanao, 290; Benguet, *Topping* 337, 338; *Elmer*, 6171.

Malaya and Polynesia.

(12) **A. grande** J. Sm., Mett. Stipe rufescent, shining; frond 1 m. high, pinnate; apex deeply 3-lobed, composed of "three confluent pinnae;" pinnae 5 to 6 pairs, 25 cm. long, 6 cm. broad, oblong-lanceolate, caudate-acuminate, subsinuate, membranaceous, glabrous, the lowest stalked,

cuneate at the base, unequally bipartite; venation of *Drynaria*; sori in rows close to the main veins, large; indusium reniform, plane, coriaceous.

"Luzon?" *Cuming s. n.*, or No. 356 fide Baker, or Panay, *s. n.*, fide Presl sub. *A. grandifolio*.

The description does not show wherein this is sufficiently distinct from *A. pachyphyllum*.

(13) *A. siifolium* (Willd.) Mett. Stipe 30 cm. or more high, brownish, naked; frond 30 cm. or more high, 15 to 20 cm. broad, with a broad, oblong, acuminate terminal pinna, and 3 to 4 lateral ones on each side, the lowest stalked, 8 to 10 cm. long, 5 cm. broad, forked at the base and rather deeply lobed, subcoriaceous; main veins close, distinct to the margin; areolæ fine, with free included veinlets; sori large, in rows close to the main veins, often confluent.

Luzon, *Cuming* 4.<sup>1</sup>

Java and Sumatra.

(14) *A. cicutarium* (L.) Sw. Rhizome ascending; stipe 30 cm. or more high, bearing scattered deciduous, spreading paleæ; frond 80 cm. more or less high, subdeltoid, apex deeply pinnatifid; below this, 3 to 6 pinnæ on each side, papyraceo-herbaceous or subcoriaceous, glabrous unless on the midribs, the lowest pinnæ subdeltoid, deeply pinnatifid or pinnate below; main veins distinct to near the margin; areolæ with few or no free included veinlets; sori rather large, in rows near the main veins; indusium round-reniform.

Isabela-Luzon, *Warburg* 11973; Mount Mariveles, *Loher, Copeland* 217; Davao, *Warburg* 14166.

Pantropic. Exceedingly variable.

(15) *A. vastum* Blume. Rhizome creeping; stipes scattered, narrowly winged often nearly or quite to the base; frond 1 m., more or less, high, 30 cm. or more broad, cut down to the very broadly winged rachis into entire, linear-oblong segments 15 to 30 cm. long, 3 to 5 cm. broad, papyraceo-herbaceous or subcoriaceous; main veins distinct three-fourths of the way to the margin; areolæ copious, with free included veinlets; sori small, scattered.

Panay, *Cuming* 356 in part.

India and Malaya.

(16) *A. melanocaulon* Blume. Rhizome ascending; stipe 30 cm. or more high, ebeneous, glossy, scaly at the base; frond 30 to 60 cm. high, ovate-deltoid, with a large, deeply pinnatifid terminal pinna, and 1 to 4 lateral ones on each side, the central one deeply pinnatifid with ovate-acuminate lobes, the lowest stalked, 15 to 30 cm. long, 10 to 15 cm. broad, often again pinnate at the base, papyraceo-herbaceous; main veins reaching the margin; areolæ fine, with free included veinlets; sori numerous, minute, scattered; indusium fimbriate, fugacious.

Luzon, *Cuming* 57.

Malaya.

<sup>1</sup> This is inserted here on the authority of the *Synopsis Filicum*, p. 299. A sterile frond in our herbarium strongly suggests *Arcypteris*, and both Smith and Hooker (Sp. Fil. V:86) treated this plant as exindusiate.

(17) **A. irriguum** J. Sm., Presl. Stipes tufted, 10 to 15 cm. high, grayish, finely villose; frond 15 to 25 cm. high, 10 to 15 cm. broad, subdeltoid, with a large oblong, terminal pinna with a pair of deep lanceolate lobes at the base, and below this 1 to 2 pairs of slightly sinuate lateral pinnae, the lowest forked at the base, papyraceo-herbaceous; main veins flexuose; areolæ fine, with free included veinlets; sori small, scattered, often confluent; indusium small, fugacious.

Luzon, *Cuming* 31; Rizal, *Loher*.

(18) **A. Menyanthidis** Presl. Rhizome creeping; stipe 15 to 30 cm. high, brownish, naked; frond 30 to 60 cm. high, 30 cm. or more broad, with an acuminate, oblong-lanceolate, sinuate terminal pinna 15 to 30 cm. long, 2 to 4 cm. broad, and 2 to 4 similar ones on each side, the lowest stalked, sometimes forked, subcoriaceous; main veins, close, conspicuous, reaching the margin; areolæ fine, with copious free veinlets; sori small, scattered, all on the connected veinlets.

Sorsogon, *Haenke*; southern Camarines, *Cuming* 183 in part; Sorsogon, *Baranda*.

New Guinea, Solomon Islands.

(19) **A. repandum** Willd. Stipe 30 to 60 cm. high, grayish brown, naked; frond 60 cm. or more high, 30 to 45 cm. broad, the apex deeply pinnatifid, with linear-oblong, slightly sinuate lobes; below this 4 to 8 pinnae on each side, 15 to 20 cm. long, about 3 cm. broad, acuminate, narrowed to the base, sinuate, subcoriaceous, the lowest stalked and forked; main veins distinct to the margin; areolæ copious with free veinlets; sori in distinct rows near the main veins; indusium orbicular, peltate, 1 mm. broad.

Luzon, *Cuming* 183 in part; Sorsogon and Catanduanes, *Baranda*.

(20) **A. calcareum** Presl. Rhizome subcreeping; stipe 10 to 15 cm. high, naked; frond 30 cm. or more high, ovate-lanceolate, with acuminate pinnatifid apex, and below it 4 to 6 distant, stalked pinnae on each side. the lowest deltoid, 15 cm. long, cut down to the rachis below into stalked lanceolate-acuminate, deeply and obtusely lobed pinnules, subcoriaceous; areolæ not very abundant and mainly costular; indusium orbicular.

Leyte, *Cuming* 310.

(21) **A. membranaceum** Hooker. Rhizome ascending, with a mass of black paleæ at the apex; stipes tufted, about 30 cm. high, nearly naked, with a few spreading linear paleæ below; frond about as high as the stipe, deltoid, acuminate, membranous, puberulous especially beneath; upper part subbipinnatifid, free pinnae 5 to 7, lowest much the largest, subdeltoid, 10 to 20 cm. long, pinnules on the lower side much the larger, pinatifid into oblong, entire or crenate segments; veins anastomosing principally in costal arches; sori copious, mostly marginal in the lobes.

"Philippines," *Cuming*; Arayat, 800 m., *Loher*; Davao, *Copeland* 898.

China, Formosa, Java, Ceylon.

(22) **A. giganteum** Blume. Stipe 30 to 60 cm. high, brown, glossy; frond 30 to 60 cm. high, broadly deltoid, with pinnatifid apex and 4 to 5 pairs of pinnae of which the upper are decurrent, the lower stalked;



lowest pinnae very large, obliquely deltoid, pinnules on its basiscopic side prolonged, and at least deeply pinnatifid in turn; veinlets anastomosing at least near the midribs, without sterile included veinlets; indusia subcordate. I suppose that *Nephrodium* (*Plcoenemia*) *giganteum* Baker is our Philippine plant; if it is distinct from *A. giganteum* Blume, Baker's name can not stand.

Leyte, *Cuming?*; Camarines and Albay, *Baranda*.

(23) **A. heterophyllum** Mett. Rhizome creeping; stipe 5 to 10 cm. high, densely villous; frond 10 to 15 cm. high, linear-oblong, simple, with obtuse, oblong, slightly falcate lobes reaching one-fourth of the way to the costa, coriaceous, villous on both surfaces, but especially on the margin and costa beneath; anastomoses of the veinlets not very regular, but suggesting *Goniopteris*; sori midway the veins and the margin of the lobes. Apparently related to *Nephrodium canescens*.

Samar, *Cuming* 322.

(24) **A. ambiguum** (Hooker) Diels. Stipe slender, nearly naked; frond 40 to 60 cm. high, 30 cm. broad, oblong-deltoid, bipinnatifid; pinnae lanceolate, 10 to 15 cm. long, 3 cm. broad, the lower ones slightly stalked, cut half way or more to the rachis into linear-oblong lobes, the fertile ones contracted, thinly herbaceous, dark green, rachis and both sides thinly clothed with long, jointed hairs; veinlets of the lobes often forked, the lower ones forming costular areolæ; sori oblong, confluent when the veins fork; indusium none.

Luzon, *Cuming* 154 (Samar, *Cuming* 321?).

(25) **A. leuzeanum** (Presl) Kunze. Rhizome erect, usually short but sometimes arborescent, densely scaly at the crown; stipe 1 m., more or less, long, stout, striate; frond 1 to 2 m. long, subdeltoid; pinnae 30 to 50 cm. long, 15 to 25 cm. broad, upper ones simple, lowest ones pinnate on the basiscopic side, and the large pinnules pinnatifid; segments 10 cm. long, 2 to 3 cm. broad, subfalcate, entire or sinuate; veinlets anastomosing sparsely and irregularly, rarely free; sori in single close rows; indusia orbicular-cordate, fugacious.

Luzon, *Cuming* 33, 34, 107; Rizal and Laguna, *Loher*; Mindanao, *Cuming* 289.

India and China to Polynesia.

## (7) POLYBOTRYA II., B. and K.

Fronds at least pinnate, the fertile much contracted; veins free in the Philippine species; sori originating in a receptacle on the veins, almost or entirely covering the under surface, exindusiate. Our species are rather small terrestrial ferns.

1. Pinnae not articulate to rachis.

2. Setæ projecting between teeth ..... (1) *P. appendiculata*

2. Without setæ.

3. Frond bipinnatifid ..... (2) *P. stenosemioides*

3. Frond bi- or tripinnate ..... (3) *P. apiifolia*

1. Pinnae articulate to rachis ..... (4) *P. articulata*

(1) **P. appendiculata** (Willd.) Blume. Rhizome short, creeping; stipe of sterile frond 10 to 20 cm. high, of fertile 20 to 40 cm., erect, scaly throughout, as is often the rachis; sterile frond 40 to 70 cm. long, apex usually rooting; pinnae about 5 cm. long in the middle of the frond, horizontal, lanceolate, acute, simply or doubly serrate with the tip of a vein excurrent from the sinus between each two main teeth, abruptly contracted at the base, sometimes auricled on the upper side, papyraceous, glabrous; fertile frond shorter and narrower, with obtuse pinnae, the lower ones stalked; pinnae often rolled up in fruit and appearing to be entirely covered by the sori.

Mount Arayat, *Loher*; Benguet, *Topping* 340, *Elmer* 6457; Mount Mari-veles, *Warburg* 12508, *Copeland* 245.

India and Malaya, Hongkong.

(2) **P. stenosemioides** Baker sub *Achrosticho*. Stipes high, chestnut, with a few lanceolate scales toward the base; sterile frond 30 to 45 cm. high, 20 cm. broad, bipinnatifid, submembranaceous, glabrous except for a few deciduous hyaline paleae on the margin; pinnae sessile, 10 cm. long, 3 cm. broad, numerous, pinnatifid to a broadly winged costa into oblong, obtuse segments 5 mm. broad; fertile frond similar, but with a longer stipe, nearly 60 cm., and smaller and more lax pinnae.

Rizal, *Loher*.

Sarawak.

(3) **P. apiifolia** Hooker. Rhizome short, stout, erect; stipe of sterile frond 2 to 7 cm. high, of fertile 15 to 20 cm. the former densely, the latter very sparsely fibrillose; sterile frond 8 to 15 cm. high, 4 to 12 cm. broad, bi- or tripinnate; pinnae close, rhomboidal, they or their divisions more dissected at the base than in the part above, where they are broader, only the lowest pair ever with pinnate pinnules, rather obtuse, with entire or dentate margin, herbaceous, glabrous beneath except on the midribs; ultimate divisions of the fertile frond reduced to isolated orbicular or globose, beadlike bodies 1 to 2 mm. in diameter.

Luzon, *Cuming* 26, *Lobb*; Rizal, *Loher*; Linao Forest Reserve, *Merrill* 3129, *Barnes* F. B. 73, *Copeland*; Masbate and Bataan Id., *Baranda*.

(4) **P. articulata** J. Sm. Stipe 30 cm. high, firm, erect, nearly naked; sterile frond 30 to 80 cm. high, 20 to 30 cm. broad, bipinnate; pinnae articulate to the rachis, narrowly lanceolate; pinnules unequal-sided, oblong, obtuse, crenate, auricled on the upper side, subcoriaceous, glabrous; pinnae of fertile frond 10 cm. long, linear-cylindrical, auricled on the upper side.

Leyte, *Cuming* 296.

Celebes across Melanesia.

#### (8) **STENOSEMIA** Presl.

Sterile frond ample, fertile reduced to linear segments, both broadly trifoliate in plan; basiseopie side of lower pinnae strongly developed; veinlets anastomosing to form areolae along the midribs and main veins, free toward the margin, without included veinlets; sori eventually covering the dorsal or both surfaces. Indusium none.

(1) *S. aurita* Presl. Rhizome erect, short; stipe of sterile frond 15 to 20 cm. high, of fertile 20 to 30 cm., ebeneous, bearing a few lax paleae; sterile frond 8 to 20 cm. high and broad, its central part deeply pinnatifid with entire, or obtusely serrate, lanceolate lobes; lateral pinnae very unequal sided, with lowest basiscopic segment pinnatifid, membranaceous, glabrous or with scattered hairs, especially on the veins; fertile on the same plan as the sterile, but rather smaller and the segments hardly over 1 mm. broad; terrestrial.

Leyte, *Cuming* 295; Zamboanga, *Copeland* 738; Davao, *Warburg* 14170, *Copeland* 957.

Malaya to Polynesia.

### (9) *GYMNOPTERIS* Bernhardt.

Rhizome usually creeping; frond simple or pinnate, the fertile much contracted; veinlets copiously anastomosing, with, or less frequently without, free included veinlets; sori covering the entire dorsal surface, exindusiate. Mostly terrestrial ferns of small or moderate stature.

1. Sterile frond simple, entire, or nearly so.
  2. Main veins evident nearly to the margin.
    3. Free included veinlets usually wanting..... (1) *G. linnaeana*
    3. Free included veinlets copious ..... (2) *G. variabilis*
  2. Main veins obscure, short, or none.
    3. Sterile frond about 5 cm. long..... (3) *G. minor*
    3. Sterile frond 15 cm. or more long.
      4. Rhizome creeping ..... (4) *G. lanceolata*
      4. Rhizome scandent ..... (5) *G. arillaris*
1. Sterile frond typically trifid ..... (6) *G. taecaeifolia*
1. Sterile frond typically pinnate.
  2. Lateral pinnae but one pair ..... (7) *G. flagellifera*
  2. Lateral pinnae several pairs.
    3. Terminal pinna unlike the lateral.
      4. Fronds 30 cm. or more high.
        5. Terminal pinna entire or sinuate..... (8) *G. subrepanda*
        5. Terminal pinna pinnatifid ..... (9) *G. repanda*
      4. Fronds rarely 10 cm. high ..... (10) *G. inconstans*
    3. Terminal pinna like the lateral.
      4. Free included veinlets few or none..... (11) *G. contaminans*
      4. Free included veinlets regularly present.
        5. Primary veins conspicuous ..... (12) *G. costata*
        5. Primary veins obscure ..... (13) *G. prestiana*

(1) *G. linnaeana* (Hooker). Rhizome wide-creeping; stipes 5 cm. more or less high, slightly fibrillose below; sterile frond 10 to 20 cm. high, 1 to 2 cm. broad, narrowed gradually to both ends, sometimes rooting at the apex, entire, papyraceous, subopaque, dark green; main veins fine, rather zigzag but distinct nearly to the margin; areolae copious, without free veinlets; fertile frond hardly 10 cm. long, less than 1 cm. broad.

Rizal, *Loher*. This plant often has a pair of minute free pinnae at the base of the linear frond; or even the sterile frond pinnate.

Malaya.

(2) *G. variabilis* (Hooker) Bedd. Rhizome wide-creeping; stipe of sterile frond 0 to 10 cm. high, of fertile 30 cm. or more; sterile frond 30



cm. more or less high, contracted gradually to the base, oblong-spatulate, acute or obtuse, entire, papyraceo-herbaceous, glabrous; main veins prominent, zigzag, reaching nearly to the margin, areolæ copious, with free included veinlets; fertile frond 15 to 30 cm. high, 4 mm. broad.

Davao, *Warburg* 14114.

India and Malaya.

(3) *G. minor* (Mett.) Bedd. (*Dendroglossa normalis* Presl in part.) Rhizome wide-creeping, firm; stipe of sterile frond 2 to 5 cm. high, glabrous, stramineous; of fertile about 10 cm.; sterile frond 3 to 5 cm. high, 1 cm. broad, obtuse, entire, with tapering base, herbaceous, glabrous; no main veins, areolæ and included veinlets copious; fertile frond 3 to 5 cm. high, 3 mm. broad.

Samar, *Cuming* 326 in part.

Khasya hills in India.

(4) *G. lanceolata* Hooker. Rhizome woody, wide-creeping; sterile frond sessile or decurrent on a short stipe, 15 to 30 cm. high, 1 to 3 cm. broad, obtuse or acute, entire, narrowed very gradually below, herbaceous, glabrous; main veins raised but falling short of the margin; areolæ copious, with free veinlets; fertile frond 15 to 30 cm. high, 2 to 4 mm. broad, on a stipe 20 cm. high.

Samar, *Cuming* 326 in part, a small form; Davao, *Copeland* 932.

India and Malaya.

(5) *G. axillaris* (Cav.) Presl. Rhizome wide-scandent, branching; stipe of sterile frond short or none, of fertile about 10 cm. high, slightly scaly at the base; sterile frond 15 to 30 cm. long, 2 to 3 cm. broad, obtuse, entire, tapering gradually to the base, papyraceous, glabrous; no main veins; areolæ very copious, with free veinlets; fertile frond 15 to 30 cm. long, 2 to 6 mm. broad, flexuous.

Luzon, *Nee, Cuming* 30; Albay, *Baranda*.

India and Malaya.

This and the two preceding species are sometimes regarded as forms of *G. variabilis*.

(6) *G. taccaefolia* (Hooker) J. Sm. Rhizome short, stout, creeping; stipe of sterile frond about 10 cm. high, of fertile about 30 cm., both clothed below with narrow, horizontal paleæ; sterile frond 30 cm. more or less, long, typically trifid, sometimes simple or pinnate, sometimes rooting at apex, pinnæ acute, entire, lanceolate, rachis winged in the more complex forms and the lowest pinnæ forked, papyraceous, glabrous; main veins distinct nearly to margin, with regular transverse veinlets and copious areolæ with included veinlets; fertile frond typically trifid with middle segment 15 cm. long, the lateral 10 cm., 3 to 4 mm. broad, exceptionally simple or pinnate. This species is regarded as including *Anapausia decurrens* Presl, *Gymnopteris subquinquefida* Presl, and *G. latifolia* Presl.

Luzon, *Cuming* 3 and 5; "Manila," *Meyen, Gaudichaud*; Rizal, *Loher*; Mindoro, *Cuming* 357; Culion, *Merrill* 534.

(7) *G. flagellifera* (Wall.) Bedd. Rhizome short and terrestrial, or scandent up tree trunks when it is scaly and climbs by means of rootlets;

stipe of sterile frond 5 to 20 cm. high, of fertile 20 to 40 cm., scaly or glabrescent; sterile frond simple, or with 1 to 3 pairs of pinnae, the terminal one lanceolate, entire, repand or subserrate, often elongate and rooting, lateral ones more or less reduced, herbaceous, glabrous; main veins distinct, areolæ of various forms, with few or no included veinlets; fertile fronds usually trifoliate or pinnate, 3 to 10 cm. long, lanceolate. This species is well distinguished from the preceding by the venation and the longer, more slender rhizome. This species includes *Pocillopteris heteroclita* Presl and *P. diversifolia* Presl.

Isabela-Luzon, Warburg 11603; "Manila," Haenke, Cuming 32; Sorsogon, Haenke, Baranda; Davao, Copeland 671, 752, 950.

India and Malaya.

(8) **G. subrepanda** (Hooker) J. Sm. Rhizome woody, wide-creeping; stipe 15 to 30 cm. high, stout, erect, nearly naked; sterile frond simple and 30 cm. long by 3 to 5 cm. broad, or pinnate, and 60 cm. long by 30 cm. broad, with several pairs of linear-oblong, entire or subrepand pinnae, subcoriaceous, glabrous; main veins distinct nearly to margin; areolæ and included veinlets copious; fertile frond like the sterile, but smaller.

Luzon, Cuming 225; Isabela-Luzon, Warburg 11622.

Penang.

(9) **G. repanda** (Blume) Christ: Rhizome creeping; stipe 15 to 30 cm. high, that of the sterile frond usually the longer, naked; sterile frond 30 to 60 cm. long, 20 to 30 cm. broad, sometimes elongate and rooting, with numerous pinnae on each side, the lower ones 10 to 15 cm. long, 2 cm. broad, cut one-fourth of the way to the costa into entire, obtuse lobes, herbaceous, glabrous; main veins distinct, areolæ copious, without free veinlets; fertile pinnae much smaller, stalked, entire or repand. *Achrostichum Quoyanum* Gaud. is a form with the lobes deeper and toothed. This species is construed as including also *Pocillopteris sinuosa* Presl, *Heteroneuron argutum* Fée, and *Heteroneuron cuspidatum* Presl.

Luzon, Cuming 104, 105, 161; Sorsogon, Haenke; Leyte, Cuming 294.

Java to China and Polynesia.

(10) **G. inconstans** Copeland. Rhizome creeping, scaly; stipe of sterile frond 1 to 3 cm. high, of fertile 3 to 10 cm., filiform, erect, green, glabrous or scaly below; sterile frond 4 to 8 cm. or more long, usually pinnate, linear to ovate in form, membranaceous, glabrous, the terminal pinna usually elongate, linear, proliferous; lateral pinnae 2 to 6 pairs, lanceolate to orbicular in form, usually entire, sessile, somewhat decurrent; veins inconspicuous, forming few areolæ, without included veinlets; fertile frond linear, with 2 to 4 pairs of round or oblong remote pinnae 1 to 4 mm. long, the lowest sometimes stalked, with few or no veins beside the costa.

Lamoo Forest Reserve, Luzon, Copeland 251, Merrill 3128.

Completely covering bowlders in beds of streams.

(11) **G. contaminans** (Wall.) Bedd. Rhizome short-creeping, thick; stipe 30 to 40 cm. high, glabrescent; sterile frond 30 to 60 cm. high, ovate; pinnae 10 or more on each side, alternate, sessile or short-stalked, lanceolate, acute, entire, crenate or pinnatifid; terminal pinna commonly

elongate and proliferous; main veins evident about half way to margin, areolæ large, with few included veinlets; fertile pinnæ much contracted, entire or sinuate. This partly includes *Achrostichum blumeanum* Hooker.

Luzon, *Cuming* 223, 225; Rizal, *Loher*; Lamac, *Copeland* 249.

India, Burmah.

(12) **G. costata** (Wall.) Bedd. Rhizome creeping, bearing subulate scales; stipe 45 cm. or less high; frond 60 cm. or more long; pinnæ reaching a length of 35 cm. and a breadth of 8 cm., stalked, acuminate, entire, sinuate or crenate, subcoriaceous, glabrous; main veins very prominent, close; areolæ and included veinlets copious; pinnæ of fertile frond smaller and more coriaceous.

"Manila," *Gaudichaud*.

Upper India, Burmah.

(13) **G. presliana** (Fée). Rhizome woody, short-creeping; stipe 10 to 20 cm. high, firm, erect, naked; sterile frond about 30 cm. long, half as broad, with numerous erecto-patent pinnæ 5 to 8 cm. long, 1 cm. broad, entire, narrowed to both ends, submembranaceous, glabrous, lower ones short-stalked; rachis winged above; venation as in *Goniophlebium*, veinlets uniting in pairs, with one free veinlet in each areola; fertile fronds usually with longer stipes and pinnæ much contracted.

Sorsogon, *Huene*.

India.

#### (10) **DIPTERIS** Reinwardt.

Rhizome creeping, stipes not articulate to it; frond cleft to the base into parts, which are dichotomously divided or lobed; main veins dichotomous; veinlets anastomosing, with free included veinlets; sori small, round, mostly along the main veins and cross veins, without indusia. Striking terrestrial ferns of large size, fan-shaped or reniform in general outline.

(1) **D. conjugata** (Kaulf.) Reinw. Rhizome covered with dark brown, linear scales; stipe usually 1 m. or more high, firm, brown, naked, polished; frond usually more than 30 cm. high and much broader, the halves lobed at least two-thirds of the way down, their divisions successively more shallowly, segments acute, coarsely or obscurely serrate, subcoriaceous, glabrous, dark green above, glaucous and bluish beneath; main veins very conspicuous, areolæ copious.

Luzon, *Cuming* 155, *Steere*; Benguet, Mariveles, and Laguna, *Loher*; Baguio, *Topping* 164, 238, *Elmer* 5782; Mount Mariveles, *Merrill* 3228, *Whitford* 250; Davao, *Warburg* 14185.

Malaya to Formosa and Polynesia.

### III. DAVALLIÆ.

Sori (except in *Oleandra*) terminal on their veins, on or near the margin of the frond; indusium opening toward the margin (wanting in *Monachosorum*); margin of frond often modified in connection with sorus: stipes articulate to rhizome, or not; fronds usually at least deeply pinatifid; pinnules of segments usually more developed on the acropetal side.

1. Pinnæ not dimidiate, i. e., the lamina is more or less developed on both sides of the costa.
2. Sori separate and distinct.
3. Indusium fastened at the base only.
4. Pinnæ articulate to the rachis.
  5. Stipe articulate to rhizome ..... (11) *Arthropteris*
  5. Stipe not articulate to rhizome.. (12) *Nephrolepis*
4. Pinnæ not articulate to the rachis, or frond simple.
  5. Stipe articulate to rhizome.
  6. Sori dorsal on veins, near costa ..... (13) *Oleandra*
  6. Sori marginal or sub-marginal ..... (14) *Humata*
  5. Stipe not articulate to rhizome.. (15) *Saccoloma*
3. Indusium fastened at base and sides.
  4. Stipe articulate to rhizome ..... } (16) *Davallia*  
   } *Microlepia ciliata*
  4. Stipe not articulate to rhizome.
  5. Margin of frond hardly modified.
  6. Ultimate divisions of frond  
not cuneate nor sori  
marginal ..... (17) *Microlepia*
  6. Ultimate divisions cune-  
ate, with sori on the  
broad apex ..... (18) *Odontosoria*
  5. Margin united with indusium to form a cup-shaped receptacle.. (19) *Dennstaedtia*
3. Indusium wanting ..... (20) *Monachosorum*
2. Sorus continuous around the pinna..... (21) *Schizoloma*
1. Pinnæ dimidiate, lower half obsolete..... (22) *Lindsaya*

(11) **ARTHROPTERIS** J. Smith, Diels.

Rhizome scandent, stipes articulate to it or a little above it; frond pinnate, the pinnae articulate to the rachis; sori orbicular, indusium reniform, fixed by the sinus, or (not in Philippine species) wanting. A small genus very near *Nephrolepis*.

(1) *A. glabra* Copeland. Rhizome wiry, climbing 3 m. high on tree trunks, sparsely clothed with black appressed scales or their bases; stipes about 5 mm. high, articulate well above the rhizome; frond 20 to 30 cm. high, 5 to 7 cm. broad, pinnate, with a terminal pinna rather larger than the others; lateral pinnæ about 8 mm. broad, obtuse, or the upper ones subacute, obscurely crenate, slightly auricled, the upper side abruptly truncate, the lower very oblique at the base, papyraceous, glabrous, remaining green when dried; sori orbicular, in a row a little nearer the margin than the costa; indusium fixed by a very narrow sinus, persistent.

E-wi-ig River, Paragua, *Merrill* 740.

(2) *A. ramosa* (Beauv.) J. Sm. Stipes very short, scattered, on a slender, wiry, wide-creeping rhizome; frond 15 to 30 cm. long, 3 to 7 cm. broad; pinnæ 1 to 3 cm. long, 1 cm. broad, slightly crenate, the upper edge auricled and truncate, parallel with the stem, the lower oblique; texture papyraceous; rachis and both sides slightly villose, the whole plant turning blackish when dried; indusium roundish, very fugacious.

Luzon, *Cuming* 101; Basilan, *Steere*.

Africa to Samoa.

#### (12) *NEPHROLEPIS* Schott.

Fronds pinnate; pinnæ articulate to the rachis but rachis not articulate to the rhizome; sori on the back of the pinnæ, near the margin or remote from it, in a row parallel to it, reniform, varying from broadly so to orbicular. The most of our species are terrestrial with erect caudices above the ground, supported by braces which also function as roots and runners.

1. Indusium with broad sinus, opening toward apex of pinna..... (1) *N. cordifolia*
1. Indusium with deep sinus, opening obliquely toward margin.
  2. Rhizome short.
    3. Frond nearly glabrous ..... (2) *N. exaltata*
    3. Frond hirsute ... (3) *N. hirsutula*
  2. Rhizome scandent ..... (4) *N. volubilis*
1. Indusium orbicular-reniform, attached at top of sinus or sub-peltate.
  2. Rachis nearly glabrous, sori far from margin..... (5) *N. acuta*
  2. Rachis tomentose, sori near margin.
    3. Pinnæ hirsute ..... (6) *N. rufescens*
    3. Pinnæ glabrous ..... (7) *N. barbata*

(1) *N. cordifolia* Presl. Caudex suberect or oblique, the wiry fibers from it often bearing tubers; stipes tufted, wiry, 5 to 15 cm. high, naked or scaly; fronds 15 to 40 cm. long, 2.5 to 3.5 cm. broad; pinnæ close, often imbricate, obtuse, entire or nearly so, the base cordate or rounded on the lower side, with a short, sharp auricle on the upper, subcoriaceous, nearly glabrous; sori large, in a row midway between midrib and margin; indusium broad, firm, opening toward the apex of the pinnæ or somewhat obliquely.



Benguet, *Loher* (altitude, 2,500 m.), *Elmer* 6507 (form with very chaffy stipe and rachis), 6528 (very lax, serrate form, in moist ravines), *Topping* 231; Nueva Ecija, *Merrill* 240; Arayat, 800 m., *Loher*; Mariveles 1,300 m., *Merrill* 3236.

Pantropic.

(2) *N. exaltata* Schott. Stipes tufted, 10 to 15 cm. high, naked or slightly scaly; fronds 30 cm. or more long, about 10 cm. broad; pinnae close but not imbricate, the fertile linear, acute, usually subfalcate, sterile shorter and less acute, base rounded on the lower side, auricled on the upper, entire or nearly so, subcoriaceous, nearly glabrous; sori submarginal; indusium reniform with a deep sinus.

Sorsogon, *Baranda*; Rizal, *Loher*, *Marave*. A form with repeatedly dichotomous pinnules is common in cultivation in Manila.

Pantropic.

(3) *N. hirsutula* Presl. Like *N. exaltata*, except that both surfaces of the pinnae, and especially the rachis, are downy.

Bataan Island, *Baranda*; Benguet and Manila, *Loher*; cultivated in Manila.

(4) *N. volubilis* J. Sm. Rhizome scandent indefinitely, naked, pale brown, wiry, bearing small clusters of fronds at the ends of very short branches; stipes about 10 cm. long, firm, naked or nearly so; fronds 25 to 50 cm. long, 4 to 6 cm. broad, the rachis firm, sparsely chaffy on the back; pinnae about 5 mm. broad, very obtuse, nearly entire, rounded on the lower side at the base, obscurely auricled on the upper, coriaceous, glabrous, or the costa minutely squamulose above: sori near the margin; indusium reniform with a deep sinus.

Luzon, *Cuming* 37; Negros, *Cuming* 346; Davao, *Copeland* 429, common sterile in low thickets.

Himalayas to New Guinea.

(5) *N. acuta* Presl. Rhizome very short, erect, with scaly props; stipes tufted, stout, 30 to 80 cm. high, squamulose at the base, glabrescent above; fronds 80 to 120 cm. high, 30 to 40 cm. broad; pinnae 15 to 25 mm. broad, separated by less than their own breadth, acute, cuneate or more abruptly contracted at the base, sterile entire, fertile obscurely crenate, herbaceous or subcoriaceous, glabrous or nearly so; sori almost as near the costa as the margin; indusium becoming orbicular by the meeting of the two broad basal lobes. (Includes *N. macrophylla* Presl.)

Luzon, *Cuming* 22, *Steere*; Benguet, *Loher* (altitude, 2,250 m.), *Elmer* 6145; Manila, *Warburg*, *Marave*; Tayabas, *Warburg*; Sorsogon, *Baranda*; Paragna, *Merrill* 725; Basilan, *DeVore* and *Hoover* 86; Davao, *Warburg* 12757, *Copeland* 365, 629.

Pantropic.

(6) *N. rufescens* Presl. Caudex erect, stout, with numerous braces, coated with small black, appressed scales; stipes 20 to 60 cm. high, firm, brown, glabrescent; frond 60 to 100 cm. high; pinnae 10 to 15 mm. broad, acute, sterile entire, fertile more or less serrate, broadly rounded at the base on the lower side, the upper usually prominently auricled, herbaceous,



under surface, and still more the rachis, ferruginous-pubescent; sori near the margin; indusium becoming orbicular.

Cagayan-Luzon, *Warburg* 12221; Benguet, *Elmer* 6235, 6469; Topping 211; Sorsogon, *Baranda*; Manila, *Santos*, *Ramos*; Tayabas, *Merrill* 2438; Mindoro, *Merrill* 884; Davao, *Copeland* 389, 485, 589, the most characteristic plant of the edges of drier thickets.

(7) *N. barbata* Copeland. Rhizome short, suberect, with many fine supporting roots; stipes 10 to 15 cm. high, firm, sparsely scaly at the base, glabrescent above; frond rather more than 50 cm. long, 8 cm. broad; pinnae, the larger sterile ones 35 mm. long, 10 mm. broad, acute, entire, the fertile 50 mm. long, 7 mm. broad, acuminate, more or less serrate toward the apex, rounded on the lower side at the base, acutely auriculate on the upper, subarcuate, subcoriaceous, glabrous, reduced toward the base of the frond; sori near the margin; indusium orbicular, the lobes overlapping.

Todaya, Davao, epiphytic on tree trunks, *Copeland* 1286.

### (13) *OLEANDRA* Cavanilles.

Rhizome creeping or erect, branching, scaly; stipes articulate to projections from the rhizome; fronds simple and entire, lanceolate; veins free, running to the margin of the frond, sori on the backs of the veins, near the costa; indusium reniform, fixed by the sinus, firm. This genus was formerly classed with the *Aspidieæ*, and has lately been separated as constituting an isolated group. It seems to me, however, that the resemblances to various *Darallieæ*, and specially to the simple species of *Humata*—the creeping, scaly rhizome, the articulate stipe, the free, forked, closely parallel veins, the shape, attachment, and texture of the indusium, and its opening obliquely toward the apex of the frond—all these can not well be construed otherwise than as evidences of real affinity; and that, while the position of the sori may well serve as a generic character, it ought not to make us adopt a larger classification that fails to express so many characters in common.

#### 1. Rhizome woody, suberect.

2. Stipe articulate just below lamina..... (1) *O. colubrina*

2. Stipe articulate "below its middle"..... (2) *O. neriiformis*

#### 1. Rhizome creeping.

2. Paleæ squarrose ..... (3) *O. Whitmeci*

2. Paleæ appressed ..... (4) *O. Cumingii*

(1) *O. colubrina* (Blanco) Copeland. Rhizome woody, stout, suberect, branching, clothed with scales whose very narrow spreading tips are deciduous, leaving the persistent, imbricate, peltate bases, black with brown margins; stipe articulate immediately below the lamina; fronds mostly clustered, 15 to 20 cm. long, about 2 cm. broad, widening toward the upper end, then abruptly contracted and caudate, narrowed gradually toward the base, entire, the margin sometimes slightly cartilaginous under the lens, ciliate with whitish hairs, with which the surfaces are sparsely and the costa densely clothed, papyraceous; sori in an irregular row on each side of costa; indusia small, brown with white margins, firm, almost without a sinus.

Mount Mariveles, *Merrill* 3238, *Copeland* 1381, *Whitford* 248.

(2) *O. neriiformis* Cav. Rhizome woody, mostly erect, branching, clothed with appressed scales; stipe articulate below the middle—that is, longer than the outgrowth of the rhizome that bears it—fronds scattered or clustered, 20 to 40 cm. high, 2 cm. broad, narrowed gradually toward both ends, usually subcoriaceous and glabrous; indusium oblique, large enough to cover sorus. This species is construed as including Presl's *O. mollis*, with pubescent fronds, and *O. macrocarpa*, with large sori and ciliate margin.

Luzon, *Nee*, *Cuming* 94, 60 in part; Baguio, *Elmer* 6286; Davao, *Warburg* 14186.

Pantropic.

(3) *O. Whitmeei* Baker. Rhizome wide-creeping, 2 mm. thick, densely beset with squarrose paleæ 4 mm. long; stipes (including both parts) about 4 cm. high, articulate about the middle; fronds 20 to 30 cm. high, one-tenth as broad, acuminate, narrowed to the base, slightly repand, membranous, glabrous except for fine short hairs along the margin, and narrow scales 2 mm. long standing horizontally from the costa, the latter sometimes deciduous; sori large, almost orbicular, indusium membranous.

Mount Apo, *DeVore* and *Hoover* 364; *Copeland* 1055.

Samoa, Celebes.

(4) *O. Cumingii* J. Sm. Rhizome creeping, 2 mm. thick, densely clothed with appressed lanceolate-subulate scales; stipe (including both parts) about 5 cm. high, articulate below the middle; frond 20 to 30 cm. high, one-tenth as broad, lanceolate, acuminate, contracted rather abruptly at the base, subentire, with narrowly cartilaginous margin, papyraceous, costa and both surfaces slightly pubescent; indusium rough.

Luzon, *Cuming* 60 in part; Baguio, *Elmer* 6513.

India, southern China.

#### (14) HUMATA Cavanilles.

Rhizome creeping, scaly, the stipes articulate to it; sori terminal, at the margin or somewhat remote from it; indusium reniform or more elongate, fixed by its broad base. Mostly small epiphytic ferns, resembling *Davallia*, from which they are distinguished by the free sides of the (usually broader) indusium.

1. *Euhumata*; indusium thin.

2. Sterile frond entire.

3. Fertile frond entire ..... (1) *H. angustata*

3. Fertile frond lobed ..... (2) *H. heterophylla*

2. Sterile frond pinnatifid or pinnate.

3. Lowest segments not greatly enlarged ..... (3) *H. gaimardiana*

3. Lowest segments or pinnæ very large.

4. Not more than bipinnatifid ..... (4) *H. repens*

4. At least tripinnatifid.

5. Sori on the teeth of the seg-

ments ..... { (5) *H. vestita*

..... { (6) *H. Cumingii*

5. Sori almost covering segments (7) *H. botrychioides*

1. *Leucostegia*; indusium thin.

2. Frond about 2 dm. high, triangular ..... (8) *H. falcinella*

2. Frond more than 3 dm. high.

3. Sori 1 to 2 mm. wide ..... (9) *H. immersa*

3. Sori minute ..... (10) *H. hymenophylloides*

(1) *H. angustata* Wallich. Rhizome wide-creeping, scaly, stout; fronds scattered, short-stalked, about 10 cm. long and 1 cm. broad, apex acute, margin slightly and irregularly crenate, very coriaceous, glabrous or with a few scales on the costa beneath; sori in a row along the edge.

E-wi-g River, Paragua, *Merrill* 778, on rocks in forest.

Malaya.

(2) *H. heterophylla* (Desv.) J. Sm. Rhizome wide-creeping, scaly; frond shortly stalked, 6 to 10 cm. long, one-fourth as broad, glabrous, coriaceous; the sterile one ovate-lanceolate, entire or slightly lobed at the base, the fertile one narrower, deeply sinuato-pinnatifid; sori 2 to 10 to a lobe.

Maquiling, *Loher*; Samar, *Cuming* 338; E-wi-g River, Paragua, *Merrill* 763, epiphytic.

Malaya and Polynesia.

(3) *H. gaimardiana* (Gaud.) J. Smith. Rhizome wide-creeping, scaly; stipe about 1 cm. high, scaly or glabrescent; frond 10 to 15 cm. high, 3 to 5 cm. broad, ovate-lanceolate, cut down nearly or quite to the rachis into parallel, entire or crenate, linear-oblong lobes, the lowest pair of which are often deeply incised on their lower side, glabrous, coriaceous; sori oblique, in full rows between midrib and margin.

Luzon, *Cuming* 61; Gimogon River, Negros, *Copeland* 54, in tree tops in the forest.

Malaya and Polynesia.

Our plant is intermediate between *Davallia parallela* Wallich and *D. pectinata* Smith.

(4) *H. repens* (L.) J. Sm. (*Davallia pedata* Smith). Rhizome wide-creeping, scaly; stipe 5 to 10 cm. high, rather scaly; frond 5 to 10 cm. long, 3 to 5 cm. broad at the base, deltoid in general outline, cut down nearly to the rachis; upper segments linear-oblong, acute, erecto-patent, inciso-dentate, the lower pair broader, deeply inciso-pinnatifid, especially on the lower side; texture coriaceous; sori placed in rows on the teeth on both sides of the lobes.

Arayat, *Loher*, *Merrill* 3818, differs from the type in that the sterile frond is smaller and broadly lobed, and the fertile larger and more deeply incised, and the rachis very scaly; Cagayan-Luzon, *Warburg* 12219; Mount Mariveles, *Merrill* 3210, *Forestry Bureau* (Barnes) 347, *Copeland*.

India to Japan and Australia.

(5) *H. vestita* J. Sm. Rhizome wide-creeping, densely scaly; stipe about 10 cm. high, rather scaly below; frond 10 to 20 cm. long, 10 cm. broad, deltoid in outline; all except the upper pinnae cut down to a narrowly winged rachis; barren frond with the segments of all except the lower pinnae blunt, scarcely toothed; lobes of the fertile pinnae narrower, sharper toothed; of the lower ones deeply so; texture coriaceous; sori placed on the teeth of the segments.

Mount Data, 2,250 m., *Loher*; Baguio, *Topping* 199 (?).

Java, Ceylon.

(Probably a mere variety of *H. repens*.)

(6) *H. Cumingii* (Hook.). Rhizome creeping, scaly; stipe 10 cm. high, both it and the rachis rather scaly; sterile frond about 3 cm. each way, deltoid-cordate, cut down nearly to the rachis; upper pinnae blunt, slightly toothed, the lower pair deeply pinnatifid below; texture coriaceous; fertile frond 10 to 12 cm. long, 8 cm. broad, the same shape, but much more divided; lowest pinnules deeply pinnatifid with sharply toothed lobes; sori placed in the teeth of the segments.

Samar, *Cuming* 138.

(7) *H. botrychioides* J. Sm. Rhizome wide-creeping, scaly; stipe 5 to 10 cm. high, scaly below; frond 6 to 20 cm. long, 5 to 10 cm. broad, deltoid in general outline, decidedly dimorphous, the barren ones with a narrowly-winged rachis; lower pinnae cut down nearly to the rachis, with deep bluntly-toothed segments; fertile pinnae much more finely divided; pinnules of the lower pinnae cut down to a narrow rachis with narrow sharply-toothed segments almost covered with sori.

Tonglon, 2,000 m., *Loher*; Baguio, *Elmer* 5843.

Aneiteum and Fiji.

This and the preceding three species are decidedly too near together. A fern differing from *H. botrychioides* in being less divided grows on Mount Apo, Mindanao (*Copeland* 1030).

(8) *H. falcinella* (Presl). Rhizome wide-creeping, thickly beset with stiff, spreading hairs, ferruginous, turning toward black; stipe 5 to 10 cm. high, glabrous, as is the frond; fronds about 13 cm. high, 10 cm. broad, deltoid, tri- or quadripinnatifid; main rachis slightly winged; lowest pinnae inequilateral; pinnules oblong, cut down nearly to the rachis into segments which are again deeply toothed, ultimate segments of the fertile frond falcate-mucronate, of the sterile frond broader and not so sharp; texture subcoriaceous; sori 2 to 6 to a lobe, placed at the bases of the teeth; indusium thin.

Leyte, *Cuming* 304; Gimogon River, Negros, *Copeland* 72; epiphytic in forest.

This fern has the aspect of *Eudavallia* and the paleæ of *Microlepia*.

(9) *H. immersa* (Wall.) Diels. Rhizome hypogaeous, wide creeping, stout, fibrillose; stipe 10 to 20 cm. high, erect; frond 30 to 45 cm. long, 15 to 25 cm. broad, deltoid, tripinnate; lowest pinnules lanceolate-deltoid, 5 to 8 cm. long, with broad segments, which are obliquely truncate at the base below, and roundly lobed, with the lobes again crenate above; texture herbaceous; sori large (2 mm. broad), 1 to 6 to a segment, oblique.

Tonglon, 2,250 m., *Loher*, a large form; Baguio, *Topping* 246, 256, 304; *Elmer* 5908. Mount Apo, Mindanao, *DeVore* and *Hoover* 322 (?).

India and Java.

(10) *H. hymenophylloides* (Bl.) (*Davallia affinis* Hook.). Rhizome thick, densely clothed with sharp-pointed ferruginous scales; stipe 10 to 25 cm. high, erect, strong; frond 30 to 60 cm. long, 15 to 30 cm. broad, deltoid-lanceolate, tri- or quadripinnate; lower pinnules with oblong

rhomboidal lobes, the segments of which are deeply and finely incispinnatifid with sharp teeth; texture herbaceous; sori 2 to 6 to a segment, small, placed at the base of the teeth.

Baguio, *Loher*, a large form, with narrow lobes; *Topping* 307 ?.

*Cuming's* 117 and 215 (*Microlepia tenuifolia* Presl), from Luzon, are probably both this species.

(15) **SACCOLOMA** Kaulfuss.

Rhizome creeping, scaly, stipe not articulate to it; frond (in our species) finely dissected; sori near, not on, the margin, small, numerous; indusium short, attached by the broad base, thin. Our species is a large terrestrial fern.

**S. moluccanum** (Bl.) Mett. Rhizome creeping, clothed with large pale-brown scales; stipe erect, about 3 dm. high, sparsely scaly; frond 6 to 10 dm. high by half as broad, quadripinnatifid, deltoid; pinnae lanceolate; the segments of the pinnules cut down to the rachis into broadly toothed, oblong lobes; texture membranous or subcoriaceous, both surfaces naked or nearly so; sori small, in the teeth, near the base.

Benguet, *Loher* 49, *Elmer* 6289.

Malaya and Polynesia.

(16) **DAVALLIA** Smith.

Rhizome short or creeping, scaly, the stipes articulate to it; sori at or very near the margin; indusium usually elongate, attached at the base and sides, the margin of the frond often so modified as to resemble it. Mostly epiphytic ferns. The two sections would better be treated as separate genera.

1. *Prosaptia*; fronds elongate, pinnatifid or simply pinnate.
  2. Frond narrowly linear ..... (1) *D. exaltata*
  2. Frond not narrowly linear.
    3. Segments lobed ..... (2) *D. contigua*
    3. Segments nearly entire ..... (3) *D. alata*
1. *Eudavallia*; fronds deltoid, at least tripinnatifid (except *D. wagneriana*).
  2. False veins present between the true ones.
    3. Sori flanked by prominent teeth ..... (4) *D. epiphylla*
    3. No prominent teeth ..... (5) *D. elegans*
  2. No false veins.
    3. Sori marginal.
      4. Paleæ of rhizome brown ..... (6) *D. solida*
      4. Paleæ whitish ..... (7) *D. bullata*
    3. Sori not reaching the margin.
      4. Distinctly deltoid ..... { (8) *D. decurrens*
      4. Lowest pinnae not enlarged ..... { (9) *D. divaricata*
      4. Lowest pinnae not enlarged ..... (10) *D. wagneriana*

(1) **D. exaltata** Copeland. Rhizome short, densely invested with linear brown chaff; fronds sessile, crowded, pendent, half a meter long and less than a centimeter wide, the lower third sterile, pinnatifid almost to the rachis, the lower segments reduced; segments inequally triangular, coriaceous, obtuse, plane, glabrous; veins invisible; sori solitary in the apices of the segments.



Mount Apo, Mindanao, *Copeland* 1006, on tree trunks, in the mossy forest, at an altitude of 1,800 m.

(2) **D. contigua** Swartz. Fronds tufted, sessile or nearly so, 30 to 45 cm. long, about 3 cm. broad, linear-lanceolate, cut down nearly or quite to the rachis into numerous linear-acuminate or bluntish, slightly-toothed lobes; texture coriaceous; sori 1 to 8 to a lobe, placed in the teeth on their upper part.

Luzon, *Cuming* 216; Benguet, *Elmer* 6275; Davao, *Copeland* 1013, *DeVore and Hoover* 335.

Ceylon to Polynesia.

(3) **D. alata** Bl. (*D. Emersoni* Hk. and Gr.) Rootstalk erect, short, scaly; fronds tufted, sessile, 20 to 30 cm. high, 3 cm. wide at the widest part, linear-lanceolate, cut more than half way down to the rachis into numerous linear-oblong, or at the lower part triangular, lobes; texture coriaceous, minor veins invisible; sori 1 to 8, placed round the edge of the lobes.

Mount Mariveles, *Topping*.

India, to Borneo.

(4) **D. epiphylla** Bl. Rhizome thick, fibrillose; stipe 10 to 50 cm. long, erect, firm; frond variable in size, deltoid-lanceolate, tri-quinque-pinnatifid; main rachis hardly at all winged; pinnules of the lowest pinnae lanceolate, segments narrow, mucronate, sharply toothed; texture coriaceous; veins not immersed, one or two carried into each tooth; sori small, submarginal, half-cupshaped, with the sharp mucro of the tooth extending beyond them.

Davao, *Warburg* 14138, *Copeland*.

Java and Malay Peninsula.

Not sufficiently distinct from *D. elegans*.

(5) **D. elegans** Swartz. Rhizome stout, creeping, densely clothed with woolly fibrous scales; stipe stout, 10 to 50 cm. high, brown; frond 30 to 60 cm. high, two-thirds as wide, deltoid tri- to quinquepinnatifid; main rachis slightly winged toward the apex; ultimate segments oblong-deltoid or narrower, themselves usually toothed, inaequilateral; texture coriaceous; venation prominent, irregular, with false veins free at both ends between the true ones; sori several to a segment, marginal but exceeded by the teeth; indusium half-cupshaped.

Luzon, *Cuming* 77; Benguet, *Elmer* 6385; Gimogon River, Negros, *Copeland* 69; Capiiz, Panay, *Copeland*.

Madagascar across Polynesia.

Very variable in size and the degree of dissection of the frond. Epiphytic and terrestrial.

*D. elata* Sw. is a larger and less coriaceous form of this species, with finer divisions.

(6) **D. solida** Swartz. Rhizome stout, densely clothed with adpressed scales or fibers; stipe 10 to 15 cm. high, strong, erect; frond 30 to 60 cm. long, deltoid, tripinnatifid; apex with a moderately broad undivided center; segments ovate-rhomboidal, deeply toothed, narrower and sharper



in fertile frond; veins uniform; texture coriaceous; sori nearly or quite marginal; involucre semicylindrical.

Cagayan-Luzon, *Warburg* 12203; Mount Mariveles, *Merrill* 3715.

Malaya and Polynesia.

**D. solida** var. **caudata** Cav. (as species); pinnules more divided with narrower segments.

Baguio, *Topping* 272, *Elmer* 6005.

(7) **D. bullata** Wallich. Rhizome creeping, stout, densely clothed with light-brown or whitish fibrillose scales; stipe about 10 cm. high, erect, strong; frond 15 to 20 cm. long, almost as broad, deltoid, tri-quadrifid; pinnules of the lower pinnae lanceolate, 5 to 8 cm. long, with deeply inciso-pinnatifid oblong-rhomboidal segments; texture coriaceous; sori deeply half-goblet shaped, occupying the greater part of the tooth in which they are placed, marginal, with usually a horn on the outside.

Benguet, *Loher*, *Elmer* 6490—epiphytic on *Pinus*, fronds purplish.

India to Korea and Celebes.

(8) **D. decurrens** Hooker. Rhizome stout, creeping, densely fibrillose; stipe 10 to 15 cm. high, stout, erect; frond 30 to 60 cm. long, deltoid, tripinnatifid; main rachis hardly at all winged at the apex; pinnules of the lower pinnae lanceolate-acuminate, 10 cm. long, 2 to 3 cm. broad, cut down throughout within a short distance of the rachis, with broadly-toothed linear-oblong segments; texture subcoriaceous; veins uniform; sori falling short of the margin; involucre half-cupshaped.

Philippines.

Resembles *D. divaricata* in the shape and position of the sori, but the frond less divided.

(9) **D. divaricata** Bl. Rhizome creeping, stout, clothed with linear ferruginous scales; stipe 15 to 30 cm. high, firm, erect; frond 60 to 90 cm. long, tripinnatifid; lower pinnae often 30 cm. long by 15 cm. broad; segments deltoid, cut down to the rachis in the lower part, with linear-oblong, sharply toothed lobes; texture coriaceous; veins uniform, not conspicuous; sori half-cupshaped, placed obliquely as regards the central veins in the teeth at some distance from the edge.

Montalban, *Loher*; Davao, *Warburg* 14137.

India to Hongkong and Java.

Best distinguished from *D. solida* and *D. elegans* by the position of the sori.

(10) **D. wagneriana** Copeland. Rhizome stout, scandent, densely clothed with lanceolate, acuminate, appressed brown scales; stipe stout, scaly near the base, glabrous above, as is the thick, slightly winged rachis; frond 20 to 25 cm. high, 10 to 15 cm. broad, glabrous, coriaceous, tripinnatifid at the base only, the fertile narrower than the sterile; the lowest pinnae not larger than the succeeding, with a few distinct, deeply toothed equal pinnules at the base of each, followed by broadly linear, acutely toothed segments; sori usually a little deeper than broad, only rarely reaching the margin.

Todaya, Davao, 1,100 m., *Copeland* 1300; epiphytic in the crown of high trees.

## (17) MICROLEPIA Presl.

Rhizome creeping, hairy, stipes not articulate to it (exc. *M. ciliata*); sori near the margin; indusium usually as broad as long, fastened at the base and sides. Terrestrial and epiphytic ferns of various aspect. As construed here, the genus includes *Wibelia* Bernh. (*M. pinnata* and its varieties).

1. *Davallodes*; fronds seriate, stipes jointed to rhizome..... (1) *M. ciliata*
1. *Wibelia*; fronds clustered, tracheides present in specialized receptacles of sorus ..... (2) *M. pinnata*
1. *Eumicrolepia*; no tracheides in receptacle, fronds seriate, not jointed to rhizome.
  2. Indusium as long as broad, or longer.
    3. Pinnules bluntly toothed ..... (3) *M. strigosa*
    3. Pinnules of lower pinnae incised nearly to rachis ..... (4) *M. rhomboidea*
  2. Indusium broader than long.
    3. Frond glabrous.
      4. Small, pinnules crenately lobed ..... (5) *M. philippincensis*
      4. Large, pinnules cut nearly to rachis..... (6) *M. platyphylla*
    3. Frond not glabrous ..... (7) *M. Spelunceæ*

(1) *M. ciliata* (Hk.). Rhizome creeping, covered with soft, brown hairs; stipe 10 cm. high, firm, erect, pubescent; frond 30 to 45 cm. long, half as broad, ovate-lanceolate, tripinnatifid; pinnae spreading, lanceolate, the central ones the largest, 10 cm. or more long, 2 to 4 cm. broad, cut down to a broadly winged rachis, with oblong pinnules cut about half way down with falcate, mucronate teeth; texture thinly herbaceous, flaccid; rachises and under surface softly hairy; sori 2 to 12 to a pinnule, very small, placed near the center of the teeth near the base.

Luzon, *Cuming* 174; Arayat 800 m., *Loher*. Todaya, Davao, 1,100 m., *Copeland* 1273.

(2) *M. pinnata* Cav. Rhizome creeping, fibrillose; stipe nigrescent and squamulose toward the base, strong, erect, 15 to 25 cm. long; frond 20 to 40 cm. long, 10 to 20 cm. wide, with distant linear slightly toothed pinnae 10 to 15 cm. long, 6 to 8 cm. broad; texture coriaceous; sori one to each tooth, small submarginal.

"Philippines," *Née, Meyen*; Luzon, *Cuming* 139; Mount Mariveles, *Loher*, *Warburg* 14183.

Malaya and Polynesia.

Warburg's Davao plant is described as epiphytic. The Mariveles specimens are terrestrial, with rhizomes so short the fronds are clustered.

*M. pinnata* Cav. var. *gracilis* (Bl.) (*Davallia Luzonica* Hk.) Lower pinnae tripinnatifid, deltoid; sometimes bipinnate throughout. Intermediate forms occur.

Davao, *Loher*, *Warburg* 14137; Mount Mariveles, *Merrill*, 3213; *Copeland*.

(3) *M. strigosa* (Sw.) Presl. Rhizome stout, creeping, pubescent; stipe erect, strong, 15 to 30 cm. high, both it and the rachis pubescent throughout; frond 30 to 100 cm. long, 15 to 30 cm. broad, lanceolate, bipinnatifid; lower pinnae 10 to 20 cm. long, 2 cm. broad, linear-lanceolate, much acuminate, cut down to the rachis with unequal-sided, broadly and

rather bluntly toothed, oblong, rhomboidal pinnules; texture subcoriaceous; veins beneath prominently raised and, like the rachises, more or less hairy; sori 2 to 12 to a pinnule, small, placed at the base of the sinuses.

Luzon, *Cuming* 95; Tonglon, 2,250 m., *Loher* 46.

India to Hawaii and Fiji.

(4) *M. rhomboidea* (Wall.) Presl. Different from *M. strigosa*, of which it is placed as a variety in Synopsis Filicum, in being larger throughout, the lower pinnules lanceolate-deltoid, 4 cm. long, cut down nearly to the rachis into oblong lobes.

Baguio, *Loher*.

India.

(5) *M. philippinensis* Harrington, Journ. Linn. Soc. 16:27 (1878). Caudex clothed thickly with narrow rufous scales; stipe about 15 cm. high, dark brown, with a few scales below like those of the caudex, glabrous above; frond deltoid, 8 to 20 cm. long, with about the same width; rachis glabrous; lower pinnae deltoid and again pinnate, the upper becoming simple, at the apex confluent; pinnules linear, crenately lobed, with the divisions extending halfway to the midrib; the first pinnules on the lower side much larger than the others; texture coriaceous; surface glabrous; venules immersed, ascending; involucre decidedly intramarginal, broader than deep. (Near *D. amboynensis* Baker.)

Mount Majayjay, Luzon, *Steere*.

(6) *M. platyphylla* (Don.) J. Sm. Rhizome creeping, stout, scaly; stipe 60 to 100 cm. high, firm, erect; frond 1 m. long, tripinnatifid; lower pinnae 30 to 40 long, 15 to 25 cm. broad, with distant linear lanceolate pinnules, which are cut nearly to the rachis below into broad, bluntish, toothed, oblong-deltoid lobes; texture subcoriaceous, both surfaces naked; sori 2 to 12 to a segment, placed one in each tooth a short distance from the edge, about 2 mm. across.

Baguio, *Loher* 43.

Ceylon to the Himalayas.

(7) *M. speluncae* (L.) Moore. Rhizome horizontal; stipe strong, 3 to 10 dm. high, stramineous, minutely squamulose; frond 1 to 2 m. high, half as broad, deltoid, usually quadripinnatifid; lower pinnae, ovate-lanceolate; pinnules lanceolate, cut down to a winged rachis into toothed or pinnatifid lobes, the lowest lobe on the upper side the largest; texture herbaceous; rachis and pinnules hairy, and indusia ornately so; veins conspicuous; sori at the base of the teeth.

Benguet, *Loher*, *Elmer* 6431; Province of Isabela, *Warburg* 11625; Montalban, *Warburg* 12753; Tanay, Rizal, *Ramos*; Sampaloc, Tayabas, *Warburg* 12763; Malita, Davao, *Copeland* 665; Culion, *Merrill* 485.

Around the Tropics.

#### (18) ODONTOSORIA Presl.

Rhizome short; stipes therefore clustered, not articulate to the rhizome; fronds at least bipinnate; ultimate divisions (in our species) cuneate; sori terminal, at or very near the truncate apex of the segment; indusium fixed by the base and sides. Two confused species. Normally terrestrial.

(1) *O. chinensis* (L.) J. Sm. (*Lindsaya tenuifolia* (Sw.) Christ.) Rhizome stout, creeping, densely fibrillose; stipe stout, erect, polished, naked, dark brown, 15 to 30 cm. high; frond 30 to 45 cm. long, half as broad, ovate, quadripinnatifid; lower pinnae ovate-lanceolate, 10 to 15 cm. long, half as broad; pinnules lanceolate, their segments cut down to the rachis below with toothed cuneate lobes, texture subcoriaceous, both surfaces naked, the upper shining; sori terminal, usually solitary, often rather broader than deep.

Tonglon, 1,500 m., and Filad, 1,200 m., *Loher* 61; Sampaloc, Tayabas, *Warburg* 12762, Nueva Ecija, *Merrill* 203.

Madagascar to Japan and Polynesia.

(2) *O. retusa* (Cav.) J. Sm. Stipes strong, erect, not prickly or climbing; frond tripinnatifid; lower pinnae 30 to 40 cm. long, 15 to 20 cm. broad; pinnules lanceolate-deltoid, the lower segments the same shape, 5 cm. long, 2 cm. broad, cut down to the rachis below, cuneate; texture herbaceous; sori narrow, marginal, occupying the whole breadth of the lobes.

Sampaloc, Tayabas, *Warburg* 12761; Limutan, Morong, *Loher* 62; southern Luzon, *Baranda* 15; Benguet, *Elmer* 5917, 6004, *Topping* 334, 289; Davao, *Copeland* 970 and 1260.

To New Caledonia.

#### (19) DENNSTAEDTIA Bernhardt.

Rhizome hairy, the stipes not articulate to it; fronds at least bipinnate; sori marginal; indusium united with the margin of the frond to form a sharply differentiated globose receptacle. Rather large ferns, superficially resembling *Dicksonia*, and formerly included under it.

1. Rachises not prickly.

2. Sori at bottom of sinuses.

3. Lower surface tomentose-glandular ..... (1) *D. Smithii*

3. Frond glabrous ..... (2) *D. cuneata*

2. Sori on ends of teeth.

3. Rhizome creeping, frond tripinnatifid ..... (3) *D. scabra*

1. Rachises prickly, rhizome scandent..... (4) *D. scandens*

(1) *D. Smithii* (Blk.) Christ. Frond tripinnate; lower pinnae 3 dm. long, 1 dm. broad; pinnules linear-acuminate, their divisions distinct, rather distant, narrow, acute, the lower ones 12 mm. long, 4 mm. broad, slightly inciso-pinnatifid; rachises and under surfaces densely tomentose-glandular; texture subcoriaceous; sori 2 to 8 to a segment; receptacle subglobose, cupshaped, 0.5 mm. across.

Luzon, *Cuming*; Rizal, *Loher*; Davao, *Warburg* 14134. *DeVore* and *Hoover* 333, from Davao, is probably this species, but has the segments of the pinules obtuse.

Java, Formosa.

(2) *D. cuneata* (Blk.) Christ. Frond ample, subdeltoid, quadripinnatifid; rachises stramineous, naked; pinnae lanceolate, 15 to 30 cm. long; pinnules close, short-stalked, lanceolate, 1 cm. broad; segments oblong-rhomboid, 2 to 4 mm. broad, inciso-pinnatifid, cuneate at base, sessile, more cut away on lower side; texture moderately firm; both sides green,

glabrous; veins subflabellate; sori at base of ultimate sinuses; receptacle cup-shaped, glabrous.

Luzon, *Cuming* 231; Mount Arayat, *Loher*.

Batjan.

(3) **D. scabra** (Wall.) Moore. Rhizome wide-creeping; stipe 30 cm. high, scabrous; frond 25 to 80 cm. high, deltoid or lanceolate, bipinnate; pinnae lanceolate; pinnules quite distinct, the lower ones cut down nearly to the rachis into numerous pinnatifid oblong deltoid segments, herbaceous or subcoriaceous; rachis and both surfaces more or less hairy; sori 2 to 6 to the lower segments; receptacles cup-shaped, subglobose.

Bagnio, *Loher*.

India to Celebes and Japan.

(4) **D. scandens** (Bl.) Moore. Rhizome scandent; fronds sometimes several meters long, growing indefinitely at the apex, climbing by means of their prickly rachises, tripinnate, with the segments bearing broad teeth, flaccid; sori small, placed in the sinuses.

Davao, *Warburg* 14160.

Malaya and Polynesia.

#### (20) **MONACHOSORUM** Kuntze.

Rhizome short; stipes therefore clustered, not articulate to the rhizome; frond large, finely dissected; sori a little below the tips of the veins, indusium wanting. The Philippine species is a fairly large terrestrial fern, of very doubtful affinity.

(1) **M. subdigitatum** (Bl.) Kuhn. Stipes tufted, firm, 20 to 50 cm. high, stramineous, glabrescent; frond 45 to 60 cm. high, hardly as broad, quadripinnate; pinnae horizontal, the lowest 20 to 30 cm. long, 10 to 15 cm. broad; pinnules lanceolate, their segments cut down in turn to their rachis into divisions which in the lowest part of the frond are deeply bifid, pellucido-herbaceous, dark green, turning back in drying, glabrous; vein one in each ultimate segment, not reaching the margin; each vein bearing one sorus below its apex.

Davao, *Warburg* 14178, *DeVore* and *Hoover* 323, *Copeland* 1032, 1143.

India, Malaya.

#### (21) **SCHIZOLOMA** Gaudichaud.

Fronds in the Philippine species tufted, pinnate; pinnae not dimidiate; veins free; sori forming a continuous submarginal line, protected by the more or less inflexed margin and the continuous extrorse indusium. Our first species, not hitherto known from the Philippines, has the aspect of an *Asplenium*, and in its fructification is strikingly like *Vittaria*, to which genus it was first referred; its nearest relatives are probably in *Lindsaya*.

(1) **S. divergens** (Wall.) Diels. Stipes erect, about 10 cm. high, black, polished; frond 15 to 30 cm. high, 3 to 4 cm. broad; pinnae close, horizontal, except the lower ones which are strongly deflexed and much reduced, lanceolate, obtuse, entire, obliquely truncate on the lower side



and obtusely auricled on the upper at the base, subcoriaceous, glabrous; veins inconspicuous, forked, costa wavy; sorus slightly interrupted, or continuous around both sides and the apex.

E-wi-g River, Paragna. *Merrill* 769.

Malaya.

(2) *S. heterophyllum* (Dry.) J. Sm. Rhizome short, creeping, clothed with fine, brown scales; stipes clustered erect, 5 to 15 cm. high, naked, green above; frond 10 to 20 cm. high, pinnate and lanceolate or bipinnate and deltoid; pinnae semiorbicular and fixed by the middle of the straight side with radiate venation and continuous submarginal indusium around the upper side, or triangular with indusium along two sides, or trapezoidal with usually continuous indusium along upper and outer sides, outer aeropetal angle rounded or acute, margin entire or finely toothed, papyraceous, glabrous; veins free except in sorus, or anastomosing more freely. An exceedingly variable fern, some of whose forms are hardly distinguishable from *Lindsaya*.

Luzon, *Cuming* 275; Mount Mariveles, *Copeland* 1375, *Whitford* 1162, *Topping* 351.

Mauritius to Honkong and Malaya.

## (22) *LINDSAYA* Dryander.

Rhizome short or creeping, stipes not articulate to it; fronds at least pinnate; the lower half of each pinna (or pinnule) almost or quite undeveloped, the "midrib" therefore running along the entire lower margin; sori along or near the upper margin; indusia fixed by the base. Small ferns, terrestrial or epiphytic, superficially resembling *Adiantum*.

### 1. Veins free.

#### 2. Fronds once pinnate.

#### 3. Upper edge of pinnae entire or lobed less than half way to costa.

#### 4. Rhizome stout and scandent.

#### 5. Simple sori about as deep as broad.

6. Upper margin, of pinna entire or lobed ..... (1) *L. repens*

6. Pinna cleft nearly to rachis ..... (2) *L. hymenophylloides*

#### 5. Sori narrow.

6. In an unbroken line .... (3) *L. scandens*

6. In a broken marginal line ..... (4) *L. pectinata*

6. Submarginal in the lobes.. (5) *L. Merrillii*

#### 4. Rhizome not stout and scandent.

#### 5. Pinnae less than 1 cm. long.

6. Frond very narrowly linear ..... (6) *L. gracillima*

#### 6. Frond not narrowly linear.

7. Stipe flexuous, pinnae somewhat auricled ..... (7) *L. ovata*



- 7. Pinnæ not auricled.
  - 8. Lamina very thin ..... (8) *L. concinna*
  - 8. Lamina subcoriaceous .. (9) *L. montana*
- 5. Larger pinnæ more than 1 cm. long.
  - 6. Upper edge of pinnæ very shallowly lobed ..... (10) *L. cultrata*
  - 6. Lobed one-third of way to costa ..... (11) *L. adiantoides*
  - 3. Pinnæ deeply bifid ..... (12) *L. loheriana*
  - 3. Pinnæ repeatedly cleft to the costa.
    - 4. Rhizome stout ..... (2) *L. hymenophylloides*
    - 4. Rhizome filiform ..... (13) *L. capillacea*
- 2. Fronds when fully developed bipinnate.
  - 3. Upper edge of pinnules entire, pinnules deep ..... (14) *L. lancea*
  - 3. Shallowly lobed ..... (15) *L. rigida*
  - 3. Cleft nearly to the winged costa..... (16) *L. triquetra*
  - 3. Cleft to the filiform costa..... (17) *L. blumcana*
  - (Diels puts the preceding two species in the next section.)
  - 1. Veins anastomosing; *Synaphlebium*.
    - 2. Anastomoses well below the sori.
      - 3. Pinnæ dimidiate at base only ..... (18) *L. Sarasinorum*
      - 3. Dimidiate throughout.
        - 4. Lobed one-third of depth ..... (19) *L. davallioides*
        - 4. Almost entire ..... (20) *L. lobata*
    - 2. Anastomoses in the sori only.
      - 3. Rhizome stout ..... (21) *L. apoensis*
      - 3. Rhizome filiform ..... (22) *L. pulchella*

(1) ***L. repens*** (Desv.) Christ (*Davallia* Desv., H. and B.). Rhizome wide-creeping, paleaceous, climbing; frond simply pinnate, 20 to 45 cm. long, 2 to 4 cm. wide; pinnæ 1 cm. long, about half as broad as deep, the lower line slightly curved, oblique at base, the upper rounded, nearly entire or crenately lobed; texture pellucido-herbaceous; sori marginal, large, about as broad as deep, often confluent in the not crenate form.

Luzon, *Haenke*, *Cuming* 50; Mount Mariveles, 1,400 m., *Loher* 59; Davao, *Warburg* 14109 and 14182.

India and Mauritius across Polynesia.

Very variable in size.

(2) ***L. hymenophylloides*** Blume. Rhizome scandent, 1 to 1.5 mm. thick, paleaceous; frond sessile, simply pinnate, larger ones 20 cm. long, 2.5 cm. wide; pinnæ 15 mm. long, 6 mm. deep, cut down to a winged costa into linear-cuneate, entire or forked segments, each bearing 1, or rarely 2, roundish sori; texture membranaceous, entire frond glabrous.

Mount Mariveles, *Merrill* 3220, *Copeland* 229, at 1,200 m. altitude.

Java and New Caledonia.

Regarded by Hooker and Baker as probably a variety of *L. repens*. Put by Diels into § *Synaphlebium*; but our material has free veins.

(3) ***L. scandens*** Hooker, Sp. Fil. I p. 205 t. 63 B. Rhizome stout, wide-creeping, scandent, paleaceous; frond 20 to 30 cm. long, 4 cm. broad,

simply pinnate; pinnae 2 cm. long, 12 mm. broad, the lower line slightly decurved, the upper rounded, entire, the point broadly rounded, placed in a long row close together, but not imbricate; texture pellucido-herbaceous; costa marginal; sori in a continuous marginal line.

Philippines, *Cuming*; Mount Dagatpan, Davao, *Warburg* 14142.

Malay Peninsula.

Said to be sometimes bipinnate, but very doubtfully distinct from *L. pectinata*. The two characterized by the stout scandent rhizome.

(4) *L. pectinata* Blume. Rhizome stout, scandent, paleaceous; stipe erect, very short; lower fronds 50 cm. long, 3 cm. broad, simply pinnate; pinnae 15 mm. long, 6 mm. deep, the lower line nearly straight, the upper margin round, slightly crenate, the point blunt, close together but not imbricate; texture pellucido-herbaceous; sori in an interrupted line along the upper edge.

Luzon, *Cuming* 186; Maquiling, *Loher* 60; Gimogon River, Negros, *Copeland* 53.

Assam and Malay region.

Habit of *L. (Odontoloma) repens*. Beside the typical fronds, old rhizomes produce finely dissected, much smaller sterile ones, resembling those of *Asplenium epiphyticum* and *Stenochlaena (Teratophyllum)*, or the fertile fronds of *L. capillacea*.

(5) *L. Merrilli* Copeland. Rhizome stout, scandent, shining, sparsely clothed with spreading ferruginous paleae; stipe 2 to 5 cm. high, stout, slightly scaly, at the top, straw-color, like the rachis; frond about 80 cm. long, 4 cm. wide, pinnate; lower pinnae stalked, the larger ones 22 mm. wide by 9 mm. deep next the rachis, dimidiate, the base strongly drawn down, making the pinnae deepest there, apex usually acute, lower margin entire, upper inciso-crenate; glabrous, membranaceous; veins free; sori wider than deep, the acute tips of the lobes projecting over them.

Baco River, Mindoro, *Merrill* 1774, on tree trunks in moist forest; Sablan, Benguet, *Elmer* 6124.

(6) *L. gracillima* Copeland. Rhizome short; stipes densely tufted, erect brown, almost smooth, 5 cm. high; frond narrowly linear, about 320 by 9 mm., pinnate, glabrous; pinnae stalked, triangular or rhomboidal, 4 mm. wide, 3 mm. deep, lower margin straight, upper rounded, entire, or when sterile crenate, the lowest pinnae minute; texture herbaceous; veins free, flabellate; sori marginal, more often continuous.

Caraballo Sur, Luzon, *Merrill* 287, on shady ground, altitude, 800 m.

(7) *L. ovata* J. Sm. Rhizome short-creeping; stipe 5 to 8 cm. high, wiry, flexuose, black; frond 10 to 15 cm. long, 2 cm. broad, simply pinnate; pinnae 8 mm. long, 4 mm. deep, not imbricate, the lower ones with their own breadth between them, horizontally oblong, the point very blunt, the lower side obliquely truncate at the base, the upper slightly auricled; texture subcoriaceous; sori in a continuous marginal line.

Luzon, *Cuming* 175.

(8) *L. concinna* J. Sm. Rhizome short-creeping; stipe 1.5 to 7 cm. long, wiry, erect; frond 10 to 30 cm. long, 12 to 17 mm. broad, simply pinnate; larger pinnae 7 mm. long, 4 mm. deep, very blunt on the outer

edge, the upper edge very slightly crenate, the upper ones close together, but scarcely imbricate; texture pellucido-herbaceous; sori in a continuous or slightly interrupted line along the upper edge.

Luzon, *Cuming* 198; Tonglon, *Loher* 51; Gubat, *Baranda* 18, Lamao River, Bataan Province, *Merrill* 3779, *Copeland* 271, 231, 228 (with remote pinnae), Gimogon River, Negros, *Copeland* 67, 52 (pinnae imbricate).

Borneo.

Baker says this is merely a variety of *L. cultrata*.

(9) *L. montana* Copeland. Rhizome very short-creeping; ferruginous-scaly; stipes 1 to 3 cm. high, tufted, slender, flexuous, red brown below, upward becoming straw color and almost glabrous, like the rachis; frond 3 to 6 cm. high, 1.5 cm. broad, pinnate; pinnae stalked, 9 mm. broad, 6 mm. deep, the lower ones very deflexed, their lower margin reflex-arcuate, upper margin round, entire or incised, general shape semiorbicular, upper pinnae smaller, ascendent, with acute bases; texture coriaceo-membranaceous; veins free, flabellate; sori submarginal, usually continuous.

Mount Mariveles, altitude, 1,100 m., *Copeland* 230, terrestrial.

Different from *L. concinna* in the much shorter fronds, and deflexed, firmer, and much deeper pinnae.

(10) *L. cultrata* Swartz, Syn. 119. Rhizome short-creeping; stipe 3 to 6 cm. long, wiry, flexuose, rich brown: frond about 20 cm. long, about 2 cm. broad, simply pinnate; largest pinnae 12 mm. long, 6 mm. deep, not imbricate, the lower margin straight or slightly curved, usually upwards, the upper edge slightly lobed, so that the continuity of the line of the fructification is broken, sometimes nearly entire, pinnae stalked; texture coriaceo-membranaceous.

Luzon, *Cuming* 65, 243; Davao, *Loher* 50; *Copeland* 1268; Hinay-Gate, *Baranda* 19; Benguet, *Topping* 197, 308.

Madagascar and Himalayas to Queensland and perhaps Japan.

*L. cultrata* Sw. var. *varia* Copeland. Differs from the type in the much shorter frond and stipe, membranous texture, and very variable form of the pinnae.

Baguio, on rocks along streams, apparently common, *Elmer* 6003, *Topping* 191, 198.

(11) *L. adiantoides* J. Sm. (*L. humilis* Kuhn). Stipes nearly tufted, black, polished, wiry, 2 to 5 cm. high; frond 10 to 15 cm. long, about 2 cm. broad, simply pinnate; pinnae 1 cm. long, 6 mm. deep, the upper imbricate, the lower edge straight or slightly curved, the upper rounded and broadly lobed about one-third of the way down; texture pellucido-herbaceous; sori marginal in the lobes.

Camarines Sur, *Cuming* 176; southern Luzon, *Baranda* 17.

Java.

(12) *L. loheriana* Christ, Bull. Herb. Bois. 6(1898):144. Rhizome short-creeping, firm; stipes 2 cm. long, fasciculate, terete, slender but firm and erect, base purple; frond 12 cm. long, 1 cm. wide, lanceolate-acuminate, simply pinnate; pinnae alternate on 2 mm. long petioles, 5 mm. long, triangular-cuneate, lower edge entire, upper deeply bifid; lobes broadly cuneate, with evident, forked, free veins; sori terminal, single

or double, the width of the lobe; indusium inflated; texture moderately firm; color yellowish, stipe stramineous.

Baguio, *Loher* 56.

Habit of a small and simple form of *L. viridis* Col.

(13) *L. capillacea* Christ, Bull. Herb. Bois. 6(1898):144. Rhizome filiform, creeping and intertwined; stipe 15 mm. long, filiform, fuscous, rachis green; frond 1 dm. long, 1 cm. wide, linear-lanceolate, acuminate, weak, flaccid, subbipinnate; pinnae alternate, 5 mm. long, oblong-triangular, lower edge entire with costa close to it, upper edge incised almost or quite to the costa into 3 or 4 erect segments which are linear, narrowed upward, the lower segments forked; sori small, terminating the segments, flanked on each side by acute teeth.

Maquiling, 600 to 1,000 m.; *Loher* 57; Baguio, *Elmer* 6020.

The dissected sterile fronds adventive on old rhizomes of *L. pectinata* resemble this plant.

(14) *L. Lancea* (L.) Christ (*L. trapeziformis* Dry.). Rhizome short-creeping; stipe strong, erect, 14 cm. long, green except at base; frond 10 to 20 cm. long, with a long entire point and 1 to 4 pairs of rather rigidly erecto-patent branches, pinnae (pinnules) about 2.5 cm. long, 1 cm. deep, the lower line nearly straight or curved downwards, the upper rounded, entire, closely placed, but scarcely imbricate; texture pellucido-herbaceous; sori in a continuous line below the upper margin.

Negros, Gimogon River, *Copeland* 66; Davao, *Loher* 52.

Tropical America, Ceylon, Malay region.

(15) *L. rigida* J. Sm. Rhizome wide-creeping; stipe 10 to 15 cm. high, rigid, erect, prickly towards the base; frond with a long unbranched central point and 1 to 4 pairs of flexuose lateral branches, 10 to 20 cm. long; pinnules 6 to 8 mm. broad, 4 mm. deep, the lower edge often falcate, the upper three or four times bluntly, not deeply lobed, placed close together but not imbricated; texture very thick and coriaceous; veins prominent; sori in a marginal line on the lobes.

Davao, *Loher* 55; Luzon, *Baranda* 20.

Malay Peninsula.

The color of the mature frond is sepia brown, and the pale veins stand out from the groundwork in relief.

(16) *L. triquetra* (Baker) Christ (*L. tenuifolia* Bl.). Rhizome creeping, fibrillose; stipe strong, erect, 10 to 15 cm. high; frond with 2 to 7 pairs of pinnae and a terminal one; lateral pinnae spreading, with subrigid rachises, 10 cm. long, 1 to 2 cm. broad; pinnules cut down on the upper side into narrow simple or forked linear segments well toward the nearly straight costa; texture pellucido-herbaceous, both surfaces naked; sori small, terminal on the segments; indusium suborbicular.

Leyte, *Cuming* 309; Davao, *Loher* 58.

Java to Samoa.

(17) *L. blumeana* (Hk.). Rhizome creeping; stipe 10 to 15 cm. high, strong, erect; frond 20 to 30 cm. long, 15 to 20 cm. broad, bipinnate; pinnae rigid, erecto-patent, 10 to 15 cm. long, 1 cm. broad; pinnules thinly herbaceous, cut down on the upper side into very slender filiform simple

or forked segments to a recurved filiform rachis; sori small, nearly terminal on the dilated apices of the segments; involucre suborbicular. Epiphytic.

Leyte, *Cuming* 309.

Celebes, Java.

(18) *L. Sarasinorum* Christ, Ann. Bot. Buitenzorg. 15:101. Rhizome short-creeping; stipe 12 cm. high, reddish brown, clustered, brown-squamulose, as is the rachis; the rest of the plant glabrous, herbaceous in texture; frond 8 to 12 cm. long, simply pinnate or tripartite; pinnæ (pinnules) halved at the base, becoming equilateral toward the apex; narrowly oval or rhomboidal, up to 3 cm. long, strongly bent outward, on the outside lobed into 4 or 5 lobes, which are often forked, broad, obtuse, with a thick, brown, apical sorus; veins freely anastomosing near the base, free toward the margin.

Maquiling, *Loher*.

Celebes.

Differs from *L. davallioides* in that the pinnæ are longer, narrower, arcuate-deflexed, and not dimidiate at the apex, and the lobes broader, deeper, and often forked.

(19) *L. davallioides* Blume. Rhizome short-creeping; stipe 6 to 12 cm. high, firm, erect; frond with a long central point and one to three pairs of spreading curved branches, 4 to 8 cm. long; pinnæ 1 cm. long, 5 mm. broad, the lower margin straight or slightly curved, the upper with 3 to 6 regular truncate lobes one-third the depth of the pinnæ, placed close together but not imbricated; texture pellucido-herbaceous; veins anastomosing below the base of the lobes; sori marginal in the lobes.

Castillo, 800 m., *Loher* 53; Daet and Gubat, *Baranda* 16; Mount Mari-veles, *Copeland* 1380.

Malay region.

(20) *L. lobata* Poir. Rhizome short-creeping; stipe 10 to 20 cm. high, firm, erect; frond simply pinnate or with a long unbranched apex, and 1 to 6 pairs of erecto-patent branches, 7 to 20 cm. long; pinnules 10 to 13 cm. long, half as broad, the lower decurved principally at the base, the outer margin rounded, the upper entire or incised enough to interrupt the sorus, close-placed, but not imbricated; texture thinly pellucido-herbaceous; veins anastomosing; sori marginal.

Luzon, *Steere*; Paragua, *Merrill* 713.

India to Polynesia and Queensland.

Much resembling *L. davallioides* in general appearance, but the pinnules are deeper and not so much lobed.

(21) *L. apoensis* Copeland. Rhizome 1 mm. thick, scandent, ferruginous, almost glabrous; stipes 12 to 18 cm. high, straight or flexuous, stout, the bottom rich brown, upward green and nearly glabrous, as is the rachis; frond about 20 cm. high, 6 cm. broad, pinnate; pinnæ short-stalked, glabrous, herbaceous, the larger ones 40 by 7 mm., the lower margin arcuate, the upper incised into usually linear lobes, more deeply toward the end of the pinna; veins free except sometimes in the sori; sori small, roundish, just below the tip of the lobe.



Mount Apo, Mindanao, altitude 1,600 m., *Copeland* 1181, *DeVore* and *Hoover* 365.

(22) **L. pulchella** (Hk.) (*Davallia* § *Odontoloma* Hooker). Rhizome slender, wide creeping, and much branched; stipe slender, wiry, erect, naked, reddish brown below, 2 to 4 cm. long; frond 15 to 25 cm. long, 10 to 17 mm. broad; pinnæ slightly stalked, larger ones 8 mm. across, 5 mm. deep, the lower or all more or less curved upward, oblique at the base, the upper cut into 2 to 3 blunt lobes or entire; texture membranaceous, rachis and both surfaces naked; sori small, placed in the lobes at a short distance from the edge; veins sometimes anastomosing at the apex, and then their sori confluent.

"Manila," *Née, Cuming* 217; Davao, *Warburg* 14189, *Copeland* 991 and 1116. altitude, 4,600 and 6,000 feet; Baguio, *Elmer* 6019.

Fiji, Samoa.

24036—5



## IV. ASPLENIEÆ.

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Sori superficial (not in grooves), springing from the sides of the fertile veins; indusium opening on the side away from the vein, or wanting; stipe not articulate to the rhizome.

1. Sori born along lateral veins or veinlets, not parallel to the midrib.
  2. Indusium wanting.
    3. Veins free, fronds pinnate ..... (23) *Coniogramme*
    3. Veins anastomosing, fronds simple.
      4. Sori anastomosing copiously..... (24) *Hemionitis*
      4. Sori seldom or never anastomosing.
        5. Veins invisible, anastomosing through-out ..... (25) *Loxogramme*
        5. Veins visible, anastomoses marginal.... (26) *Syngramme*
  2. Indusium present.
    3. Veins forming regular areolæ.
      4. Indusium opening along its margin..... (27) *Callipteris*
      4. Indusium rupturing irregularly ..... (28) *Allantodia*
    3. Veins free (unless at the margin).
      4. Some sori double, on both sides of a vein, the free sides opening ..... (29) *Diplazium*
      4. All sori simple ..... (30) *Asplenium*
      4. Sori between two veins, indusia attached to veins, opening along middle ..... (31) *Triphlebia*
1. Sori parallel to midribs (*Blechnæ*).
  2. Indusium wanting, rhizome scandent..... (32) *Stenochlaena*
  2. Indusium present, mostly terrestrial.
    3. Veins free between sori and margin..... (33) *Blechnum*
    3. Veins anastomosing between sori and margin..... (34) *Woodwardia*

### (23) CONIOGRAMME Fée.

Rhizomes creeping; fronds pinnate or bipinnate, glabrous, fertile frond nowise differentiated; veins pinnately arranged, forked, in Philippine material free; sori covering the veins from the midrib to well toward the margin, exindusiate, without paraphyses. Large terrestrial ferns, thin in texture.

(1) **C. fraxinea** (Don) Fée (*Gymnogramme Javanica* Bl.). Stipe 0.3 to 1.2 m. high, naked unless at the base, stramineous or brown, polished; frond about 1 m. high, broadly lanceolate, pinnate or bipinnate; pinnae (or pinnules) short-stalked, the upper sessile, lanceolate, long-acuminate, entire or serrate, herbaceous; veins mostly once forked; sori along all of them.

Baguio, *Elmer* 6032; Arayat, *Loher*; Davão, *Copeland* 980, 1135.

Tropical Africa across Malaya to Hawaii.

Two reasonable distinct Philippine ferns are included here, one entire and usually simply pinnate, the other serrate, bipinnate, and more membranous, usually at a higher altitude.

(24) **HEMIONITIS** Linnaeus.

Rhizome short; stipes clustered, chaffy, those of the sterile frond much the shorter; fronds in the Philippine species entire or lobed, with ample base, pubescent; veins copiously anastomosing, bearing sori throughout. Striking ferns; with a cluster of sterile fronds on the ground, and the single or few fertile ones long stalked.

(1) **H. arifolia** (Burm.) Beddome. Stipes of the sterile fronds 2 to 5 cm. long, of the fertile 20 to 30 cm., brown or black, glossy, chaffy throughout; fronds 5 to 7 cm. long, 3 to 4 cm. broad, entire or nearly so, apex rounded, base deeply cordate, the fertile frond rather the smaller and with more developed basal lobes, coriaceous, lower surface chaffy, sparsely unless on the costa and margin; midrib disappearing below the apex, other veins almost invisible; sori forming a fine network over the fruiting surface.

Corregidor, *Cuming* 285; Manila, *Loher*; Antipolo, *Guerrero*; Mount Mariveles, *Merrill* 3259.

India.

The Philippine plant differs from the Indian in having narrower fronds, the sterile shorter stalked, stipes squamulose throughout, and texture more coriaceous.

(2) **H. Zollingeri** Kurz. Fronds clustered in a dense rosette; the sterile nearly sessile, oblanceolate, entire, about 10 cm. long, membranaceous; main veins distinct nearly to margin, with copious fine, irregular areolæ between them; fertile fronds linear, slightly repand, 8 cm. long, less than 1 cm. broad, with a stipe 3 to 5 cm. high; sori in 2 to 3 rows, parallel with costa and margin, anastomosing by short cross-bars.

Panay, *Steere*.

Sumatra to Celebes.

(3) **H. gymnopteroidea** Copeland. Caudex short, erect, scaly at the tip; fronds clustered, the sterile sessile or subsessile, 7 to 17 cm. long, 2.3 to 5 cm. broad, oblanceolate, obtuse or acute, margin repand and crisped, broad or contracted at the base, papyraceo-herbaceous, dark green with light patches, glabrous except for the usually squamulous costa; areolæ rather large, with copious free included veinlets; fertile frond on a stipe 5 to 15 cm. high, itself 5 to 10 cm. high, 2 to 4 mm. broad, the lamina often interrupted; soriferous veins 1 to 3 on each side, about parallel to the costa, occasionally anastomosing; entire lower surface early covered by sporangia.

Lamao Forest Reserve, terrestrial at lower elevations, *Copeland*, *Merrill* 3113; *Barnes* 166.

(25) **LOXOGRAMME** Presl.

Fronds somewhat clustered, not articulate to the rhizome, simple and entire, sessile or nearly so; veins immersed, anastomosing irregularly to form large areolæ with few or no included free veinlets, no main veins; sori elongate, forming an acute angle with the costa or even parallel to it, exindusiate.

*Loxogramme* is combined with *Selliguea* as a part of *Gymnogramme* in Synopsis Filicum, and buried with it by Diels in *Phymatodes*. It differs more than ordinarily generically from *Selliguea* in the venation and the absence of articulations to the rhizome. The type species, *L. lanceolata*, was more reasonably placed by Blume in *Antrophyum*. Placing all these exindusiate genera in the *Aspleniceæ* is arbitrary.

(1) ***L. involuta*** (Don.) Presl. Rhizome short-creeping, stout, clothed with dull brown, lanceolate, acuminate scales; frond 30 to 45 cm. high, 5 to 6 cm. broad, subacute, somewhat repand and inclined to roll upward, gradually attenuate to the base, very leathery, glabrous; costa stout and prominent, veins invisible; sori oblique, almost reaching the costa and margin.

Rizal, Merrill 2663; Davao, Warburg 14116, Copeland 961.

India to Polynesia.

(2) ***L. lanceolata*** (Blume) Presl. Rhizome creeping, clothed with dull brown linear scales; frond 15 to 30 cm. high, 1 to 2 cm. broad, acute, entire, narrowed uniformly from well above the middle to the sessile base, coriaceous but flaccid, glabrous, bright green; costa evident but not stout, veins hidden; sori very oblique, falling well short of margin.

Benguet, Loher, Elmer 6276; Mount Mariveles, Copeland 1406.

Africa to Japan and Polynesia.

(3) ***L. parallela*** Copeland. Rhizome short-creeping, clothed with ashy brown, lanceolate, acuminate scales; fronds linear, about 15 cm. high, 6 mm. broad, straight or sinuate, acuminate, entire, gradually attenuate to the subsessile base, coriaceous, glabrous; costa conspicuous below, veins invisible, free included veinlets none; sori oblong, in a single series on each side of the costa, near and almost or quite parallel to it.

Mount Santo Tomas, Benguet, Elmer 6569.

(4) ***L. conferta*** Copeland. (*Drymoglossum*, Copeland in Perkins' Fragmenta, Fas. III, 1905.) Rhizome slender, intricate, clothed with small, thin, brown, lanceolate, acuminate scales; fronds short stalked, forming a dense mat, coriaceous, the veins forming a few areolæ without free included veinlets, the sterile frond ecostate, elliptical, 18 mm. long, 13 mm. broad, apex round, base cordate, fertile frond 25 by 3.5 mm., apex round, base attenuate; sori midway between costa and margin, covering the entire lamina when old.

Catalonan, Davao, Copeland 942; San Ramon, Zamboanga, Copeland 1583. The San Ramon plants are the younger, and show the real affinity to *Loxogramme*. But it is a very foreign element in this genus.

## (26) SYNGRAMME J. Sm.

Rhizome creeping; fronds simple, and entire or merely sinuate, fertile and sterile alike; veins pinnately arranged, simple or forked, anastomosing near the margin only; sori in unbroken straight rows along the veins, naked. Terrestrial ferns, notable for their ample simple fronds.

(1) *S. vittaeformis* J. Sm. Stipes subtufted, not very tall, naked, flexuose, dark brown; frond 20 to 30 cm. tall, 2 to 6 cm. broad, spatulate-oblong, irregularly repand, acute, coriaceous, glabrous; veins fine, parallel, forming one or two rows of distinct areolæ near the edge; sori extending from the midrib to the margin.

Samar, *Cuming* 329.

(2) *S. alismaefolia* (Presl) J. Sm. Rhizome short, clothed with minute chestnut hairs; stipes 20 to 60 cm. high, firm, polished, chestnut-brown; frond 15 to 25 cm. long, 6 to 10 cm. broad, acuminate, entire, with rounded base, coriaceous, glabrous; veins fine, indistinct where they unite, near the margin; sori on all the veins, from the midrib to where they unite.

Luzon, *Haenke*; Gimogon River, Negros, *Copeland* 75.

Singapore.

(3) *S. Wallichii* Hooker (sub *Gymnogram.*). Rhizome creeping underground; stipes subfascicled, 15 to 40 cm. high, ebeneous; fronds subcoriaceous-membranaceous, simple, 15 to 25 cm. long, 3 to 5 cm. broad in the middle, broadly lanceolate or subelliptico-acuminate, entire, cuneate-attenuate at the base; veins numerous, approximate, simple or forked, anastomosing only near the margin, forming rarely more than 2 series of oblong, hexagonal areolæ; sori narrowly linear, on all the straight veins, but hardly extending to the anastomosing ones. Distinguished from *S. alismaefolia* by the longer fronds and the tapering base.

Jolo Archipelago, *Burbidge*.

Singapore and Borneo.

## (27) CALLIPTERIS Bory.

Rhizome short, erect; fronds accordingly in clusters, simple, pinnate, or bipinnate; veins from neighboring clusters anastomosing; sori as in *Diplazium*, that on the lowest acropetal branch double, the others single as in *Asplenium*. Terrestrial ferns, mostly with large glabrous fronds.

*Callipteris* is combined with *Diplazium* by Diels, and both are included in *Asplenium* in Synopsis Filicum. Underwood says twelve species are known from the Philippines. Beside those here described, Presl enumerates *Microstegia ambigua*, *M. serrulata*, and *Callipteris attenuata*.

1. Simple, or with terminal pinnæ like lateral.

2. Cordate, lateral pinnæ at most 2 pairs..... (1) *C. cordifolia*

2. Not cordate.

3. Lateral pinnæ at most 3 pairs, veins about 3 together ..... (2) *C. alismaefolia*

3. Lateral pinnæ at most 6 pairs, veins 4 to 8 together ..... (3) *C. elegans*

3. Lateral pinnæ more than 6 pairs, veins mostly 2

together ..... (4) *C. pariens*

1. Pinnate with pinnatifid apex..... (5) *C. prolifera*

1. Twice or more pinnate ..... (6) *C. esculenta*

(1) *C. cordifolia* (Blume) J. Sm. Stipes clustered, 20 cm. long, firm, erect, scaly below; frond 30 cm. long, 10 cm. broad, entire, cordate, acuminate, coriaceous; veins in close groups of about 4, anastomosing copiously in the outer half of the pagina; sori reaching from the midrib to the margin. Less frequently there are one or two pairs of smaller lateral pinnæ (*Diplazium integrifolium* Blume).

Leyte, *Cuming* 307.

Africa to Polynesia.

(2) *C. alismaefolia* J. Sm. Hook. Journ. Bot. 3:409. Stipes 5 to 15 cm. high, firm, erect, scaly throughout; frond varying in shape from simple, oblong-lanceolate, 15 to 25 cm. long, 5 to 8 cm. broad, entire, acuminate, to ternate or pinnate, with a large terminal and three pairs of lateral pinnæ, each like the entire frond of the simple state, coriaceous; veins about three to a group in the inner half, but anastomosing copiously with hexagonal areolæ toward the edge.

Luzon, *Cuming* 116; Davao, *Warburg* 14115 (simple), 14102 (trifoliate), 14177 (pinnate).

Celebes.

Although Presl separates this plant as the genus *Ochlogramme* from the neighboring two, it is too near them for easy specific separation by the descriptions.

(3) *C. elegans* J. Sm. Hooker's Journ. Bot. 3:409. (First described as *Anisogonium elegans* Presl, Epim. Bot. p. 93. *Asplenium lineolatum* Mett. in Syn. Fil.) Stipes 15 to 25 cm. high, firm, erect, gray, scaly below; frond occasionally simple, usually with a terminal pinna and 3 to 6 pairs of lateral ones, which are 15 to 30 cm. long, 5 cm. or more broad, entire, often suddenly acuminate, coriaceous; rachis naked; veins 4 to 8 to a cluster, uniting slightly toward the edge.

Luzon, *Cuming* 276; Leyte, *Cuming* 305 (*A. grossa* Presl).

Malaya.

(4) *C. pariens* Copeland. Caudex black, clothed with lanceolate, dark brown paleæ 8 mm. long; stipe channeled, about 35 cm. high, black and somewhat scaly at the base, like the rachis above, green and clothed with very minute fibrils; pinnæ in the type 11 pairs, those of the lower half of the frond larger, 10 cm. long, 4 cm. broad, ovate, acuminate, base rounded, short stalked, entire, subcoriaceous, glabrous; terminal pinna like the lateral; upper axils bearing bulbils which grow into young plants before falling; veins once or twice forked, anastomosing and indistinct in the marginal third of the blade; sori linear, straight, extending as far as the veins are distinct.

Todaya, Davao, altitude 1,100 m., *Copeland* 1287.

(5) *C. prolifera* Bory (*Asplenium decussatum* Swartz, Syn. Fil.). Stipe 20 to 40 cm. tall, firm, erect, muricate; frond 40 to 120 cm. tall,



with numerous pinnæ and a large pinnatifid terminal segment; pinnæ 8 to 20 cm. long, 3.5 to 5 cm. broad, entire or serrate or slightly lobed, acuminate, the lower stalked, the upper sessile and sometimes proliferous; veins in pinnate groups, the veinlets from neighboring veins uniting to form a series of arches; sori on all these veinlets, but the veins running from the costa to the margin sterile.

Luzon and Leyte, *Cuming* 303; Baco River, Mindoro, *Merrill* 1776; Davao, *Copeland* 663, 949; San Ramon, Zamboanga, *Copeland* 737.

Africa across Polynesia.

(6) *C. esculenta* (Retz). Caudex sometimes rising above the ground; stipes 30 to 60 cm. high, firm green, almost smooth; fruiting fronds 80 to 150 cm. high, half as wide, bipinnate; pinnules more or less lobed, acute, truncate at base, sometimes auricled, glabrous, herbaceous; veins pinnate running directly from costa to margin, sterile, their branches bearing sori, anastomosing in pairs from neighboring veins forming a series of small arches.

Luzon, *Haenke*; Manila, *Loher*; Warburg 12746; Province of Bataan, *Merrill* 2542, 2552; Carranglang, *Merrill* 280; Benguet, *Topping* 210; Davao, *Copeland* 604.

India to Malaya and Formosa.

The young plants are eaten as greens by natives everywhere, called "Paco."

## (28) *ALLANTODIA* R. Brown (in part).

Veins forming 2 or 3 series of areolæ in the marginal half of the lamina and ending in an intramarginal cross-vein; sori running from near the costa to the first areola; indusium fastened all round its margin, and rupturing irregularly when the spores mature. A single terrestrial fern, apparently related to *Callipteris*.

The first plant described in this genus has since been placed in *Asplenium* § *Athyrium*; but the genus is now universally recognized as defined here.

(1) *A. javanica* (Blume) Beddome. Rhizome short; stipe about 30 cm. high; frond 30 to 60 cm. high, half as broad, pinnate; pinnæ lanceolate, entire or serrulate at the apex, glabrous, membranaceous.

Davao, *Warburg* 14118.

India across Polynesia.

## (29) *DIPLAZIUM* Swartz.

Rhizome creeping, or more often erect; fronds simple to tripinnate; veins free; the lowest acroscopic branch of each vein bearing a double sorus, the other fertile veinlets bearing single sori on the side facing the apex of the vein the veinlet springs from, as in *Asplenium*. Mostly robust terrestrial ferns. Paleæ often harsh and dark; main roots usually stout and black.



On some species, and on sparsely fruiting fronds of others, the lowest pinnae are sterile, and the sori present are all of the *Asplenium* type.

1. Simply pinnate.
  2. Pinnæ entire or nearly so.
    3. Pinnæ few.
      4. Terminal pinna like lateral.
        5. Sori reaching margin ..... (1) *D. bantamense*
        5. Sori remote from margin ..... (2) *D. palauanense*
      4. Apex pinnatifid ..... (3) *D. cultratum*
    3. Pinnæ 8 or more pairs.
      4. Veins once or twice forked.
        5. Frond membranous ..... (4) *D. camarinum*
        5. Frond subcoriaceous ..... (5) *D. pallidum*
      4. Veinlets more numerous ..... (6) *D. sylvaticum*
  2. Pinnæ lobed.
    3. Upper half of pinna the more developed.
      4. Stipe and rachis more or less hairy ..... (7) *D. grammitoides*
      4. Rachis naked, stipe nearly so ..... (8) *D. japonicum*
    3. Pinnæ equilateral.
      4. Rachis naked unless at base.
        5. Small, pinnæ less than 10-jugate (9) *D. bulbiferum*
        5. Large, pinnæ more than 10-jugate ..... (10) *D. speciosum*
      4. Rachis fibrillose or hairy.
        5. Lower pinnæ sessile ..... (11) *D. sorsogonense*
        5. Lower pinnæ stalked ..... (12) *D. petiolare*
1. Frond barely bipinnate ..... (13) *D. brachypodium*
1. Frond copiously bipinnate.
  2. Pinnules lobed less than half way to costa.
    3. Rachis naked, stipe nearly so ..... (14) *D. cyathæaefolium*
    3. Rachis naked, stipe scaly below ..... (15) *D. latifolium*
    3. Rachis and stipe tomentose ..... (16) *D. vestitum*
  2. Pinnules lobed more than half way to costa.
    3. Fronds less than 50 cm. tall ..... (17) *D. deltoidcum*
    3. Fronds 1 m. or more tall.
      4. Sori reaching nearly to margin ..... (18) *D. meyenianum*
      4. Sori falling well short of edge.
        5. Rachis green ..... (19) *D. polypodioides*
        5. Rachis ebeneous ..... (20) *D. ebenum*

(1) *D. bantamense* Blume. Rhizome short, stout, scaly; stipe 15 to 30 cm. high, scaly at the base, firm, erect, stramineous; frond 20 to 40 cm. high, rarely simple, usually with a large terminal pinna and 1 to 3 pairs of similar but usually smaller lateral ones; pinnæ 1 to 2 dm. long, broadly lanceolate, entire or nearly so, acute or acuminate, narrowed to an almost sessile base, glabrous, coriaceous; veins forked about three times; diplazoid sori extending from the midrib nearly to the margin.

Sablan, *Elmer*; Rizal, *Ramos*; Negros, *Copeland* 60, 80; Balabac Island, *Steere*.

Himalayas, Hongkong, Malaya.

(2) *D. palauanense* Copeland. Stipe firm, 30 to 40 cm. high, black and black-scaly at the base, stramineous or brown above, glabrous; frond 30 to 60 cm. high, pinnate, terminal and lateral pinnæ alike; pinnæ about 6 pairs, alternate, remote, larger ones 30 cm. long, rather narrowly lanceolate,

acute, obscurely serrate, glabrous, coriaceous, the lower ones short stalked; veins 2 or 3 times forked; sori linear, not reaching the margin.

Palauan, in open woods; altitude, 500 m., *Merrill* 746.

(3) *D. cultratum* Presl Epim. Bot., p. 84. Stipes tufted, 10 to 15 cm. high, gray, naked, or the upper part and the rachis bearing a short hyaline horizontal pubescence; frond 15 to 25 cm. high, half as broad, pinnate with pinnatifid apex; pinnae 3 to 5 pairs, oblong-ovate, acute, subfalcate, nearly entire, narrowed abruptly at base, and auricled, the lower stalked, coriaceous, glabrous; veins twice forked; sori linear, reaching the edge but not the midrib.

Luzon, *Cuming* 199, *Steere*.

(4) *D. camarinum* Baker. Stipe and rachis dull brown, naked; frond oblong, simply pinnate, 30 to 45 cm. long, 15 to 25 cm. broad; pinnae 8 to 12 pairs, distant, stalked, linear-ligulate, acute, crenate, 10 to 15 cm. long, 2 cm. broad, rather reduced on lower side, rounded on both sides at base, lowest not reduced, membranous, glabrous, dull green; veins distinct, in close, little ascending pairs, posterior forked, anterior simple; sori reaching from costa to edge, indusium persistent.

South Camarines, *Cuming*.

(5) *D. pallidum* Blume. Stipe 15 to 30 cm. high, firm, erect, naked; frond 30 to 60 cm. long, 15 to 30 cm. broad, with numerous horizontal pinnae on each side, the lower ones stalked, 4 cm. apart, 8 to 15 cm. long, 2 cm. broad, linear-lanceolate, acuminate, base rounded especially on the upper side, edge often sharply toothed, subcoriaceous; veins once or twice forked; sori in regular lines from the costa very nearly to the edge.

Davao, terrestrial in the forest, *Copeland* 956.

Malaya.

The Davao fern is larger in every way than this description, copied from Synopsis Filicum, states, but otherwise agrees perfectly.

(6) *D. sylvaticum* Swartz Syn. Fil., p. 92. Caudex decumbent or erect, stout, short, bearing crowded stout roots; stipes 10 to 30 cm. high, firm, erect, scaly at the base only; frond 20 to 40 cm. high, half as broad, pinnate with pinnatifid apex; pinnae numerous but not crowded, acute, broadly but shallowly lobed and lobes entire or obscurely toothed, rather abruptly narrowed at the base, mostly stalked, glabrous, subcoriaceous, pale beneath; veins pinnate-forked; sori not quite reaching the margin.

"Luzon," *Haenke*; Montalban, *Loher*; Mount Mariveles, *Copeland* 238, *Whitford* 234; Davao, *Copeland* 672, 701.

Pantropic.

The plants with erect root stalks and those with decumbent ones are undoubtedly the same species.

(7) *D. grammitoides* Presl Epim. Bot., p. 84. Rhizome wide-creeping slender, chaffy; stipes 10 to 20 cm. high, gray-green, clothed throughout with light, slender scales; frond 15 to 25 cm. high, about 7 cm. wide, pinnate below, pinnatifid above; pinnae acute, sessile, subauriculate, glabrous, membranaceous, cut half way to the costa into entire or dentate

lobes; veins 4 to 7 forked; sori copious, the simple ones linear-oblong, the diplazoid oblong.

Luzon, *Cuming* 56; Baguio, *Topping* 156, *Loher*.

Malay Islands.

Presl says *Diplazium tenerum* is a related species from Leyte, *Cuming* 333 in part.

(8) *D. japonicum* Thunb. Rhizome slender, wide-creeping; stipe 15 to 30 cm. high, stramineous or brownish, slightly scaly towards the base; frond 25 to 35 cm. long, 10 to 15 broad, ovate-lanceolate, with 8 to 10 rather distant pinnæ below the pinnatifid apex, the lower ones sessile, 10 cm. long, 2 cm. broad, cut down in the lower part two-thirds of the way to the costa into close, oblong, slightly toothed lobes, herbaceous, nearly naked, both surfaces bright green; veins about 6 on each side in the lower lobes, with sori on each reaching two-thirds of the way to the edge, the lowest 3 mm. long, indusium broad, brown, tumid.

Davao, *Warburg* 14125.

Japan and Formosa to the Himalayas.

(9) *D. bulbiferum* Brack. (*Asplenium Brakenridgei* Bak.). Stipes 15 to 25 cm. high, firm, grayish, naked; frond 30 to 45 cm. long, 15 to 25 cm. broad, the apex pinnatifid, below this 6 to 9 pinnæ on each side, the lower ones 3 to 5 cm. apart and distinctly stalked, 10 to 12 cm. long, 2 cm. broad, acuminate, sharply serrate, cut down one-third of the way to the costa into blunt incised lobes 6 mm. broad, subcoriaceous; veins pinnate in the lobes; sori in long lines, reaching to the edge.

Philippines, *Cuming* 333, 388.

Fiji.

This is possibly *D. tenerum* Presl, from Leyte.

(10) *D. speciosum* Blume. Stipes tufted, 30 cm. or more long, firm, erect, stramineous or brownish, nearly naked; frond 30 to 60 cm. long, 20 to 30 cm. broad, with 10 to 20 pairs of pinnæ below the pinnatifid apex, the lower ones often stalked, 10 to 15 cm. long, 3 cm. broad, very acuminate, lobed down at least two-thirds of the way to the costa into close slightly toothed lobes 6 mm. broad, truncate or subcuneate at base, herbaceous but firm; veins pinnate in the lobes; sori reaching nearly to the edge.

Philippines, according to Synopsis Filicum.

Malaya, Hongkong.

(11) *D. sorsogonense* Presl Tent. Pterid., p. 114. Stipes tufted, 10 to 15 cm. high, densely fibrillose below; frond 30 to 60 cm. long, 20 to 30 cm. broad, with numerous pinnæ on each side, the lower ones sessile, 10 to 15 cm. long, 25 mm. broad, cut down regularly throughout two-thirds of the way to the costa into spreading, blunt, subentire lobes about 4 mm. broad, herbaceous; rachis slightly fibrillose; veinlets of the lobes simple, with sori in regular rows reaching from the midrib to the edge.

Sorsogon, *Haenke*; Leyte, *Cuming* 301.

Himalayas, Malacca.

(12) *D. petiolare* Presl Epim. Bot., p. 86. Stipe brown, smooth; frond about 50 cm. high, pinnate with pinnatifid apex; pinnæ about 12 cm.

long, the lowest a little shorter but longer stalked, linear, acute, pinnatifid half way down to the costa, with equilateral, acute base, glabrous, herbaceous, bright green above, pale beneath; rachis densely beset with short patent hairs; veinlets all bearing sori.

Bohol, *Cuming* 349.

(13) **D. brachypodium** (Baker). Stipes tufted, slender, about 2 cm. high, dark green, with a few minute linear scales; frond oblanceolate, acuminate, 10 to 15 cm. long, 2.5 cm. broad, bipinnate; lower pinnae lanceolate-deltoid, 6 mm. broad, distinctly stalked, square on upper side, cuneate-truncate on lower, cut down to rachis below, many lower distant, reduced; lowest anterior pinnule much largest, cuneate-oblong, dentate, 2 to 3 mm. broad, the others lanceolate, entire; texture moderately firm, surfaces dull green; rachis naked; veins pinnate in lower lobes; sori medial, linear.

Luzon, *Cuming* 56.

(14) **D. cyatheaeifolium** (Bory) Presl. Caudex erect, subarborescent; stipe firm, erect, dark brown, nearly naked; frond 45 to 60 cm. long, 30 to 45 cm. broad, lower pinnae 25 cm. long, 8 cm. broad, cut down to their rachis in the lower two-thirds into numerous pinnules on each side, the lower ones 4 cm. long, 1 cm. broad, the upper ones inciso-crenate, the lower ones cut down one-third of the distance to the costa into oblong, falcate, sharply-toothed lobes, herbaceous; veins pinnate, with 3 or 4 veinlets on each side in the lower lobes; sori falling considerably short of the edge.

Luzon, *Cuming* 158.

(15) **D. latifolium** (Don). Caudex erect, subarborescent; stipes tufted, strong, erect, 30 cm. or more high, livid, smooth, clothed toward the base with linear crisped, dark brown scales; frond 1 m. long, 30 to 45 cm. broad, subdeltoid, with about 12 pinnae on each side, the largest 30 cm. long, 10 cm. broad; pinnules numerous, the largest 5 cm. long, 2 cm. broad at the base, acuminate, slightly toothed, abruptly truncate at the base on both sides, subcoriaceous; veins about 6 in a group; sori linear, the lowest often 4 mm. long.

Philippines.

Ceylon to Celebes and southern China.

(16) **D. vestitum** Presl Epim. Bot., p. 87. Rhizome erect; stipe stout, erect, brownish, tomentose, sometimes muricate; frond 60 to 90 cm. long, 25 to 45 cm. broad, with numerous pinnae on each side, the lower ones 25 cm. long, 10 cm. broad, with numerous distinct sessile pinnules, which are 5 cm. long, 25 mm. broad, blunt, bluntly lobed to a depth of 3 to 6 mm., base narrowed suddenly or even cordate, thin-herbaceous; rachis like the stipe; veins pinnate in the lobes, with 4 to 5 veinlets on each side; lower sori 6 to 8 mm. long, not reaching the margin.

Samar, *Cuming* 336.

Luzon specimens, *Merrill* 2667 from Rizal, *Copeland s. n.*, from Mount Mariveles, resemble this in their pubescent rachises, but have acute pinnules, and are very large, reaching a height of 3 m.

(17) *D. deltoideum* (Presl) Christ. Caudex erect, clothed with black paleæ, and bearing stout roots; stipes about 20 cm. high, black and black-scaly at the base, glabrous and greenish above; frond 30 to 40 cm. high, two-thirds as wide, deltoid, with a few distant pinnae; the lowest pinnae about 12 cm. long, 5 cm. broad, bearing numerous sessile pinnules; pinnules obtuse, lanceolate, cut two-thirds of the way to the costa into blunt lobes, glabrous, herbaceous; veins pinnate-forked in the lower lobes; sori rich-brown, reaching the margin.

Luzon, *Cuming* 29; Davao, *Warburg* 14126, *Copeland* 966, the Davao plant differing from the type in having narrower pinnae and their rachis green.

Celebes.

(18) *D. meyenianum* Presl Epim. Bot., p. 86. Frond probably about 1 m. high, ovate-triangular, bipinnate; pinnae 40 cm. long, alternate, stalked, oblong-lanceolate, acuminate; pinnules sessile, linear-oblong, acuminate, pinnatifid three-fourths of way to costa into subopposite ovate-oblong subfalcate obtuse serrulate segments, glabrous, thin-coriaceous; veins pinnate-forked; rachis brown, channeled above; sori copious, reaching from the midrib nearly to the edge.

"Manila," *Meyen*, Arayat, 800 m., *Loher*. Christ distinguishes this from *D. polypodioides* by its thinner texture, broader, less serrate segments, and sori less lined up. A plant from San Ramon, Zamboanga, *Copeland* 734, agrees with Presl's diagnosis, but the sori are sparse and remote from the costa.

(19) *D. polypodioides* Blume. Caudex erect, subarborescent, densely clothed at the top with long, dark brown, fibrillose scales; stipes densely tufted, erect or spreading, ebeneous at the base, green above, stiff, muricate, 50 to 100 cm. high; frond 1 m. or more high, rather over half as wide, bipinnate; pinnae alternate, the lower ones in large fronds reaching a length of 60 cm. and a breadth of 18 cm., bearing many alternate pinnules; pinnules stalked, acuminate, cut down almost to their costa into numerous linear-oblong obtuse more or less serrate segments, herbaceous or sub-coriaceous; veins pinnate in the segments, veinlets numerous, simple; sori in regular rows, usually falling considerably short of the margin.

Southern Luzon, *Baranda*; Isabela Province, *Warburg* 11618, 11623; Tarlac, *Hall*; Caraballo Sur, *Merrill* 233; Bataan Province, *Barnes* 132, *Copeland* 235, *Whitford* 194.

India and Malaya.

Forms corresponding to Blume's *D. asperum*, with rather coriaceous fronds are common, but not separable even as a variety.

(20) *D. ebenum* J. Sm. differs from *D. polypodioides* in having a slender naked ebeneous rachis, and erecto-patent lobes, with but 4 distinct veinlets in each.

Philippines, *Cuming* 159.

### (30) *ASPLENIUM* Linnaeus.

Sori simple, usually confined to the acropetal side of the veins; indusium the shape of the sorus, and continuous across the vein in the few species



in which the sorus curves across it. Ferns of the most various form, simple to finely dissected, growing in all situations, and all over the world. As construed here, it includes several sections the types of some of which are different enough to have been generically separated, but whose characters intergrade. Through § *Athyrium* it is closely related to *Diplazium*.

1. § *Neottiopteris*; frond simple, usually entire, elongate.
  2. Veins connected near margin (*Thamnopteris*) ..... (1) *A. Nidus*
  2. Veins as a rule free.
    3. Frond entire, more or less coriaceous.
      4. Indusium leaving a ridge at dehiscence ..... (2) *A. scolopendrioides*
      4. Indusium not leaving a ridge.
        5. Stipe scaly.
          6. Frond acuminate or caudate ..... (3) *A. squamulatum*
          6. Frond merely acute ..... (4) *A. apoense*
          5. Stipe naked ..... (5) *A. vittaeforme*
        3. Frond serrate, membranaceous ..... (6) *A. epiphyticum*
  1. § *Euasplenium*; once or more pinnate, veins forked in segments, sori confined to one side of vein.
    2. Frond once pinnate.
      3. Pinnæ deep, not narrower than oblong.
        4. Rachis green, at least in part.
          5. Rachis pubescent ..... (7) *A. loherianum*
          5. Rachis glabrous.
            6. Pinnæ auricled, frond narrow ..... (8) *A. toppingianum*
            6. No auricles, frond broad .. (9) *A. subnormale*
        4. Rachis glossy, nearly black ..... (10) *A. normale*
      3. Pinnæ usually linear-oblong or linear.
        4. At least half of lower side of pinna cut away ..... (11) *A. resectum*
        4. Pinnæ equal sided at base.
          5. Herbaceous, dark green ..... (12) *A. multilineatum*
          5. Coriaceous, pale green ..... (13) *A. vightianum*
        4. Upper side of base of pinnæ nearly parallel with main rachis, lower side obliquely truncate.
          5. Veins conspicuous.
            6. Frond herbaceous, dark green.
              7. Apex of pinnæ rounded ..... (14) *A. tenerum*
              7. Apex of pinnæ obtuse or acute.
                8. Inciso crenate throughout .... (15) *A. lunulatum*
                8. Upper side lobed at base ..... (16) *A. Steerei*
            7. Apex of pinnæ acuminate.
              8. Veins usually simple ..... (17) *A. prionurus*
              8. Veins forked .... (18) *A. persicifolium*
        6. Frond firmer, pale green.
          7. Pinnules broad ..... (19) *A. griseum*
          7. Pinnules narrow ..... (20) *A. hirtum*



- 5. Veins inconspicuous.
- 6. Sori equal, at wide angle to costa ..... (21) *A. anisodontum*
- 6. Sori unequal, veins leaving costa at very acute angle.
- 7. Pinnæ only toothed.... (22) *A. macrophyllum*
- 7. Pinnæ deeply lobed.
- 8. Stipe nearly smooth.
- 9. Sori almost reaching edge .... (23) *A. falcatum*
- 9. Falling well short of edge .... (24) *A. contiguum*
- 8. Stipe fibrillose.. (25) *A. crinicaule*
- 8. Stipe chaffy, sori costal .... (26) *A. caudatum*
- 2. Fronds more than once pinnate.
- 3. Stipe smooth.
- 4. Pinnules of lower pinnæ few..... (27) *A. cuneatum*
- 4. Pinnules of lower pinnæ many.
- 5. Pinnules inciso-serrate or lobed.. (28) *A. affine*
- 5. Pinnules cut to their rachis.
- 6. Segments inciso-serrate .... (29) *A. nitidum*
- 6. Segments deeply pinnatifid.. (30) *A. laserpitiifolium*
- 3. Stipe wooly ..... (31) *A. praemorsum*
- 1. § *Darea*; ultimate segments linear, with solitary simple veins.
- 2. Rhizome short, stipe long..... (32) *A. Belangeri*
- 2. Rhizome scandent, stipe short ..... (33) *A. scandens*
- 1. § *Athyrium*; sori more or less curved across their veins, sometimes horseshoe-shaped.
- 2. Indusia naked.
- 3. Small fern, pinnules round-oval, lobes narrow ..... (34) {*A. Sarasinorum*  
var. *philippinense*
- 3. Large fern, pinnules elliptic-rhomboidal, lobes broad ..... (35) *A. nigripes*
- 2. Indusia ciliate ..... (36) *A. woodwardioides*

### § Neottiopteris.

(1) *A. (Thamnopteris) Nidus* L. Fronds 60 to 120 cm. long, 8 to 20 cm. broad, entire, acute or acuminate, tapering gradually into a short stem, midrib rounded on the back; coriaceous, glabrous; veins fine and parallel, 1 mm. more or less apart, their ends connected; sori reaching about half way toward the margin.

Luzon, *Haenke*, *Cuming* 59; southern Luzon, *Baranda*; Montalban, *Loher*; Baguio, *Topping* 299; Paragua, *Merrill* 722; Todaya, Davao, 1,000 m. *Copeland* 1261, 1296.

Mauritius to Japan and New Caledonia.

*Asplenium Phyllitidis* Don is a smaller fern, usually bearing longer sori. Samar, *Cuming* 319.

I am unable to locate *Thamnopteris stipitata* Presl, collected in Luzon by *Cuming* 195.

(2) **A. scolopendrioides** J. Sm. Rhizome 8 mm. in diameter, clothed with lanceolate, brown chaff; stipe 2 to 4 cm. high, scaly or almost naked, passing insensibly into the attenuate base of the frond; fronds 40 to 50 cm. high, 3 to 4 cm. broad, apex caudate, margin entire, texture subcoriaceous; veins oblique, usually simple, rather remote; sori reaching from the midrib to within 6 mm. of the margin; edge of the indusium leaving a distinct ridge on the lamina where it dehisces.

Philippines, *Cuming* 318; Baco River, Mindoro, *Merrill* 1810. (This description adapted to *Merrill's* plant.)

The fern of *DeVore* and *Hoover* 329, from Mount Apo, differs most conspicuously in the indusium's leaving no prominent line where it dehisces, but the material in hand does not justify its description as a new species.

(3) **A. squamulatum** Blume. Stipe tufted, 5 to 10 cm. long, scaly below; frond lanceolate, 30 to 70 cm. long, 4 to 6 cm. broad, acuminate, base gradually attenuate to the stipe, entire or nearly so, lamina coriaceous, glabrous, midrib somewhat chaffy; veins inconspicuous, as a rule free; sori reaching from near midrib to within 1 cm. of the margin.

Southern Luzon, *Baranda*; Montalban, *Loher*; Todaya, Davao, 1,200 m., *Copeland* 1201, 1288.

Java, Borneo.

(4) **A. apoense** *Copeland*. Rhizome very short, erect; stipes clustered, stout, scaly, 1 to 5 cm. high, passing insensibly into the attenuate base of the frond; costa stout, scaly; frond 20 to 35 cm. high, 1.5 to 2.5 cm. broad, entire, acute, glabrous, coriaceous; veins inconspicuous, erecto-patent, usually forked; sori linear, reaching two-thirds of the way from the costa to the margin.

Mount Apo, Mindanao, 1,800 m., *Copeland* 1108; epiphytic in clumps.

(5) **A. vittaeforme** Cav. Rhizome creeping, naked; stipe short, erect, naked; frond lanceolate, 30 to 45 cm. long, 4 to 8 cm. broad, narrowed to an acute point and very gradually into the stem below, the margin obscurely toothed; texture coriaceous; veins simple, close, nearly horizontal, the copious sori often reaching from the midrib nearly to the edge.

Davao, *Warburg* 14112; southern Luzon, *Baranda*.

Java, Fiji.

The stipes are jointed to the rhizome, as in *Polypodium*.

(6) **A. epiphyticum** *Copeland*. Rhizome scandent, bearing scattered, minute scales; stipes about 8 cm. long, clothed with minute ferruginous scales; typical fronds simple, 20 to 30 cm. high, about 4 cm. wide, acuminate, base obtuse or subacute, margin serrate or erenate, texture membranaceous; costa stout, like the stipe; lamina glabrous; veins conspicuous, usually forked, almost transverse; sori linear, touching neither costa nor margin; younger plants bear fronds bi-tri-pinnati-dissected; and there are intermediate forms.

Davao, Mindanao, epiphytic on trunks in coast forest, *Copeland* 664.

§ *Euasplenium*.

(7) *A. loherianum* Christ, Bull. Herb. Boissier 6(1898):152. Rhizome small; stipe very short; fronds only 2 to 5, scarcely 10 cm. high; rachis weak, flexuous, decumbent, pubescent with linear scales, base purple or green, apex rooting; pinnae alternate, 12 to 18 on each side, very remote, 3 mm. long, ovate, deeply crenate-dentate; texture subfleshy; sori oblong, early confluent and covering the under side of the pinnae.

La Trinidad, Benguet, *Loher* 99, on limestone.

(8) *A. toppingianum* Copeland. Rhizome creeping, chaffy; stipe 3 to 8 cm. high, the base brown and chaffy, upward becoming like the rachis, green and glabrous; fronds 10 to 15 cm. high, 2 to 2.5 cm. broad, herbaceous, glabrous, acuminate, apex not rooting, pinnate; about 6 pairs of pinnae free but sessile, and as many more connected by a wing widening toward the cleft apex; pinnae smooth, thin, oblong, obtuse, serrate-crenate, acroscopic half of lower pinnae auricled at base; sori mostly not confluent, straight and confined to the one side of the vein, or curved and even horseshoe-shaped.

Baguio, *Topping* 284, *Elmer* 5787.

*A. toppingianum* var. *mistum* Copeland. Differs from the type in being larger, with the teeth of the pinnae more rounded, and especially in the lowest pair of pinnae, which are of more than twice the dimensions of those above, and deeply incised.

Baguio, with the type, *Topping* 194.

(9) *A. subnormale* Copeland. Fronds solitary or few on a short, creeping, terrestrial rhizome; stipe about two-fifths of the total height, smooth except at the base, slender, seldom straight, dark and polished, but shading into a green rachis with green lateral lines representing wings; frond 4 to 9 cm. high, lanceolate-ovate, acute, apex not rooting, pinnate; distinct pinnae about 6 pairs, 2 or 3 more pairs indicated by clefts, the lowest smaller than or equalling the next above, crenate, mostly trapezoid, irregular in shape, but the lower half of the pinnae always cut away to the midrib at the base, the base of the acroscopic half parallel to the rachis: sori 6 or less to the pinna, not confluent; indusia narrow.

Lamao River, Bataan Province, *Copeland* 236, 1395.

(10) *A. normale* Don. Stipe 2 to 6 cm. long, tufted, wiry, blackish, polished; frond 10 to 25 cm. long, 10 to 17 mm. broad, with very numerous close-placed pinnae, the lower ones reduced and deflexed, the point obtuse, the edge inciso-crenate, the upper side auricled and narrowed suddenly at the base, the lower truncate in a straight line; texture herbaceous; rachis glossy, nearly black; veins mostly once forked; sori in two unequal parallel rows.

Benguet, *Loher*, *Elmer* 6537.

Madagascar to Japan.

Christ inclines to regard this as a form of *A. Trichomanes*, to which the Benguet plants are very close. This description is adapted to our plant.

(11) **A. resectum** Smith. Rhizome slender, creeping on ground; stipes scattered, slender, 10 to 25 cm. high, dark brown, polished; fronds 20 to 30 cm. high, 6 cm. broad, acuminate with numerous subsessile pinnæ, the lowest not reduced; pinnæ with more than half of the basiscopic side cut away, base of upper side truncate at a right angle, rather obtuse, margin inciso-crenate except the part cut away, membranaceous, glabrous; rachis like the stipe or sometimes green above; veins once or twice forked; sori not touching either costa or edge.

Luzon, *Cuming* 110; Tonglon 2,250 m., *Loher*; Isabela Province, *Warburg* 11607; Davao, *Copeland* 955, 1112.

Africa to Hawaii.

(12) **A. multilineatum** Hook. Stipe 15 cm. high, firm, erect, naked, grayish green; frond 30 to 45 cm. long, 15 to 20 cm. broad, oblong-lanceolate, with a long linear-lanceolate terminal pinna and 9 to 18 lateral ones on each side, which are 10 to 15 cm. long, 12 to 20 mm. broad, acuminate, the edge faintly toothed, but the point more deeply, the base cuneato-truncate with a short petiole; texture herbaceous; color dark-green; rachis naked; veins mostly simple, with sori on each reaching from the midrib to the edge.

Tonglon 2,250 m., *Loher*.

Samoa and Fiji.

(13) **A. wightianum** Wall. Stipes tufted, 15 to 25 cm. high, greenish, naked; frond 30 to 45 cm. long, 15 to 20 cm. broad, oblong-lanceolate, with 6 to 9 pinnæ on each side, which are distinctly stalked, and the lowest 5 cm. apart, 12 to 15 cm. long, 12 to 18 mm. broad, acuminate, irregularly crenate, the base gradually truncate-cuneate, equal on both sides; texture coriaceous; color pale green; veins inconspicuous, distant, often forked; sori distant, falling short of the edge.

Luzon, *Steere*.

Madras and Ceylon.

(14) **A. tenerum** Forst. Stipes tufted, firm, erect, grayish, nearly naked, 6 to 25 cm. high; frond 10 to 40 cm. long, 3 to 12 cm. broad, oblong-lanceolate, with 10 to 25 stalked horizontal pinnæ on each side, which are  $1\frac{1}{2}$  to 4 times as long as broad, bluntly rounded at the point, the edge deeply toothed throughout, the two sides unequal, the upper one narrowed almost at a right angle, sometimes slightly auricled, the lower one very obliquely truncate, lower pinnæ deflexed; texture herbaceous; rachis compressed; veins usually simple; sori numerous, regular, parallel, not reaching either edge or midrib.

Maquiling, *Loher*; Davao, *Warburg* 14146; Baco River, Mindoro, *Merrill* 1771 (very large); Gimogon River, Negros, *Copeland* 78; Mount Mariveles 1,050 m., *Copeland* (very small).

Ceylon across Polynesia.

This fern varies widely in stature, but is comparatively constant in other respects.

(15) **A. lunulatum** Swartz. Stipes tufted, 5 to 10 cm. high, firm, nearly naked, gray or ebeneous; frond 15 to 45 cm. long, 3 to 5 cm.

broad, narrowly lanceolate-oblong, with 12 to 20 horizontal pinnae on each side, which are 3 to 4 cm. long, 1 cm. broad, bluntish or acute at the point, more or less deeply inciso-crenate throughout, the two sides unequal, the upper one at the base narrowed suddenly at about a right angle, the lower one obliquely truncate; lower pinnae often deflexed; texture herbaceous; rachis firm, grayish; veins simple or once forked; sori falling short of both edge and midrib.

Mountains of Panay, *Steere*.

Tropics, everywhere.

(16) **A. Steerei** Herrington. Stipe dark gray, 12 to 15 cm. high, firm, with a few small, brown, scattered scales; frond 20 to 25 cm. long, 5 cm. broad, oblong-lanceolate; pinnae 12 to 15 on each side, short petioled, 3 to 5 cm. long, 1 cm. broad, apex acute, margin coarsely crenate, unsymmetrical; upper side abrupt at the base with a more or less distinct large lobe; lower side obliquely truncate; lower pinnae slightly deflexed; texture firm, herbaceous; surface dark green above, brownish below; veins distant, simple, or once forked; sori 2 to 8 in a row on each side of the midrib, regular, falling a little short of midrib and margin.

Mount Majajay, Luzon, *Steere*, in small clusters on tree trunks.

(17) **A. prionurus** J. Sm. Stipes tufted, 15 to 25 cm. high, firm, erect, slightly scaly below; frond 30 to 45 cm. long, 15 to 25 cm. broad, oblong, with 9 to 18 pinnae on each side, which are 10 to 15 cm. long, rather over 1 cm. broad, very acuminate, deeply and regularly toothed throughout, the base rather unequal, more truncato-cuneate on the lower side, with a short, distinct petiole on the lower ones; texture herbaceous; veins usually simple, with sori on each reaching nearly to the edge.

Philippines, *Cuming* 197.

Ferns collected by DeVore and Hoover, 348 and 377, from Mount Apo, probably represent this species, but are too imperfect for certainty; they seem equally near *A. lineatum* Swartz, indicating, as is suggested in Synopsis Filicum, that the two species are not distinct.

(18) **A. persicifolium** J. Sm. Stipe and rachis gray, with a few scattered minute gray scales; frond oblong-lanceolate, 60 to 90 cm. long, often gemmiparous at apex; pinnae distant, ascending, 15 to 30 jugate, subpetiolate, 10 to 12 cm. long, linear-ligulate-acuminate, 1 to 2 cm. broad, distinctly inciso-crenate throughout, more cuneate on the lower than on the upper side at the base, the lowest not reduced; texture thin but firm; surfaces dark green, naked; veins erecto-patent, fine, forked, not close; sori regular, parallel, 6 to 8 mm. long, reaching nearly to midrib and edge.

Southern Luzon, *Baranda*.

Formerly accredited to Hawaii, but incorrectly, according to Hillebrand, Flora of Hawaiian Islands, p. 591.

(19) **A. griseum** Copeland. (*A. insigne* Copeland in Perkin's Fragmenta, not of Blume nor Liebm.) Rhizome short, stout, densely coated with large, brown scales; stipe 40 to 50 cm. high, stout, dark green or brown, slightly chaffy; frond 30 cm. broad, more than 60 cm. high, pinnate; pinnae about 12 pairs, stipitate, about 20 cm. long by 3.5 deep, lanceolate, acuminate, subserrate, tough-herbaceous, ash-green, somewhat unequal at



the base, cuneate below, truncate-cuneate above; veins oblique, usually forked, conspicuous, sori large, close to the midrib and reaching half way to the margin.

Davao, Mindanao, on rocky bed of Sibulan River, altitude, 700 m., *Copeland* 983.

The apex of fertile fronds often wanting.

(20) *A. hirtum* Kaulf. Stipes tufted, 5 to 10 cm. high, strong, erect, brownish, deciduously fibrillose; frond 30 to 60 cm. long, 10 to 20 cm. broad, with very numerous horizontal pinnæ on each side, which are 5 to 8 cm. long, 1 cm. broad, acuminate, broadly not deeply toothed, the base on the upper side conspicuously auricled, on the lower side rather suddenly but obliquely narrowed; texture coriaceous; rachis dark colored, strong, more or less fibrillose; veins oblique (Syn. Fil. says inconspicuous; Diels says evident); sori in two regular rows, which fall considerably short of the edge.

Mount Mariveles, *Merrill* 3760, *Barnes*; Mount Arayat, *Merrill* 3816, *Topping*; southern Luzon, *Baranda*; Mount Apo, *DeVore* and *Hoover* 319.

Madagascar to Polynesia.

*A. hirtum* Kaulf. var. *repressum* Copeland. Differs from the type in being smaller, less than 20 cm. high, almost sessile, and having obtuse pinnæ.

Mount Mariveles, 1,200 m., on exposed ridges, *Merrill* 3212.

*Asplenium meyenianum* Presl, Epim. Bot. p. 73, said to differ from *A. hirtum* in the serration of the pinnæ and the form of the pubescence is probably not really separable from it.

Manila, *Meyen*, *Cuming* 147.

(21) *A. anisodontum* Presl. Stipes tufted, firm, erect, gray, naked or slightly fibrillose; frond 30 to 45 cm. long, 10 to 15 cm. broad, with numerous horizontal or subfalcate sessile pinnæ on each side, which are 5 to 8 cm. long, 1 cm. broad, acuminate, ineiso-crenate, the base on the upper side auricled and narrowed rather obliquely, on the lower side obliquely truncate; texture subcoriaceous; rachis firm, erect; veins oblique, mostly once branched; sori parallel, in two regular rows, reaching nearly from the midrib to the edge.

Luzon, *Cuming* 128.

Java.

No. 334 of *DeVore* and *Hoover*, from Mount Apo (but from no such altitude as their label states) may be *A. anisodontum*, but is serrate, not crenate; many pinnæ have a free lobe in the place of an auricle, as *A. Steerei* is described.

(22) *A. macrophyllum* Swartz. Stipes tufted, 15 to 30 cm. high, stout, erect, brownish, nearly naked; frond 15 to 45 cm. long, 15 to 30 cm. broad, with 6 to 12 opposite pairs of stalked nearly horizontal pinnæ, which are 10 to 20 cm. long, 3 to 8 cm. broad, acuminate, sharply serrate, the two sides nearly equal, but the lower one narrowed rather more obliquely; texture subcoriaceous; rachis naked, firm, erect; veins very oblique; sori in close long parallel lines reaching from the midrib nearly to the margin.



Masbate and southern Luzon, *Baranda*; Montalban, *Loher*; Mariveles, 1,400 m., *Loher*, *Whitford* 275; Culion, *Merrill* 509. *Elmer's* 6147, from Baguio, is a small form of this.

India across Polynesia.

(23) *A. falcatum* Lam. Rhizome short-creeping; tips tufted, 10 to 15 cm. high, firm, erect, dark grayish, nearly naked; frond 15 to 35 cm. high, 7 to 15 cm. broad, with 6 to 12 stalked pinnae on each side, which are 4 to 7 cm. long, 1 to 1.5 cm. deep, acuminate, shallowly lobed and lobes toothed, inequilateral, lower side very obliquely truncate, texture coriaceous; rachis almost naked; veins very oblique; sori reaching almost to margin.

Luzon, *Haenke*; Calolbon, Catanduanes, *Baranda*.

Zambesi Land to New Zealand and Polynesia.

*A. chamissonianum* Presl, collected "at Manila" by *Chamisso* and *Meyen*, may be a form of *A. falcatum*.

(24) *A. contiguum* Kaulf. Stipes tufted, 15 to 25 cm. high, firm, erect, chestnut-brown, naked; frond 30 to 45 cm. long, 10 to 15 cm. broad, with 20 to 30 horizontal subfalcate pinnae on each side, which are acuminate, more or less deeply inciso-serrate or lobed, the base narrowed suddenly, and sometimes auricled on the upper, obliquely truncate in a curve on the lower side; texture subcoriaceous; rachis firm, naked or slightly villose, chestnut-colored; veins oblique, obscure; sori close, copious, falling considerably short of the margin.

Arayat, 800 m., *Loher*; Montalban, *Loher*; Baguio, *Topping* 317.

Hawaii, Hindostan.

*A. contiguum*, var. *bipinnatifidum* Christ, Bull. Herb. Boiss. 6 (1898); 152. Pinnae again pinnate at the base; pinnules cuneiform, auriculate, deeply dentate; looking like a hybrid between *A. contiguum* and *A. affine* Sw.

Arayat, 800 m.; Tonglon, 1,900 m., *Loher*.

*A. lepturus* Presl, Epim. Bot., p. 72, is described as differing from *A. contiguum* in the form of the frond, which is lanceolate, about 20 cm. high, and in the incision of the pinnae into sharply and inequally serrate, truncate lobes; the sori seem to be costal, as in *A. caudatum*.

Luzon, *Cuming* 211.

(25) *A. crinicaule* Hance. Stipes densely tufted, 8 to 10 cm. long, erect, dark brown, slightly fibrillose; frond 15 to 20 cm. long, 4 cm. broad, with 9 to 15 horizontal pinnae on each side, which are 2 cm. long, hardly 1 cm. broad, bluntish, irregularly inciso-crenate, the upper side narrowed suddenly, sometimes auricled at the base, the lower obliquely truncate; texture subcoriaceous; rachis firm, slightly fibrillose, no distinct midrib; veins subflabellate; sori few, linear, very oblique.

Davao, *Warburg* 14163 and 14178.

India, southern China.

(26) *A. caudatum* Forst. Rhizome very short, adscendent; stipes tufted, 6 to 15 cm. high, firm, erect, densely clothed with fine, brown fibrillose scales; frond 15 to 35 cm. high, 8 to 16 cm. broad, with 20 to 30 pinnae on each side, the point acuminate, the edge deeply toothed sometimes

lobed more than half way down to the rachis in the lower part, the two sides unequal, the upper auricled and narrowed suddenly, the lower very obliquely truncate at the base; texture coriaceous; rachis deciduously villose; veins very oblique; sori subflabellate.

Arayat, 800 m.; Tonglon, 2,250 m.; Mariveles, 1,400 m., and Montalban, *Loher*, pinnae strongly auricled, resembling *A. dimidiatum*, but the point acuminate; Nueva Vizcaya, *Merrill* 295; Baguio, *Topping* 266.

Tropics, around the world.

*A. polyodon* Forst., collected at Sorsogon by *Haenke* and in Laguna by *Cuming*, and *A. zamiaefolium* Presl, collected at Sorsogon by *Haenke*, are hardly separable by the descriptions from *A. caudatum*. *Tarachia truncatiloba* Presl is also the plant commonly called *A. caudatum*—on the assumption that the real *A. caudatum* Forst. is not, as Presl states, *A. horridum* Kaulf.

(27) *A. cuneatum* Lam. Stipes tufted, 15 to 25 cm. high, firm, erect, naked; frond 15 to 40 cm. long, 15 to 25 cm. broad, with numerous spreading pinnae on each side, the lower ones 10 cm. long, 3 cm. broad, lanceolate-deltoid, cut down to the rachis into several distinct ovate-cuneate pinnules, which are inciso-dentate and cut down in the lower part nearly or quite to the rachis; texture subcoriaceous; rachis firm, grayish, nearly naked; veins fine, conspicuous on the upper surface; sori linear, subflabellate.

Davao, *Warburg* 14144; Maquiling, *Loher*.

Tropics, everywhere.

See comment under *A. laserpitiifolium*.

(28) *A. affine* Swartz. Stipe 15 to 30 cm. high, firm, erect, gray, nearly naked; frond 30 to 45 cm. long, 15 to 30 cm. broad, with numerous pinnae on each side, the lower ones lanceolate-rhomboidal, cut down to the rachis into numerous distinct rhomboidal pinnules, which are again inciso-serrate or deeply lobed; texture subcoriaceous; rachis firm, naked; veins subflabellate; sori copious, linear.

Luzon, *Steere*; Mount Mariveles, 1,400 m., *Loher*.

Ceylon to Hawaii.

(29) *A. nitidum* Swartz. Stipe stout, erect, grayish-black, naked; frond 6 to 10 dm. high, with numerous lanceolate-deltoid pinnae, the lowest of which are 20 cm. long, 8 cm. deep, with numerous stalked subdeltoid pinnules, which are again cut down to their rachis into broad, flabellato-cuneate segments inciso-serrate round the outer edge; texture subcoriaceous; rachis stout, gray, naked; veins channeled, flabellate; sori short, radiant.

Montalban, Marambibi, *Loher*.

India and Malaya.

This description covers two ferns.

(30) *A. laserpitiifolium* Lam. Stipes tufted on an erect scaly root-stalk, 20 to 40 cm. high, stout, erect, gray-black, naked; fronds reaching a length of above 1 m., by one-third as broad, with numerous pinnae; the lowest pinnae deltoid-lanceolate, with numerous stalked pinnules, the lowest of which are again pinnate, and their segments incised or pin-

natifid; texture herbaceous; veins fine, deeply channeled; sori short, linear-oblong, irregular.

Luzon, *Cuming* 43, *Chamisso*; southern Luzon, *Baranda*; Montalban, *Loher*; Batangas, *Marave*; Bataan Province, *Barnes* 153; Mindoro, *Merrill* 1814; Mindanao, *Née*.

India, across Polynesia.

This and the preceding three species are decidedly too near together. Young plants of *A. laserpitiifolium*, and plants in poor situations, bear fronds indistinguishable from those of the less dissected species. Thus plants from Davao that would very probably have become typical *A. laserpitiifolium* bear fronds smaller and less dissected than typical *A. cuneatum*; and the same is true of Elmer's 6538, from Benguet.

(31) *A. praemorsum* Swartz. Stipes tufted, 10 to 20 cm. high, firm, erect, wooly; frond 15 to 45 cm. long, 10 to 15 cm. broad, with 12 to 20 pinnæ on each side, which are lanceolate-deltoid in general outline, 5 to 8 cm. long, 2 cm. broad, cut down throughout nearly or quite to their rachis into linear-cuneate pinnules, which are sharply serrate on the outer edge; texture coriaceous; rachis firm, erect, more or less fibrillose like the stem; veins deep-channeled, flabellate; sori linear, radiant.

Arayat, 800 m.. *Loher*.

Most tropical countries.

Specimens from Mount Apo, *Copeland* 1195, differ in that the pinnules are ovate-cuneate, giving a very different appearance.

#### § *Darea*.

(32) *A. Belangeri* Kunze. Stipes tufted on a very short, chaffy root-stalk, erect, 15 to 30 cm. high, greenish, naked except near the base; frond 30 to 40 cm. high, 10 to 12 cm. broad, with numerous horizontal pinnæ about 6 cm. long, 1.5 cm. deep, obtuse, the basiscopic side obliquely truncate at the base, acroscopic somewhat auricled; cut down throughout to a regularly winged rachis into linear, erecto-patent segments 1 mm. broad separated by more than their breadth, the lowest of which are once or twice forked; texture subcoriaceous; color pale green; rachis compressed; one vein and sorus to each segment, the latter marginal.

Davao, *Warburg* 14133 and 14164, *Copeland* 1198.

Sumatra to Amboyna.

The Davao plants, to which this description is adapted, differ from the typical in being broader, in the frequently more than once forked lower segments, the chaffy base of the stipe, and thinner texture.

(33) *A. scandens* J. Sm. Mett. Stipes scattered on a stout scandent rhizome, very short; frond 30 to 60 cm. long, 15 to 30 cm. broad, with numerous horizontal pinnæ, which are 10 to 15 cm. long, 4 cm. broad, cut down to a distinctly winged rachis into numerous subdistant ovate-rhomboidal pinnules, which are cut down to a rachis throughout; lower segments again pinnatifid; ultimate divisions narrowly linear; texture thinly herbaceous; rachis firm, erect; one vein in each division; sori solitary, marginal.

Leyte, *Cuming* 297.

New Guinea.

§ *Athyrium*.

(34) *A. (Athyrium) Sarasinorum* (Christ Ann. Jard. Bot. Buitenz. 15 (1898):123, var. *philippinense* (Christ Bull. Herb. Bois. 6 (1898): 154). Caudex short, bearing long, dark-brown scales; stipes 3 to 6 in a cluster, slender, weak, brown, sparsely scaly, 15 cm. or more high; frond above 10 cm. high, two-fifths as broad, acute, tripinnatifid; pinnae 10 or more on each side, alternate, the lowest the longest; pinnules sessile or the lowest short stalked, round-oval, divided to the costa below into segments which in turn are incised into linear-lanceolate subacute lobes; sori 1 to each lobe, slightly curved, with oval, loose, brown indusia.

Mount Data, Benguet, 2,250 m., *Loher*.

The type of the species in Celebes.

(35) *A. (Athyrium) nigripes* Blume. Stipes tufted, 15 to 30 cm. high, stramineous, erect, scaly below; frond 30 to 60 cm. long, 20 to 30 cm. broad, ovate-lanceolate, with numerous pinnae on each side, the lowest lanceolate, 15 to 25 cm. long, 4 to 5 cm. broad, cut down to the rachis into numerous elliptico-rhomboidal pinnules, which are broadly lobed about half way down and the lobes slightly toothed; texture herbaceous; lateral veins of the segments forked; sori linear-oblong, often curved, 2 to 3 mm. long, principally in two parallel rows close to the midrib of the pinnule.

Mount Arayat, 800 m., *Loher*.

India to Java and Japan.

(36) *A. (Athyrium) woodwardioides* (Presl) Baker. Stipe firm, erect, naked, dark chestnut-brown; frond 60 to 100 cm. long, 30 cm. or more broad; lower pinnae 15 to 25 cm. long, 8 cm. broad; pinnules lanceolate, slightly stalked, 4 cm. long, 1 cm. broad, cut down two-thirds of the way to the costa into linear-oblong, subfalcate, finely toothed lobes, herbaceous, glabrous; veins pinnate in the lobes, with 4 to 5 veinlets on a side, the upper ones forked, ends clavate; sori oblong, confined to the lower lobes close to the costa and not reaching more than half way to the margin.

Luzon, *Cuming* 153; Baguio, *Loher*.

• Java.

(31) *TRIPHLEBIA* Baker.

Veins free; sori borne on a special receptacle between two parallel veins; indusium double, each bounding vein bearing half of it, opening regularly down the middle. Our two species are exclusively Philippine.

(1) *T. longifolia* (Presl) Baker. Differs from the following species only in that the frond is simple and entire, and the line where the two halves of the indusium meet is not emphasized.

Luzon, *Haenke*; Sorsogon, *Baranda*; Davao, *Warburg* 14117.

(2) *T. pinnata* (J. Sm.) Baker. Stipe compressed, grayish; frond 50 to 120 cm. long, lanceolate-deltoid, rooting at the apex, with an entire or finely crenate terminal pinna and 1 to 6 pairs of similar lateral ones, glabrous, subcoriaceous; veins usually once forked; sori numerous, oblique, linear, the indusium ridged where the halves meet.

Philippines, *Cuming* 187, 311; Biga, Catanduanes, *Baranda*.

(32) *STENOCHLAENA* J. Smith.

High-scandent ferns, with pinnate dimorphous or polymorphous fronds; veins free near the margin; sori parallel to the costa, finally spreading over the whole under surface; indusium wanting. The stipe in some species is segmented to the rhizome, as in *Polypodieæ*. *Stenochlaena* is not very evidently related to any other genus.

1. Stipes articulate to the rhizome.

2. Rhizome scaly, frond herbaceous ..... (1) *S. sorbifolia*

2. Rhizome naked, frond coriaceous ..... (2) *S. palustris*

1. Stipes not articulate to rhizome..... (3) *S. laurifolia*

(1) *S. sorbifolia* (L.) J. Sm. Rhizome climbing indefinitely high, woody green, muricate, bearing few hard brown scales (roots?); stipes obscurely articulate to rhizome, 10 to 30 cm. long, stramineous with or without a conspicuous umber line; frond simply pinnate, the segments articulate to the rachis on stalks about 1 cm. long; sterile pinnæ 15 cm. long, nearly 2 cm. broad, acuminate, entire or obscurely serrate, base cuneate, glabrous, herbaceous or subcoriaceous; fertile pinnæ 20 cm. long, filiform.

Castillo, 800 m., and Mariveles, 1,400 m., *Loher*; foot of Mariveles, *Barnes Forestry Bureau* 368; Isabela Province, *Warburg* 11600, 11974, 11978; Paragua, *Merrill* 773; Davao, *Warburg* 14107, 14108, 14111.

Pantropic.

Beside the sterile fronds described above, bipinnate variously incised or divided ones also occur.

*S. haenkeana* Presl is a dubious species described from the sterile plant alone; the pinnæ are elliptic-oblong, abruptly acuminate, rounded at the base, the terminal twice as large as the lateral; rhizome and base of stipe clothed with peltate scales.

Sorsogon, *Haenke*.

(2) *S. palustris* (L.) Mett. Rhizome climbing indefinitely, scaleless; stipes naked, 15 to 30 cm. long; fronds 50 to 80 cm. long the sterile rather the larger, pinnate, with almost sessile pinnæ articulate to the rachis; pinnæ of sterile frond 10 to 12 cm. long, 2.5 cm. broad, finely but sharply serrate, subcoriaceous, the two sides at the base forming a right angle; segments of the fertile frond 15 to 20 cm. long, 3 mm. broad, the lower ones remote.

Luzon, *Haenke*, *Cuming* 133; Davao, *Copeland* 532.

India to Queensland and Fiji.

*S. juglandifolia* Presl is described as differing from *S. palustris* in having longer naked petioles, the sterile pinnæ rounded at the base, fertile pinnæ leafy at the base, and muricate stipes; it is usually regarded as only a form of the same species.

Luzon, *Haenke*, *Cuming* 133 in part.

(3) *S. laurifolia* (Hook.) Diels. Stipes firm, erect, naked; frond 60 to 90 cm. long, 30 to 45 cm. broad, simply pinnate; sterile pinnæ 15 to 25 cm. long, 4 cm. broad, narrowed gradually from the cordate base to



the apex, sharply but finely toothed, sessile, not articulate to the rachis and without a gland, coriaceous, glabrous; fertile pinnae 15 to 25 cm. long, about 1 cm. broad, the lower ones 1 cm. apart.

Luzon, *Cuming* 226.

Solomon Islands.

**S. fraxinifolia** Presl Epim. Bot., p. 164. Pinnae stalked; the sterile oblong-lanceolate, acuminate, subacute and equal at the base; fertile pinnae narrowly linear. This plant is included by J. Smith under *S. scandens*, and placed by Presl close to *S. laurifolia*, but with a different characterization of the latter from that just given.

Negros, *Cuming* 347.

### (33) **BLECHNUM** Linnaeus.

Sterile fronds with free veins (except in *B. areolare*), fertile with a series of areolæ along the costa, otherwise free; sori along the far side of these areolæ, linear, usually continuous, parallel to the costa, sometimes spreading over the parenchyma; indusium the shape of the sorus, opening on the costal side. Mostly terrestrial ferns of moderate size, with erect caudices. The two sections are usually treated as genera, but are not sufficiently distinct.

1. § *Eublechnum*: sori close to the costa; fertile and sterile fronds not exceedingly different.
  2. Fronds pinnatifid ..... (1) *B. nitidum*
  2. Fronds pinnate.
    3. Lower pinnae contracted at base..... (2) *B. orientale*
    3. Pinnae with spreading, adherent base..... (3) *B. cgregium*
1. § *Lomaria*: sori occupying most of the space from costa to margin; fronds decidedly dimorphous.
  2. Simply pinnate.
    3. Sterile frond with costal areolæ..... (4) *B. areolaris*
    3. Sterile frond with free veins..... (5) *B. capense*
  2. Bipinnate ..... (6) *B. Fraseri*

(1) **B. nitidum** Presl. Stipes stout, erect, naked, 10 cm. high; frond oblong-lanceolate, 30 cm. or more long, 10 to 15 cm. broad; pinnae numerous, erecto-patent, subfalcate, linear, 10 cm. long, 1 cm. broad, narrowed gradually toward the point, dilated and connected at the base, the edge undulato-crenate, the lower ones linear-acute and not much smaller than the rest; texture coriaceous, both surfaces and rachis naked; veins fine; sori in a continuous line close to the midrib; indusium conspicuous.

Luzon, *Cuming* 164; Sorsogon, *Haenke*.

India, Polynesia, southern Brazil.

(2) **B. orientale** L. Caudex erect, often subarborescent, clothed at the crown with fibrillose, dark-brown scales; stipe 15 to 30 cm. high, strong, erect, scaly at the base; frond 40 to 100 cm. high, ovate, with very numerous close linear pinnae; pinnae 10 to 25 cm. long, 1 cm. broad, narrowed to a long point, contracted to a sessile base, the upper ones decurrent, the lowest abruptly reduced to mere auricles strung along the stipe; subcoriaceous, glabrous; sori in a long continuous line close to the midrib.

Isabela, *Warburg* 11975; Benguet, *Loker*, *Elmer*, 5824, *Topping* 243, 298;



Nueva Vizcaya, Merrill 256; Culion Merrill 480; Panay, Copeland 56; Basilan, DeVore and Hoover 56.

India to Australia and Polynesia.

The following species are included under *Blechnum orientale*: *B. eum- ingianum* Presl, Luzon, Cuming 257, 259, 166; *B. pyrophyllum* Blume, Luzon, Meyen; *B. elongatum* Presl, Manila, Meyen; *Blechnopsis stenophylla* Presl, Luzon, Cuming 165, in part. *B. salicifolium* Kaulf., collected "at Manila" by Chamisso, I have not been able to locate.

(3) *B. egregium* Copeland. Stipes clustered in form of a nest, 10 to 20 cm. high, stout, brown, black below and densely clothed with long black scales; frond about 1 m. high, 30 cm. broad, pinnate, glabrous, moderately dimorphous; pinnae acuminate, serrate, confluent at the top, lower down attached to the rachis by a broad base but distinct, at the bottom reduced gradually to remote auricles; fertile pinnae coriaceous, 15 cm. long, 15 to 20 mm. broad next the rachis, contracted gradually until the sorus occupies very nearly the whole breadth; pinnae of the sterile frond thinner but broader; indusia coriaceous, persistent.

Sibulan River, Davao, along mountain creeks, Copeland 1314.

(4) *B. areolaris* (Harrington, Journ. Linn. Soc. 16:28). Caudex long, slender, twisted, naked; stipe 15 cm. long in the sterile, nearly twice as long in the fertile fronds, glabrous; barren frond ovate, 10 to 15 cm. long, 10 cm. broad, pinnate; pinnae 7 to 9, lateral nearly sessile, terminal stalked, linear-lanceolate, 5 to 8 cm. long, 12 to 16 mm. broad, acute, finely serrate, obtuse or rounded at the base; texture coriaceous; nerves forming a series of arches close to the midrib, thus forming on each side a row of long narrow areolæ parallel to the midrib; beyond this, nerves are free and simple or forking; surface naked, except that the midribs and nerves are a little chaffy below; fertile pinnae 7 to 9, narrowly linear, 4 to 5 cm. long, rather distant; indusium narrow, marginal.

Mount Majayjay, growing among the leaves of a *Pandanus*, Steere.

(5) *B. capense* (L.) Schlecht (*Lomaria procera* Spr.). Caudex stout, woody, elongate, clothed with large ovate or lanceolate-acuminate ferruginous scales; stipe 15 to 30 cm. high, stout, erect, scaly below; frond 30 to 100 cm. high, one-third as broad, the fertile and sterile not always very different, coriaceous; pinnae of sterile frond linear, the lower stalked, with rounded or cordate base, acuminate; fertile pinnae narrowly linear; indusium broad, membranaceous, ciliate, sometimes slightly intramarginal; rachis densely chaffy.

Luzon, Cuming 141.

Southern Hemisphere and Mexico.

(6) *B. Fraseri* (Cunn.) Mett. var. *philippinense* (Christ). Caudex arborescent, 0.5 to 1.5 m. high, 1 to 2 cm. thick, black, clothed with lanceolate-ovate, dark brown, subulate scales 3 mm. long, and above with the bases of stipes, flexile, woody, bearing a crown of 6 to 8 fronds; stipe short, 3 to 4 cm. long, densely scaly; frond 40 cm. long, 20 to 25 cm. broad, long-acuminate, attenuate to the base; pinnae about 12 to 18 on each side, alternate, 1 to 2 cm. broad with their own breadth between them, strongly

decurrent, cleft almost to the costa into crowded lobes; lobes scarcely 1 cm. long, half as broad, triangular-oblong, subfalcate, finely but acutely serrate; rachis bearing triangular, often bifurcate lobes between the pinnae; sori linear, midway between the margin and midrib of the lobe but soon occupying the entire lamina; indusium narrow, gray, evanescent.

Central Cordillera of Luzon, gregarious, apparently fruiting rarely, *Loher*.

Type of the species in New Zealand.

(34) **WOODWARDIA** Smith.

Veins anastomosing to form a series of areolæ along the costa, and in our species several series of similar areolæ between this and the margin; sori linear-oblong, one occupying each costal areola, the indusium opening toward the costa. Large terrestrial ferns with bipinnatifid fronds.

(1) **W. radicans** (L.) Smith. Rhizome short, erect; stipe 40 to 100 cm. high, strong, naked except at the base; frond 1 m. or more high, one-third as wide; pinnae broadly lanceolate, acuminate, subsessile, cut down almost to the costa into narrowly linear segments serrate toward their apices, subcoriaceous.

Benguet, *Loher*, *Elmer* 6512.

Warmer parts of Northern Hemisphere.

Our plant is intermediate between *W. radicans* as originally described and *W. orientalis* Swartz of Japan and Formosa, which is no longer regarded as a distinct species.

## V. PTERIDEÆ.

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Stipes not articulate to the rhizome; frond at least pinnate, in most species more or less deltoid; sori near the margin, on the ends of the veins, or a strand connecting their ends, protected, except in *Nothochlaena*, by the inflexed and modified margin of the frond.

1. Sorus on inner face of reflexed lobe..... (35) *Adiantum*
  1. Sori on main body of frond, on tips of veins.
    2. Fronds not dimorphous.
      3. Indusium continuous ..... (36) *Doryopteris*
      3. Indusium interrupted.
        4. Sori distinct and solitary ..... (37) *Hypolepis*
        4. Sori more or less confluent..... (38) *Cheilanthes*
      3. Indusium wanting ..... (39) *Nothochlaena*
    2. Fronds dimorphous ..... (40) *Plagiogyria*
  1. Sori on intramarginal strand connecting vein tips.
    2. Extrorse indusium wanting.
      3. Ultimate divisions fine, almost covered by sori..... (41) *Onychium*
      3. Ultimate divisions more ample.
        4. Lowest pinnules like others ..... (42) *Pteris*
        4. Lowest pinnules stipule-like ..... (43) *Histiopteris*
    2. Extrorse indusium typically present.
      3. Stipe with many vascular strands..... (44) *Pteridium*
      3. Stipe with one vascular strand..... (45) *Paesia*
- (*Ceratopteris*, a fern growing in brackish or fresh marshes, may be looked for here; it is not in the *Polypodiaceæ*.)

### (35) ADIANTUM Linnaeus.

Stipes not articulate to rhizome, usually black and polished; frond, in our species, pinnate to tripinnate, pinnae inclined to be dimidiate; portions of the margin of the pinnules altered and reflexed, and a sorus borne on the inside of each such portion and protected by it. A natural genus of chiefly terrestrial ferns of most graceful habit, universally cultivated under the name of "maiden-hair."

1. Sporangia springing only from veinlets.
  2. Frond simply pinnate, apex rooting.
    3. Frond glabrous, pinnules stalked.
      4. Rachis not winged ..... (1) *A. philippense*
      4. Rachis winged ..... (2) *A. alatum*
    3. Frond hairy ..... (3) *A. caudatum*
  2. Frond tripinnate ..... (4) *A. Capillus-Veneris*
1. Sporangia on veinlets and parenchyma between them.
  2. Stipe and rachis glabrous ..... (5) *A. diaphanum*
  2. Stipe and rachis squamulose ..... (6) *A. hispidulum*

(1) *A. philippense* L. Stipes 5 to 20 cm. high, wiry, naked, polished, dark brown; from 15 to 25 cm. long, or the apex more prolonged and rooting, about 5 cm. broad, simply pinnate; pinnae variable, mostly about 2 cm. long by 1 cm. broad, more or less deciduous from the upper end of a stalk sometimes 15 mm. long, the side toward the rachis forming an obtuse angle with the basiscopic, or sometimes a straight line with it, the upper and outer margins rounded, more or less incised; veins only moderately conspicuous; sori narrower than the lobes they are borne on, and lunulate rather than straight. *A. lunulatum* Burm.

Luzon, *Cuming* 73; Philippines, *Kuhn*; Baguio, *Elmer* 6596; Pangasinan, *Merrill* 281; Lamao Forest Reserve, *Copeland* 397; Manila, *Marave*, *Topping* 6; Albay, *Baranda*.

Pantropic.

(2) *A. alatum* Copeland. Like the preceding species in size and general appearance; stipe, rachis, and petiolules with a membranous wing 0.5 mm. broad on each side; petiolules rather shorter; inner and lower sides of pinnae at about a right angle, upper side nearly straight; venation very prominent; sori the width of the lobes bearing them, straight rather than lunulate.

Lamao Forest Reserve, *Copeland* 243, 1399; Culion, *Merrill* 482.

(3) *A. caudatum* L. Stipes tufted, spreading, 3 to 10 cm. long, tomentose; frond 15 to 30 cm. long, usually elongate and rooting at the apex, simply pinnate; pinnae 10 to 15 mm. long, half as deep, horizontal or ascending, almost sessile, dimidiate, broadest next the base, lower line straight and entire, upper finely incised more deeply than in the preceding species, herbaceous or subcoriaceous, villose; veins prominent, close; sori mostly roundish, on the ends of the lobes.

Luzon, *Cuming* 11; Cagayan-Luzon, *Warburg* 12213; Benguet, *Loher*, *Elmer* 6403; Nueva Ecija, *Merrill* 278; Bataan Province, *Merrill* 1603, *Barnes Forestry Bureau* 164, *Whitford* 200; Manila, *Loher*, *Warburg*; Masbate, *Baranda*; Capiz, *Copeland* 55; Mindanao, *Cuming* 292; Davao, *Copeland* 633.

Africa to Malaya.

(4) *A. Capillus-Veneris* L. Stipes about 20 cm. high, black, polished; frond 20 to 40 cm. high, deltoid or narrower; lowest pinnae themselves sparingly bipinnate; ultimate segments fan-shaped, 10 to 18 mm. deep, with cuneate base and rounded, lobed outer side, membranous, glabrous; sori (in Philippine specimens) decidedly broader than deep.

Benguet, *Elmer* 6417; Mariveles *Loher*.

Southern Europe and Tropics everywhere.

(5) *A. diaphanum* Blume. Stipe 10 to 20 cm. high, slender, blackish, polished; frond 10 to 15 cm. high, 2 to 3 cm. broad and simply pinnate, or usually with 1 to 3 branches at the base, which are sometimes nearly as large as the terminal one; pinnules 1.5 cm. long, half as deep, lower line rather decurved, upper parallel with it and crenate like the outer edge, membranaceous, not quite glabrous; sori round-reniform, in the sinuses of the upper and other margin. Beside the usual mature form, young plants

with simply pinnate fronds hardly 3 cm. high, on filiform stipes, are sometimes copiously fertile.

Benguet, *Loher*, *Topping* 225, 280; Lamao Forest Reserve, *Whitford* 266, *Copeland* 1400; Davao, *Copeland* 969, 1113.

China to New Zealand.

(6) **A. hispidulum** Sw. Stipe (in Philippine plants) 3 to 15 cm. high, deciduously squamulons, then scabrous; frond pseudo-pedate, really tripinnate at base, the longer pinnae ascending together or somewhat divaricate; segments about 1 cm. long, over half as deep, lower ones stalked, lower side entire and straight or curved upward, upper and outer sides sharply toothed, subcoriaceous, not quite glabrous; rachises decidedly hairy; sori round, contiguous around the upper and outer margin; indusium hairy, conspicuously veined. Our plant is not the typical *A. hispidulum*, but does not seem to me reasonably separable from it.

Mount Mariveles, 1,200 m., *Merrill* 3256, *Copeland* 1390.

Paleotropic.

(36) **DORYOPTERIS** J. Smith.

Rhizome short, its paleae costate; stipe black and shining; frond more or less deltoid, simple or pinnate with the pinnae not articulate to the rachis, opaque; sori terminal, submarginal, in our species fusing laterally and forming a continuous marginal line, protected by the narrow indusium formed by the inflexed margin. A chiefly American genus, represented here by two terrestrial species, readily distinguishable from *Pteris* by the black stipes.

(1) **D. concolor** (Langsd. & Fisher) Kuhn. Stipe 10 to 15 cm. high, erect, wiry, with a few scales near the base like those on the rhizome; frond triangular, 5 to 10 cm. each way, cut down nearly to the rachis into 3 to 5 pairs of segments, of which the lowest, sometimes distinct pinnae, are much the largest, and especially deeply cut on the lower side into oblong segments, which in turn are deeply lobed, with margin entire in detail, subcoriaceous, opaque, glabrous or glaucous beneath, greenish above, brown beneath; veins free, invisible, midribs conspicuous, black.

Luzon, *Cuming* (260 ?); Benguet, *Elmer* 6481; Manila, *Loher*.

Pantropic.

(2) **D. ludens** (Wall.) J. Sm. Rhizome slender, creeping; stipe about 10 cm. high, that of fertile frond higher, naked unless at the base; sterile frond variable in shape, ovate-lanceolate or triangular, hastate, deeply cordate or auriculate, sometimes with two or three pairs of lobes, acuminate, with entire or crisped margin, subcoriaceous, glabrous, pale green beneath, dark above; fertile frond deltoid, 15 to 20 cm. high, cut down to a central part 10 to 15 cm. broad into terminal segment and 1 to 3 pairs of lateral ones, of which the lowest are deeply forked, all acuminate, ascending, entire; veins hidden, anastomosing everywhere; fruiting line continuous except at the tips of the segments, narrow.

Luzon, *Cuming* 238; Benguet, *Elmer* 6349; Rizal, *Loher*.

India and Malaya.



(37) **HYPOLEPIS** Bernhardi.

Rhizome creeping, stipes not articulate to it; fronds at least bipinnate, thin, pubescent; veins free, sori hardly terminal, single in the sinuses, protected by reflexed marginal lobes too small to cover them permanently. Our species is a large terrestrial fern.

(1) **H. tenuifolia** Bernh. Rhizome wide-creeping, densely glandular-puberulent; stipe about 30 cm. high, maroon, shining, puberulous like the rhizome but less so; frond 50 to 250 cm. high, quadripinnatifid; lower pinnae ovate-lanceolate, 20 to 50 cm. long; pinnules about 10 cm. long, lanceolate; pinnules of second order 2 to 3 cm. long, lanceolate, cut down about to the rachis into linear-oblong, toothed ultimate divisions, herbaceous, sparingly glandular-pubescent beneath, the rachises more so; sori placed in the sinuses of the teeth or ultimate divisions. The resemblance of this species to *Nephrodium rugulosum* is most striking, extending to every detail except the position and protection of the sori; and in that matter I have specimens of the later species with the sorus nearer the margin than usual, with the tip of the tooth somewhat curled upward, strongly suggesting that these two ferns, apparently representing widely separated groups, may really be the same.

Luzon, *Cuming* 118, 140, 233; Benguet, *Loher*; Lamao River, *Copeland* 233; Mount Apo, *Copeland* 1130, this plant possibly distinct.

Malaya to New Zealand.

(38) **CHEILANTHES** Swartz.

Rhizome short, scaly; fronds at least bipinnatifid; veins free; sori terminal on their thickened ends, usually confluent at maturity, protected at first or permanently by the infolded and modified (membranous) margin of the frond. Terrestrial ferns, chiefly of warm and dry countries.

- |  |                          |
|--|--------------------------|
| 1. Lower pinnae smaller than others.....     | (1) <i>C. Boltoni</i>    |
| 1. Lower pinnae somewhat larger than others. |                          |
| 2. Frond glabrous, not waxy.                 |                          |
| 3. Frond lanceolate, bipinnatifid .....      | (2) <i>C. varians</i>    |
| 3. Frond deltoid, tripinnatifid .....        | (3) <i>C. tenuifolia</i> |
| 2. Frond waxy beneath.                       |                          |
| 3. Frond and stipe chaffy.....               | (4) <i>C. rufa</i>       |
| 3. Frond and stipe not chaffy.....           | (5) <i>C. farinosa</i>   |
| 1. Lowest pinnae decidedly largest.....      | (6) <i>C. argentea</i>   |

(1) **C. Boltoni** Copeland. Stipes densely clustered, 15 to 30 mm. high, brown-black, sparsely clothed with hairs of the same color; frond linear-oblongate, larger ones 16 cm. high, 15 mm. broad, bipinnate, broadest two-thirds of the way to the top; pinnae almost sessile, remote, larger ones 8 mm. long, 6 mm. broad; pinnules 1 to 5 pairs, ovate, minute, crenulate, plane when moist, curling up when dry, glabrous, very thin but firm when dry; indusium interrupted.

Malalag, Davao, on rocks along sea, *Copeland* 616.

(2) **C. varians** Hooker. Stipes densely tufted, 5 to 15 cm. high, chestnut-brown, polished, fibrillose below, slender and brittle; frond 15 to 25 cm.



high, narrowly lanceolate, bipinnatifid; pinnae in numerous pairs, lower ones opposite, very remote, 3 cm. long, deltoid-acuminate, cut down to the rachis in the lower part into oblong or linear-oblong entire or slightly toothed lobes, herbaceous, glabrous; sori copious, continuous; indusium narrow.

Luzon, *Cuming* 408.

Himalayas to Malacca and southern China.

(3) *C. tenuifolia* (Burm.) Swartz. Rhizome short-creeping; stipes subtufted, 10 to 20 cm. high, wiry, flexuose, dark brown, polished; frond 10 to 20 cm. high, deltoid, tripinnatifid; pinnae in numerous opposite pairs, the lowest 5 to 10 cm. long, half as broad, with the largest pinnules on the lower side, the latter pinnules cut down to the rachis into oblong, entire or sinuate-pinnatifid segments, subcoriaceous, glabrous; sori subcontinuous; indusium narrow, brownish, more or less toothed.

Luzon, *Cuming*, 62, 281; Benguet, *Elmer*, stipe and rachis puberulous; Manila, *Loher*, *Warburg*; Culion, *Merrill* 508.

India to New Zealand and Polynesia.

This species sometimes occurs without any indusium, even when very young; judged by its genus-characters it is then a *Nothochlaena*, but I am unable to separate it specifically: examples are: *Whitford* 536 and *Merrill* 3134, both from the Lamao Forest Reserve.

(4) *C. rufa* Desv. Stipes densely clustered, 4 to 10 cm. high, densely clothed with rusty-brown tomentum; frond 8 to 15 cm. high, ovate-lanceolate, bipinnatifid; pinnae opposite, the lower remote or not, oblong; pinnules on the lower side the larger, oblong or linear-oblong, crenate, obtuse, both surfaces somewhat tomentose, the lower the more so and beneath the pubescence waxy; sori copious; indusium ragged.

Baguio, *Elmer* 6575.

Himalayas.

(5) *C. farinosa* (Försk.) Kaulf. Stipes densely tufted, 10 to 30 cm. high, erect, dark brown, polished, scaly when young or at the base; frond 15 to 30 cm. high, narrowly ovate, tripinnatifid; pinnae opposite, the lower pairs the larger, with the longer pinnules on the lower side; largest pinnules deeply pinnatifid into entire, obtuse segments; most pinnae only pinnatifid, papyraceous or subcoriaceous, glabrous, lower surface covered with white or greenish or brownish waxy powder; sori forming a continuous narrow line along the margin.

Luzon, *Cuming*, 235; Benguet, *Topping* 224, *Elmer* 5889; Arayat and Mariveles, *Loher*. A triangular fern about 5 cm. high on Mount Mariveles is not the next species and may be this.

Pantropic.

(6) *C. argentea* (Gmelin) Hook. Stipes densely tufted, 8 to 15 cm. high, wiry, dark brown, polished, scaly at the base when young; frond triangular, about 8 cm. in diameter, bi- or tripinnate, upper part not cut down to the rachis; lower pinnae much the largest; cut down nearly to the costa, and the lowest basipetal segment pinnatifid, dark green above, white-waxy beneath; sori very small, fusing.

Benguet, *Loher*.

Siberia to Malacca.

## (39) NOTHOCHLAENA R. Brown.

Stipes clustered; fronds at least pinnate; pinnae not very inequilateral, not glabrous; sori on the ends of the veins, usually coalescing when old, naked or partly covered by the unmodified margin of the frond. Hardly sufficiently separated from *Cheilanthes* by the modification of the margin of the latter. *C. tenuifolia* has a form with unmodified margin, which will be looked for here. Mostly natives of dry, warm countries.

(1) *N. densa* J. Sm., Hooker. Rhizome creeping, short, scaly; stipe 3 to 12 cm. high, erect, firm, like the rachis, maroon, bearing sparse fibrillose paleæ; frond 10 to 20 cm. high, 2 to 3 cm. broad, tripinnatifid at base; pinnae ovate-lanceolate, the lowest ones deltoid, remote, equaling or smaller than those next above; pinnules linear-oblong, entire or crenate or pinnatifid, obtuse, herbaceous, slightly hairy above, matted beneath with whitish or brown tomentum; sori at length almost covering the lamina, partly protected at first by the incurved margin.

Corregidor, *Cuming* 282; Benguet, *Elmer* 6384; Mount Mariveles, *Loher*.

(2) *N. distans* R. Br. Stipes densely tufted, about 8 cm. high, bearing linear scales; frond 15 to 20 cm. high, 3 cm. broad, bipinnate; lower pinnae remote, deltoid, cut down to the rachis into oblong, obtuse, entire or slightly lobed pinnules, subcoriaceous, pale green and slightly villous above, lower surface and rachis more or less densely coated with long, linear, ferruginous scales; pinnae often much curled together, and the edge incurved.

Mount Mariveles, *Loher*.

Australia, New Zealand, New Caledonia.

## (40) PLAGIOGYRIA Kunze.

Stipes clustered, the base abruptly enlarged and bearing 3 to 6 spongy projections on the upper side; fronds dimorphous, simply pinnate; veins free; sori on the somewhat thickened ends of the branched veins, at maturity sometimes covering the contracted frond; sporangium with an oblique continuous annulus; reflexed margin serving at first as an indusium. A small genus of terrestrial ferns, with very much the appearance of *Blechnum-Lomaria*, and sporangia resembling those of the *Cyatheaceae*.

(1) *P. adnata* (Blume) Bedd. Rhizome short, erect; stipe 15 to 45 cm. high, firm, erect, naked; frond ovate-lanceolate, 30 to 45 cm. high, 10 to 15 cm. broad; pinnae linear, falcate, the largest about 8 cm. long, 1 cm. broad, the lowest equal to those next above them, narrowed at the base and separated by rather more than their own breadth, those in the middle of the sterile frond widened at the base and contiguous, acuminate, finely serrate, subcoriaceous; rachis naked; indusium brown, membranous, very distinct.

Mount Mariveles, 1,400 m. *Loher*.

India, Japan, Java.

(2) *P. pycnophylla* (Presl) Mett. var. *remota* Chr. Rhizome stout, erect, woody; stipe stout, erect, naked, 15 to 25 cm. high; frond ovate-lanceolate, 60 to 90 cm. high, 15 to 25 cm. broad; pinnae very numerous, linear,

spreading, 10 to 15 cm. long, separated by about their own breadth, contracted toward the base, acuminate and finely toothed toward the apex, coriaceous, glabrous, as is true of the other species, except when very young; pinnae of the fertile frond more distant, short-stalked, with a gland at the base; indusium at first conspicuous, brown.

Mount Data, Lepanto, *Loher*.

India and Malaya (the typical form).

(3) *P. glauca* (Blume) Mett. var. *philippinensis* Christ. Stipe 30 cm. high, naked; erect; frond ovate, 30 to 60 cm. high, 15 to 25 cm. broad; pinnae separated by as much as their own breadth, linear, erecto-patent, 10 cm. more or less, long, acute, minutely serrulate, contracted to the base, coriaceous; terminal pinna like the lateral; lower surface glaucous; fertile frond similar except that the pinnae are more distant and narrowly linear.

Mount Data, Lepanto, *Loher*.

India, Java, Celebes (the typical form).

#### (41) *ONYCHIUM* Kaulfuss.

Rhizome creeping, chaffy; stipes light colored; frond finely divided, fertile and sterile divisions more or less unlike; veins free except as the tips of the veins of the fertile divisions are connected by an intramarginal strand, on which the sorus is formed; indusium formed by the inflexed margin, broad enough to reach the costa, or nearly so. A small genus, differing from *Pteris* in the finely dissected frond and broad indusium.

(1) *O. japonicum* (Thunb.) Kunze. Rhizome wide-creeping, densely beset with lanceolate-subulate brown paleae; stipes 15 to 30 cm. high, naked, stramineous or pale brown; frond 20 cm. or more high, ovate, 4- to 5 pinnatifid; pinnae and pinnules of all orders except the ultimate segments deltoid, with few divisions; ultimate divisions linear-cuneate, about 5 mm. long, trifid at the apex of the sterile segments, the fertile very acute, herbaceous or subcoriaceous, glabrous; sori light brown.

Benguet, *Loher*, *Topping* 159, 323.

Japan to India and Java.

(2) *O. auratum* Kaulf. Rhizome short, densely scaly; stipes clustered, stout, erect, naked, dull brown, 20 to 30 cm. high, those of the sterile fronds shorter; fronds dimorphous, the sterile 15 to 20 cm. high, the fertile 20 to 30 cm. both ovate, quadripinnate, pinnae and pinnules mostly deltoid, with few divisions; ultimate segments of sterile frond minute, 3 mm. long, linear-cuneate, trifid or entire, thin-coriaceous, glabrous; segments of fertile frond 10 to 20 mm. long, 1 to 2 mm. broad, entire, cuspidate, given a pod-like appearance by the broad indusia; sori bright golden yellow.

Luzon, *Cuming* 38, *Lobb* 452; Isabela-Luzon, *Warburg* 11605, 12749, 12750; Nueva Ecija, *Merrill* 286; Benguet, *Topping* 173, 216, *Elmer* 5950; Manila, *Chamisso*, *Loher*, *Warburg*; Masbate, *Baranda*.

India and Malaya.

#### (42) *PTERIS* Linnaeus.

Stipes not black and polished, traversed by a single fibro-vascular bundle; frond at least pinnate, lowest pinnae usually the most developed, especially

on the lower side; sorus on a submarginal strand connecting the ends of the veins, wanting in the sinus between the segments, protected by the reflexed and specialized margin, without an extrorse indusium. A genus of terrestrial ferns, most remarkable for the poor definition of the species. Among our species, *P. cretica* and *P. quadriaurita* are especially notable for the number of their more or less distinct forms and related species.

1. Veins free.
  2. Fronds simply pinnate.
    3. Pinnæ cuneate at base ..... (1) *P. opaca*
    3. Pinnæ truncate or cordate ..... (2) *P. longifolia*
  2. Lowest pinnæ forked or pinnate.
    3. Pinnules or segments of lowest pinnæ 1 to 3.
      4. Fronds all equally pinnate.
        5. Sterile fronds serrate.
          6. Stipes pale ..... (3) *P. cretica*
          6. Stipes dark ..... (4) *P. melanocaulon*
        5. Sterile fronds not serrate ..... (5) *P. pellucida*
      4. Sterile fronds more pinnate than the fertile ..... (6) *P. ensiformis*
    3. Segments or pinnules of lowest pinnæ at least 5.
      4. Only lower side pinnatifid ..... (7) *P. semipinnata*
      4. Both sides incised.
        5. Only pinnatifid.
          6. Apex serrate ..... (8) *P. distans*
          6. Apex entire ..... (9) *P. heteromorpha*
        5. Pinnate ..... *P. dispar*
  2. Lower pinnæ at least bipinnatifid.
    3. Lowest pinnæ not greatly enlarged.
      4. Frond not over 1 m. high.
        5. Fronds all alike ..... (10) *P. quadriaurita*
        5. Fronds dimorphous ..... (11) *P. grevilleana*
      4. Frond well over 1 m. high ..... (12) *P. excelsa*
    3. Lowest pinnæ greatly enlarged ..... (13) *P. longipes*
1. Veins forming areolæ along costa, otherwise free.
  2. Ultimate segments abruptly widened at base ..... (14) *P. patens*
  2. Ultimate segments not abruptly widened.
    3. Lowest pinnæ of moderate size.
      4. Margin entire ..... (15) *P. biaurita*
      4. Sterile margin crenate, large fern ..... (16) *P. kleiniana*
    3. Lowest pinnæ greatly enlarged ..... (17) *P. callichiana*
1. Veins more copiously anastomosing ..... (18) *P. tripartita*

(1) **P. opaca** J. Sm. Stipe strong, erect, pale, finely pubescent; frond 60 to 90 cm. high, oblong, simply pinnate; pinnæ in numerous opposite pairs, the largest 30 cm. long, narrowly linear, entire, cuneate at base, coriaceous, glabrous except for the costa beneath; rachis pubescent like the stipe; veins sunk in the frond and only visible as faint striations; indusium narrow, brownish.

Samar or Cebu, *Cuming* 342.

Celebes.

(2) **P. longifolia** L. Stipes clustered, 15 to 30 cm. high, firm, erect, pale, more or less clothed at the base with pale brown scales; frond 30 to 50 cm. high, 10 to 20 cm. broad, attenuate below, simply pinnate; pinnæ sessile, numerous, 10 to 15 cm. long, the lowest reduced, the upper linear,

acuminate, entire, truncate or cordate or subauricled at the base, subcoriaceous, glabrous; rachis naked or slightly scaly; veins close and fine, usually once forked; indusium membranous, yellowish brown.

Luzon, *Cuming* 6; Cagayan-Luzon, *Warburg* 12214; Benguet, *Loher*, Manila, *Loher*, *Warburg*; Camarines, Albay, and Catanduanes, *Baranda*; Zamboanga, *Challenger Exp.*

Tropical and warm-temperate lands, everywhere.

(3) *P. cretica* L. Rhizome short-creeping; stipes 15 to 30 cm. high, erect, wiry, naked, polished, pale; frond 15 to 30 cm. high, 10 to 20 cm. broad; pinnae 2 to 6 pairs, the upper sometimes decurrent, ascending, the fertile narrowly linear, sterile broader, spinulose-serrate, the lowest pair usually cut about to the base into 2 to 3 linear pinnules, subcoriaceous, glabrous; veins fine, close, parallel, simple or forked; indusium membranous, pale.

Rizal, *Loher*; Mount Mariveles, *Merrill* 3122; Masbate, *Baranda*; Davao, *Copeland* 700.

Most warm countries; exceedingly variable.

*Pteris stenophylla* Hook. and Grev. is a variety with 3 to 5 pinnae clustered at the apex of the stipe, collected on Corregidor by *Cuming*, No. 283, known also from India.

(4) *P. melanocaulon* Fée. Rhizome erect, small; stipe slender, naked, black, shining, fragile; total height 25 to 30 cm.; frond ovoid, pinnate, with the basal pinnae forked to the base; pinnae stalked, linear, arcuate, sterile toward the apex and crenate, acuminate, membranous, glaucous; venation obscure, indusium broad. Treated as a variety of *P. cretica* in *Synopsis Filicum*.

Isabela-Luzon, *Warburg* 11972; Benguet, *Elmer* 6160 (?); Rizal, *Loher*; Catanduanes, *Baranda*; Jolo Archipelago, *Burbidge*; Davao, *Warburg* 14121.

(5) *P. pellucida* Presl. Stipe 30 cm. or more high, erect, naked, stramineous, frond 30 to 60 cm. high, ovate-lanceolate, simply pinnate, or the lowest pinnae forked; pinnae 3 to 6 pairs, sessile, linear, entire or serrulate toward the point, upper ones slightly decurrent, coriaceous, bright green, often glossy; veins conspicuous, fine, close, simple or forked; indusium membranous, brownish.

Luzon, *Haenke*, *Cuming* 85; Benguet, *Loher*. *Merrill's* No. 3772, from the Lamao Forest Reserve, may be this or a form of *P. longifolia* with the lowest pinnae forked.

Guinea, India, Malaya.

(6) *P. ensiformis* Burman. Rhizome short, creeping; stipe of sterile frond 5 to 10 cm. high, of fertile, 10 to 30 cm. slender, erect, naked, stramineous; sterile from 10 to 15 cm. high, 3 to 8 cm. broad, bipinnatifid or bipinnate, the segments with rounded, dentate apex, obovate, about 10 mm. long; fertile frond 20 to 30 cm. high, pinnate; pinnae entire or the lower pinnatifid, 8 to 15 cm. long, linear, sterile apex serrate, upper ones adnate at base, herbaceous, glabrous; veins usually forked, not conspicuous. Exceedingly variable.

Luzon, *Cuming* 45, 46; Manila *Loher*, *Warburg* 12745, *Marave*; Mindoro,



Merrill 3347; Masbate and Bataan, *Baranda*; Capiz, *Copeland* 56; Davao, *Copeland* 375.

India to Polynesia.

(7) *P. semipinnata* L. Stipe about 30 cm. high, firm, erect, naked, bright chestnut brown; frond about 30 cm. high, half as broad, ovate-lanceolate, the upper part cut down to the rachis into close entire lobes, the lower two-thirds with 6 to 8 pairs of opposite distantly-placed pinnae; pinnae with long, entire points, and a broad entire wing on the upper side, but the lower side with several linear pinnules, sterile margins finely serrate, subcoriaceous, glabrous; veins simple or once forked; indusium membranous.

Luzon, *Cuming* 258. *Merrill's* No. 3790, from the Lamao Forest Reserve, differs only in that all the divisions are shorter, and proportionally broader.

India to Japan and Borneo.

(8) *P. distans* J. Sm. Stipe about 15 cm. high, slender, erect, naked, pale; frond about 30 cm. high, 10 to 15 cm. broad, upper part long, linear, sharply serrate, below this 12 to 20 pairs of close short lobes, the lower two-thirds of the frond with 6 to 9 pairs of opposite, distant, linear-pointed pinnae; each with a few spreading pinnules at its base, coriaceous; rachis scabrous; veins conspicuous, simple or once forked; sterile lobes finely spinulose-serrate; indusium membranous.

Luzon, *Cuming* 410.

(9) *P. heteromorpha* Fée. Stipe 15 to 30 cm. high, naked, erect, pale; frond 30 to 45 cm. high, half as broad, ovate-lanceolate, the upper part with a long entire terminal point, below which it is sinuate and furnished with a few short, linear lobes; pinnae in several opposite pairs, the lowest of which are 1 dm. apart, the upper ones entire or slightly compound at the base, the lowest pair cut down nearly to the rachis, with several spreading linear pinnules on each side, subcoriaceous, glabrous, the margins slightly crisped; veins conspicuous, usually once forked; indusium narrow, membranous.

Luzon, *Cuming* 409; Rizal and Manila, *Loher*.

Celebes.

*P. dispar* Kunze is a fern differing from *P. semipinnata* only in that the upper side of the pinnae as well as the lower, is more or less pinnate; they are hardly specifically distinct.

Isabela-Luzon, *Warburg* 11613.

China and Japan.

(10) *P. quadriaurita* Retz. Stipe 30 to 60 cm. high, strong, erect, naked or slightly scabrous, stramineous or brownish; frond varying from 15 to 100 cm. in height, 10 to 30 cm. or more broad, with a terminal, central pinna cut down nearly to the rachis into numerous, close, parallel linear-oblong lobes 1 to 2 cm. long, 4 to 6 mm. broad, the sterile ones entire or slightly serrate; lateral pinnae several pairs, 15 to 30 cm. long, 2 to 5 cm. broad, the lowest ones usually again compound, having 1 or 2 similar but smaller pinnules branching from the base on the lower side, all cleft to the rachis into close, erecto-patent, entire, linear or linear-oblong segments;



veins conspicuous, usually once forked; sori often continuous along the whole margin of the segments.

Luzon, *Cuming* 69, 79; Isabela-Luzon, *Warburg* 11612; Nueva Vizcaya, *Merrill* 234; Benguet, *Topping* 287, *Elmer* 5619, 6213; Arayat, *Loher*, *Merrill* 3813, puberulous; Lamao River, *Copeland* 239; Manila, *Warburg*, *Merrill* 642; Camarines and Masbate, *Baranda*; Jolo Archipelago, *Burbridge*; Davao, *Warburg* 14120, *DeVore* and *Hoover* 254, *Copeland* 667. We have many more specimens very near this.

All warm countries.

**P. quadriaurita** var. **setigera** Hooker is a form with fine, spine-like scales on the rachises and main veins, at least on the dorsal surface, and usually more linear segments.

Luzon, *Cuming* 253, 413; Cagayan-Luzon, *Warburg* 12215; Arayat, *Merrill* 3814; Rizal, *Loher*; Basilan, *DeVore* and *Hoover* 93.

India, Hongkong.

(11) **P. grevilleana** Wall. "Dimorphic, barren stipe shorter, winged toward the apex; barren frond pedately 5-fid, scarcely pinnate, margin spinulose-serrate; fertile frond with 5 pinnæ, the lower pair bipartite, veins exceedingly obscure. Suspiciously like *P. quadriaurita*, except that the fronds are dimorphic."

Benguet and Rizal, *Loher*.

India.

(12) **P. excelsa**, Gaud. Stipe thick, erect, naked, glossy, pale brown; frond nearly 2 m. high, sometimes more; terminal pinna 30 cm. or more long, 8 cm. broad, with numerous close, falcate, linear lobes on each side, which are sometimes more than 5 cm. long, hardly 1 cm. broad, narrowly obliquely decurrent, and slightly serrate where sterile; lateral pinnæ several, similar to the terminal one, the lowest remote, sometimes bipartite, subcoriaceous, glabrous; veins once forked; sori not reaching the apex of the segments.

Philippines, *Gaudiehaud*.

Himalayas, Hawaii.

(13) **P. longipes** Don. Stipe 30 to 60 cm. high, erect naked, stramineous; terminal pinna about 15 cm. high, linear, cleft to the rachis into numerous erecto-patent, linear-oblong lobes which are obtusely toothed toward the point when sterile; lateral pinnæ numerous, close, the longest simple ones about 15 cm. long, the lowest pair compound, sometimes nearly as large as the whole of the rest of the frond, 30 cm. long, 15 cm. broad, herbaceous, glabrous; veins not prominent, forked; sori falling short of the apex of the segments. Costa of pinnules sometimes spinulose on the upper side.

Luzon, *Cuming* 8; Masbate, *Baranda*.

India to New Guinea.

(14) **P. patens** Hooker. Stipe 30 cm. or more high, erect, naked glossy, chestnut brown; frond ample, 1 m. high, 60 cm. or more broad; terminal pinna 15 to 25 cm. long, 4 to 5 cm. broad, with several linear lobes on each side, which are widened suddenly near the base on each side, the sterile ones slightly serrate; lateral pinnæ numerous, similar but larger, some-

times 45 cm. long, 5 cm. broad, the lowest forked, scarcely coriaceous, glabrous; veins oblique, not conspicuous, usually forked, sori reaching nearly to the end of the segment. I am sceptical as to the anastomosing of the veins.

Luzon, *Cuming* 103; Davao, *Warburg* 14123.

Himalayas to Japan and Polynesia.

(15) *P. biaurita* L. Stipe 30 to 60 cm. high, strong, erect, naked, stramineous; frond with a terminal pinna 15 to 30 cm. long, 3 to 5 cm. broad, cut down within about 5 mm. of the rachis into numerous spreading linear-oblong lobes; lateral pinnae several pairs, similar to the terminal one, the lowest rather remote and usually once forked, segments entire, obtuse, papyraceous or subcoriaceous, glabrous; veins evident, forming single areolæ along the costa of the pinna but entirely free in the segments.

Rizal, *Marave* 130.

Pantropic.

*P. armata* Presl. "Fronds cordate-ovate glabrous glaucescent pinnate, pinnae opposite sessile pinnatifid lowest ones bipartite, segments linear obtuse entire unequal, terminal one elongate, repand, secondary rachises and costa above spinose, stipes smooth." This is probably *P. quadriaurita* var. *setigera*, fitting perfectly with the plant from Arayat.

Sorsogon, *Haenke*.

(16) *P. kleiniana* Presl. Total height 2 m.; frond pedately ovate, pinnate; pinnae broadly lanceolate, long-caudate, deeply pinnatifid into subfalcate segments, crenate where sterile, submembranaceous; sori falling well short of the apex of the segments; otherwise like *P. biaurita*, with which Hooker and Baker unite it.

Cagayan-Luzon, *Warburg* 11617, 12202.

India.

(17) *P. wallichiana* Agardh. Stipe about 15 cm. high, strong, naked, glossy, bright chestnut brown; frond tripartite with lateral divisions again forked, the central often 60 cm. long, 30 cm. broad, with numerous lanceolate, sessile, opposite pinnules, the largest of which are 15 cm. long, 2 cm. broad, cut down within about 2 mm. of the costa into numerous contiguous linear-oblong lobes, the sterile ones nearly entire, herbaceous, glabrous; lateral pinnae nearly as large as the terminal one; veins not conspicuous, forming single areolæ along the costa between the main veins, rarely another areola at the base of the main vein; sori continuous along nearly the entire margin.

Luzon, *Cuming* 204, *Lobb* 481.

Himalayas to Samoa.

(18) *P. tripartita* Sw. Stipe 30 to 100 cm. or more high, strong, erect, naked, polished, stramineous or brownish, like the rachises; frond tripartite, the central part 60 cm. or more long; terminal pinna 15 to 25 cm. long, 15 to 30 mm. broad, cut deeply into numerous close, linear or oblong lobes, which are subfalcate and slightly toothed where sterile, herbaceous, glabrous; lateral pinnae numerous, close, all unbranched; lateral divisions similar, but shorter and usually branched; veins fine, anastomosing chiefly along the costa and main veins, sori not reaching the apices of the segments.

Luzon, *Cuming* 41, 204; Isabela-Luzon, *Warburg* 11616; Benguet, *Loher*, *Elmer* 6028; Lamac River, *Copeland* 242; Rizal, *Ramos*; Laguna, *Loher*; Mindoro, *Merrill* 877; Masbate (?), *Baranda*; Paragua, *Merrill* 824a; Tropics, Africa across Polynesia.

(43) **HISTIOPTERIS** Agardh.

Rhizome wide-creeping; stipe polished, stramineous to purplish; frond bi-quadrupinnatifid, lowest pinnules usually stipule-like; sori as in *Pteris*, but commonly continuous around the sinus, and the spores bilateral instead of tetrahedral. A genus of pantropic terrestrial ferns, usually all reduced to a single species.

(1) *H. incisa* (Thunb.) Agardh. Entire height commonly 2 m.; stipe stout, erect, sometimes muricate toward the base; frond ovate or narrower, bi-tripinnate; uppermost pinnae with entire oblong or linear-oblong pinnules; those next below with numerous long, pinnatifid pinnules, the lowest of which are close to the rachis and often adnate to it; lowest pinnae often very large, and quadrupinnatifid, herbaceous or subcoriaceous, glabrous or glaucous beneath; veins anastomosing to form several series of areolae, free near the margin; sori interrupted, or continuous around the sinuses and apices of the segments.

Luzon, *Cuming* 192; Baguio, *Topping* 239, *Elmer* 6007; Mount Mariveles. Tropics and farther south.

(2) *H. montana* Copeland. Rhizome beset with minute, brown paleae; stipe firm, 10 to 20 cm. high; frond 15 to 30 cm. high, often broader than high, bi-tripinnatifid, lowest pinnae slightly larger than succeeding, very coriaceous; veins prominent, raised above upper surface; indusia broad, margin everywhere rolled in, giving segments a lomarioid appearance.

Mount Apo, above 2,500 m.; *DeVore* and *Hoover* 332, *Copeland* 1049.

(44) **PTERIDIUM** Gleditsch.

Rhizome creeping, scaly; stipe with many fibro-vascular bundles; frond at least bipinnate, deltoid; sorus on an intramarginal strand connecting the ends of the veins, covered by an extrorse indusium, and this by the inflexed margin of the frond; spores tetrahedral. A single polymorphous species.

(1) *P. aquilinum* (L.) Kuhn. Rhizome stout, wide-creeping, underground; stipe 30 cm. or more high, strong, erect, naked, stramineous or light brown; frond 60 to 100 cm. or more high, 30 to 60 cm. broad; uppermost pinnae simple, the next pinnatifid, then pinnate; the lowest the largest, bipinnatifid or tripinnatifid, coriaceous, glabrous.

Lepanto and Benguet, *Loher*.

Cosmopolitan, chiefly northern.

*P. aquilinum* var. *lanuginosum* Bory. Fronds evidently pubescent or silky-tomentose beneath; pinnules more generally and regularly pinnatifid.

Luzon, *Cuming* 24, 100; Bohol, *Cuming* 353.

Cosmopolitan, chiefly tropical.

*Topping*, No. 242, from Baguio is a mixture, perhaps including both forms of this species.

(45) **PAESIA** St. Hilaire.

Rhizome creeping; stipe with a single horseshoe-shaped fibro-vascular bundle; otherwise like *Pteridium*, except that the extrorse indusium is sometimes wanting, and the spores are bilateral.

(I) **P. rugulosa** (LaB.) Kuhn. Stipe and rachises slender, glutinous-pubescent, castaneous; frond quadripinnatifid, rhomboidal; pinnae close, erecto-patent, under 30 cm. long; pinnules close, lanceolate, nearly sessile, 1 cm. broad; segments lanceolate, cuneate-truncate on lower side at base, the lower deeply pinnatifid with oblique blunt lobes, subcoriaceous, glutinous and minutely furfuraceous especially below, dull green; sterile segment serrate, fertile with revolute margin, the sorus reaching to the costa.

Mount Data, Lepanto, in pine forest, *Loher*.

New Caledonia, Otaheite (?).

I do not know this fern, but find nothing in the descriptions to indicate that it has an extrorse indusium; its aspect must be that of *Hypolepis*, to which it was assigned by Hooker.

## VI. VITTARIEÆ.

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Fronds simple and entire, not articulate to the rhizome; veins free or anastomosing without free included veinlets; sori marginal or dorsal, linear, usually immersed. Small ferns, mostly epiphytic.

- 1. Sori single, lines parallel to the costa, fronds grass-like.
  - 2. Sori on or near the costa..... (46) *Monogramme*
  - 2. Sori in or near the margin..... (47) *Vittaria*
- 1. Sori following the veins and anastomosing with them, fronds broader ..... (48) *Antrophyum*

### (46) **MONOGRAMME** Schkuhr.

Rhizome creeping; fronds (in our species) scattered, small, linear, without other veins than the costa, glabrous; sorus on or near the costa, usually protected by an outgrowth of leaf-tissue. Exceedingly simple epiphytes.

- 1. Sori on the costa..... (1) *M. trichoidea*
- 1. Sori beside the costa.
  - 2. Outgrowth of tissue on both sides of costa..... (2) *M. paradoxa*
  - 2. Outgrowth of tissue on one side of costa..... (3) *M. dareaecarpa*

(1) **M. trichoidea** J. Sm. Rhizome slender; fronds numerous, filiform, 10 cm. or less long; the fertile ones dilated in two or three places, and there bearing the sori, with high-raised edges on each side.

Luzon, *Cuming* 160.

(2) **M. paradoxa** (Fee) Bedd. Rhizome creeping, scaly; fronds forming a turf, 5 to 30 cm. long, 1 mm. broad, flaccid, herbaceous; sori sunk in a furrow on one or both sides of the costa.

Philippines, according to Synopsis Filicum.

Ceylon to Hawaii and Australia.

(3) **M. dareaecarpa** Hooker. Rhizome clothed with minute, narrow, brown scales; fronds forming a turf on living trees, about 2 cm. high, hardly 1 mm. broad near the top, subacute, narrowed downward but without a distinct petiole, the fertile taller and relatively more slender than the sterile, often notched at the apex by the projection of the pseudo-indusium; sorus along one side of the costa, covered by an outgrowth from it reaching almost to the margin, confined to the apex of the frond, not more than 3 mm. long.

Gimogon River, Negros, *Copeland* 63.

Labuan, New Guinea (?).

The Negros plant differs from the type in the absence of a distinct stipe, and the very short sorus.

## (47) VITTARIA Smith.

Rhizome creeping; fronds grass-like, more or less tufted; veins free; sori in continuous marginal or intramarginal lines. Epiphytes in moist forests, very common. There is no genus of ferns whose species are more difficult of determination. The following list by no means exhausts the Philippine species; but includes all of whose identity and distinctness I feel certain.

1. Sorus in a two-lipped marginal groove..... (1) *V. elongata*
1. Sorus a slightly intramarginal line, with the margin rolled back over it at first.
  2. Sorus narrow, fronds thick.
    3. Sori subimmersed ..... (2) *V. lineata*
    3. Sori immersed ..... (3) *V. falcata*
  2. Sorus broad, fronds thin..... (4) *V. scolopendrina*

(1) *V. elongata* Sw. Fronds 15 to 60 cm. long, seldom 1 cm. broad, acute or obtuse, coriaceous; veins simple, oblique, immersed, parallel, connected by the intramarginal soriferous veinlet; sori quite sunk in a marginal groove with two nearly equal lips opening outward. As defined here, this species includes *V. ensiformis* Sw., collected in Luzon by *Cuming*, nos. 28 and 76, and several other rather diverse forms.

Malanipa, Zamboanga, *Challenger Exp.*; Jolo Archipelago, *Burbridge*; Benguet and Rizal, *Loher*; Mount Mariveles, *Copeland* 1401; Mount Apo, *Copeland* 992.

Tropics of Eastern Hemisphere.

(2) *V. lineata* Sw. Frond 15 to 50 cm. long, less than 1 cm. broad, attenuate below, passing insensibly into the stipe, coriaceous; costa reaching the apex, veins immersed, parallel, oblique; sorus intramarginal in a shallow groove, protected when young by the margin of the frond.

Benguet, *Loher*, *Topping* 219, *Elmer* 6125, 6277; Mount Arayat, *Loher*, *Merrill*; Mount Mariveles, *Copeland* 221, 222; southern Luzon, *Baranda*; Negros, *Copeland* 57.

Pantropic.

*V. lineata*, var. *trichoides* Christ. Differs from the typical form in having fronds only one-half mm. broad, and the margin so folded over the sorus that it may scarcely appear.

Davao, *Warburg* 14151.

(3) *V. falcata* Kunze. Frond 10 to 15 cm. long, 3 mm. broad, obtuse, narrowed gradually to the base, very thick; costa reaching the apex of the sterile but not of the fertile fronds, veins short, oblique, parallel, immersed; sori quite sunk in slightly intramarginal grooves. *V. minor* Fée is a smaller fern included here.

Rizal, *Loher*.

Malaya.

(4) *V. scolopendrina* Mett. Fronds 30 to 50 cm. long, 1 to 2 cm. broad, acute, contracted gradually to the base, coriaceous, but not exceedingly thick; costa thick, veins fine, oblique, simple; sorus in a rather broad submarginal groove protruding slightly from the upper surface, protected at first by the margin.

Catanduanes, *Baranda*; Davao, *Warburg* 14152.

Paleotropic.



(48) **ANTROPHYUM** Kaulfuss.

Rhizome short, creeping, clothed with copious very narrow brown paleæ; fronds clustered, simple, entire, rather thick; veins anastomosing, without free included veinlets; sori along the veins, in general lengthwise of the leaf and anastomosing with the veins. Aside from *Vittaria*, the nearest relatives of *Antrophyum* in our flora are *Loxogramme*, treated by Blume as a section of it, and *Hemionitis*, under which the first species were described. The species are variable, and not at all sharply distinguishable.

1. Stipe long (10 cm.) ..... (1) *A. plantagineum*
1. Stipe short or none.
  2. Costa reaching half way up the frond..... (2) *A. semicostatum*
  2. Costa disappearing near base of frond.
    3. Apex broadly rounded ..... (3) *A. obtusum*
    3. Apex obtuse or acute.
      4. Frond broad, sori free..... (4) *A. callaeifolium*
      4. Narrow or sori anastomosing.
        5. Frond very thick ..... (5) *A. coriaceum*
        5. Frond only moderately coriaceous.
          6. Frond small (15 cm.), stipitate, sori free ..... (6) *A. parvulum*
          6. Frond larger, sori usually anastomosing ..... (7) *A. reticulatum*

(1) ***A. plantagineum*** Kaulf. Stipes stout, glabrous, about 10 cm. high; fronds 10 to 20 cm. long, one-third as broad, broadest above the middle, acute at both ends, very fleshy when fresh; costa wanting but median line of frond sterile; sori copious, deeply immersed, anastomosing somewhat.

Rizal, *Loher*; southern Luzon, *Baranda*; Davao, *Copeland* 632.

India across Polynesia.

(2) ***A. semicostatum*** Blume. Frond 15 to 40 cm. high, 5 to 8 cm. broad, broadest near the apex, narrowed abruptly to the acute apex, and gradually to the base or short stipe; costa blackish, visible half way up the frond; sori copious, anastomosing freely, rising above the surface.

Sorsogon and Catanduanes, *Baranda*.

Ceylon across Polynesia.

(3) ***A. obtusum*** Kaulf. Fronds 2 to 6 cm. high, spatulate, gradually contracted from the broad, rounded apex to a short stipe, thin-coriaceous, very young fronds black-hairy; costa entirely wanting; sori in grooves but rising well above surface, forking, and sometimes anastomosing.

Davao, *Copeland* 845, 931; Paragua, *Merrill* 786.

Bourbon, Java.

(4) ***A. callaeifolium*** Blume. Fronds 15 to 30 cm. high, 4 to 8 cm. broad, "spatulate-lanceolate," abruptly contracted to the acuminate or obtuse apex, gradually to a base decurrent on a short stipe, coriaceous; costa wanting; sori free, rather straight.

Rizal, *Loher*; Davao, *Warburg* 14161, *DeFore* and *Hoover* 277, *Copeland* 1253.

Java, Celebes.

(5) *A. coriaceum* Wall. Fronds 15 to 20 cm. high, 1 to 2 cm. broad, narrowed gradually from the middle to the acute apex and usually sessile base, very thick; costa wanting; sori entirely immersed, confluent or not.

Los Baños, *Loher*.

Himalayas, southern China, Malaya.

(6) *A. parvulum* Blume. Fronds 10 to 20 cm. high, 1 to 2 cm. broad, attenuate from the middle to the acute apex and short stipe; costa wanting; sori rather sparse and straight, in grooves, mostly free.

Mount Apo, *Copeland* 1117.

Java.

(7) *A. reticulatum* Kaulf. Fronds 15 to 50 cm. high, mostly about one-tenth as broad, exceedingly variable, broadest in the middle or near the apex, gradually or abruptly contracted to an acuminate or merely subacute apex, attenuate below to a sessile base, or (in Philippine specimens) short stalk, thin-coriaceous; costa black or green, usually visible for a few centimeters into the frond, sometimes wanting, venation very evident; sori usually copious and anastomosing, rarely sparse, or even reduced to two lines on each half of the lamina. This is our commonest *Antrophyum*, and in one or another of its forms approaches almost all the other species. Our commonest form is *A. falcatum* Bl., which is shorter-stalked than the type, but not really distinguishable. *A. Cumingii* Fee, *Cuming* 416, also collected in southern Luzon by *Baranda*, is likewise inseparable from it.

Benguet, *Elmer* 6126; Mount Arayat, *Loher*; Mount Mariveles, *Merrill* 2540, *Copeland* 210, 211; Rizal, *Merrill* 2665; Davao, *Copeland* 974; Jolo Archipelago *Burbridge*.

India across Polynesia.

## VII. POLYPODIEÆ.

Stipes articulate to the rhizome; indusium wanting. The fronds are simple or variously cut, the pinnæ as a rule equilateral; veins free or variously anastomosing; sori terminal or dorsal on them, usually of definite form and size, superficial or less often sunken.

1. Sori linear, parallel to the midrib, sometimes spreading over the parenchyma (*Taenitidæ*).
  2. Sori on sharply differentiated apex of frond..... (49) *Hymenolepis*
  2. Sori not confined to a specialized apex.
    3. Fronds pinnate, stipes not articulate to rhizome.... (50) *Taenitis*
    3. Fertile fronds trident-shaped ..... (51) *Christopteris*
    3. Fronds entire ..... (52) *Drymoglossum*
1. Sori usually round, sometimes elongate but not along costa.
  2. Fronds with stellate pubescence, fronds simple..... (53) *Nipholobolus*
  2. Fronds naked, or pubescence not stellate.
    3. No distinct brown basal fronds.
      4. Sori definite, not spreading over parenchyma.
        5. Sori dorsal ..... (54) *Polypodium*
        5. Sori in reflexed outgrowths of margin.. (55) *Lecanopteris*
      4. Sori spreading over parenchyma, confined to apical segments of frond.
        5. Frond pinnate ..... (56) *Photinopteris*
        5. Frond pinnatifid ..... (57) *Dryostachyum*
    3. Dimorphous, basal fronds brown and rigid..... (58) *Drynaria*

### (49) HYMENOLEPIS Kaulfuss.

Rhizome stout, creeping, scaly; fronds simple, entire or repand, contracted to a sharply differentiated fertile apex; no distinct sori in the fertile region; veins anastomosing, with free included veinlets. Small or moderate sized ferns.

(1) *H. spicata* (L. f.) Presl. (Including *H. revoluta* Bl. and *H. ophioglossoides* Bl.). Rhizome creeping, scaly; stipe 2 to 4 cm. high, glabrous, stramineous or the base ebeneous; sterile part of frond 15 to 40 cm. high, one-tenth as broad, entire, attenuate to both ends, or more abruptly contracted above, glabrous, herbaceous or coriaceous, flat or carinate; fertile part narrowly linear, 5 to 25 cm. long, decurved. Epiphytic.

Luzon, *Meyen, Cuming* 92; Benguet, *Loher, Barnes Forestry Bureau* 961; Mount Arayat, *Loher, Merrill*; Mount Mariveles, *Copeland* 213; Mount Apo, *Copeland* 1001 (very small), 1026.

Madagascar to southern China and Polynesia.

(2) *H. platyrhynchos* (J. Sm.) Kunze. (*Macroplethus* Presl.) Rhizome very short, scaly; fronds clustered, attenuate to almost sessile bases,

sterile part about 25 cm. high, more than one-fifth as broad, margin wavy, both surfaces glabrous, coriaceous; fertile segment about 5 cm. high, more than one-fourth as broad, obtuse, with a broad laminal wing on both sides of the fertile area. Terrestrial or epiphytic.

Luzon, *Cuming* 196, *Steere*; Benguet, *Elmer*, *Barnes* 960; Mount Arayat 800 m., *Loher*.

Celebes.

(50) **TAENITIS** Willdenow.

Rhizome creeping, hairy; stipes not articulate to it; fronds simply pinnate; veins anastomosing, without free included veinlets; sori linear, about midway between margin and costa, usually uninterrupted. Terrestrial ferns of moderate size. Not very evidently related to its neighbors here, and perhaps better transferred with *Platytaenia* to the neighborhood of *Gymnopteris*.

(1) **T. blechnoides** Swartz. Stipe 20 to 40 cm. high, fibrillose at base, glabrous above, brown or maroon; frond 20 to 50 cm. high; pinnae 3 to 6 pairs, 15 to 25 cm. long, linear-lanceolate, entire, acute at both ends, sessile or short-stalked, glabrous, coriaceous, bright green above, brownish below; sori rather nearer the margin than the costa.

Sorsogon, *Baranda*; Negros, *Copeland* 71; Guimaras, *Cuming* 277; Paragua, *Merrill* 719.

Ceylon to Malaya.

*Platytaenia requiniana* (Gaud.) Kuhn is a fern very like *Taenitis* in its vegetative characters, but with the entire back of the contracted fertile frond covered by sporangia. From the meager descriptions it seems likely to me that it is a *Gymnopteris*, but Diels places it next to *Taenitis*.

Philippines, *Née*.

Moluccas to New Hebrides.

(51) **CHRISTOPTERIS** Copeland.

Rhizome creeping, scaly; fronds dimorphous, the sterile triangular, ample, the fertile tripartite into linear segments; veins anastomosing, with free included veinlets; sori parallel and close to the costa, linear, finally covering the whole surface. Epiphytic.

**C. Sagitta** (Christ) Copeland. Rhizome creeping or scandent, the young part densely beset with spreading cinnamon-colored hairs about 8 mm. long, which are deciduous, leaving older parts sparsely clothed with ferruginous scales about 4 mm. long; stipes fuscous or ebeneous, of sterile frond about 10 cm., of fertile about 20 cm. high, glabrous; sterile frond triangular, 15 to 20 cm. high, and broad, the points acuminate, with a triangular sinus 2 cm. high and wide where the stipe is attached, and broad shallow ones between the lateral points and the apex, glabrous, coriaceous; the 3 main ribs conspicuous, their branches strictly parallel, subevident; fertile frond cleft to within 1 cm. of the base into 3 narrowly linear somewhat spreading obtuse segments 8 to 20 cm. long, 3 mm. broad.

Benguet, *Loher*; Mount Mariveles, *Copeland*, *Whitford* 321; *Borden Forestry Bureau* 1339.

(52) **DRYMOGLOSSUM** Presl.

Rhizome creeping; fronds simple and entire, dimorphous; veins anastomosing; sori linear, parallel to the costa, mixed with peltate scales. Small epiphytic ferns, with apparent affinity to *Niphobolus*, from which they are distinguished by the form of the sorus.

1. Sorus remote from margin (*Lemmaphyllum* Presl).

2. Apex very obtuse ..... (1) *D. spatulatum*

2. Apex subacute ..... (2) *D. carnosum*

1. Sorus marginal ..... (3) *D. piloselloides*

(1) *D. spatulatum* Presl, Tent. Pterid. p. 227. Sterile frond elliptic-lanceolate, obtuse, with acute base, fertile linear-spatulate, very obtuse, with stipe 1 cm. long; sorus continuous but confined to the upper half of the frond.

Manila, *Meyen*.

This species is distinguished from *D. carnosum* Hooker by the stipitate but not decurrent, very obtuse fertile frond, and restriction of the sori to its upper half: as the last character often marks a stage in development, and *D. carnosum* is more or less stalked. *D. spatulatum* is a doubtfully distinct species. There is no other record of any form of *D. carnosum* from the Philippines, until the discovery of the following.

(2) *D. carnosum* Hooker. Rhizome wide-creeping, slender, sparsely scaly; the sterile frond 5 to 6 cm. long, on a stipe 1 to 2.5 cm. long, rather obtuse, the fertile fronds linear-spatulate, about 5 cm. long, 6 mm. broad, on a stipe 3 to 4.5 cm. long, subacute, attenuate to the stipe; texture coriaceous; areolæ large, with few free usually hamate veinlets; sori nearer the midrib than the margin.

Mount Santo Tomas, Benguet, *Elmer* 6562.

Himalayas, Formosa, Amboyna.

(3) *D. piloselloides* Presl. Rhizome firm, wide-creeping, with black roots; sterile fronds obovate-elliptical 2 to 3 cm. long, 12 to 15 mm. broad, fertile ones linear-oblong, 5 to 10 cm. long, 4 to 5 mm. broad, both narrowed to a short stem, coriaceous; veins immersed, with copious free included veinlets; sori in a broad continuous submarginal line.

Luzon, *Cuming* 115, *Stecre*; large long-stipitate sterile fronds collected by *Loher* on Tonglon are ascribed by Christ to this species; Davao, *Copeland* 349.

India to Celebes.

(53) **NIPHOBOLUS** Kaulfuss.

Rhizome creeping; fronds simple, almost always entire, coriaceous, with stellate pubescence; veins anastomosing, with free included veinlets. Small epiphytes, recognizable superficially by the narrow, rigid fronds.

1. Areolæ regular, with included veinlets running toward margin.

2. Fronds not, or but slightly, dimorphous.

3. Lower surface loosely and copiously woolly.

4. Frond 2 to 3 cm. broad..... (1) *N. fissus*

4. Frond about 1 cm. broad..... (2) *N. flocciger*

- 3. Lower surface appressed—woolly.
  - 4. Veins hidden ..... (3) *N. achrostichoides*
  - 4. Veins evident ..... (4) *N. Lingua*
- 3. Lower surface very sparsely pubescent.
  - 4. Veins evident ..... (5) *N. sphaerostichum*
  - 4. Veins hidden ..... (6) *N. varius*
- 2. Fronds decidedly dimorphous.
  - 3. Sterile frond nearly glabrous, spatulate.... (7) *N. adnascens*
  - 3. Sterile frond orbicular, very woolly..... (8) *N. nummulariaefolius*
- 1. Areolæ irregular, with included veinlets in various directions.
  - 2. Stipe 2 to 10 cm. high.
    - 3. Paleæ of rhizome linear, entire..... (9) *N. samarensis*
    - 3. Paleæ of rhizome ovate, serrulate..... (10) *N. angustatus*
  - 2. Frond sessile ..... (11) *N. splendens*

(1) **N. fissus** Blume. Rhizome stout, short-creeping, clothed with squarrose, lanceolate-acuminate ferruginous scales; fronds sessile or nearly so, 15 to 30 cm. high, 15 to 35 mm. broad, narrowed very gradually to both ends, entire, subcoriaceous, upper surface naked, lower densely coated with soft woolly, ferruginous tomentum; veins invisible; sori close, scattered, immersed among the tomentum.

Benguet, *Loher*.

India, Java.

(2) **N. flocciger** Blume. Rhizome wide-creeping clothed with squarrose lanceolate-acuminate scales which are ferruginous when young, turning white; stipes 30 to 45 mm. high, floccose-woolly; fronds 20 to 30 cm. high, 6 to 10 mm. broad, acute, attenuate to base, entire, rigidly coriaceous, upper surface naked, lower densely matted with whitish or subferruginous tomentum; veins invisible; sori immersed among the tomentum, covering the upper part of the frond.

Luzon, *Cuming* 93; Sorsogon, *Baranda*; Mount Arayat, *Merrill* 3820; Mount Mariveles, *Whitford* 312.

India, Java.

(3) **N. achrostichoides** (Forst.) J. Sm. Rhizome woody, wide-creeping clothed with roundish or elliptical scales, black except at the margin; stipes about 5 cm. high, stout, erect, glabrous or nearly so, conical at base and inserted into the branch of the rhizome specialized to bear it; frond 30 to 40 cm. high, 10 to 15 mm. broad, attenuate to both ends, entire, rigidly coriaceous, upper surface naked, lower with a closely appressed whitish tomentum; veins invisible; sori distinct but contiguous, usually covering rather more than the upper half of the frond.

Luzon, *Cuming* (88 = *Cyclophorus blumeanus* Presl ?) 127; Los Baños, *Loher*; Negros, *Copeland*; Davao, *Copeland*.

Ceylon to the New Hebrides and Queensland.

(4) **N. Lingua** (Thunb.) J. Sm. (The Philippine form, described here is *Polypodium heteractis* Mett. and Kuhn.) Rhizome wide-creeping, clothed with spreading, lanceolate, ferruginous scales; stipes about 10 cm. high, firm, erect; frond not much higher, oblong-lanceolate or oval, apex often cuspidate, base rounded, entire, coriaceous, upper surface naked, lower



matted with appressed tomentum; main veins distinct to the margin; sori rather prominent, in close rows of 4 to 6 between the main veins.

Mount Mariveles, *Lohr*.

India to Japan and Malaya.

(5) *N. sphaerostichus* (Mett.). Rhizome woody, wide-creeping, clothed with ovate, acuminate, brown, crisped scales; stipe 6 to 10 cm. high, firm, erect; fronds 10 to 15 cm. high, oblong-lanceolate, acuminate, base narrowed abruptly, coriaceous, upper surface naked, lower sparsely tomentose; main veins distinct to the margin; sori in several series between the transverse veinlets, confluent, covering the whole lower surface.

Luzon, *Cuming* 127.

Celebes.

(6) *N. varius* Kaulf. Rhizome wide-creeping, clothed with scales whose long ferruginous or whitish tips are squarrose near the growing points, appressed farther back, then deciduous leaving the elliptical peltate bases, black in the center; stipes 2 to 5 cm. high, glabrescent; fronds usually somewhat dimorphous, the fertile 15 to 25 cm. high, 1 cm. more or less broad, attenuate to both ends but more abruptly to the base, coriaceous, glabrous or nearly so on the upper surface, the lower very sparsely pubescent, sterile fronds usually shorter and relatively broader; veins invisible; sori distinct but contiguous, covering rather more than the upper half of the frond.

Luzon, *Meyen*, *Chamisso*, *Cuming* 17, 67, 88, 135, 240; Benguet, *Barnes* Forestry Bureau 962, *Topping* 343; Mount Arayat, *Merrill* 3822; Corregidor, *Cuming* 286; Romblon, *Copeland* 301; Culiñon, *Merrill* 545; Samar, *Cuming* 323; Davao, *Copeland* 311, 938.

Java to China and Mariannes.

*N. varius* is construed here as including *N. elongatus* Bl., *N. pertusus* Spreng., *N. albicans* Bl., *N. Blumeanus* Kunze, and *N. caudatus* Kaulf.

(7) *N. adnascens* (Sw.) Kaulf. Rhizome wide-creeping, clothed with scales whose slender tips are deciduous; stipes 1 to 4 cm. high, erect, puberulous; fronds dimorphous, the sterile rarely more than 6 cm. high, 10 to 15 mm. broad, broadest near the rounded apex, contracted to the stipe, the fertile usually 10 to 15 cm. high, 6 to 10 mm. broad, broadest below the middle, both coriaceous, both surfaces smooth or sparsely pubescent; veins invisible; sori distinct but contiguous, occupying more or less than the upper half of the frond, with dense pubescence between them.

Manila, *Lohr*; Tayabas, *Warburg*; Mount Arayat, *Merrill* 3821; Capiz, Panay, *Copeland* 102, 103; Davao, *Copeland* 554, 626, 656; a common epiphyte over beaches.

Africa to Fiji.

(8) *N. nummulariaefolius* (Sw.) J. Sm. Rhizome very slender, wide-creeping, clothed with spreading bright-ferruginous fibrillose scales; stipes scaly, of the fertile frond erect, 5 to 15 mm. high, of the sterile much shorter, horizontal; fronds dimorphous, the sterile 10 to 15 mm. long, orbicular or elliptical, with or without a basal sinus, upper surface glabrous or sparsely stellate, lower with a very dense white or ferruginous tomentum,

fertile frond about 3 cm. high, 6 mm. broad, widening toward the rounded apex, contracted gradually to the stipe; veins invisible; sori covering the entire back.

Luzon, *Cuming* 246; Rizal *Loher*; Mount Arayat, summit, *Merrill* 3819; Mount Mariveles, *Merrill* 3757; Davao, *Copeland* 694 (along beach), 934. India to Celebes.

(9) **N. samarensis** (Presl). Rhizome firm, wide-creeping, clothed with deciduous, spreading, white, linear scales; stipe 3 to 10 cm. high, firm, erect; frond 30 to 60 cm. high, 1 to 2 cm. broad, coriaceous, upper surface naked, lower with dense whitish tomentum; veins invisible by reflected light, anastomosing irregularly; sori confluent, occupying the whole surface of the contracted upper half of the frond.

Samar, *Cuming* 323 in part; Albay, *Baranda*; Arayat and Mariveles, *Loher*.

(10) **N. angustatus** (Sw.) J. Sm. Clothed with linear deciduous scales; stipe 6 to 10 cm. high, strong, erect; frond 15 to 30 cm. high, 2 to 5 cm. broad, very coriaceous, upper surface naked, lower clothed with appressed subferruginous tomentum; veins invisible by reflected light, forming fine irregular areolæ; sori large, on the upper third of the frond, near the margin, sometimes confluent.

Luzon, *Cuming*.

India to Tahiti and New South Wales.

(11) **N. splendens** J. Sm. Rhizome short, fibrillose; fronds tufted, sessile or nearly so, 30 to 40 cm. high, one-fourth as broad, obtuse, attenuate to base, coriaceous, upper surface with appressed scattered cottony fibers, lower with dense ferruginous tomentum; main veins distinct and evident to the margin, with straight cross-veinlets, the areolæ thus formed divided into a few smaller ones, with a few free veinlets running in any direction; sori confluent, confined to the upper part of the frond, not reaching the margin.

Rizal, *Loher*; Sorsogon, *Baranda*; Samar, *Cuming* 331; Davao, *Copeland* 684.

#### (54) **POLYPODIUM** Linnaeus.

Fronds articulate to the rhizome, the fertile and sterile rarely different, the sterile always green, glabrous or the pubescence not stellate; sori dorsal on the frond, dorsal or terminal on the veins, or on their anastomoses, without indusia. A very large genus, including ferns of every habitat, the Philippine species never bipinnate. The preceding and the four following genera are derived from *Polypodium*, and intimately related to some of its sections. The subgenera are sometimes regarded as genera, as also have been various minor divisions not recognized at all in this arrangement, but all are very intimately related, and their separation costs as much as it gains in convenience, beside demanding many new names.

- |  |                        |
|--|------------------------|
| 1. Veins all free .....  | § <i>Eupolypodium</i>  |
| 1. Veins anastomosing to form regular areolæ, each with a single free included veinlet running toward the margin and bearing the sorus ..... | § <i>Goniophlebium</i> |

1. Veins anastomosing irregularly, with free included veinlets in various directions.
  2. Base of frond like the upper part.
    3. Rhizome not inflated nor inhabited by ants.
      4. Sori not confluent nor in single rows between veins ..... § *Phymatodes*
      4. Sori in single rows between main veins and often confluent ..... § *Selliguea*
    3. Rhizome inflated and inhabited by ants. .... § *Myrmecophila*
  2. Base of frond brown and rigid. .... § *Drynariopsis*

## § EUPOLYPODIUM.

1. Fronds simple and entire.
  2. Fronds hirsute, with red or brown hairs.
    3. Hairs in stellate clusters. .... (1) *P. jagorianum*
    3. Hairs solitary as a rule.
      4. Fronds 3 mm. or less broad.
        5. Hairs long and flexile ..... (2) *P. Christi*
        5. Hairs short and stiff ..... (3) *P. Merrillii*
      4. Fronds larger.
        5. Veins trifid, stipe long ..... (4) *P. setigerum*
        5. Veins once forked.
          6. Fronds obtuse ..... (5) *P. hirtellum*
          6. Fronds narrow, acute ..... (6) *P. setosum*
    2. Fronds glabrous.
      3. Fronds stipitate.
        4. Sori immersed ..... (7) *P. caespitosum*
        4. Sori superficial ..... (8) *P. fasciatum*
      3. Fronds sessile ..... (9) *P. sessilifolium*
  1. Fronds crenate or shallowly lobed.
    2. Sori scattered ..... (10) *P. pleiosoroides*
    2. Sori in regular rows parallel to costa ..... (11) *P. lohrianum*
  1. Fronds pinnatifid very nearly to the rachis.
    2. Sorus one on each segment.
      3. Segments less than their own width apart. .... (12) *P. cucullatum*
      3. Several times their width between segments. .... (13) *P. gracillimum*
    2. Sori several on each segment ..... (14) *P. solidum*
  1. Fronds pinnate.
    2. Veinlets simple.
      3. Sori superficial.
        4. Pinnæ entire ..... (15) *P. inconspicuum*
        4. Pinnæ slightly crenate.
          5. Lamina hirsute ..... (16) *P. minutum*
          5. Lamina glabrous ..... (17) *P. macrum*
        4. Pinnæ sharply toothed ..... (18) *P. subfalcatum*
      3. Sori immersed.
        4. Sori parallel to costa ..... (19) *P. cclcbicum*
        4. Sori oblique to costa.
          5. Young sorus almost inclosed.
            6. Frond lax, 25 cm. or more long ..... (20) *P. obliquatum*
            6. Frond firm, usually smaller ..... (21) *P. decorum*
          5. Rim of cavity not covering sorus.
            6. Rim of cavity elevated. .... (22) *P. craterisorum*
            6. Rim of cavity plane ..... (23) *P. subobliquatum*
    2. Veinlets forked.
      3. Sori immersed ..... (24) *P. papillosum*
      3. Sori superficial ..... (25) *P. Leysii*

## § GONIOPHLEBIUM.

1. Frond simple ..... (26) *P. nummularium*  
 1. Frond pinnate.  
   2. Lamina glabrous.  
     3. Margin entire ..... (27) *P. verrucosum*  
     3. Margin serrate ..... (28) *P. subauriculatum*  
   2. Lamina hairy ..... (29) *P. molliculum*

## § PHYMATODES.

1. Fronds simple, not deeply lobed.  
   2. Sori in a single row on each side of midrib.  
     3. Fronds more or less dimorphous, small.  
       4. Main veins evident.  
         5. Sori not restricted to upper half (30) *P. neglectum*  
         5. Sori restricted to upper half..... (31) *P. rhynchophyllum*  
       4. Veins obscure.  
         5. Fertile frond broad ..... (32) *P. acedens*  
         5. Fertile frond linear ..... (33) *P. hammatisorum*  
     3. Fronds alike, minute ..... (34) *P. rudimentum*  
     3. Fronds alike, larger.  
       4. Sori round ..... (35) *P. stenophyllum*  
       4. Sori oblong ..... (36) *P. longifolium*  
   2. Sori in several rows or scattered.  
     3. Venation fine or obscure.  
       4. Frond narrowly linear ..... (37) *P. tenuilore*  
       4. Frond linear-oblong ..... (38) *P. punctatum*  
       4. Frond broadly oblong ..... (39) *P. validum*  
       4. Frond ovate ..... (40) *P. oodes*  
     3. At least the main veins conspicuous.  
       4. Main veins falling short of margin.  
         5. Base attenuate ..... (41) *P. myriocarpum*  
         5. Base rounded ..... (42) *P. linguaciforme*  
       4. Main veins reaching margin.  
         5. Sori in two rows between main veins ..... (43) *P. triquetrum*  
         5. Sori scattered.  
           6. Frond narrowed below.  
             7. Lamina membranous ..... (44) *P. membranaceum*  
             7. Texture firmer.  
               8. Sori numerous.  
                 5. Sori round.. (45) *P. Zippelii*  
                 5. Sori irregular (46) *P. heterocarpum*  
               8. Sori few, large (47) *P. hemionitideum*  
             6. Base of frond broad..... (48) *P. muscfolium*  
             6. Base of frond broad..... (49) *P. anomalum*  
   1. Shallowly lobed or pinnatifid.....  
   1. Deeply pinnatifid. (Fertile simple entire fronds rare.)  
     2. Sori small and scattered.  
       3. Textile coriaceous ..... (50) *P. pentaphyllum*  
       3. Texture thin.  
         4. Stipe naked, winged almost to base..... (51) *P. insigne*  
         4. Stipe usually chaffy, less winged..... (52) *P. pteropus*  
     2. Sori large.  
       3. Fronds dimorphous ..... (53) *P. incurvatum*

- 3. Fertile and sterile fronds similar.
  - 4. Sori superficial.
    - 5. Sori uniseriate, rhizome scaly.
      - 6. Frond green ..... (54) *P. trifidum*
      - 6. Lower surface blue ..... (55) *P. glaucum*
    - 5. Sori pluriseriate, rhizome naked ..... (56) *P. affine*
  - 4. Sori shallowly immersed, veins inconspicuous ..... (57) *P. Phymatodes*
  - 4. Sori deeply immersed, veins evident.
    - 5. Segments linear-oblong ..... (58) *P. nigrescens*
    - 5. Segments linear ..... (59) *P. longissimum*
- 1. Fronds pinnate.
  - 2. Main veins conspicuous.
    - 3. Rachis mostly winged by decurrent pinnæ.... (60) *P. palmatum*
    - 3. Most of rachis not winged ..... (61) *P. angustatum*
  - 2. Main veins not conspicuous.
    - 3. Spots of lime on upper surface..... (62) *P. albidosquamatum*
    - 3. Without lime spots ..... (63) *P. lagunense*

## § SELIGUEA.

- 1. Frond simple and entire.
  - 2. Frond membranous.
    - 3. Rhizome scales linear, nearly black..... (64) *P. Seliguea*
    - 3. Rhizome scales lanceolate, brown..... (65) *P. macrophyllum*
  - 2. Frond coriaceous.
    - 3. Apex caudate ..... (66) *P. caudiforme*
    - 3. Apex obtuse ..... (67) *P. vulcanicum*
  - 2. Frond exceedingly leathery ..... (68) *P. Elmeri*
- 1. Frond deeply pinnatifid ..... (69) *P. ellipticum*

## § MYRMECOPHILA.

- 1. Frond entire ..... (70) *P. sinuosum*
- 1. Frond deeply pinnatifid ..... (71) *P. lomarioides*

## § DRYNARIOPSIS.

- 1. No specialized fertile part of frond..... (72) *P. heracleum*
- 1. Sori restricted to contracted apical part of frond..... (73) *P. meyenianum*

## § Eupolypodium.

(1) *P. jagorianum* Mett. Rhizome 3 to 10 cm. long, clothed with light-brown chaff; fronds clustered, sessile or narrowed to a very short petiole, the larger ones 10 cm. long and 6 mm. broad, entire, obtuse, coriaceous, clothed, especially near the margin and apex, with reddish hairs about 1 mm. long, usually in stellate clusters; veins almost invisible, forked once; sori near the midrib, on a linear-oblong superficial receptacle.

Philippines *Jagor* 835; Castillo, *Loher*; Mount Mariveles, 1200 m. *Merrill* 3230, *Copeland*.

(2) *Polypodium Christi* Copeland n. Sp. Rhizome short, bearing deciduous stramineous paleæ; stipes clustered, not articulate, 0 to 15 mm. high, beset with short hairs; fronds linear, 4 to 8, or rarely to 15 cm. high, 2 to 3 mm. broad, obtuse or subacute, very gradually attenuate downward, entire or nearly so, subcoriaceous, both surfaces bearing sat-

tered, stiff, nearly black hairs 1 to 2 mm. long; veins immersed, forked; sori oblong, oblique, superficial, ultimately confluent. Epiphytic on mossy trunks.

Mount Apo, Mindanao, *Copeland* 1520 (Type), 1101.

I conceive this to be the plant from the same locality, *Warburg* 14140, determined by Christ as *P. parasiticum* Mett. "*aut ei proximum*;" and would have let my plants bear the same name and doubt, but that Mettenius' name is invalidated by *P. parasiticum* L.

(3) *P. Merrillii* Copeland. Rhizome erect, short, clothed toward the apex with light-brown scales; fronds minute, the largest 23 mm. high, less than 2 mm. broad, linear-oblong, obtuse, contracted gradually to a very short petiole or sessile, coriaceous, with a pubescence of short, straight red-brown hairs mostly confined to the upper surface and margin; midrib conspicuous, veins simple, almost invisible; sori superficial, near the midrib, and so large that they extend from near the margin to well across it, forming a single wavy line, about 6 sori on a frond.

Paragua, *Merrill* 754, growing on rocks along a small stream in the mountains near the E-wi-g River.

(4) *P. setigerum* Blume. Rhizome erect or creeping, very short; stipes densely clustered, 3 to 6 cm. high, slender, densely beset with spreading cinnamon-colored hairs about 2 mm. long; fronds 15 to 25 cm. high, about 17 mm. broad, ligulate, obtuse or subacute, entire, herbaceous or subcoriaceous, sparsely clothed throughout with soft hairs like those of the rachis; veins immersed, twice or three times forked; the sori round, large, superficial, dorsal on the first acropetal branch of each vein.

Mount Apo, *Copeland* 1000, 1059, 1204, epiphytic in the mossy forest. Java and the Moluccas.

(5) *P. hirtellum* Blume. Rhizome short-creeping scaly; frond 5 to 8 cm. long, one-tenth as broad, obtuse, entire, contracted gradually to the short stipe, subcoriaceous, sparsely clothed throughout with long, soft, brown hairs; veins hidden; sori in a single close row on each side of the costa, nearer to it than to the margin.

Luzon, *Steere*.

Java and Ceylon.

(6) *P. setosum* (Blume, Christ). Stipes clustered on an erect rhizome, wiry, hirsute, about 2 cm. high; fronds 9 to 13 cm. long, about 7 mm. broad, narrowed toward both ends, but not acute, entire or very slightly wavy, subcoriaceous, sparsely hirsute; veins once forked, not or but slightly visible by reflected light; sori terminal on the short acropetal branch, superficial, round.

Luzon, *Cuming* 222; Mount Mariveles, *Copeland* 215; Mount Apo, 1,800 m.; *Copeland* 1008.

Java, Celebes.

The Davao plant is typical; that from Mariveles differs in having longer hairs, more abundant near the margin, and veins quite invisible by reflected light, the fertile ones of the broader fronds not infrequently twice forked; but it is not safely separable. Neither can I distinguish *P. Hookeri* Brack., also reported from the Philippines.



(7) *P. caespitosum* (Blume) Mett. Stipes clustered on a very short chaffy rhizome, 2 to 4 cm. high, wiry, weak, clothed with short weak hairs; fronds 8 to 15 cm. long, rather over one-twentieth as broad at the middle, gradually narrowed toward both ends, entire, subcoriaceous, usually quite glabrous; veins as a rule twice forked, inconspicuous; sori somewhat immersed, oblong, oblique to the costa.

Mount Apo, 1,800 m. *Copeland* 1008a, 1009, 1010.

Java.

A very variable species, especially in the texture and venation, and the shape and direction of the sori; a form occurs rarely with two irregular rows of sori on each side of the costa.

(8) *P. fasciatum* Mett. Rhizome strong, wide-creeping, clothed with broad gray scales; stipes 2 to 5 cm. high, rigid, deciduously ciliate, frond 30 cm. or more long, 1 cm. broad narrowed gradually toward both ends, entire, coriaceous, glabrous; costa prominent, veins immersed, forked; sori superficial, oblong, arranged end to end close to the costa.

Mount Data 2,250 m., *Loher*; a dwarf form, scarcely 7 mm. high, with stipe almost naked.

Malaya.

(9) *P. sessilifolium* Hooker. Fronds tufted, 7 to 22 cm. long, 4 to 6 mm. broad, narrowed gradually below the point, bluntish, entire or slightly undulate, subcoriaceous, glabrous; veins forked; sori oblong, placed end to end close to the costa.

Luzon, *Cuming* 382.

Malaya.

(10) *P. pleiosoroides* Copeland. Rhizome short, creeping, its scales broadly lanceolate, acuminate, stramineous; stipe 2 to 4 cm. high, slender, densely beset with very short stramineous hairs; frond 10 to 15 cm. high, one-tenth as broad, lanceolate, contracted to both ends, coriaceous, glabrous, margin sinuate, especially toward the base, bearing a few short hairs; veins immersed, inconspicuous, about 4 times forked; sori large, round, superficial, in 1 to 3 irregular lines or altogether scattered.

Mount Apo, 1,800 m., *Copeland* 1011, epiphytic.

(11) *P. loherianum* Christ, Bull. Herb. Boiss. 6 (1898):197. Rhizome short, with purplish hairs; stipes clustered, 1 to 3 cm. high, naked; frond ligulate-lanceolate, 15 cm. high, 7 to 10 mm. broad, rather obtuse, gradually contracted to the base, crenate-dentate, the teeth of irregular width, 3 mm. or less deep; nervature inconspicuous, veins pinnate in the teeth; sori dorsal on the lowest acropetal veinlets, scarcely immersed, round or oval, in a row rather nearer the costa than the margin, rarely a second imperfect row present; texture coriaceous.

Mount Data, 2,250 m., *Loher*.

(12) *P. cucullatum* Nées. Rhizome short, scaly; fronds very densely tufted, nearly sessile, 7 to 15 cm. long, about 7 mm. broad, but little contracted toward the ends, flaccid, glabrous or nearly so, pinnatifid to the winged rachis into numerous obtuse segments 1.5 mm. broad, separated by less than their own breadth, each with a single conspicuous vein;

sorus one in each segment, large, superficial, the lower half of the segment folded over it until maturity.

Luzon, *Cuming* 206, *Steere*; Mount Mariveles, *Copeland* 216; Davao, *Warburg* 14188, *Copeland* 1005, 1061.

Ceylon to Samoa.

(13) *P. gracillimum* Copeland. Rhizome creeping or suberect, clothed with minute brown lanceolate scales; fronds in dense clusters, almost sessile, the larger ones 12 cm. long, 4 mm. broad, flaccid, glabrous throughout, pinnatifid almost to the rachis into numerous fine, acute, remote, decurrent, erecto-patent, alternate segments; one vein and one sorus to each segment, the lower half of the lamina folded over the sorus.

Mount Apo, 1,800 m., epiphytic on mossy tree trunks, *Copeland* 1007.

(14) *P. solidum* Mett. Rhizome short, erect, clothed with lanceolate ferruginous scales; stipes clustered, glabrous, 0 to 2 cm. high; frond 8 to 15 cm. high, 1 to 2 cm. broad, narrowed from the middle toward both ends, acute, pinnatifid down very nearly to the ebeneous rachis into erecto-patent sharply serrate or incised acute segments, coriaceous, glabrous or the lower surface glaucous; main veins of the segments conspicuous, veinlets invisible, simple; sori large, round, costal. A small, relatively narrow form, with short, broadly triangular, almost entire segments is *Grammitis denticulata* Blume.

Mount Apo, 1,800 m., *Copeland* 1102, 1103.

Java.

(15) *P. inconspicuum* Blume. Rhizome short-creeping, clothed with linear scales; fronds sessile or nearly so, 10 to 15 cm. high, 1 cm. broad, contracted toward the ends, pinnate; pinnae erecto-patent, entire, coriaceous, glabrous or glabrescent; veinlets immersed, simple; sori costal.

Davao, *Warburg* 14190.

Java.

(16) *P. minutum* Blume. Stipes tufted, 4 to 7 cm. high, clothed with soft yellowish hairs; frond 10 to 15 cm. high, 2 cm. broad, narrowed toward the ends, pinnate; pinnae close, erecto-patent, obtuse, crenate, papyraceo-herbaceous, clothed on both sides with soft yellowish hairs; veinlets simple, very short; sori costal, 1 to 3 on each side.

Luzon, *Steere*.

Ceylon, Malaya.

(17) *P. macrum* Copeland. Rhizome short, erect, densely covered with roots, bases of dead stipes and brown scales; fronds crowded, on stipes 1 to 2.5 cm. long, the larger ones 25 cm. high, one-tenth as broad, narrowed toward both ends, curved, lax, pinnate; pinnae 1 to 2 mm. broad, rather acute, sinuate, decurrent, the upper ones confluent, the lower remote, sub-coriaceous, glabrous; veinlets simple; sori superficial, somewhat elongate, nearer the margin than the costa.

Mount Apo, 1,650 m., epiphytic on mossy trunks, *Copeland* 1016.

(18) *P. subfalcatum* Blume. Rhizome short, erect; stipes 1 to 2 cm. high, hairy; fronds about 15 cm. high, 2 to 3.5 cm. broad, narrowed toward

both ends, pinnate; pinnae close, spreading, decurrent, sharply toothed, papyraceo-herbaceous, sparsely villose; veinlets simple; sori round, midway between the costa and margin.

Luzon, *Cuming* 113, 205.

Malaya.

(19) *P. celebicum* Blume. Rhizome very short, clothed with linear brown scales; stipes 4 to 8 cm. high, firm, erect, beset with short, cinnamon-colored hairs; frond 35 to 50 cm. high, 5 to 7 cm. broad, apex of mature frond rather abruptly contracted; pinnae linear, about 3 mm. broad, separated by their own width, acute, entire, coriaceous, glabrescent; rachis short-hairy; veinlets simple, inconspicuous; sori half immersed, oblong, near the margin and parallel to it.

Mount Apo, 1,500 m., *DeVore* and *Hoover* 336, *Copeland* 1004, 1017.

Sumatra to Celebes.

(20) *P. obliquatum* Blume. Rhizome short, clothed with large lanceolate scales; stipe 2 to 4 cm. long, firm, spreading hirsute; frond 20 to 40 cm. long, about 6 cm. broad, pinnate; pinnae narrowed from broad bases to acuminate apices, horizontal or subfalcate, entire, coriaceous, glabrous; pinnules immersed, simple; sori immersed, the rim of the cavity almost roofing over the young ones, oblong, oblique to the costa, reaching almost from costa to margin.

Mount Mariveles, *Loher*; Davao, *Warburg* 14173, *Copeland* 1018.

India across Malaya.

*P. Schenkii* Harrington, collected by Steere in Panay and by Loher in Benguet, does not seem to be distinct.

(12) *P. decorum* Brack. Rhizome short, creeping, densely scaly; stipes 0 to 3 cm. high, firm, clothed with exceedingly short hairs or glabrescent; frond 10 to 25 cm. high, rather firm, broadly lanceolate, rather abruptly contracted to the ends, pinnate; pinnae close, erecto-patent or horizontal, obtuse or acute, coriaceous, glabrous; veinlets simple, invisible; sori immersed and when young almost roofed over, oblique, falling short of both costa and margin.

Benguet, *Topping* 193; Arayat, *Merrill*; Mariveles, *Copeland* 214, *Whitford* 244.

Ceylon to Hawaii.

A small form on mount Mariveles has usually a single sorus in or near the apex of the pinna.

(22) *P. craterisorum* Harrington, Journ. Linn. Soc. 16:31. Rhizome erect, clothed with brown lanceolate scales; stipes clustered, 1 to 4 cm. high, hirsute with brown hair, firm, erect; frond 20 to 30 cm. long, 4 to 6 cm. broad, oblong or oblong-oblancoate, tapering above and below, pinnate; pinnae numerous, linear, about 25 mm. long and 4 mm. broad, obtuse, entire, broadened and more or less confluent at the base, passing below into the narrow lobed wing of the stipe; rachis pubescent, lamina glabrous, membranous; veinlets simple, falling short of the margin; sori confined to the upper part of the frond, immersed, oval, 5 to 10 in a row

on each side of the costa, about midway between it and the margin; rim of cavity projecting but not overarching.

Mount Majajay, epiphytic on tree trunks, *Steere*.

(23) *P. subobliquatum* Christ, Bull. Herb. Boiss. 6 (1898):197. Rhizome short-creeping, sparsely scaly; stipe 1 to 2 cm. high, beset with very short cinnamon-colored hairs; frond 10 to 15 cm. high, 2 cm. broad, oblong-lanceolate; pinnae obtuse, alternate with broad bases, remote, reduced toward the ends of the frond, 2 mm. broad, coriaceous, rufescent, glabrous; veinlets oblique, simple, inconspicuous; sori 4 to 6 on each side of costa, ovate, scarcely immersed, midway between costa and margin, rim of cavity plane, not at all crateriform.

Mount Mariveles, 1,420 m., *Loher*. This fern must be rare, as our rich collections from its type locality contain no representative of the group without more or less crateriform rim around the sorus.

(24) *P. papillosum* Blume. Rhizome wide-creeping, subscaly; stipes 8 to 20 cm. high, firm, erect, almost glabrous; frond 30 to 50 cm. long, 4 to 6 cm. broad, drooping, abruptly acuminate, pinnate, lower pinnae not reduced; pinnae close, horizontal, about 4 mm. broad, obtuse, serrate toward the apex, herbaceous, glabrous; veinlets evident, forked; sori nearer the margin than the costa, round, so immersed that they project, often more than 1 mm. from the upper surface.

Luzon, *Cuming* 185; Nueva Vizeaya, *Merrill* 342; Sorsogon, *Baranda*; Davao, *Copeland* 972, 982, 1277.

Malaya.

(25) *P. Leysii* Baker, Journ. Bot. 17 (1879), p. 66.

Sulu Archipelago, *Burbridge*. Description not available.

### § *Goniophlebium*.

(26) *P. nummularium* Mett. Rhizome wide-creeping, slender, clothed with linear subulate, ferruginous scales; stipes scattered, of sterile frond short, of fertile 6 to 10 cm. high; fronds dimorphous, entire, the sterile suborbicular, scarcely 2 cm. long, the fertile 6 to 10 cm. long and narrowly linear, both coriaceous, glabrous; veins immersed, obscure, anastomosing to form a regular series of triangular and rhomboidal areolæ; sori in a single series, round, superficial, but their position marked on the upper surface of the frond.

Jala-Jala, Rizal, *Meyen*; Laguna, *Cuming* 121.

(27) *P. verrucosum* Wall. Stipes 40 to 60 cm. high, glabrous, erect, terete; frond 30 to 120 cm. high, 30 cm. broad, pinnate; pinnae numerous, 15 to 20 cm. long, about 2 cm. broad, entire, coriaceous, glabrous or nearly so; veins forming several rows of areolæ; sori confined to the costal areolæ, immersed so as to form distinct papillæ on the upper surface.

Sorsogon and Bataan Island, *Baranda*; Davao, *Warburg* 14155.

Malacca to northern Australia.

*P. (Goniophlebium) phlebodioides* Copeland (ined.) is a still larger fern with the bases of the pinnae acute, and mostly three rows of areolæ, differing from *P. verrucosum* in that the pinnae are broadly serrate.

Mount Apo.

(28) *P. subauriculatum* Blume. Rhizome wide-creeping, bluish, clothed with broadly linear ferruginous scales; stipes 15 to 35 cm. high, firm, brown, shining, glabrous; frond 40 to 120 cm. long, about 25 cm. broad, firm, more or less horizontal, pinnate; pinnae 10 to 15 cm. long, one-tenth as broad, acute or acuminate, serrate toward the apex, rounded or auricled on the lower or both sides at the sessile base, herbaceous or subcoriaceous, glabrous; areolæ a single row in the original description, but 2 or 3 rows in more recent descriptions and in most of our specimens; sori only in the costal areolæ, immersed.

Luzon, *Cuming* 244; Benguet, *Loher*, *Barnes* 974; Mount Mariveles, *Merrill* 3208, *Whitford* 318, *Copeland* 1382.

Himalayas to Samoa and New Caledonia.

(29) *P. molliculum* Copeland. Rhizome wide-creeping, clothed with small, subulate, ferruginous scales; stipe about 10 cm. high, suberect, becoming glabrous; frond 15 to 20 cm. high, 8 cm. broad, pinnate; pinnae narrowly lanceolate, 6 to 8 cm. broad, acute, serrate, or crenate toward the base, short-auricled, more or less truncate, sessile but not adnate, herbaceous, clothed on both surfaces with a short soft tomentum; veins free beyond a single costal series of areolæ; sori scarcely immersed.

Baguio, epiphytic on pines, *Elmer* 6505.

#### § Phymatodes.

(30) *P. neglectum* Blume. Rhizome slender, wide-creeping, clothed with grayish-ferruginous scales; stipes scattered, 1 to 2 cm. high, firm, glabrous; sterile fronds broadly ovate, 2 to 2.5 cm. high, 1.5 cm. broad, obtuse, rounded below, entire, coriaceous, glabrous; main veins very distinct almost to the edge, veinlets half evident; fertile frond lanceolate-ovate, obtuse at both ends, 3 to 3.5 cm. high; sori large, round, in a single row, superficial, in well-developed fronds about 5 sori in each row, reaching the entire length of the frond.

Luzon, *Meyen*: Mount Mariveles, on exposed ridges, *Merrill* 3244.

Java.

(31) *P. rhynchophyllum* Hooker. Rhizome firm, wide-creeping, with copious fibrillose bright-ferruginous scales; frond dimorphous, the sterile ones ovate, 3 to 4 cm. long, with stipes about the same length, fertile ones 8 to 15 cm. long, 15 mm. broad, narrowed very gradually upwards, obscurely toothed, on stipes 5 to 10 cm. long, coriaceous, glabrous; main veins distinct to the margin, with copious fine areolæ between them, with free included veinlets; sori uniserial, confined to the upper half of the fertile fronds.

Mount Mariveles, *Loher*.

Upper India.

(32) *P. accedens* Blume. Rhizome wide-creeping, slender, sparsely clothed with linear-subulate, dull brown scales; stipes 2 to 10 mm. high, firm; fronds not very dimorphous, the sterile 2 to 4 cm. high, ovate, obtuse or subacute, rounded or subcuneate at the base, coriaceous, glabrous except for a few dark scales along the margin; veins invisible; fertile



frond 3 to 8 cm. high, lower broad part sterile, upper part contracted and soriferous; sori rather large, round, in single rows, often confluent, and covering the apex of the frond.

Luzon, *Steere*; Benguet, *Elmer* 6128; Arayat, *Merrill* 3817; Mount Mari-veles, *Loher*, *Merrill* 3225, 3750, *Whitford* 314; Mount Apo, *DeVore* and *Hoover* 325, *Copeland*; the Mount Apo plants are larger than those from Luzon.

Malaya and Polynesia

(33) **P. hammatisorum** Harrington, Journ. Linn. Soc. 16(1878):32. Rhizome long and slender, clothed with membranous, long-lanceolate, light brown scales; stipes scattered, those of the sterile frond 1 to 4 cm. high, of the fertile 3 to 7 cm., slender, naked, erect; sterile frond elliptical, 1 to 4 cm. long, 6 to 25 mm. broad, obtuse, coarsely and shallowly crenate except at the tapering base; fertile frond linear, 5 to 12 cm. long, 4 mm. broad, with a lobe under each sorus, coriaceous, glabrous; midrib distinct, veins immersed; sori about 20 in a row on each side of the costa, nearly opposite, large, giving the fertile frond a knotted appearance.

Mount Majajjay, on fallen timber, *Steere*.

(34) **P. Rudimentum** Copeland. Rhizome wide-creeping, slender, clothed with linear-subulate scales; stipes 15 to 25 mm. high, filiform, straight and erect, glabrous; frond orbicular-ovate, the fertile rather the narrower, 10 to 20 mm. long, rounded at both ends, entire or with fine incisions marking the place of teeth, coriaceous, very glabrous; costa disappearing below the apex, veins hidden, anastomosing irregularly or rarely free but hamate; sori few in a row on each side of the costa, nearer it than the margin, round, somewhat immersed.

Baguio, on wet boulders, *Elmer* 6022.

(35) **P. stenophyllum** Blume. Rhizome moderately thick, wide-creeping, densely clothed with linear, pale brown scales; stipes 1 to 2 cm. high, firm, erect; fronds 10 to 12 cm. high, 1 cm. broad, rounded above, attenuate to the base, entire, coriaceous, glabrous; veins immersed, invisible, with few veinlets; sori in single rows near the margin, round, deeply immersed, and prominent from the upper side.

Luzon, *Cuming* 122.

Java to Celebes.

(36) **P. longifolium** Mett. Rhizome short-creeping, woody, its scales linear, very dark; stipe about 2 cm. high, not distinct from frond; frond 30 to 40 cm. high, 10 to 20 mm. broad, subacute, entire and often revolute, attenuate to the base, coriaceous, glabrous or nearly so; veins invisible, areolæ fine, with copious free veinlets; sori oblong, quite immersed, placed in a single row close and parallel to the margin, separated by more than their own length.

Mount Atoe, 1,500 m., *Loher*; Paragua, *Merrill* 752.

Malaya.

(37) **P. tenuilore** Kunze. Rhizome slender, scandent; frond 20 to 50 cm. high, at most 12 mm. broad, acuminate, entire, attenuate to the sessile or short-stipitate base, coriaceous, glabrous; main veins none, areolæ fine,



invisible; sori minute, copious, scattered, sometimes confluent, especially along the margin.

Mindanao, *Cuming* 287; Catanduanes, *Baranda*; Benguet, *Topping* 262.

(38) **P. punctatum** (L.) Christ. Rhizome short, stout, with sparse scales but usually covered with roots; fronds sessile or nearly so, 30 to 60 cm. high, one-tenth as broad, oblanceolate, acute or obtuse, attenuate to the base, entire, subcoriaceous, glabrous; midrib prominent, veins fine, not immersed, with copious fine areolæ and free veinlets; sori small and copious, scattered irregularly.

Baguio, *Topping* 314, *Elmer* 5884 (large sori); Mount Mariveles, *Copeland* 253, 257 (broad), *Whitford* 197; Rizal, *Merrill* 2353; Mount Apo, *Copeland* 1194.

Tropical Africa across Polynesia.

(39) **P. validum** Copeland. Rhizome short, stout, clothed with ovate, obtuse, cordate or peltate, appressed, brown scales; fronds clustered, almost sessile, broadly oblanceolate, subacute, entire, attenuate to the base, thick-coriaceous, brittle, glabrous; main veins fine but not immersed, running almost to the margin, major areolæ about 7 between costa and margin, each inclosing many fine minor ones; sori numerous, minute, irregularly scattered.

Davao, on rocks along Sibulan River, *Copeland* 973, 1259.

(40) **P. oodes** Kunze. Rhizome slender, clothed with small fibrillose, yellowish scales; stipes distant, slender, glabrous; frond 4 to 6 cm. long, 3 cm. broad, ovate, entire, with rounded but hardly decurrent base, coriaceous, glabrous; main veins distinct nearly to the margin, with fine areolæ and free veinlets; sori rather large, few, scattered.

Philippines, *Cuming* 58; Mount Data, Benguet, *Loher*.

(41) **P. myriocarpum** Mett. Rhizome stout, creeping, sparsely scaly; stipes subclustered, 1 to 2 cm. high; frond 40 to 60 cm. high, 3 to 6 cm. broad, acuminate, entire, attenuate to the base, papyraceous, glabrous or the lower surface pubescent; main veins distinct two-thirds of way to margin, where they are connected, forming a conspicuous row of large rhomboidal areolæ, outside which is a row of smaller ones, both including numerous fine ones; sori numerous, minute, scattered irregularly.

Benguet, *Topping* 346, *Elmer* 6142; Mariveles, *Merrill* 2549, *Copeland* 227, *Whitford* 50; Rizal and Tarlac, *Loher*; Mindoro, *Merrill* 1772.

Cochin China, Malaya.

(42) **P. linguaeforme** Mett. Rhizome stout, short-creeping; frond sessile, 20 to 50 cm. long, 7 cm. broad, narrowed from the middle to three-fourths of the way down, and then dilated again to the broadly rounded base, entire, papyraceous, glabrous; veins very distinctly raised, the main ones irregular, areolæ subquadrangular, with an immersed sorus on free or jointed veinlets in the center of each.

Castillo, *Loher*.

Borneo, the Solomon Isles.

(43) **P. triquetrum** Blume. Rhizome slender, creeping, clothed with brown or whitish, lanceolate, acuminate scales; stipes 3 to 12 cm. high,

those of the fertile fronds the higher, straight or crooked, stramineous, glabrous; fronds somewhat dimorphous, the sterile 3 to 10 cm. long, lanceolate or ovate, obtuse or acute, entire, rounded or cuneate at the base, coriaceous, glabrous, the fertile frond usually longer and narrower; main veins conspicuous very nearly to the margin, areolæ invisible; sori moderately large, in two rows between each two main veins, round, superficial. Including *P. rupestre* Blume, this species varies exceedingly in the size and shape of the fronds.

Luzon, *Cuming* 245; Benguet, *Loher*. *Topping* 149; Arayat, *Loher*; Mount Mariveles, *Barnes* 346, *Whitford* 126, *Copeland* 1391.

Malaya and Polynesia.

(44) *P. membranaceum* Don. Rhizome stout, clothed with ovate, membranaceous scales; stipe short, winged, erect, firm; frond 30 to 50 cm. high, about 8 cm. broad, narrowed gradually toward both ends, repand or entire, very thin; main veins distinct, with very copious fine areolæ with free veinlets; sori mostly in two rather irregular rows near the main veins.

Philippines, fide Baker, *Ann. of Bot.* 5:477; Baguio, *Elmer* 5873, *Topping* 226, 263.

Ceylon to west China.

(45) *P. Zippelii* Blume. Rhizome creeping, clothed with thin, lanceolate, squarrose, brown scales; stipes short and stout; fronds about 30 cm. high, 4 to 5 cm. broad, acute, decurrent below, entire or nearly so, submembranaceous, glabrous; venation very evident; sori mostly in rows along the main veins.

Philippines, *Steere*; Sorsogon and Masbate, *Baranda*.

Java.

As originally described this species is very doubtfully distinct from the preceding.

(46) *P. heterocarpum* Blume. Rhizome wide-creeping, clothed with squarrose, linear, dull brown scales; stipes 30 cm. or more high, angular, winged above; frond 30 cm. or more long, oblong-lanceolate, subacute, attenuate below, repand, thin but firm, glabrous; main veins distinct, areolæ rather ample; sori more or less in rows parallel to the main veins, irregular in shape.

Benguet and Rizal, *Loher*; Davao, *Copeland* 962, 965, 1251.

India to Borneo.

(47) *P. hemionitideum* Wall. Rhizome woody, hypogaeous; stipe about 10 cm. high, firm, erect; frond 20 to 50 cm. high, 10 cm. or less broad, narrowed to both ends, entire, subcoriaceous, glabrous; veins very evident, main ones not quite reaching the margin, areolæ rather large; sori large, irregularly arranged.

Isabela, Luzon, *Warburg* 11603, 11621; Mariveles, *Warburg* 11527.

India and south China.

(48) *P. musaeifolium* Blume. Rhizome woody, with ovate, dull brown scales; stipe about 1 cm. high, very stout; frond over 1 m. high, 15 cm. broad, oblanceolate, obtuse, nearly entire, broad to the base, coriaceous,

glabrous; venation evident, main veins running very nearly to the margin, with regular arched cross veins; sori small, in rows parallel to the cross veins and scattered.

Davao, epiphytic forming poor nests, *Copeland* 1295.

Malaya.

(49) *P. anomalum* Christ. Bull. Herb. Boiss. 6 (1898):201. Rhizome creeping, clothed with ovate-subulate, crisped, brown scales; stipe 3 to 4 cm. high, stramineous, glabrous; frond 20 cm. high, 15 cm. broad, irregular in form, attenuate below, undulate-crenate, or pinnatifid into lobes of irregular form 3 cm. long, the apex of the frond irregularly dentate, membranous, pale green, especially below, glabrous; main veins distinct, areolæ about 4 series along the costa, large; sori large, round, irregularly pluriseriate.

Mount Data, 2,250 m., *Loher*.

(50) *P. pentaphyllum* Baker, Ann. of Bot. 5 (1891):478. Rhizome wide-creeping, woody, 3 mm. in diameter, sparsely clothed with small lanceolate-acuminate paleæ; stipe naked, 2 to 3 cm. high; frond 30 cm. or more high, simple in the lower half, forming a mere wing to the rachis, deeply pinnatifid in the middle into distant, linear-lanceolate lobes 1 cm. broad, membranous, green glabrous; veins fine, copious; sori minute, scattered.

Philippines, *Wallis*; Castillo, Arayat, and Los Baños, *Loher*.

(51) *P. insigne* Blume. Rhizome slender, dull brown; stipe 10 to 15 cm. high, often winged throughout, glabrous; frond 10 to 20 cm. high, two-thirds as broad, with an entire, acute, lanceolate terminal lobe one-third the height of the frond and 15 mm. broad, and 2 to 4 similar lobes on each side, separated to within 1 cm. of the rachis, firm-herbaceous, glabrous; venation fine, irregular, visible; sori small, irregularly scattered.

Luzon, *Cuming* 52, Brackenridge.

Malaya.

(52) *P. pteropus* Blume. Rhizome wide-creeping, bearing blackish, lanceolate-subulate scales; stipe 10 to 15 cm. high, naked or as a rule scaly; frond 10 to 20 cm. high, up to 5 cm. broad, rarely simple, usually ternate or pinnatifid, with a large, broad, acute, repand terminal lobe and similar but smaller lateral ones, thin but firm, dark green, glabrous; main veins falling short of the margin, as in *P. punctatum*; sori small, scattered.

Samar, *Cuming* 324.

India and Malaya to Formosa.

(53) *P. incurvatum* Blume. Rhizome creeping, clothed with ovate, whitish, membranous, appressed scales; stipe of sterile frond 10 to 15 cm. high, of fertile 20 to 40 cm. high, erect, firm, glabrous; fronds simple, ternate or pinnatifid, or the fertile even pinnate; the sterile 10 to 20 cm. long, mostly broadly triangular, the lobes broad, entire or repand, acute, coriaceous, glabrous; fertile frond larger, with acuminate lobes about 1 cm. broad; main veins reaching the margin, veinlets invisible; sori large, round, one in each areola, in a single row between midrib and margin, partly immersed.

Davao, Warburg 14162, Copeland 1063; different from typical plants in that the sori are not entirely immersed.

Java.

(54) *P. trifidum* Don. Rhizome stout, creeping, clothed with large, lanceolate, squarrose, ferruginous scales; stipe 8 to 20 cm. high, erect, firm, polished; frond 10 to 15 cm. high, most frequently trifid, the segments 10 to 15 cm. long, one-tenth as broad, or the sterile rather broader, acuminate; entire or repand, coriaceous, glabrous, green on both sides; main veins conspicuous to the margin, veinlets obscure; sori in single series, rather nearer the midrib than the margin, one between each two main veins.

Benguet, Loher, Elmer 5815; Arayat, Merrill 3812; Mount Mariveles, Loher, Copeland 219, Whitford 142.

Ceylon to Japan.

This is very probably only an undeveloped state of *P. palmatum*.

(55) *P. glaucum* Kunze. Rhizome creeping, stout, clothed with acicular, stiff, purplish brown paleæ 1 cm. or more long; stipe 15 to 20 cm. high, erect, firm, polished; frond 20 to 30 cm. high, 15 to 20 cm. broad, pinnatifid to within 5 mm. of the rachis into erecto-patent, acute, entire segments 10 cm. long and 7 mm. broad, or the sterile rather broader, coriaceous, glabrous, the under side with a blue bloom; no main veins, veinlets visible from the upper but not from the lower side; sori superficial, round, in single rows near the midribs.

Luzon, Cuming; Mount Mariveles, Whitford 147, Copeland 1392; epiphytic on high ridges.

(56) *P. affine* Blume. Rhizome woody, scaleless; stipe 30 to 45 cm. high, firm, glossy; frond 60 to 120 cm. long, 30 cm. or more broad, cut down nearly to the rachis below, within 1 cm. of it above, into erecto-patent, slightly repand, very acuminate lobes, 15 to 25 cm. long, about 25 mm. broad, papyraceous, glabrous; no main veins, areolæ large; sori superficial, in 2 to 3 irregular rows.

Luzon, Cuming 97; Sorsogon and Albay, Baranda.

Malaya.

(57) *P. Phymatodes* L. Rhizome wide-creeping, stout, bearing sparse deciduous fibrillose scales, becoming glabrous except for very few appressed ovate black paleæ; stipes 10 to 20 cm. high, erect, firm, polished, brown; frond exceedingly various, sometimes simple, lanceolate or oblong, acute or obtuse, entire or nearly so, 10 to 20 cm. long; usually pinnatifid into segments similar to the simple form, the sinuses reaching to about 1 cm. from the rachis, usually rounded, coriaceous, glabrous; main veins none or very fine and not nearing the margin; sori large, round, immersed, in single or double rows or scattered; epiphytic.

Luzon, Cuming 27, 201; Mariveles and Manila, Loher; Tayabas, Merrill 3353; Mindoro, Merrill 1780; Gimogon River, Negros, Copeland 77; Davao, Warburg 14113, Copeland 310, 657.

Africa across Polynesia.

(58) *P. nigrescens* Blume. Rhizome short, very thick, the ovate scales usually concealed by roots; stipe 10 to 50 cm. high, firm, glabrous, straight; frond rarely simple or ternate, usually pinnatifid to about 7 mm. from the rachis into few or many broadly linear segments, which are acuminate, entire or repand, 20 to 30 cm. long, 2 cm. or more broad, herbaceous, glabrous, dark green; main veins fine, indirect, falling short of margin, included free veinlets copious; sori round, deeply immersed, in single rows nearer the midrib than the margin.

Benguet, *Topping* 339; Mount Mariveles, *Copeland* 1404; Rizal and Laguna, *Loher*; Tayabas, *Warburg* 12756; Sorsogon, Albay, and Camarines, *Baranda*; Davao, *Copeland* 690, 964.

India across Polynesia.

(59) *P. longissimum* Blume. Rhizome very stout, clothed with large, ovate, deciduous scales; stipe stout, 30 to 60 cm. high, polished, stramineous; frond 40 to 100 cm. high, 25 to 35 cm. broad, pinnatifid to the narrowly winged rachis into linear erecto-patent, acuminate, entire or repand segments usually not more than 1 cm. broad, subcoriaceous, glabrous; venation inconspicuous; sori deeply immersed, round, in single rows rather nearer the midrib than the margin.

Rizal, *Merrill* 1356, 2267; south Luzon, *Baranda*; Basilan, *DeVore* and *Hoover* 24 (?).

India to Java and Formosa.

(60) *P. palmatum* Blume. Rhizome creeping, densely clothed with large, spreading, lanceolate-subulate ferruginous paleæ; stipe 15 to 30 cm. high, firm, glabrous; frond 15 to 35 cm. high, 15 to 30 cm. broad, pinnatifid very nearly to the rachis or pinnate; pinnæ 10 to 15 cm. long, 1 cm. more or less broad, broadest in the middle, acuminate, entire or suberenate, cuneate-decurrent at the base, coriaceous, glabrous; main veins conspicuous, veinlets obscure; sori round, in slight depressions, in single rows, one sorus between each two main veins.

Luzon, *Cuming*, *Steele*; Benguet, Arayat, and Mount Mariveles, *Loher*; Benguet, *Topping* 189, 292; Mount Mariveles, *Merrill* 3235, *Copeland*; Davao, *Warburg* 14154, *DeVore* and *Hoover* 328, *Copeland* 1062; Jolo Archipelago, *Burbidge*.

Malaya.

(61) *P. angustatum* Blume. Rhizome stout, creeping, clothed with very large, ovate-lanceolate paleæ, brown with scarious margins; stipe 30 cm. high, firm, erect, glabrous; frond 35 to 45 cm. high, pinnate; pinnæ 15 to 20 cm. long, 2 to 3 cm. broad erecto-patent, acuminate obscurely serrate, the lower ones sessile, the upper broadly adnate to the rachis, coriaceous, glabrous; main veins conspicuous, veinlets obscure; sori large, round, superficial, in single rows, one sorus between each two main veins.

Mount Apo, *DeVore* and *Hoover* 330, 341, 376, *Copeland*.

Java and Celebes.

This species is united with *P. palmatum* in Synopsis Filicum and by Christ; but the two Philippine species, each agreeing perfectly with the figure and description of Blume, differ in the size and position of the sori,



shape, and margin of the pinnae and their freedom from the rachis, and size of the paleæ.

(62) *P. albido-squamatum* Blume. Rhizome stout, wide-creeping, clothed with reddish or gray-brown paleæ which are ovate at the base and long-subulate; stipe 15 to 40 cm. high, erect, polished; frond 30 to 60 cm. high, about 30 cm. broad, pinnate; pinnae erecto-patent, linear or lanceolate, very acuminate, entire or nearly so, coriaceous, glabrous, the lower stalked, the upper sessile; main veins visible but not conspicuous, veinlets ending under submarginal lime-spots; sori in single rows, usually nearer the midrib than the margin. Philippine specimens are mostly narrower than the type, belonging in *P. varians* Blume, which is not a distinct species.

Luzon, *Cuming* 202, 236; Mounts Arayat and Mariveles, *Loher*; Benguet, *Topping* 150, 215, 202, *Elmer* 6263; Mount Mariveles, *Copeland*; Jolo Archipelago, *Burbidge*.

Malaya.

(63) *P. lagunense* Christ, Bull. Herb. Boiss. 6 (1898):201 cum Leone. Rhizome wide-creeping, solid, clothed with ovate-subulate, umbonate, reddish-brown appressed scales; stipe 10 to 15 cm. high, firm, glabrous; frond 15 to 20 cm. high, 10 to 15 cm. broad, pinnate, dimorphous; pinnae of the sterile frond 6 or 7 on each side, remote, oval, 4 cm. long, 2 cm. broad, acuminate, subrenate, sessile or short-stalked, coriaceous, glabrous; pinnae of fertile frond linear-lanceolate, caudate, erecto-patent, 12 cm. long, 4 to 10 mm. broad, crenate; costa prominent, veins inconspicuous, veinlets hidden; sori large, round, immersed, in single rows, one sorus between each two main veins, midway between costa and margin.

Los Baños, Laguna, *Loher*.

### § *Selligaea*.

(64) *P. Selligaea* Mett. (*Gymnogramme membranacea* Hooker). Rhizome wide-creeping, clothed with small, linear, nearly black scales; stipe 5 to 15 cm. high, nearly naked; frond 15 to 30 cm. high, 2 to 4 cm. broad, very acuminate entire, attenuate below and decurrent, papyraceo-herbaceous, glabrous; main veins distinct to the margin but zigzag and very slender, united by similar transverse veinlets to form large hexangular areolæ; sori in oblique interrupted lines, one line between each two main veins.

Samar, *Cuming* 325, 334.

Malaya.

(65) *P. macrophyllum* Mett. Rhizome creeping, clothed with small, dark, lanceolate scales; stipe 2 to 3 cm. high, firm, sealy; frond 30 to 60 cm. high, 6 to 8 cm. broad, narrowed gradually toward both ends, entire or repand, papyraceous, glabrous; main veins conspicuous, not straight, areolæ rather quadrangular, free veinlets evident; sori in single continuous or interrupted rows between the main veins.

Bohol, *Cuming* 351; Rizal, *Loher*; Benguet, *Barnes* 967.

Malaya.

(66) **P. caudiforme** Blume. Rhizome wide-creeping, clothed with ovate-lanceolate, scariosus-ferruginous scales; stipe 10 to 20 cm. high, firm, glabrous; frond 10 to 20 cm. high, the fertile lanceolate, the sterile ovate, long-acuminate, entire or crenate, rounded or acute at the base, coriaceous, glabrous; main veins conspicuous, reaching the margin, veinlets invisible; sori large, globose or elongate, as wide as the space between the main veins, rarely confluent; epiphytic.

Mount Apo, 1,800 m., *Copeland*, 1055, 1106.

Malaya and Polynesia.

(67) **P. vulcanicum** Blume. Rhizome creeping, clothed with ovate, brown scales; stipe of the sterile frond 3 to 8 cm. high, of the fertile 8 to 20 cm., rigid, glabrous; sterile frond 3.5 to 6 cm. high, ovate, obtuse, rounded below, entire, coriaceous, glabrous; fertile frond 5 to 12 cm. high, ovate-lanceolate, obtuse, acute at base; main veins conspicuous, falling short of margin, or barely reaching it, veinlets invisible; sori globose, mostly confluent in rows from the costa to the margin, so large that they touch across the main veins; terrestrial.

Mount Apo, above 2,100 m., *DeVore* and *Hoover* 337, *Copeland* 1048.

Sunda to Celebes, highest mountains.

(68) **P. Elmeri** Copeland. Rhizome creeping, stout, clothed with ovate, acuminate scales 6 mm. long, with peltate, black-centered bases; stipes stout, dark, glabrous, that of the sterile frond 3 to 6 cm. high, of the fertile 15 to 20 cm.; sterile frond ovate-triangular, about 10 cm. high, 6 to 8 cm. broad, obtuse, entire or subrepand, abruptly truncate at base, glabrous, very rigidly coriaceous; main veins conspicuous, reaching the margin, veinlets invisible; fertile frond 10 cm. high, 4 cm. broad, acute, subentire, cuneate at base, coriaceous; sori uninterrupted, reaching from the costa to the margin, not quite filling the space between the main veins; epiphytic.

Mount Santo Tomas, Benguet, *Elmer* 6547.

(69) **P. ellipticum** Thunberg. Rhizome creeping, woody, bearing small, lanceolate, brown scales; stipe 30 to 60 cm. high, firm, naked; frond 30 to 50 cm. high, 15 to 30 cm. broad, pinnate below, rachis winged above; pinnae or segments 7 to 11 on each side, about 20 cm. long, linear-lanceolate, acute, entire, herbaceous, glabrous; venation conspicuous, main veins zigzag, not reaching the margin, areolae large, irregular, mostly with single free veinlets; sori linear, oblique, touching the midrib but not the margin; terrestrial. Includes *Selliguea pothifolia* J. Sm.

Luzon, *Cuming* 53; Benguet, *Elmer* 5876, *Barnes* 963; Rizal, *Loher*; Mount Mariveles, *Loher*, *Merrill* 3116, *Copeland* 220; Catanduanes, *Baranda*; Samar, *Cuming*; Davao, *Copeland* 1256.

India to Japan and Queensland.

#### § Myrmecophila.

(70) **P. sinuosum** Wallich. Rhizome wide-creeping, tubular, 1 to 3 cm. in diameter, covered with roundish peltate scales with black center and scariosus margin; stipes brown, erect, glabrous, of sterile frond about 4 cm. high, of fertile about 6 cm.; sterile frond about 10 cm. high, 1.5 to

2 cm. broad, obtuse, base subacute, entire, subcoriaceous, glabrous; fertile frond about 20 cm. high, 1.5 to 2 cm. broad, subacute, acute at base, subrenate; veins hidden, main veins not reaching margin; sori large, round, immersed, in single rows nearer the margin than the costa.

Tayabas, *Merrill* 3355; Negros, *Copeland* 101.

(71) *P. lomarioides* Kunze. Rhizome forming a thick, wide-spreading crust, thickly clothed with small, peltate scales which are ferruginous in the center, with a scarious border; stipe about 10 mm. high, erect; frond 30 to 50 cm. high, 10 to 15 cm. broad, the sterile pinnatifid into close, horizontal, oblong, entire, obtuse lobes 2 cm. broad, the fertile cut nearly to the rachis throughout into more numerous lobes, hardly 1 cm. broad, coriaceous, glabrous; veins hidden, irregular; sori round or oblong, completely immersed, in single rows near the midrib.

Luzon, *Cuming* 242 (?).

Malaya to Formosa.

#### § *Drynariopsis*.

(72) *P. heracleum* Kunze. Rhizome very stout, clothed with long, fibrillose, light-brown scales; fronds seriate, 100 to 350 cm. long, 60 to 100 cm.; broad, the base reduced to a broad rigid wing, 15 cm. broad, weak in chlorophyll, the upper part cut down nearly to the rachis into acute entire lobes 50 cm. long, 10 cm. broad, rigidly coriaceous, glabrous; main veins distinct to the margin, with about eight series of large areolæ inclosing numerous small ones with free veinlets; sori small, numerous, scattered, slightly immersed.

Sorsogon and Catanduanes, *Baranda*; Mindoro, *Merrill* 1800.

Java, Celebes.

(73) *P. meyenianum* Schott. Rhizome very stout, densely beset with long, linear, crisped, ferruginous scales; frond 60 to 100 cm. high, the basal part about 15 cm. broad, shallowly lobed, rigid, brown; the sterile vegetative region 40 to 60 cm. high, 20 to 30 cm. broad, pinnatifid almost to the rachis into erecto-patent obtuse, entire lobes 2 to 3 cm. broad, coriaceous, glabrous; main veins reaching the margin, between them four or five series of rather regular major areolæ, each including about eight rectangular minor ones; apical fertile part about 30 cm. high, pinnate, the pinnae sinuous, narrowly linear, about 20 cm. long, lobed to the midrib into roundish segments, each covered by a single sorus.

Luzon, *Cuming* 49; Mount Mariveles, *Merrill* 3224, *Whitford* 221, *Copeland* 1386, on lofty ridges.

#### (55) *LECANOPTERIS* Blume.

Rhizome creeping, inflated, cavernous and inhabited by ants; fronds on conical cavernous outgrowths of the rhizome, pinnatifid or pinnate; veins anastomosing with free included veinlets; sori on reflexed marginal outgrowths of the fronds, facing upward. Epiphytic, usually in the tops of lofty trees. Closely related to some species of *Polypodium*.

(1) *L. carnosa* Blume. Rhizome and phyllophores forming a thick close covering over the host, glabrous on the outside; stipes about 5

cm. high, glabrous; fronds 20 to 30 cm. high, about 5 cm. broad, rachis winged throughout; segments broadly or narrowly ovate, acute, contracted at base, margin shallowly lobed by the soriferous projections, coriaceous, glabrous; veins inconspicuous.

Leyte, *Cuming* 312; Mount Mariveles, *Whitford* 334.

Malaya.

(2) *L. pumila* Blume, *Flora Javæ* T. 2, Tab. 94. Rhizome as in the preceding; stipe about 10 cm. high, glabrous; frond 20 to 30 cm. high, about 7 cm. broad, rachis winged throughout; segments lanceolate, obtuse, hardly contracted at the base, lobed by the soriferous projections, firm but pellucid; veins conspicuous. Blume's figure of this species (and of the preceding as well) is unaccompanied by any description; the most conspicuous difference between them seems to me to be in the form and apex of the segments, and I have used his names for my plants on the assumption that that difference is diagnostic. The difference in texture would be less easily figured.

Davao, *Copeland* 1299.

Java.

#### (56) *PHOTINOPTERIS* J. Sm.

Rhizome creeping; frond pinnate, the lower pinnae sterile, each subtended by a stipule-like outgrowth, the upper fertile, very narrow, all articulate to the rachis; veins anastomosing, with free included veinlets in all directions; sori occupying the entire under side of the fertile pinnae. Epiphytic. The sterile plants are readily recognizable by the auricles subtending the pinnae.

(1) *P. speciosa* (Bl.) J. Sm. Rhizome bluish, clothed with dirty-brown fibrillose scales; stipe hardly 1 cm. high, glabrous and brown, like the rachis; sterile pinnae 10 to 15 cm. long, half as broad, ovate, abruptly acuminate, subuneate at the base, entire, coriaceous, glabrous; main veins and cross-veinlets forming large areolae evident, veinlets forming smaller areolae inconspicuous; fertile pinnae 10 to 15 cm. long, 3 mm. broad, deciduous. A form with a single fertile pinnae was named *P. simplex* J. Sm.

Luzon, *Cuming* 64; Arayat, 800 m., *Loher*; Mindoro, *Cuming* 362; Davao, *Copeland* 649.

Malaya.

#### (57) *DRYOSTACHYUM* J. Sm.

Rhizome stout, creeping, scaly; fronds pinnatifid, the segments articulate to the rachis; venation evident, with major, divided into minor areolae, with free included veinlets; sori only on the contracted upper part of the frond, coalescing so that each major areola includes a single cushion of sporangia. Epiphytic, with large, conspicuous fronds, more or less clustered into nests. Intimately related to *Drynaria*.

(1) *D. splendens* J. Sm. Fronds sessile, the lower part brown, rigid, collecting humus into which the roots run, as the cup-leaves of *Drynaria* do, shallowly lobed, about 20 cm. broad and more than as high; above this a narrower part, about 40 cm. high and less than 10 cm. broad,

sinuate-lobed; above this 50 cm. or more of the sterile region, pinnatifid within 1 cm. of the rachis into erecto-patent segments about 25 cm. long and 4 cm. broad; finally the fertile apex, more than 30 cm. high, cut to the rachis into segments 10 to 20 cm. long, about 1 cm. broad, separated by twice their own breadth; sori occupying the entire dorsal surface except the midrib and main veins running to the margin.

Luzon, *Cuming* 87; Benguet, *Topping* 245; Davao, *Copeland* 1285.  
Malacca to New Guinea.

(58) **DRYNARIA** Bory.

Rhizome very stout, scaly, creeping; fronds of two kinds, (*a*) cup-leaves, brown, rigid, like sessile oak leaves, and (*b*) ordinary leaves, large, green, pinnatifid, with segments deciduous from the rachis, or pinnate; veins anastomosing copiously, with free included veinlets in all directions. Large, conspicuous epiphytes. The cup-leaves collect quantities of detritus, forming a soil into which the roots grow.

(1) **D. quercifolia** (L.) Bory. Scales of the rhizome about 1 cm. long, brown, narrowly lanceolate, from a cordate base; cup-leaves 20 to 30 cm. long, 15 to 20 cm. broad, shallowly lobed below, deeply toward the apex; normal fronds on petioles sometimes 35 cm. long, winged nearly or quite to the base; frond 60 to 100 cm. long, about 30 cm. broad, pinnatifid as a rule to about 5 mm. from the rachis, into segments 10 to 15 mm. broad; sori in regular rows, one row on each side of each main vein running to the margin.

Luzon, *Cuming* 25, 273, 414; Nueva Viscaya, *Merrill* 311; Benguet, *Topping* 174, 344; Mount Mariveles, *Whitford* 372; Sorsogon, Catanduanes, Bataan, and Masbate, *Baranda*; Culion, *Merrill*; Capiz, Panay, *Copeland* 70; Guimaras, *Ritchie*, *Forestry Bureau*, 36; Cebu, *Barrow* 21; Davao, *DeVore* and *Hoover* 161, *Copeland* 1321.

India to Melanesia and Queensland.

(2) **D. Linnaei** Bory. Scales of the rhizome broadly ovate with peltate base; cup-leaves bluntly lobed; normal fronds 60 to 100 cm. long, 15 to 30 cm. broad, long stalked, cut down nearly to the rachis into entire, erecto-patent lanceolate lobes, rigid, glabrous; sori small and scattered.

Cagayan, Luzon, *Warburg* 12209, 12210; Davao, *Warburg* 14141.

Ceylon to Polynesia and Queensland.

(3) **D. rigidula** (Sw.) J. Sm. Rhizome creeping, intertwined, clothed with ferrugineous, black-centred, long-pointed scales; cup-leaves sessile, deeply cordate, oblong, narrowed upward, 15 to 25 cm. long, sinuate near the base, deeply lobed toward the apex; normal leaves pinnate, 50 to 100 cm. or more long; pinnae 10 to 25 cm. long, broadly linear, acuminate, unequal-sided at base, on short, winged petiohules, very readily cast, serrate, glabrous, hard; fertile pinnae usually narrower than the sterile, with a single row of round, immersed sori along each side of the costa. A tree-top fern, forming large nests.

Philippines, *Cuming* 248, 263; Mindanao, *Copeland* 1044.

Malacca to Polynesia and Australia.



## VIII. ACROSTICHEÆ.

Fronds articulate to the rhizome or not so, simple, dichotomous, or pinnate, when pinnate the pinnae equal-sided; sterile and fertile fronds or parts of fronds distinct but not usually very different; sporangia covering the fertile surface, without being collected into sori; indusia therefore wanting.

1. Fronds pinnate, or the primary venation so.
  2. Fronds simple ..... (59) *Elaphoglossum*
  2. Fronds pinnate ..... (60) *Achrostichum*
1. Fronds or main veins dichotomous.
  2. Stipe present, not articulate ..... (61) *Cheiropleuria*
  2. Fronds sessile, articulate to rhizome..... (62) *Platynerium*

### (59) *ELAPHOGLOSSUM* Schott.

Rhizome in our species creeping; fronds simple, entire, firm in texture, the fertile and sterile not exceedingly different, clothed with broad, ornate scales or glabrous; veins free unless at the margin; sporangia densely covering the lower surface. A large genus in tropical America, sparingly represented in the Old World. Our species are epiphytes of rather small size.

1. Margin cartilaginous, not ciliate ..... (1) *E. conforme*
1. Margin ciliate.
  2. Surface glabrous ..... (2) *E. decurrens*
  2. Surface somewhat scaly ..... (3) *E. Cumingii*

*E. latifolium* (Sw.) J. Sm. was reported by Harrington from Steere's collection from Luzon: the species is usually regarded as exclusively American, and this determination was probably not quite accurate, or the specimen may have been ascribed to the wrong region, as Steere collected in tropical America.

(1) *E. conforme* (Sw.) Schott. Rhizome woody, creeping or scandent, clothed with large ovate, membranous paleæ 5 mm. long; stipes 5 to 15 cm. high, firm, erect, stramineous, glabrescent; frond 15 to 25 cm. high, 1.5 to 3 cm. broad, obtuse, cuneate at the base, entire and cartilaginous at the margin, coriaceous, glabrous; veins mostly once forked.

Benguet and Arayat, *Loher*; Mount Mariveles, 1,200 m., *Merrill* 3250, *Copeland* 1384.

Pantropic.

*Achrostichum ophioglossoides* Mett. is a small thick-leaved form collected at Manila by *Meyen*.

(2) **E. decurrens** (Desv.). Rhizome woody, the paleæ large, ovate, dull brown; stipe 6 to 10 cm. high, firm, erect, scaly; frond 10 to 15 cm. high, 5 cm. broad, round at the apex, narrowed gradually to the stipe, very thick, surface glabrous, but the margin densely fringed with ovate, yellowish, toothed, deciduous scales 1 mm. long; veins immersed, nearly hidden.

Luzon, *Cuming* 144.

(3) **E. Cumingii** (Fee). Rhizome woody, clothed with large, ovate, dull brown scales; stipe 15 to 20 cm. high, firm, erect, scaly below; sterile frond 20 cm. high, 3 cm. broad, obtuse, narrowed gradually below, margin densely fringed by mostly slightly intramarginal minute scales; frond very thick, surfaces, especially the upper, clothed with minute, scattered scales; veins quite hidden; fertile frond as long as the sterile but rather narrower.

Luzon, *Cuming* 193; Arayat, *Loher*.

#### (60) **ACHROSTICHUM** Linnaeus.

Rhizome thick, erect, stipes not articulate to it; frond large, simply pinnate; pinnae with prominent costa, and veinlets copiously anastomosing, without free included veinlets; sporangia covering the backs of the fertile pinnae, except for the costa and sometimes for a narrow marginal line. Large terrestrial ferns, in brackish marshes throughout the Islands. The genus *Achrostichum* formerly included all ferns with the sporangia covering the fruiting surface, without evident differentiation of sori; which was probably more convenient than the present, presumably more natural, arrangement.

(1) **A. aureum** L. Rhizome woody, somewhat scaly; stipe 30 to 60 cm. high, stout, erect, polished; frond 60 to 200 cm. high, 30 to 60 cm. broad; pinnae numerous, 15 to 30 cm. long, about 5 cm. broad, stalked, obtuse or sometimes retuse and bluntly mucronate, entire, glabrous, leathery; areolæ small, evident; upper pinnae fertile, hardly as large as the sterile.

Manila, *Loher*, *Marave*, *Merrill* 57, *Elmer* 5510; Camarines, Bataan, and Masbate, *Baranda*; Iloilo, *Copeland*, including a freak with forked pinnae; Davao, *Warburg*; Balabac, *Steere*.

Pantropic.

#### (61) **CHEIROPLEURIA** Presl.

Rhizome creeping, stipes not articulate to it; fronds dimorphous, the sterile dichotomously veined and lobed, fertile linear, costate; sori covering the lower surface, excepting costa and margin. A fern remarkably distinct in appearance, epiphytic or terrestrial in the mossy forest.

(1) **C. bicuspis** Presl. Rhizome short, stout, densely clothed with golden, jointed, hairs; stipes 20 to 40 cm. high, angular, stramineous, naked except at the base; sterile frond about 10 cm. long, ovate or, if the tips spread, as broad as long, normally lobed half way to the base by a broad sinus into two erect or spreading acute lobes, entire, subcuneate at base, glabrous, thin-coriaceous; main veins dichotomous; veinlets anas-

tomosing, with copious branched included veinlets; fertile frond about 15 cm. long, 1 cm. broad.

Tonglon and Arayat, *Loher*; Baguio, *Topping* 153, *Elmer* 5844; Mount Mariveles, *Copeland*, *Whitford* 331.

Java to Formosa and New Guinea.

(62) **PLATYCERIUM** Desvaux.

Fronds articulate into a depression in the short rhizome, remarkably dimorphous; "basal fronds," reniform in general form, sessile, closely applied to the substratum, imbricate, sheltering the roots; and "normal fronds," standing out from the substratum, dichotomously branched, fertile in definite parts; pubescence stellate; main veins dichotomous, veinlets anastomosing, with free included veinlets, the mesh especially fine under the fertile surface. A most natural genus of tropical epiphytes, whose extraordinary appearance has made them universal favorites in cultivation.

(1) **P. grande** J. Sm. Basal frond very large, suborbicular, convex, or the upper ones erect, deeply laciniate with spreading or inflexed divisions; normal frond 1 to 2 m. long, pendent, in pairs, each with a single fertile region on the broadly cuneate base, to which the two repeatedly dichotomous appendages are attached; glabrous.

Luzon, *Cuming* 157 (fide J. Sm.); Albay, Ticao, and Masbate, *Baranda*; Davao, *Loher*.

Singapore to north Australia.

(2) **P. biforme** (Sw.) Blume. Basal fronds imbricate, very thick especially toward the base, margin irregularly lobed; normal fronds 1.5 to 5 m. long, repeatedly dichotomous from a small subcuneate base, the sterile division 2 to 3 cm. broad, continually forking, the fertile distinct, stalked, reniform, entire, 15 to 20 cm. broad. (See frontispiece.)

Luzon, *Cuming* 156; Albay, Ticao, and Masbate, *Baranda*; Davao, *Warburg* 14147.

South India across Malaya.

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## II. NEW SPECIES OF EDIBLE PHILIPPINE FUNGI.

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By EDWIN BINGHAM COPELAND, Ph. D., *Botanist*.

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It is still true of the Philippine Archipelago, as until within a decade it was of the entire Orient from Ceylon to Japan and Australia, that its fungus flora is a practically untouched field. From the little work in it that has been possible for us, it appears that our *Agaricaceæ*, at least, are almost entirely new to science as well as locally unknown. It can also be safely said, contrary to a rather prevalent opinion of the condition in tropical countries, that our *Basidiomycete* flora is a very rich one, in species if not in individuals.

As to their edible properties, the writer has personally tested more than 100 Philippine species, and can state with the confidence personal experience justifies that the species described here are without exception palatable and harmless. In the individual descriptions the statement as to taste and odor apply of course to the mushrooms when raw and fresh. The diagnoses of these fungi were originally written in Latin. However, it was thought inadvisable to have them appear as a Government publication in this language; therefore the following translation has been made, and the Latin diagnoses are published in *Annales Mycologici*, volume 3, No. 1:

***Lycoperdon todayense*** Copeland. Peridium obovate or pyriform, 1 to 2 cm. in height, 1 to 1.5 cm. in thickness, plicate at the base, entire above, clothed when young with minute deciduous warts or flakes which are hyaline when moist, later finely and obscurely areolate, white at first, turning yellow, opening by a small aperture at the top; the fertile gleba very distinct from the sterile, cellular base; spores globose, smooth, 3.5 to 4  $\mu$  in diameter; capillitium rudimentary, irregular, thick.

Todaya, Davao, caespitose about the base of a Musa.

**Coprinus confertus** Copeland. Gregarious and caespitose, varying greatly with the weather; pileus fleshy, conical; if grown in dry weather very thick, covered with appressed, whitish, cottony flakes, the margin entire or cleft a few times; but when rainy thinner, clothed with an evanescent, silky net, grayish-black, striate, with tawny or stramineous disk and lacerate margin; gills grayish-black, crowded, lanceolate, free but close; spores ovate, 14 to 16 by 7.5 to 9  $\mu$  truncate, black; stipe white, smooth, hollow, in dry weather turbinate, 2.5 cm. high, 1.5 cm. thick; but when rainy, as much as 16 cm. high, 6 to 15 mm. thick, equal, or narrowing upward, base equal or subbulbose, with a strong radical cord.

Manila, on horse manure.

This species is near *C. picaceus* Fries, differing from it chiefly in the strongly rooting base and in growing on manure instead of on ground.

**C. ater** Copeland. Odorless, with fairly agreeable taste; pileus obtusely conical at first, becoming plane, 14 mm. broad, disk tawny, periphery passing from dark gray to very black, bearing minute, deciduous, dark brown scales or granules, the flesh 30  $\mu$  thick; gills free, narrow, black; spores black, 15 by 9  $\mu$ , exstipitate; stipe fistulose, smooth, white, equal, or narrowed upward, at most 5 cm. high, 1.5 mm. thick, most often 2.5 cm. high, 0.8 mm. thick.

Davao, on horse manure.

**C. ornatus** Copeland. Odorless, with fair flavor; pileus passing from campanulate to broadly conical, obtuse, 12 mm. wide, sulcate, the disk tawny, ornately beset with dark brown granules, the periphery smooth or pulverulent, changing from white or tawny to black; gills 7 mm. long, 1.2 mm. deep, narrowly adnate, without cystidia; spores 10 by 7  $\mu$ , black; stipe straight, 2.5 cm. or less high, 1 mm. thick, equal or slightly contracted upward, smooth, white or hyaline, with ferruginous base, scarcely hollow.

Gimogon River, Negros, on wood of various kinds, and ground in chip-yard, mostly solitary. Related to *C. Staudtii* Hennings.

**C. Bryanti** Copeland. Pileus passing from white through brown to black, smooth, campanulate, 6 to 8 mm. high, 5 mm. wide, thin, odorless, fine-flavored; gills free but touching the stipe, 1 to 1.5 mm. deep, dark brown, obtuse; stipe straight, white, solid, 2.5 to 3 cm. high, 1.5 mm. thick, equal, smooth, substrate at the top, with scarcely thickened base surrounded by white hairs 1.5 mm. long; veil obsolete; spores smooth, brown, 8 by 4.5  $\mu$ , with hyaline, truncate apex.

Gimogon River, Negros, on a rotten Ficus trunk; a smaller form collected on rotten wood by the Baroring River, Mindanao. This is a real *Coprinus*, in spite of the spore color of *Bolbitius*. It bears the name of R. C. Bryant, of the Forestry Bureau, my host when it was collected.

**C. concolor** Copeland. Odor none, taste mild; pileus conical, with spreading margin, about 2.5 cm. high and wide, subfleshy, brown, very smooth and naked, deliquescing first at the lacerate margin; disk brownish, subumbonate; gills 2 mm. deep, free, crowded, obtuse, remaining a long time pale, then turning dark at their edges first; spores dark brown, 8 by



COPRINUS CONFERTUS COPELAND.



4.5  $\mu$ ; cystidia wanting; stipe about 9 cm. high, 5 mm. thick or a little more at the base, white or brownish, smooth, hollow, without annulus.

Todaya, Davao, terrestrial in forest.

Eaten by the Bagobos, who call it "ligbus."

**C. volutus** Copeland. Pileus 1 to 1.5 cm. wide, thin, naked, early explanate and later revolute or involute, turning from gray to black, the flat disk ferruginous and warty; gills free but very close, at first obtuse at both ends, soon splitting from the top of the pileus but not from the margin, spores black, narrowly ovate, 12 to 13 by 6.5  $\mu$ ; stipe 4 cm. high, 1 to 1.5 mm. thick, slightly attenuate upward, white, naked, hollow.

Manila, on rotting leaves.

Differs from *C. deliquescens* Fries in that the lamellae are so close to the stipe as to appear adnate.

**C. revolutus** Copeland. Pileus 2 cm. or less wide, passing from campanulate through plane to broadly revolute, the disk flat and brown-granulose, the periphery subfurfuraceous, sulcate; gills 70 or less, barely touching the stipe, narrow, acute at both ends, black; spores 11 to 13 by 8  $\mu$ , black, apiculate at base; stipe about 10 cm. high, 1 to 1.5 mm. thick at the top, 2 to 2.5 mm. toward the base, white, hollow, fragile, velvety below.

Manila, coprophilous.

Related to *C. nebulosus* Zoll., but distinguished by the stipe's being velvety below but not bulbous; similar to *C. rostrupianus*, but essentially different in the split gills. Among the species of its own section, this is notable for its crowded gills.

**C. rimosus** Copeland. Pileus 1.5 to 2 cm. high and wide, thin, cylindric-campanulate or conical, truncate, naked, very early split downward through the gills and so plicate in appearance, tawny-gray outside, turning black in clefts, the tawny disk flat or concave; gills free and somewhat remote, cut away toward the stipe, obtuse at the margin, black, becoming pale with age, without cystidia; spores 15 by 13.5  $\mu$ , black, typically subangular and broadest toward the apex, stipe hollow, white, naked, equal.

Manila, on horse manure.

This species differs from *C. plicatilis* Fries in the non-explanate pileus, broader spores and habitat of manure.

**C. pseudo-plicatus** Copeland. Pileus early flattened out, about 3 cm. wide, thin, at first squamulose, becoming black because of its thinness, deeply split downward through the gills, making the structurally entire margin cuspidate-dentate; disk brown, subumbonate, or in age concave; gills about 60, 3 mm. deep, adnate to a narrow collar, black, or pale after the spores are cast; spores 20 to 22 by 11 to 12  $\mu$  obtuse, thickest toward the base, black; basidia 30  $\mu$  high, disposed regularly over the hymenium, 15 to 20  $\mu$  apart; stipe 10 cm. or less high, 1 to 4 mm. thick, equal, straight, smooth, hollow.

Manila, on horse manure and rotten leaves.

Related to *C. plicatilis* (Curt.) Fries and *C. sociatus* Fries but distinguished from both by the large spores, close gills and flakes on the young pileus.



**Panaeolus pseudopapilionaceus** Copeland. Pileus 1.5 to 3 cm. wide, hemispherical, without umbo, whitish, not zonate, dry, naked, subfleshy; gills narrowly adnate; stipe changing from nearly white to black, 6 to 10 cm. high, 1.5 to 3 mm. thick in the middle, thicker toward both ends, white-powdery at the top, firm, with a narrow axial canal; spores 6.5 to 8 by 5 to 6  $\mu$ .

Manila, on manured ground.

Very like *P. papilionaceus* Fries, but differing in unequal stipe, less adnate gills, and especially in the shorter spores.

**P. panaiense** Copeland. Pileus 7 cm. or less wide, conical, tawny, fleshy, the surface flocculose when dry, like blotting paper when wet; veil fugacious; gills deep, adnate, ashy-black; spores elliptical, 7.5 to 9 by 5.5 to 6.5  $\mu$ , appendiculate; stipe 12 cm. or less high, 1 cm. thick, equal, solid, brittle.

Capiz, Panay, on horse manure.

**Agaricus (Psalliota) Boltoni** Copeland. Pileus 10 to 15 cm. wide, passing from globose through cylindrical and conical to more or less plane, clothed with brown scales which are denser and larger toward the fuscous, fissured, plane or subumbonate disk, fleshy, the flesh white, well-flavored, almost odorless; gills numerous, crowded, free, 6 mm. deep, white when young, ultimately dark brown; spores 8 to 9 by 5 to 6  $\mu$ , with short basal appendage; stipe 8 to 15 cm. high, stout, with globose base, becoming hollow with age; annulus fixed, ample, persistent, declined, subentire.

Davao. A striking species, common in sunny pastures; named for Governor Bolton, of Davao.

**A. (Psalliota) Merrillii** Copeland. A large species, sometimes 10 cm. high and wide, almost without taste or odor; pileus naked or scaly, turning from white to brown, shining, subfleshy, truncate or with concave apex when young, sometimes umbonate in the middle of the depression, when old plane, with a horizontal, entire or incised border, 1 to 2 mm. broad, derived from the veil; gills about 250, crowded, 5 mm. deep, subacute at the margin, salmon-colored when the veil ruptures, finally turning black-brown; spores minute, 6 by 3.5  $\mu$ , uninucleate; veil rupturing late; annulus high up, white on both sides, floccose without, very lacerate, pendent; stipe somewhat contracted toward the top, abruptly enlarged at the base, solid or nearly so, whitish or turning brown outside and inside.

Manila, terrestrial under trees.

This species is near *A. platensis* Sacc. & Sydow. (*A. lepiotoideus* Speg.), but differs in its larger size, entire periphery, annulus white on both sides, and abruptly enlarged base. It is very variable in color and scaliness. Named for my colleague, Elmer D. Merrill.

**A. (Psalliota) argyrostectus** Copeland. Pileus 3.5 cm. wide, passing from conical to convexo-plane, shiny white, always naked, subfleshy, with unchanging gray flesh without odor, tasting like *A. campestris*; gills 3 mm. deep, free, obtuse at both ends, gray, turning dark; spores 5.5 to 6 by 4 to 4.5  $\mu$ , without guttules; stipe 3 to 4 cm. high, 4 to 8 mm. thick, firmly attached to the pileus, terete, scarcely enlarged downward, solid or nearly so; annulus membranous, pendent, early breaking up and disappearing.

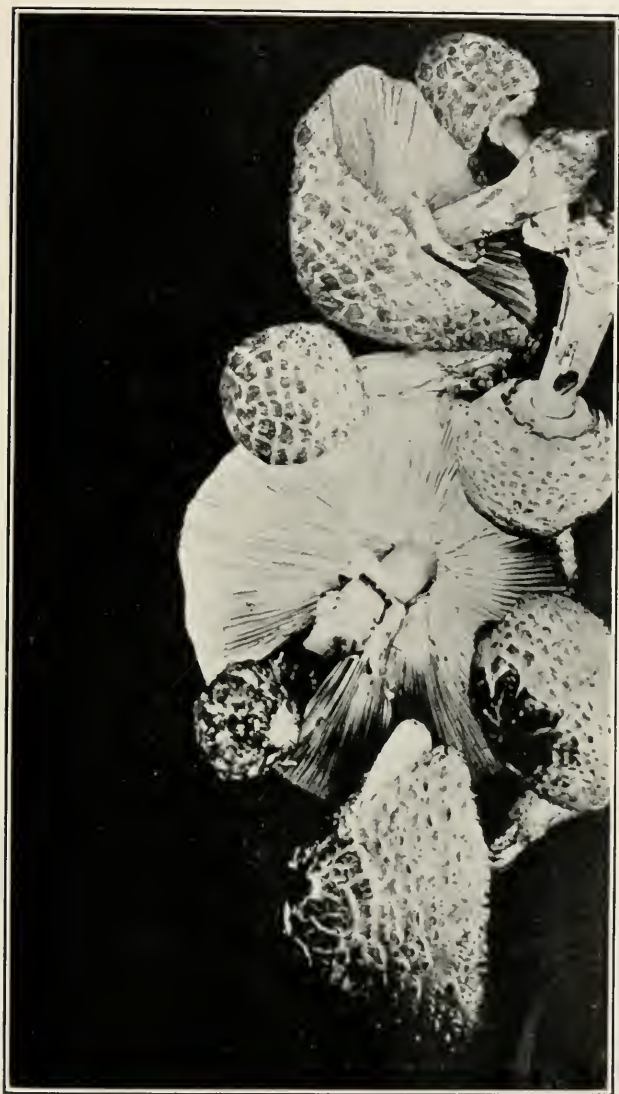


Photo by Copeland.

AGARICUS BOLTONI COPELAND.





AGARICUS MERRILLII COPELAND.





Davao, in sunny pastures, not common.

This species resembles *A. argenteus* Braendle and *A. argyropotamius* Speg.; it differs from them in the pileus' being conical at first, the disk's shining like the periphery, unchanging flesh, and eguttulate spores.

**A. (Psalliota) manilensis** Copeland. Pileus convex, smooth, squamulose with disk flat and dark brown; toward the margin, where the scales are sparse, becoming white, subfleshy; gills free, rounded toward the stipe, turning from rose to dark-brown; spores about 7.5 by 4  $\mu$ , obtuse, oblique at the base; stipe 5 cm. high, 2.5 mm. thick, equal, naked, smooth, hardly solid; annulus fixed, entire, convex upward.

Manila, in lawns.

Resembles *A. haematospermus* Bull. and *A. dyspices* B. & Br.

**A. (Psalliota) perfuscus** Copeland. Entire fungus brown, darkening with age, odorless, with the flavor of *A. campestris*; pileus early expanded, 3 to 4 cm. wide, undulate, squamulose, subfleshy, disk slightly depressed, margin strongly but deciduously appendaged; gills free, close, obtuse at both ends, 4 mm. deep; spores elliptical, 6 to 6.5 by 4.5  $\mu$ , obscurely 1- or 2-guttulate; stipe 3 to 4 cm. high, 3 to 4 mm. thick equal, firm, naked, subhollow; annulus high up, fugacious.

Manila, subgregarious on manured ground in the old botanical garden.

Resembles *A. insinuatus* Cooke and *A. haematospermus* Bull.

**Lepiota chlorospora** Copeland. Pileus fleshy, passing from globose through campanulate to broadly conical, 8 cm. wide, 4 cm. high, the periphery sometimes explanate, disk with a brown, entire or fissured cap, periphery sparsely clothed with pale brown scales and fibers, white near the entire or subciliate margin; gills free, remote, 5 cm. long, 8 mm. deep, crowded, narrowed toward the stipe, white at first, turning a greenish-blue, their edges made of hyaline vesicles 25 to 35 by 20  $\mu$ ; spores hyaline-green, 8 by 5  $\mu$ , smooth, short-stalked, each with a single large globule containing the green pigment; stipe 8 to 10 cm. high, 6 to 8 mm. thick, straight or crooked, knotted, firmly attached to the pileus, brown outside and inside, with white pith; annulus 1 cm. broad, conspicuous, fixed, persistent, split in its own plane, white above until discolored by the spores.

Manila, in lawns.

Distinguished from *L. esculenta* (Masse) Sacc. and Sydow by the brown scales and fixed annulus. Masse established the genus *Chlorophyllum* for these green-spored species; but it seems to me better to keep them in *Lepiota* and extend its characterization sufficiently to cover them. The spores are of the same color as those of *Aspergillus glaucus*.

**L. manilensis** Copeland. Flavor excellent, odor almost none; pileus 5 to 9 cm. wide, campanulate-conical, later flat, subumbonate, striate near the margin, the disk densely clothed with minute brown scales, which become sparse toward the margin; flesh whitish, unchanging; gills free, not attached to a collar, crowded, deep, whitish, subacute at both ends; spores variable, commonly 10 by 6 to 7  $\mu$ , the largest 13 to 15 by 7.5 to 9  $\mu$ , hyaline; stipe 10 cm. or less high, 1 cm. thick, firm, equal or somewhat

thickened downward, with an axial canal, white or pale brown, naked; ring movable, or half-fixed, entire, with a dark brown margin.

Manila, around *Pithecolobium* and *Terminalia*.

**L. elata** Copeland. Odor and taste mild; pileus conical at first, but soon flat, 4 to 6 cm. wide, umbonate, fleshy, silky-squamulose about the disk, elsewhere naked, margin substrate, broadly reflexed when old, disk brownish, periphery white, turning dark red; gills also turning from white to dark wine-color, free, close, crowded, ventricose; spores 9 to 10 by 5 to 6  $\mu$ , hyaline, symmetrical; stipe 5 to 8 cm. high, 5 mm. thick at the middle, somewhat thickened downward, but not bulbous, naked, with an axial canal; ring midway, free, convex, narrow, entire, brown, fugacious, sometimes attached to the margin of the pileus.

Manila, in manured lawns.

Judging by the descriptions, this resembles *L. inebriata* B. and Br. and *L. microspila* Berk., both species Ceylonese.

**L. candida** Copeland. Odor wanting, taste mild; pileus 7 cm. wide, flat, strongly umbonate, dry, shining, almost naked, the disk fleshy, the margin thin, substrate, minutely crenate, the flesh unchanging; gills free, close, very crowded, lanceolate, subacute at both ends, thin, white; spores 9.5 by 6  $\mu$ , hyaline, guttulate, apiculate; stipe 15 cm. high, 5 mm. thick near the top, with a narrow axial hollow, much enlarged but not bulbous in the solid lower part, naked, shining white, deeply sunken into disk but not confluent with it; annulus high up, deciduous.

Manila, solitary in sunny grass.

Well characterized by the strongly fusiform lower third of the stipe.







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(Continued from second page of cover.)

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<sup>1</sup>The first four bulletins in the ornithological series were published by the Ethnological Survey under the title "Bulletins of the Philippine Museum." Future ornithological publications of the Government will appear under the title "Publications of the Bureau of Government Laboratories."





No. 29.—SEPTEMBER, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

I. NEW OR NOTEWORTHY PHILIPPINE  
PLANTS, III

II. THE SOURCE OF MANILA ELEMI

BY

ELMER D. MERRILL, BOTANIST

MANILA  
BUREAU OF PUBLIC PRINTING  
1905

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(Continued on third page of cover.)

No. 29.—SEPTEMBER, 1905

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I. NEW OR NOTEWORTHY PHILIPPINE  
PLANTS, III

II. THE SOURCE OF MANILA ELEMI

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BY

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MANILA  
BUREAU OF PUBLIC PRINTING  
1905





## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,

*Manila, P. I., December 1, 1904.*

SIR: I have the honor to transmit herewith and recommend for publication two articles: (1) New or Noteworthy Philippine Plants, III; (2) The Source of Manila Elemi: by Elmer D. Merrill, Botanist.

Very respectfully,

RICHARD P. STRONG,  
*Director Biological Laboratory,  
Acting Superintendent Government Laboratories.*

Hon. DEAN C. WORCESTER,  
*Secretary of the Interior, Manila, P. I.*



## I. NEW OR NOTEWORTHY PHILIPPINE PLANTS. III.

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By ELMER D. MERRILL, *Botanist*.

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Two previous articles have been published under this title, Bureau of Government Laboratories publications 6 and 17, the third and present paper having been prepared as material and data became available. In order to facilitate reference to the preceding papers, a full index to all species considered in the three publications has been included in the present one.

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### PANDANACEÆ.

#### ***Sararanga philippinensis*, sp. nov.**

An erect tree 6 to 8 m. high, branched at the top, the inflorescence a long compound panicle 100 to 120 cm. long. Leaves about 2 m. long, 7 cm. wide, the margins stoutly antrorsely toothed throughout, the midrib beneath antrorsely toothed, above glabrous. Axis and branches of the inflorescence densely grayish stellate pubescent throughout. Flowers unknown. Fruit yellowish, glabrous, 6 to 8 mm. wide, 5 mm. long, subreniform, sulcate between the pyrenes when dry, subtended by a discoid entire or slightly lobed calyx-like bract, sessile, the stigmas small, about 16, arranged in two parallel rows along the median portion of the fruit. Pyrenes 3 mm. long, 2 mm. wide, thin, broadly ovate, both ends rounded, about 16 in each fruit, arranged in two parallel rows.

Type specimen No. 749. (H. N. Whitford.) Timuan River, Province of Tayabas (Infanta), Luzon, September 4, 1904. Growing in forests along the seashore at 3 to 5 m. above the sea.

This genus was based on a single species from New Guinea, and the discovery of a second species in the Philippines is of special interest.

#### ***Pandanus pallidus*, sp. nov. § *Sussea*.**

A small shrub 2 m. high or less, with elongated leaves, which are gradually narrowed upward to the long, slender, acute, scarcely acuminate apex, the fruits globose, 4 to 5 cm. in diameter, dull white when mature, 5 to 7 crowded in a dense, erect raceme about 24 cm. long. Trunk erect,

5 cm. in diameter, the bark smooth, dull gray, somewhat scaly, the branches 3 to 5, terminating the trunk, ascending. Leaves 1 to 1.2 m. long, 3 to 4 cm. wide below, gradually narrowed upwards to the apex, the margins antrorsely toothed throughout, the midrib on the upper surface glabrous, beneath with scattered antrorse teeth or in part glabrous, the lateral nerves on the upper surface sparingly antrorsely toothed in the upper part of the leaf, beneath glabrous. Raceme 25 cm. long or less, erect, the heads crowded, short pedunculate, each subtended by a broad bract, the lower bracts acuminate, exceeding the raceme, the upper ones much shorter, triangular acute, the margins and midrib finely serrate toothed. Drupes closely packed, about 75 in each fruit, obovate, irregularly 5 to 6 angled, 1.5 cm. long, 0.8 to 1.2 mm. thick above, tapering from near the apex to the cuneate base, the apex abruptly rounded or convexly subpyramidal, striate, the stigmas plane, 2 mm. in diameter, the loculi 2 to 4 in each drupe.

Type specimen No. 5840 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904. Growing in open grass lands along streams in the pine region, not common. Staminate flowers were observed by the collector in July, but could not be preserved.

***Pandanus caudatus* sp. nov. § *Keura*.**

A tree 7 to 8 m. high, with solitary, pendant, subglobose or ellipsoid fruits about 17 cm. long, the leaves tapering above to the slender caudate-acuminate apex. Trunk 25 cm. in diameter, with yellowish bark, beset with small scattered conical spines, the aerial roots wide spreading, 2 to 3 m. long, the few short branches crowded at the apex of the trunk. Leaves 1.2 to 1.8 m. long, about 5 cm. wide, the margins antrorsely toothed throughout, the midrib above glabrous, beneath finely antrorsely toothed, the two lateral nerves antrorsely toothed on the upper surface for the upper third of the leaf, the caudate apex antrorsely toothed, about 6 cm. long. Fruit yellowish red, fragrant, about 17 cm. long, nearly as thick, with 60 or 70 or more drupes, the peduncle about 30 cm. long. Drupes about 6 cm. long, 2.5 to 3 cm. thick, irregularly 4 to 6 angled, obovate, tapering below to the nearly cuneate base, scarcely or slightly narrowed at the apex which is truncate, flattened, the apex about 1.5 cm. wide, and 3 cm. long, sulcate, the sulci between the loculi about 5 mm. deep; loculi irregularly disposed, 10 to 12 in each drupe, their apices irregular convexly conical; stigmas 1 to 2 mm. in diameter, more or less oblique.

Type specimen No. 6143 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904. Not common, in thickets along streams.

***Pandanus simplex* sp. nov. § *Brayantia*.**

An erect, unbranched tree about 6 m. high, the leaves about 3 m. long and 11 cm. wide, the fruit solitary, cylindrical or subglobose, about 9 cm. in diameter. Margins of the leaves toothed, the teeth below, stout and distant 2 to 3 cm., above small and close, the midrib beneath with scattered teeth, above glabrous. Peduncle stout, triangular, 3 to 3.5 cm. thick. Drupes 1-celled, 3 cm. long, about 1 cm. thick, many, obovoid, the basal portion 2 cm. long, compressed, angular, narrowed below, the apical portion angular, subpyramidal, the tip smooth and rounded, scarcely truncate. Stigma plain, sessile, sublateral, about 2 mm. in diameter.

Type specimen No. 782 (Whitford), Tinuan River, Province of Tayabas (Infanta), Luzon, September 6, 1904. Growing on hilltops at an elevation of about 150 m. Locally known as *Calaquimay*. Perhaps most closely related to *Pandanus conoideus* Lam., from the Moluccas.

## GRAMINEÆ.

### *Agrostis elmeri* sp. nov.

A weak, erect, tufted, glabrous, perennial grass about 40 cm. high, with linear, flat leaves, more or less contracted panicles about 20 cm. long, subequal empty glumes and awnless flowering glumes, the palea equaling the glume in length. Culms slender, the nodes glabrous. Sheaths about equaling the internodes, glabrous. Ligule 3 to 4 mm. long, minutely scabrid, entire, obtuse, or slightly lacerate in older specimens. Leaves about 10 cm. long, 3 mm. wide, the cauline ones similar in shape and size to the radical. Panicles greenish, the rhachis glabrous, the branches minutely scabrous; branches ascending, subverticillate, 5 to 7 cm. long, the pedicels scabrous, 3 mm. long, filiform, thickened at the base of the spikelet. Empty glumes subequal, lanceolate, acute or slightly acuminate, 2 mm. long, 0.8 mm. wide (when spread), the keel scabrous, the margins minutely so. Flowering glume 1.6 mm. long, acute, awnless, glabrous. Palea equaling the flowering glume. Anthers 0.5 mm. long.

Type specimen No. 6558 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, July 1, 1904. This species grows on the open, grassy slopes of the mountain, at an altitude of 2,000 m. and above, forming tufts, the weak stems often more or less reclining. *Agrostis elmeri* is according to Hackel, to whom specimens were sent, very closely related to *Agrostis perennans* Tuck., a species of the northeastern United States. No species of the genus has previously been reported from the Philippines.

*Dinochloa diffusa* (Blanco) Merrill, Govt. Lab. Publ. 27:93. 1905. (*Bambusa diffusa* Blanco, Fl. Filip. ed. 1, 289; ed. 2, 187; ed. 3, 1:334. *Dinochloa dielisiana* Pilger in Perkins Frag. Fl. Philip. 149: 1904; at least in part, Nos. 1408 and 2550 Merrill.)

This species was reduced by Fernandez-Villar<sup>1</sup> to *Schizostachyum acutiflorum* Munro, which is apparently an error. The species here considered to represent Blanco's *Bambusa diffusa* is very abundant throughout the region from which Blanco received his material, and as it apparently produces flowers at least once a year it is very doubtful whether Blanco overlooked it. On account of its diffuse and often somewhat spiny branches it is much used by the natives for making rough brush fences about their clearings as noted by Blanco. It is represented by the following specimens, all from the Island of Luzon: Province of Bataan, Lamao River, Mount Mariveles: No. 2550 (Merrill), June, 1903; No. 3297 (Merrill), October, 1903; No. 519 (Whitford), July, 1904; No. 1261 (Forestry Bureau), collected by Borden, July, 1904. Province of Zambales, No. 388 (Forestry Bureau), collected by Maule, March, 1904. Province of Pampanga, Arayat,

<sup>1</sup> Nov. App., 324.

No. 1408 (Merrill), March, 1903. Province of Benguet, Mount Santo Tomas, No. 6566 (Elmer), July, 1904.

***Coelachne hackeli* sp. nov.**

A low, spreading grass, rooting in the mud and forming dense mats in shallow water, the flowering branches 3 to 5 cm. high, with much reduced few flowered spike-like inflorescence 1 to 1.5 cm. long, scarcely exerted from the upper sheaths, the empty glumes slightly ciliate at the apex, the flowering glumes pubescent, at least in the lower third. Stems prostrate, rooting at the nodes, the nodes bearded. Sheaths about 1 cm. long, glabrous, those on the flowering branches overlapping; ligule obsolete; leaf blades 1 to 1.5 cm. long, 2 mm. wide or less, acuminate, slightly scabrous above. Panicles slightly purplish, the few branches erect, appressed, 2 to 4 mm. long, each with 2 to 4 spikelets. Spikelets 2-flowered, 2.5 mm. long; empty glumes ovate, obtuse or subtruncate, slightly ciliate at the apex, one somewhat larger than the other, 1 to 1.2 mm. long. Flowering glumes 2 mm. long, 1.2 mm. wide, acute, sparingly pubescent on the back, at least in the lower third. Palea about equaling the glume, glabrous. Seed 1 mm. long. Upper spikelet sterile.

Type specimen No. 5752 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904. Forming dense floating mats on stagnant or slowly running water.

Specimens of this plant were forwarded to Dr. E. Hackel, of Graz, Austria, who pronounced it to be an undescribed species of *Coelachne*, most closely related to *Coelachne pulchella* R. Br., var. *simpliuscula* (Munro) Hook. f., and kindly supplied the author with specimens of the latter variety. As Dr. Hackel points out, the species here proposed differs from the above variety in its larger spikelets, ciliated tips of the empty glumes, and pubescent flowering glumes. Two species of this genus, *Coelachne pulchella* R. Br., and *C. brachiata* Munro, are credited to the Philippines by F. Villar,<sup>1</sup> but the record in the case of both species needs verification.

## MORACEÆ.

***Ficus propinqua* sp. nov. § *Eusyce*.**

A scandent species, the stem 2.5 cm. in diameter or less, with ovate-oblong, cordate, acuminate leaves, villous beneath, and axillary glabrous receptacles. Stems dark brown, the branchlets reddish-brown, densely villous with yellowish-brown hairs. Leaves 9 to 12 cm. long, 3.5 to 6 cm. wide, coriaceous, glabrous and shining above, beneath the midribs and nerves densely fulvous-villous, the reticulations with few scattered similar hairs, the margins recurved, the base broad, 5-nerved; lateral nerves about 6 pairs, very prominent beneath, apex narrowed gradually to the slender, short acumen; petioles densely fulvous-villous, 1.5 cm. long; stipules thin, brown, subsistent, ovate-lanceolate, acuminate, 2.5 cm. long, 1 cm. wide, glabrous, except the slightly villous midrib above. Receptacles shortly peduncled, 1 to 3, in the axils of the leaves, subglobose,

<sup>1</sup> Nov. App., 321. 1883.



the apex slightly depressed, glabrous, about 1 cm. in diameter, golden-yellow when mature, the bracts 2 mm. long or less. Fertile female flowers sessile or pedicelled, the perianth of four free, brown, lanceolate segments, 2 to 2.5 mm. long, which exceed the ovary, which is oblong-elliptical, 1.5 mm. long, slightly compressed and keeled, the style short. Male and gall flowers not seen.

Type specimen No. 6521 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, June, 1904.

A species apparently closely related to *Ficus villosa* Blume, from the Malayan region, differing especially in its entirely glabrous receptacles.

***Ficus gigantifolia* sp. nov. § *Eusyce*.**

A tree about 12 m. high, with broadly ovate, cordate, bluntly acute, subcoriaceous, glabrous leaves, 42 cm. long or less, the receptacles solitary, axillary, on the ultimate branchlets. Branches glabrous, annular, the ultimate branchlets somewhat thickened, the leaf scars prominent. Leaves alternate, 20 to 42 cm. long, 16 to 23 cm. wide, shining above; nerves about 14 on each side of the midrib, prominent beneath, spreading, curved upwards; petioles stout, glabrous, 2 to 4 cm. long. Receptacles globose, 2 to 2.5 cm. in diameter, glabrous, each subtended by three glabrous, ovate, acuminate bracts, 8 mm. long, 6 mm. wide. Male flowers about 3 mm. long, few and only near the umbilical scales, the perianth of five free, subequal, brown segments, 2 to 2.5 mm. long, exceeding and inclosing the stamens. Stamens, 2; filaments very stout, the anthers 0.8 mm. long. Gall flowers 3 to 6 mm. long, sessile, pedicelled, the perianth of five free subequal segments 2 to 2.5 mm. long, exceeding and inclosing the ovary. Ovary ellipsoid, 1.2 mm. long, the style sublateral, bifid, 1.5 mm. long.

Type specimen. No. 1728 (Forestry Bureau), collected by W. W. Clark, Burias Island, June, 1904; also Nos. 392 and 606 (G. P. Ahern), Province of Zamboanga, Mindanao, 1901.

This tree reaches a diameter of 45 cm., growing on forested slopes, but little above the sea level. The bark is gray, smooth, and about 1 cm. thick. It is known to the Bicolos of Burias as *Talitigang* and to the Moros of Zamboanga as *Marang-marang*.

***Ficus elmeri* sp. nov. § *Sycidium*.**

A shrub 3 or 4 m. high, hispid throughout, with very unequal sided, ovate, falcate, abruptly short acuminate, slightly dentate leaves 10 cm. long or less, the receptacles fasciculate on very short branchlets on the branches below the leaves. Branches brownish, densely pubescent. Leaves 5 to 10 cm. long, 3 to 6 cm. wide, the base strongly semisaggitate, on one side of the midrib oblique, on the other with a large, rounded lobe, with about 5 radiating nerves, both surfaces harsh, hispid pubescent, the lower surface very densely so; nerves excluding basal, 6 to 7 on each side of the midrib, rather prominent, the reticulations subparallel; petioles densely hispid pubescent, 1 cm. long. Branchlets bearing the receptacles, from the ultimate branches, 2 to 3 cm. long, simple, densely pubescent, each with few, 3 to 6, receptacles. Receptacles slightly narrowed at both ends, yellow to brick red, about 1.5 cm. long, glabrous. Male flowers few,

immediately below umbilical scales, the perianth of three distinct subequal segments, 2 to 3.5 mm. long, exceeding and enveloping the single stamen; filament 1.5 mm. long; anther 1 mm. long. Gall flowers about 3 mm. long, pedicellate the perianth of four unequal, free segments, 2 to 2.5 mm. long, enveloping and exceeding the ovary, which is 1.5 mm. long, the style sublateral less than 1 mm. long.

Type specimen No. 6643 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904.

\* A species closely related to *Ficus semicordata* Miq., from Celebes, differing from that species in its short peduncled receptacles, which are differently disposed, smaller, more numerous, nerved leaves, few male flowers, and other characters.

***Ficus elmeri*, var. *subintegra* Merrill, sp. nov.**

A species similar to the type in general appearance, shape, and size of the leaves, etc., differing in its harsh, but not pubescent, nearly entire leaves, and reddish, glabrous branches.

Type specimen No. 6317 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, May, 1904. A shrub about 5 m. high.

***Ficus benguetense* sp. nov. § *Sycidium*.**

A shrub or small tree 3 to 10 m. high, with ovate, lanceolate, acuminate, glabrous, submembranous leaves, and axillary, peduncled subglobose or somewhat pyriform, glabrous, axillary receptacles, 1 to 1.5 cm. long. Branches dark brown, glabrous, the branchlets strigose pubescent. Leaves submembranous, 8 to 14 cm. long, 4 cm. wide, tapering above to the blunt acumen, and below to the inequilateral base, one side of the lamina acute at the base the other more or less rounded, both surfaces smooth, the lower densely punctate; nerves about 8 on each side of the midrib, curved, ascending, prominent, somewhat anastomosing, the reticulations rather dense, valid; petioles 1 to 2 cm. long, slightly strigose pubescent, the stipules ovate, lanceolate, acuminate, 6 mm. long, slightly pubescent. Receptacles solitary or two or three from the same axil, glabrous, when fresh with few scattered whitish tubercles, yellowish when mature, the peduncles 3 to 8 mm. long, glabrous or slightly pubescent, the three ovate, acute bracts at the base of the receptacle, glabrous, about 3 mm. long. Male flowers only near the ostiole, 3 mm. long, short pedicelled; the perianth of three distinct, brown segments about 1.5 mm. long, about equaling the thickened filament. Stamen 1, the anther nearly 1 mm. long, just exerted from the perianth. Gall flowers pedicelled, the ovary subglobose, about 1.5 mm. in diameter, the style sublateral, very short, the segments of the perianth short, not, or but slightly, inclosing the ovary.

Specimens examined all from the Province of Benguet, Luzon: Baguio, Nos. 5847, 5789, 6038 (Elmer), March, 1904; Nos. 926 and 944 (Forestry Bureau), collected by Barnes, May-June, 1904; No. 1059 (Merrill), January, 1903; Sablan, No. 6111 (Elmer), April, 1904.

Apparently very common in Benguet, growing in ravines and along streams. Among the numerous specimens of *Ficus* at present in the herbarium from various portions of the Archipelago there are none from the other localities closely related to this species.

***Ficus angustissima* sp. nov. § *Sycidium*.**

A shrub, with linear, slightly scabrous leaves, 10 to 25 cm. long, and 8 mm. wide or less, and axillary, short peduncled, subglobose, glabrous receptacles, 8 to 10 mm. in diameter. Branches slender, light gray, glabrous, the ultimate branches more or less hispid, scabrous. Leaves alternate or opposite, pale beneath, shining, the apex attenuate, blunt acuminate, the base acute, slightly inequilateral; nerves very many, spreading at right angles from the midrib, at intervals of 2 or 3 mm.; petioles 5 to 10 mm. long. Receptacles solitary, pale when dry. Fertile female flowers only seen, sessile or pedicelled, the perianth segments inclosing and usually exceeding the ovary, rather copiously ciliate with long white hairs. Ovary subellipsoid, 1 to 1.3 mm. long, the style lateral, filiform, 1 to 1.5 mm. long.

Type specimen No. 2696 (Merrill), Bosoboso, Province of Rizal, Luzon, June, 1903. A most distinct species, at once recognized by its very narrow elongated leaves.

***Ficus bordeni* sp. nov. § *Synoecia*.**

A scandent shrub, with narrowly ovate or oblong ovate, acuminate, cordate, slightly scabrous leaves, 13 cm. long or less and subglobose receptacles, 5 to 6 cm. in diameter. Branches slender, appressed to the trunk of the supporting tree, freely rooting, light brown, striate, glabrous, or sparingly strigose pubescent. Leaves 8 to 13 cm. long, 3 to 5.5 cm. wide subcoriaceous, slightly rough, but not at all pubescent, the under surface tessellate, the apex short acuminate, the base somewhat cordate, rarely only rounded; nerves about 8 on each side of the midrib, ascending, prominent beneath; petioles 1 to 2 cm. long, ferruginous scaly. Receptacles brown, very sparingly strigose, pedunculate. Male flowers numerous, 8 to 9 mm. long, the pedicel about 4 mm. long, the perianth brown, 1.5 mm. long, of three narrow distinct segments, the single stamen long exserted; filament 3 mm. long; anther 1.5 mm. long. Gall flowers numerous, the pedicel long or short; ovary 2 to 2.5 mm. long; the style 1 mm. long.

Type specimen No. 1211 (Forestry Bureau), collected by T. E. Borden, Lamao River, Province of Bataan, Luzon, June, 1904. A vine in the hill forests at an altitude of about 650 m. above the sea.

***Ficus chrysolepis* Miq. var. *longipedunculata* var. nov. § *Urostigma*.**

A form strongly resembling the type, differing in its longer petioles, 3 to 4.5 cm., longer peduncles, 2.5 to 3 cm., nearly glabrous stipules and smaller, slightly obovoid receptacles, 2.5 to 3 cm. in diameter.

Type specimen No. 6176 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904. A tree about 7 m. high. *Ficus chrysolepis* Miq., is known only from Celebes.

***Ficus palauanense* sp. nov. § *Urostigma*.**

A medium-sized or large tree, 15 m. high or more, with coriaceous, glabrous, slightly cordate, ovate elliptical, acuminate leaves, 2 to 2.5 cm. long. Branches thickened, subannular at the leaf scars, grayish-brown, glabrous, the tips densely pubescent, the leaf scars prominent. Leaves 20 to 27 cm. long, 6 to 13 cm. wide, entirely glabrous, except the slightly

pubescent nerves beneath, the upper surface shining, the lower surface dull, the apex abruptly sharp acuminate, the acumen 1 to 1.5 cm. long, narrowed below to the rounded, cordate base, the sinus sharp, very narrow, shallow; nerves from the base five, the inner ones ascending, lateral nerves about 12 on each side of the midrib, curved, ascending, very prominent beneath, anastomosing in a submarginal nerve, the primary reticulations lax, prominent, the secondary fine; petioles 2.5 to 3.5 cm. long, slightly pubescent, becoming glabrous. Receptacles near the tips of the branchlets, bright red, the umbilicus obscure, bracts green, orbicular-ovate, rounded, about 8 mm. in diameter, coriaceous, glabrous. Male flowers few, only near the ostiole, 3 to 4 mm. long, the perianth of three broad, unequal segments inclosing the single stamen, the anther sessile, 1.2 to 1.4 mm. long. Gall flowers 4 to 5 mm. long, the perianth of the three subequal free segments about 3 mm. long, closely investing the ovary, which is ovoid, about 2 mm. long, the style subterminal, 2 mm. long or less. Fertile female flowers similar to the gall flowers, but usually sessile, the style much longer.

Type specimen No. 761 (Merrill), Ewiig River, Island of Paragua (Palauan), February 15, 1903. A tree growing in the forests along the river bank at an altitude of about 100 m. above the sea.

## CARYOPHYLLACEÆ.

*Stellaria laxa* sp. nov. § *Eustellaria*.

A diffuse, prostrate, spreading plant, rooting at the nodes, the leaves, young branches, and inflorescence densely, or only slightly stellate pubescent. Stems glabrous or with few stellate hairs, shining, 60 to 80 cm. long, branched, forming large, lax mats, the flower bearing branches suberect, 25 cm. long or less. Leaves thin, ovate-lanceolate, or lanceolate, acuminate, rounded at the base, sometimes acute, sessile or nearly so, 10 to 30 mm. long, 4 to 10 mm. wide; nerves faint, about 5 or 6 on each side of the midrib, the reticulations very lax, obscure. Cymes on slender peduncles, axillary, few (3 to 6) flowered; the pedicels 1 to 1.5 cm. long, the bracts lanceolate, acuminate, pubescent, 3 mm. long or less. Flowers white, about 8 mm. in diameter. Sepals 5, free to the base, lanceolate, acuminate, 4 mm. long, 1.5 mm. wide, 3-nerved, glabrous or with few stellate hairs. Petals 5, membranaceous, about 4 mm. long, cleft nearly to the base, the segments 0.5 to 0.8 mm. wide, obtuse. Stamens 10, hypogynous; filaments filiform, 2 to 3 mm. long; anthers 0.4 mm. long. Ovary 1-celled; styles three, 1.5 mm. long. Capsule about 5 mm. long, slightly exceeding the calyx, 6-valved. Seeds few, 5 to 6, light brown, minutely tubercled or reticulate, 1.5 to 1.8 mm. long.

Type specimen No. 6612 (A. D. E. Elmer), Kias, Province of Benguet, Luzon, June, 1904.

Another species of this genus, *Stellaria saxatilis* Hamilt., has been found in northern Luzon, No. 1623 (Loher), according to the manuscript list of identification of his collection made at Kew.

## MAGNOLIACEÆ.

*Talauma grandiflora* sp. nov.

A small tree about 7 m. high, with oblong lanceolate or ovate lanceolate, acuminate, glabrous, subcoriaceous leaves, solitary fragrant flowers 9 to 10 cm. long, and ovoid or ellipsoid fruit of about the same length. Branches dark brown, striate, glabrous, or with few appressed hairs, the terminal bud densely appressed pubescent. Leaves 15 to 27 cm. long, 6 to 9 cm. wide, both surfaces shining, the base acute, the acumens short, blunt; nerves 15 to 18 pairs, prominent, the reticulations rather dense, prominent; petioles glabrous, or with few appressed hairs, 12 to 18 mm. long. Flowers before opening ovoid, obtuse, 4.5 cm. in diameter on an annulate pubescent peduncle 2 cm. long, 7 mm. thick. Sepals 3, ovate or obovate, obtuse, 9 cm. long, 5 to 6 cm. wide, glabrous, or at first slightly pubescent, and densely so at the very base. Petals 6, in two whorls, the outer ones obovate, 9 cm. long, 5 to 5.5 cm. wide, glabrous, obtuse, fleshy, the inner ones thicker and narrower. Ovaries 2 ovuled; styles pubescent. Anthers sessile, about 15 mm. long. Ripe fruit 9 to 10 cm. long, 6 cm. thick, obtuse, glabrous, the individual carpels about 75 in each fruit, 2.5 to 3 cm. long, the beak terminal, 5 mm. long.

Type specimen No. 314 (Forestry Bureau), collected by J. A. Gammill, Nagaba, Guimaras Island, February, 1904; No. 861 (Forestry Bureau), collected by Gammill, same locality, June, 1904, is the same. A small tree reaching a diameter of 15 cm., growing in dry soil at an elevation of about 200 m. above the sea, the trunk straight, cylindrical, 2 m. to the first branches, the branches ascending, bark gray, wood white. V., *Tabisan*.

## ANONACEÆ.

*Goniothalamus elmeri* sp. nov.

A shrub 3 or 4 m. high, with oblong, narrowly oblong or rather broadly oblanceolate abruptly blunt acuminate glabrous leaves, and solitary axillary pendulous, dull red flowers, the style cylindrical, the stigma minutely and equally 2-toothed. Branches light brown or grayish, striate, glabrous. Leaves 12 to 18 cm. long, 4 to 6 cm. wide, subcoriaceous, the base acute; nerves 12 to 15 on each side of the midrib, not prominent, the reticulations lax, obscure; petioles glabrous, rugose, 5 mm. long. Flowers 3 cm. long, solitary, from the axils of fallen leaves, their pedicels 1.5 cm. long, nearly glabrous, or with very few scattered appressed rufous hairs, and with 4 to 6 pairs of small distichous, ovate, acute, sparingly rufous pubescent bracts 2 mm. long or less, near the base of the pedicel. Sepals broadly ovate or suborbicular, obtuse, about 1 cm. long, very slightly pubescent with appressed, scattered, rufous hairs. Petals with very few appressed, scattered, rufous hairs, the outer ones ovate, acute, 3 cm. long, 15 to 18 mm. wide, the keel scarcely evident; inner petals broadly ovate, acute, 1 cm. long, the keel slightly evident. Stamens numerous, 3 mm. long, the apical appendage orbicular, 0.5 mm. long. Ovaries indefinite.



1-ovuled, oblong, about 2 mm. long, densely rufous pubescent in part, one side glabrous; style slender, glabrous, 3 mm. long; stigma slightly bifid.

Type specimen No. 6105 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904. Apparently also represented by Nos. 277 and 324 (H. N. Whitford), Lamao River, Province of Bataan, Luzon, May, 1904. A shrub or small tree growing in the hill forests.

**Orophea glabra** sp. nov.

A small tree about 10 m. high, with ovate-lanceolate, acuminate, glabrous leaves, solitary, yellow, odorless flowers about 1 cm. long with 9 to 12 stamens, the ripe carpels globose. Branches slender, brown or brownish gray, glabrous, the ultimate branchlets with very few scattered ferruginous hairs. Leaves membranous, 5 to 10 cm. long, 2 to 4 cm. wide, the apex slender acuminate, the base acute; nerves about 6 on each side of the midrib, not prominent, the reticulations very lax; petioles glabrous, 1 to 2 mm. long. Flowers axillary, the pedicels about 5 mm. long, rusty pubescent and with 4 to 5 alternate distichous bracts 1 mm. long or less. Sepals red, broadly ovate or suborbicular, blunt, about 1 mm. long, the margins rusty pubescent. Outer petals broadly obovate or suborbicular, glabrous, except the pubescent margins, 3.5 mm. long, 3 mm. wide. Inner petals 9 cm. long, the claw 4 mm. long, the lamina trapezoidal 5 mm. long, 4 mm. wide, glabrous except the cohering margins above which are pubescent. Stamens 9 or 12, 0.6 to 0.8 mm. long, the connective with a short, conical, apical point. Ovaries 6 to 7, each 2-ovuled, ellipsoid or oblong, 1 mm. long, sparingly pubescent, the stigmas sessile, subglobose or oblong. Carpels (immature) globose, smooth and shining, 8 mm. in diameter.

Type specimen No. 1017 (Forestry Bureau), collected by W. W. Clark, Island of Ticao, May 31, 1904. A small tree reaching a diameter of about 15 cm., growing in open hill forests, the timber being used for rafters and frames in house construction, common in Ticao and known to the Visayans as *Lanutan*, a name commonly applied to many different species of the *Anonaceæ*. A species apparently most closely related to *Orophea uniflora* Hook. f. et Thoms., a species of British India.

**Uvaria stellata** sp. nov.

A stout scandent shrub with subcoriaceous, entirely glabrous oblong, acuminate or nearly acute leaves, and solitary, axillary or subterminal dark-red flowers 4 cm. in diameter, the petals outside, densely fulvous lepidote-stellate pubescent. Branches dark, nearly black when dry, striate, glabrous. Leaves 12 to 17 cm. long, 5 to 6.5 cm. wide, both surfaces smooth and shining, slightly narrowed to the rounded base, the apex bluntly acuminate; nerves about 15 on each side of the midrib, not prominent, the reticulations lax; petioles rugose, glabrous, thickened, 5 mm. long. Flowers solitary, their pedicels thick, densely fulvous stellate pubescent, about 1 cm. long. Calyx deeply lobed, densely stellate pubescent outside, pubescent inside, the lobes broadly ovate, acute, about 1 cm. long, 1 cm. wide below. Petals ovate or elliptical, the apex rounded,



2 cm. long, 12 to 15 mm. wide, subequal, the outside densely ferruginous stellate-lepidote pubescent, the inside sparingly pubescent with scattered short hairs. Stamens indefinite, the anthers sessile, 3 mm. long, the connective somewhat produced, the apex truncate, somewhat oblique, less than 1 mm. in diameter. Ovaries many, 4 mm. long, ferruginous stellate pubescent, each with 8 to 10 ovules.

Type specimen No. 6322 (A. D. E. Elmer), Twin Peaks, Province of Benguet, Luzon, May, 1904. A species growing in the forests along streams, the flowers with the odor of ripe apples. It is apparently most closely related to *Ucaria oralifolia* Blume, but is especially characterized by the peculiar stellate-lepidote pubescence of the petals.

## MONEMIACEÆ.

### *Kibara grandifolia* sp. nov.

A tree about 5 m. high, with subcoriaceous, broadly ovate leaves 20 to 28 cm. long. Branches yellowish, glabrous. Leaves 11 to 18 cm. wide, the base broadly rounded, the apex obscurely acuminate or subacute, the margins entire below, above more or less coarsely, shallowly toothed or merely undulate, the upper surface smooth and shining, except along the midrib and main nerves, which are more or less pubescent, the lower surface uniformly pubescent with scattered, straight, short hairs; main nerves about 6 or 7 on each side of the midrib, prominent, freely anastomosing, the reticulations lax; petioles stout, about 1.5 cm. long, pubescent. Inflorescence axillary, about 8 cm. long, the axis and branches densely pubescent. Flowers not known. Drupes broadly ellipsoid, obtuse, glabrous, sessile, 1.5 cm. long, about 12 mm. thick, the peduncles of the thickened, pubescent receptacles 3 to 4 cm. long.

Type specimen No. 1158 (Forestry Bureau), collected by Ahern's collector, mountains near Bosoboso, Province of Rizal, Luzon, June, 1904.

## LAURACEÆ.

### *Beilschmiedia glomerata* sp. nov.

A tree about 30 m. high, with alternate, broadly ovate, or ovate-elliptical, obtuse, glabrous leaves, and axillary, densely flowered almost spikelike panicles, 2 to 4 cm. long. Branches glabrous, scaly, gray, the tips brownish, the leaf scars numerous, rather prominent. Leaves 11 to 15 cm. long, 5 to 9 cm. wide, subcoriaceous, the base acute or rounded, equal or nearly so, the apex rounded, the upper surface smooth and shining, the lower surface brownish when dry, especially the nerves, which are not prominent, about 9 pairs, the reticulations rather lax; petioles 1.5 to 2 cm. long. Panicles densely pubescent, glomerate, the peduncle nearly obsolete, subtended by many imbricated, suborbicular bracts, the bracts, rhachis, and branches densely pubescent; bracts 5 to 6 mm. in diameter; branchlets 0.5 cm. long. Flowers greenish yellow, slightly fragrant, 5 to 6 mm. in diameter, the pedicels 2 mm. long, pubescent. Calyx 6-lobed, densely pubescent outside, minutely pubescent inside, cleft nearly to the base,

the lobes 3 mm. long, 2 mm. wide, obtuse, 3-nerved. Fertile stamens 9, the anthers 1 mm. long, filament 0.5 mm. long; sterile stamens 3 mm. long, pubescent. Ovary sparingly pubescent, the style simple, 2 mm. long.

Type specimen No. 335 (Forestry Bureau), collected by Barnes, Lamao River, Province of Bataan, Luzon, February, 1904. A tree reaching a diameter of 40 cm., with gray bark and white wood, growing in the hill forests at an altitude of about 100 m. above the sea. T., *Terukan*.

## CRASSULACEÆ.

### *Sedum australis* sp. nov.

A slender, succulent, erect or suberect, simple or sparingly branched glabrous biennial (?), from slender roots, with oblanceolate obovate or spatulate leaves 2 cm. long or less, and few (three to seven) flowered terminal, once or twice branched cymes, the flowers 5-partite. Leaves 5 to 20 mm. long, 3 to 6 mm. wide, entire, obtuse, alternate, fleshy. Flowers short pedicelled, the branches of the cyme 1 cm. long or less, each flower subtended by a rosette of three or four reduced leaves, hermaphrodite, golden yellow, 5 to 6 mm. long. Sepals oblong, 2.5 to 4 mm. long, 1 mm. wide, obtuse. Petals 5, ovate-lanceolate, 5 to 6 mm. long, acute or acuminate. Stamens 10, the filaments 5 to 4 mm. long, the anthers elliptical or subglobose, 0.5 mm. long. Carpels 5, ovate, acuminate, 5 mm. long, 2.5 mm. wide, more or less divaricate when mature, marked with few purplish dashes, the style less than 1 mm. long. Seeds 12 to 15 in each carpel, oblong, cylindrical, minutely apiculate, minutely punctate throughout, 0.8 mm. long, 0.3 mm. in diameter.

Type specimen No. 6568 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, June, 1904. No. 6314 (Elmer), Baguio, Benguet, May, 1904, is the same. A species growing in wet rock crevices, etc., from 1,500 to 2,500 m. above the sea.

No species of this genus has previously been reported from the Philippines, nor is the genus represented in the Malayan region, and therefore the discovery of this species in northern Luzon is especially interesting, as the genus is characteristic of the north temperate zone. A single species, *Sedum formosanum* N. E. Br., is known from the Island of Formosa to the north of Luzon.

## SAXIFRAGACEÆ.

### *Polyosma philippinensis* sp. nov.

A small tree, with usually oblong-lanceolate, nearly glabrous, membranous, remotely glandular-toothed, or subentire leaves, and terminal racemes 12 to 20 cm. long. Branches grayish or reddish-brown, striate, glabrous, the tips densely yellowish-brown pubescent. Leaves opposite, 8 to 13 cm. long, 2 to 5 cm. wide, the apex rather slender-acuminate, the base acute, upper surface smooth and shining, the lower glabrous, except the more or less puberulous midrib and nerves, teeth mostly obscure, 1 to 1.5 cm. apart; nerves about 10 on each side of the midrib, spreading,

prominent beneath, anastomosing, the reticulations lax; petioles 1.5 to 3.5 cm. long, densely pubescent, becoming glabrous. Racemes erect, the rachis pubescent. Flowers 10 to 12 mm. long, numerous, white or slightly pink, faintly fragrant, the pedicels about 2 mm. long, densely pubescent, the bracteoles very small. Calyx 2 to 3 mm. long, pubescent, the teeth 4, acute, less than 1 mm. long. Corolla densely pubescent outside, the petals valvate, 10 to 12 mm. long, 1.5 mm. wide, much recurved above in anthesis. Stamens 4, about 10 mm. long. Ovary inferior, 1-celled, many-ovuled. Fruit immature, 5 to 6 mm. long, pubescent.

Specimens examined, all from Mount Mariveles, Province of Bataan, Luzon: No. 828 (Forestry Bureau), collected by T. E. Borden, June, 1904, flower (type); No. 1509 (Forestry Bureau), Ahern's collector, July, 1904, flower; No. 3877 (Merrill), August, 1904, flower.

A species apparently most closely related to *Polyosma ilicifolia* Blume, from Java and Sumatra, differing especially in its leaf characters, shorter pedicels, etc., reaching a height of about 10 m., growing in dense hill forests at an elevation of from 600 to 800 m. above the sea. No species of this genus has previously been reported from the Philippines.

## LEGUMINOSÆ.

### *Bauhinia kappleri* Sagot.

This species is discussed at length by Dr. J. Perkins,<sup>1</sup> having been collected at Arayat, Province of Pampanga, Luzon, by Dr. O. Warburg in the year 1888, No. 13743. As the home of the species is not definitely known, and Dr. Warburg's notes did not show whether the species was cultivated or native at Arayat, Dr. Perkins offered the suggestion that it might be a native of the Philippines. Recently I had an opportunity to collect botanical material at Arayat, and discovered the species in question in a small "barrio" at the foot of Mount Arayat, about one and one-half miles distant from the town, and can definitely state that the plant is not a native of the Philippines, but that it has been introduced from some other country, probably tropical America, and is only cultivated in the Philippines for ornamental purposes, although it is apparently now somewhat spontaneous. The Arayat plant, No. 3934 (Merrill), was in flower, also with immature fruit, in October, 1904, and was observed only in the vicinity of houses. Careful inquiry of the natives brought out the information that the species was to be found only in the town, and that it did not grow on the neighboring mountain, or in the thickets or forests. The residents of the little village, where the plant was found, speak the Pampangan dialect, and not one was found who had even a rudimentary knowledge of the Spanish language, yet they have no name for this very striking species other than one of Spanish origin, "Rosas de Francia." In addition to the Arayat locality I also have this species from Manila, a single unnumbered specimen in fruit, collected in November, 1903.

<sup>1</sup> Frag. Fl. Philip., 13, 1904.

Fernandez-Villar<sup>1</sup> erroneously identifies this species with *Bauhinia subrotundifolia* Cav., and the species is figured under this name in the third edition of Blanco's *Flora de Filipinas*, pl. 82. This citation should be added to the synonymy of the species above. While the material on which Cavanilles based his *Bauhinia subrotundifolia* may have been collected in the Philippines, still it is more probable that it was of Mexican origin, although Cavanilles cites Calauan (Province of Laguna, Luzon) and Acapulco (Mexico) as the localities from which he received his material. His description however does not apply to the species here considered.

Blanco does not describe this species in his *Flora de Filipinas*, and it is scarcely possible that he would have overlooked such a prominent species had it been commonly cultivated in the Philippines at the time when he did his work. It seems probable that the species has been introduced into the Philippines at a comparatively recent date, certainly since Blanco's death in 1845, as even at the present time, although very ornamental, it is not at all common or widely distributed in the Philippines, having been observed by the author but twice, while no other collector other than Warburg has secured specimens in the Philippines.

***Millettia piscatoria*** (Blanco) Merrill, Govt. Lab. Publ., 20:37. 1905.  
(*Cylista piscatoria* Blanco, Fl. Filip. ed. 1. 589. 1837; *Galaetia* (?)  
*terminaliflora* Blanco, l. c., ed. 2, 411. 1845; ed. 3. 2:390; *Millettia*  
*splendens* F. Vill. Nov. App. 59. 1880, non W. et A.

This species is represented by No. 60 (Whitford), Lamao River, Mount Mariveles, Province of Bataan, Luzon, April, 1904, and No. 473 (Forestry Bureau), Ahern's collector, Antipolo, Province of Rizal, Luzon, April, 1904, both specimens in flower. Blanco's description is quite complete, and according to that author the natives employ the macerated leaves and branches for stupifying fish, whence his specific name. T., *Tubli*.

***Millettia merrillii*** Perkins, Frag. Fl. Philip. 81. 1904.

This species, which reaches a height of 6 or 8 m., is common in the thickets and broken forests in the foothills in central Luzon, and is well represented by pl. 79, of the third edition of Blanco's *Flora de Filipinas*. Accordingly the following synonyms should be added: *Millettia caerulea* F.-Vill. Nov. App. 59. 1880, non Baker; *Millettia xylocarpa* Naves, Fl. Filip. ed. 3, pl. 79, non Miq. Additional material of this species: No. 3831 (Merrill), Mount Arayat, Province of Pampanga, Luzon, May, 1904 (fruit); Bosoboso, Province of Rizal, Luzon, No. 2673 (Merrill), June, 1903 (fruit); No. 1147 (Forestry Bureau), Ahern's collector, June, 1904 (fruit), and No. 6166 (Elmer), Sablan, Province of Benguet, Luzon, April, 1904 (flower).

***Mucuna longipedunculata*** sp. nov.

A vine reaching a height of 10 or 12 m. or more, with pendant inflorescence, the slender peduncles 1.5 to 4 or 5 m. long, the flowers ivory white, 8 cm. long. Branches slender, brown, appressed pubescent. Leaves trifoliate, about 20 cm. long, the petiole appressed pubescent, 7 cm. long; leaflets 10

<sup>1</sup>Nov. App., 72. 1880.

to 12 cm. long, 6 to 8 cm. wide, acuminate, nearly glabrous above, except the somewhat pubescent midrib, hirsute beneath with scattered hairs, the nerves 5 to 6 on each side of the midrib; stipules 2 to 3 mm. long, the stipels 6 to 8 mm. long, subulate. Inflorescence axillary, the flowers crowded at the apex of the much elongated peduncle in a racemose panicle, the flower-bearing portion 15 cm. long or less, the branches about 7 cm. long; pedicels densely pubescent, 1.5 cm. long, three or four from the tip of each branchlet; bracteoles at the base of the calyx very slightly pubescent, green, 2.5 cm. long, 1.5 cm. wide, exceeding the calyx in bud, deciduous. Calyx about 2.5 cm. long, 2 cm. in diameter, densely grayish pubescent but without stinging hairs, the teeth very unequal, the upper one broad, 8 mm. long, the apex emarginate, the lower one very broad, short, also emarginate, the lateral ones broadly ovate, acute or subobtus. Corolla white, the keel 8 cm. long, inflexed at the tip; wings 7 to 7.5 cm. long, 1.5 cm. wide; standard 5 cm. long, 3 cm. wide, the apex rounded.

Type specimen No. 6233 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904, a vine in thickets and forests.

This species is apparently in the section *Carpopogon*, but in the absence of fruits this can not be definitely determined. In his notes Mr. Elmer describes the fruit as a pod 6 inches long covered with brown stinging hairs, but has no notes as to whether or not the pod was smooth or plaited, but is of the opinion that it was smooth. No specimens of the fruit were preserved.

***Pithecolobium parvifolium* sp. nov.**

A shrub or small tree 4 to 6 m. high, with evenly bipinnate leaves, 6 to 12 pairs of pinnae, and 10 to 28 jugate leaflets, the leaflets 5 to 10 mm. long, the terminal pair similar to the others in shape and size. Branches dark brown, striate, more or less pubescent, becoming glabrous. Leaves 8 to 18 cm. long, the rachis ferruginous pubescent, 6 to 12 cm. long, the petiolar portion 1.5 to 3 cm. long, with a rather prominent sessile gland below each pair of pinnae; pinnae 8 to 10 mm. apart, their rachises ferruginous pubescent, the upper ones gradually longer, the distal 5 to 8, the basal 2 to 3 cm. long; leaflets 5 to 8, rarely 10 mm. long, 2 to 4 mm. wide, those on the upper pinnae 18 to 28 jugate, on the lower pinnae about 10 jugate, trapeziform, the apex acute or subobtus, the base inequilaterally truncate, the upper and lower margins parallel, the midrib diagonal, shining above, dull and brown beneath, both surfaces with scattered ferruginous hairs; petiolules 0 or very short. Inflorescence a terminal panicle about 15 cm. long, the branches ascending, angular, and with the axis densely ferruginous pubescent. Flowers in small subumbellate corymbs 1 cm. across or less, the peduncles 1 to 2 cm. long, vertically superposed above bracts on the branches and on the axis. Calyx campanulate, 2 mm. long, externally ferruginous pubescent, with 5 short deltoid teeth. Corolla white or yellowish, densely ferruginous pubescent externally, 6 to 7 mm. long, the lobes ovate, acute or subobtus, nearly half as long as the tube. Filaments glabrous, united below into a short tube, the free portions 8 to 9 mm. long. Ovary pubescent, stipitate. Pod spirally twisted, 7 to 9 cm. long, 1 cm. wide, dark red, densely rusty pubescent,



becoming glabrous, dehiscing along the lower suture, more or less sinuate between the seeds on the lower margin. Seeds 5 to 10, ovoid, compressed, 8 mm. long, 6 mm. across.

Type specimen No. 5863 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904 (flower); also No. 128 (D. L. Topping), same locality, February, 1903 (fruit); No. 3876 (Merrill), Mount Arayat, Province of Bataan, Luzon, August, 1904 (fruit). No. 3836 (Merrill), Mount Mariveles, Province of Bataan, Luzon, May, 1904, is closely related if not identical.

This species grows in Benguet in thickets along streams in the pine region at an elevation of about 1,700 m. above the sea, and on Mount Mariveles and Mount Arayat on exposed wind-swept ridges near the summit of the mountain in each case. It is apparently related to *Pithecolobium subacutum* Benth., and *P. montanum* Benth., differing from both especially in its very small leaflets.

***Strongylodon elmeri* sp. nov.**

A woody vine with trifoliate glabrous leaves, the leaflets oblong, acuminate, the flowers in axillary racemes, the axis 20 cm. long or less, the flowers a peculiar dark greenish blue color, 2.5 to 3 cm. long. Stems light brown, striate, glabrous. Leaves 20 to 25 cm. long, the common petiole glabrous, 8 to 9 cm. long, the petiolules 5 to 7 mm. long; leaflets 11 to 17 cm. long, 4 to 6.5 cm. wide, abruptly acuminate, the acumen short, blunt; terminal leaflets with a slightly rounded or subacute base, the lateral ones strongly inequilateral, rounded or truncate at the base; nerves 5 or 6 on each side of the midrib, freely anastomosing. Racemes 20 cm. long or less, the peduncle glabrous, 15 cm. long, the flower-bearing portion 5 to 6 cm. long, the flowers many from each protuberance, forming a rather dense, subglobose inflorescence. Flowers 2.5 to 3 cm. long, their pedicels slender, glabrous, about 3 cm. long. Calyx tubular, slightly inflated, 6 to 9 mm. long, 5 to 6 mm. wide, glabrous, the teeth very short, rounded, the bracts, if present, caducous. Corolla glabrous: standard 2 cm. long, 1.5 cm. wide, strongly reflexed, acute, wings 1.5 cm. long, clawed, the claw 5 mm. long, the blade obtuse, 10 mm. long, 6 mm. wide, slightly attached to the lamina of the keel; keel 2.5 to 3 cm. long, strongly curved, clawed. Ovary pedicellate, densely and minutely pubescent and with 5 or 6 ovules. Pod (immature) fleshy, oblong lanceolate, 5 to 7 cm. long, 2 cm. wide, compressed, the apex with a short, curved apicula.

Type specimen No. 6260 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904.

***Strongylodon caerulea* sp. nov.**

A vine with trifoliate glabrous leaves about 30 cm. long, the inflorescence an axillary racemose panicle about 20 cm. long, the axis thickened, horizontal, the flowers 3 to 3.5 cm. long, the calyx indigo blue, the corolla light azure blue. Stem about 2.5 cm. in diameter, soft and ropelike, the bark dark brown, rough, the branches light brown, glabrous, striate. Leaves alternate, the common petiole glabrous, 13 cm. long, the petiolules 1 cm. long or slightly less; leaflets ovate, 15 cm. long, 7 to 9



cm. wide, the apex acuminate, the acumen blunt, the base rounded or truncate, the lateral leaflets strongly inequilateral; nerves 8 or 9 on each side of the midrib, rather prominent beneath, the reticulations lax. Inflorescence glabrous, the peduncle proper 6 cm. long, the branchlets 1 cm. long or less, each bearing numerous flowers, their pedicels slender, glabrous, about 1.8 cm. long. Calyx 5 to 8 mm. long, about 6 mm. in diameter, glabrous, the teeth unequal, very broad, short, rounded, often obscure. Standard 3.5 cm. long, 1.5 cm. wide, acute, wings 2 cm. long, the claw 7 mm. long, the blade 13 mm. long, 6 mm. wide, obtuse, the latter more or less united to the lamina of the keel, keel about as long as the standard. Ovary glabrous, pedicellate, with 4 or 5 ovules. Anthers 1.2 mm. long.

Type specimen No. 6079 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904.

No. 6438 (Elmer), Twin Peaks, Province of Benguet, Luzon, June, 1904, is apparently a fruiting specimen of this species, the pod being fleshy, ovoid, pointed, 6 to 7 cm. long, 3 to 4 cm. wide, somewhat compressed, glabrous, purplish with numerous yellow spots.

## MELIACEÆ.

### *Aglaia parvifolia* sp. nov. § *Euaglaia*.

A tree about 12 m. high, with unevenly pinnate, bijugate leaves, the leaflets 6 cm. long or less, and ample many flowered panicles which exceed the leaves in length. Branches light gray, glabrous, the branchlets densely brown or grayish lepidote. Leaves 15 cm. long, the common rachis densely brown lepidote, 6 to 7 cm. long, leaflets narrowly elliptical-ovate sometimes somewhat oblanceolate, firm, 4 to 6 cm. long, 2 to 2.5 cm. wide, blunt acuminate, the base cuneate, the upper surface entirely glabrous except the sparingly lepidote midrib, the under surface pale, punctate, the midrib densely brown lepidote, a few scattered scales on the blade also; nerves obscure, 8 to 10 on each side of the midrib, not more prominent than the obscure reticulations; petiolules about 1 cm. long, densely brown lepidote. Panicles axillary, 15 to 18 cm. long, the branches spreading or ascending, the lower ones 6 cm. long, densely brown lepidote throughout. Flowers white, 1 to 1.2 mm. in diameter, their pedicels about 2 mm. long. Calyx lepidote, 5-toothed, the teeth short. Petals 5, broadly elliptical, obtuse, glabrous, 1 mm. long. Staminal tube 0.8 mm. long, glabrous, the margin obscurely toothed. Stamens, 5, inserted on the lower half of the staminal tube, the anthers about 0.3 mm. long, not exerted.

Type specimen No. 968 (Forestry Bureau), collected by W. W. Clark, Island of Burias, June, 1904. A small tree reaching a diameter of 18 cm., common in the dry hill forests and thickets at an altitude of about 50 m. above the sea.

### *Aglaia clarkii* sp. nov. § *Euaglaia*.

A tree about 12 m. high, with 8 to 12 jugate leaves, 70 cm. long or less, and oblong, or oblong-elliptical leaflets, which are dark brown, glabrous and shining above, densely ferruginous lepidote pubescent beneath, their

apices usually obtuse, their bases strongly cordate. Branches much thickened, 2 to 2.5 cm. thick immediately below the leaves, which are crowded at the apices of the branches, densely dark brown pubescent, the leaf scars very prominent, about 2 cm. wide. Leaves alternate, the rhachis densely dark brown lepidote pubescent; leaflets 9 to 16 cm. long, 4 to 6 cm. wide, the upper surface densely punctate, the apex obtuse, subacute, or obscurely broadly acuminate, the sinus at the base acute, 1 cm. deep or less, the basal lobes overlapping, rounded; nerves parallel, spreading, prominent beneath, 18 to 30 on each side of the midrib; petiolules stout, densely ferruginous pubescent about 1 cm. long. Panicles axillary, densely dark brown lepidote pubescent, 25 cm. long or less, subpyramidal, the peduncle 7 to 11 cm. long, the branches spreading or ascending, the lower ones 8 cm. long, the branchlets 2 cm. long or less, the flowers numerous, crowded in fascicles of four or five. Flowers about 2 mm. long, sessile. Calyx ferruginous pubescent, the lobes rounded or subreniform, 1 mm. long. Petals 5, glabrous, oblong, about 2 mm. long, 0.8 to 1 mm. wide, the apex obtuse. Staminal tube 1.2 mm. long, glabrous, minutely toothed, the five stamens inserted near the base of the tube, included, the anthers broadly ovate, 0.7 mm. long. Ovary glabrous. Fruit reddish brown, densely lepidote pubescent, pear shaped, about 5 cm. long.

Type specimen No. 1717 (Forestry Bureau), collected by W. W. Clark, Island of Burias, August, 1904 (flower); also No. 988 (Forestry Bureau), collected by Clark, Island of Masbate, June, 1904; No. 2028 (Merrill), Guinayangan, Province of Tayabas, Luzon, May 5, 1903 (fruit); No. 18 (Ahern), Pasacao, Province of Camarines, Luzon, February, 1902.

A tree reaching a diameter of 40 cm., locally common in hill forests, the leaves and fruits containing more or less milk sap. The bark is nearly smooth, about 2 cm. thick, and somewhat fragrant. The dark reddish brown timber is used in house and naval construction and also in the manufacture of furniture. T., *Tucanocalao*, B., *Consuyod*.

***Aglaia micrantha* sp. nov.** § *Hearnia*.

A small tree, 9 m. high or less, with unequally 2 to 3 pinnate leaves, nearly glabrous above, more or less ferruginous stellate pubescent beneath, the rhachis very densely rusty tomentose, the flowers minute, yellow. Branches nearly glabrous, striate, the ultimate branchlets very densely ferruginous tomentose. Leaves 20 to 35 cm. long, the rhachis 17 cm. long or less, the petiole proper 3 to 7 cm. long, and with the petiolules very densely ferruginous tomentose, the hairs being stellate, but so dense is the pubescence that the stellate arrangement is obscure; leaflets opposite, the upper ones larger than the lower, elliptical-lanceolate or broadly oblanceolate, the base acute, more or less unequal, the apex acuminate, 10 to 16 cm. long, 3 to 5 cm. wide, the upper surface glabrous except for the densely ferruginous stellate midrib, the under surface more or less ferruginous stellate pubescent throughout, the midrib and nerves very densely so; nerves about 12 pairs, ascending, rather prominent beneath; petiolules about 5 mm. long, that of the terminal leaflet about 1 cm. long. Panicles 15 cm. long or less, elongated in fruit, the peduncle 2 cm. long, the rhachis and branches very densely ferruginous stellate pubescent, the lower branches

spreading, about 5 cm. long, the secondary branchlets 1.5 cm. long or less. Flowers subglobose, minute, about 1.5 mm. long, their pedicels about 1 mm. long. Calyx densely ferruginous stellate pubescent, deeply 5-toothed, the teeth acute. Petals 5, obovate, obtuse, 1.3 mm. long, about 1 mm. wide or less, glabrous. Staminal tube 0.7 mm. long, glabrous, the margin entire. Stamens 5, inserted on the edge of the tube but scarcely exerted, the anthers less than 0.3 mm. in diameter. Fruit bright red, globose or somewhat pear shaped, 2 cm. in diameter, sparingly stellate pubescent, becoming glabrous. Seed solitary, large, surrounded by a soft, transparent integument.

Type specimen No. 477 (H. N. Whitford), Lamao River, Province of Bataan, Luzon, July, 1904 (flower); also, from the same locality, No. 3724 (Merrill), January 1, 1904 (fruit); and No. 1195 (Forestry Bureau), collected by Borden, June, 1904 (fruit and immature flowers); Nos. 104, 215 (Whitford), April, May, 1904 (fruit).

This species is not common in the forests, growing in the more open portions of the forest at from 400 to 600 m. above the sea, the fruit being edible, the fleshy integument surrounding the seed having the appearance and taste of similar portions of the fruit of *Euphoria cinerea* Radlk.

***Amoora elmeri* sp. nov.**

A small tree about 5 m. high, entirely glabrous, with 5 to 6 jugate, even or odd pinnate leaves 20 to 30 cm. long, and axillary panicles 25 cm. long or less, the spikelike branches spreading. Branches glabrous, reddish brown. Leaves alternate, the petiole 7 cm. long, the rachis, including the petiole, 20 to 25 cm. long; leaflets opposite, oblong, 7 to 13 cm. long, 3 to 4.5 cm. wide, subcoriaceous, opaque, the base acute, strongly inequilateral, the apex shortly and abruptly blunt acuminate, shining above, dull beneath, brownish when dry; nerves 9 to 12 pairs, prominent beneath, obscure above, the reticulations nearly obsolete; petiolules 2 to 3 mm. long. Panicles pyramidal, the axis glabrous, reddish brown, the lower branches 10 to 11 cm. long, the upper gradually shorter. Flowers yellow, globose, about 6 mm. in diameter, nearly sessile, each subtended by 1 or 2 small triangular bracteoles. Calyx 4 to 5 lobed, the lobes slightly imbricate, rounded, 2 mm. long or less, the margins ciliate. Petals 3, broadly ovate or nearly orbicular, concave, 5 mm. long, glabrous. Staminal tube cylindrical, 4 mm. long, entire. Stamens 6, the anthers 2.5 mm. long, included. Ovary 3-celled, the stigma sessile, conical.

Type specimen No. 6306 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, May 17, 1904, a small tree with dark-gray, rather smooth bark, not common, in dry thickets, the leaves crowded toward the ends of the elongated branches.

***Dysoxylum grandifolium* sp. nov.**

A small or medium-sized tree, about 7 m. high, with 6-jugate leaves about 120 cm. long, the leaflets 15 to 20 cm. long, and elongated panicles, 120 cm. long or more. Leaflets opposite or subopposite, glabrous, subcoriaceous, oblong-ovate to oblong-elliptical, the apex abruptly short, blunt acu-

minate, the base broad, rounded; nerves prominent, parallel, about 20 pairs; petiolules stout, rugose, slightly pubescent, about 1 cm. long. Branches and branchlets of the inflorescence densely appressed, grayish-brown pubescent, the ultimate branchlets 10 to 25 cm. long. Flowers solitary or in fascicles of 3 to 5 on the branchlets, sessile or nearly so. Calyx about 3 mm. long, appressed grayish-brown pubescent, with four broad, obscure teeth. Petals 4, 1.5 cm. long, 3 mm. wide, acute, valvate in bud, the outside densely appressed grayish-brown pubescent. Staminal tube free, about 14 mm. long, tubular, the apex obscurely toothed. Stamens 8, inserted near the top of the tube; anthers 1.4 mm. long. Ovary pubescent, 4-celled; style filiform, glabrous; disc 8 mm. long, tubular, ciliate at the apex.

Type specimen No. 632 (H. N. Whitford), Atimonan, Province of Tayabas, Luzon, August 15, 1904. A small tree growing along streams at an altitude of about 100 m. above the sea.

## SABIACEÆ.

### *Meliosma luzonensis* sp. nov.

A tree with odd pinnate 4 to 5 jugate leaves 20 cm. long or less, the leaflets glabrous or nearly so, their margins entire or distantly spinulose serrate above, and many flowered panicles which are shorter than the leaves. Branches thick, dark brown, glabrous, the tips more or less deciduously tomentose, the terminal bud densely ferruginous pubescent. Leaves opposite or subopposite, the rachis 7 to 13 cm. long, deciduously ferruginous tomentose; leaflets firm, opposite or subopposite, ovate, ovate lanceolate or oblong, 3 to 7 cm. long, 2 to 3 cm. wide, the base rounded or rarely subacute, the apex acuminate, upper surface glabrous, shining, the lower surface pale, at first with few hairs on the midrib and prominent veins, soon becoming glabrous except for the barbate vein axils, the margins entire below, above distantly spinulous serrate; nerves 8 to 10 on each side of the midrib, rather prominent beneath, anastomosing, the reticulations lax; petiolules about 5 mm. long, that of the terminal leaflet 1 cm. long, at first sparingly pilose, becoming glabrous. Panicles erect, 15 cm. long, the rachis and branches dark brown pubescent, the peduncle 6 cm. long becoming nearly glabrous, the branches spreading, the lower ones 5 to 6 cm. long, the upper ones gradually shorter. Flowers dull white, 2 to 2.5 mm. long, the pedicels densely ferruginous pubescent, 1 mm. long or less. Sepals ovate, 2 mm. long, subacute glabrous except the slightly ciliate margins, the bracteole about equaling the sepals. Outer petals three, orbicular, glabrous, 2.5 to 3 mm. in diameter, the inner two opposite the fertile stamens and slightly adnate to them, deeply cleft, forming two slender teeth 0.8 mm. long. Fertile stamens 2, 2 mm. long, the anther 1 mm. broad; sterile stamens 3, opposite the outer petals, about 1 mm. long. Ovary 1-celled, 2-ovuled, glabrous.

Type specimen No. 6267 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, May, 1904. A tree 8 to 10 m. high and 30 cm. in diameter, with soft wood and thick, checked bark growing on exposed ridges

near the summit of the mountain at an elevation of about 2,500 m. above the sea.

***Meliosma multiflora* sp. nov.**

A tree with odd pinnate 3 to 5 jugate leaves, 35 cm. long or less, the leaflets glabrous or nearly so, their margins spinulose serrate, and erect, many flowered, terminal and axillary panicles 20 cm. long. Branches thickened, dark brown, glabrous, the lenticels prominent, the tips ferruginous pubescent. Leaves alternate, the rachis 23 cm. long or less, sparingly ferruginous pilose, the upper surface flattened in the petiolar portion, deeply channeled above; leaflets opposite, lanceolate, ovate lanceolate or oblong lanceolate, 5 to 11 cm. long, 3 to 4 cm. wide, the base slightly inequilateral, rounded, rarely subacute, the apex slender acuminate, the margins below entire, above spinulose serrate, the teeth distant 5 to 8 or 10 mm., upper surface glabrous, shining, the lower surface pale, glabrous or with few scattered hairs and the midrib sparingly pilose, the axils of the veins not bearded; nerves 10 to 11 on each side of the midrib, prominent beneath, anastomosing, the reticulations lax, prominent; petioles sparingly pubescent, becoming glabrous, 1 cm. long. Panicles erect the axis and ascending branches densely ferruginous pubescent, the lower branches 10 cm. long, the upper gradually shorter. Flowers yellowish, sessile, fasciculate, the buds globose. Sepals four, ovate, obtuse, glabrous except the sparingly ciliate margins, 2 mm. long, the bracteole similar but one-half smaller than the sepals. Three outer petals (immature) orbicular, glabrous, 2 mm. in diameter, the two inner ones opposite the fertile stamens, 0.3 mm. long, 0.4 mm. wide, regularly 3-toothed. Fertile stamens 2, less than 1 mm. long, the sterile ones nearly as long. Ovary glabrous.

Type specimen No. 930 (Forestry Bureau), collected by P. T. Barnes, Mount Santo Tomas, Province of Benguet, Luzon, May 11, 1904. A tree about 10 m. high and 20 cm. in diameter, growing in damp forests at an altitude of about 1,800 m. above the sea. Apparently related to *Meliosma luzonensis* Merrill, but differing in its longer leaves and petiolules, very different panicles, sessile flowers, and much smaller, differently shaped inner petals.

***Meliosma pendula* sp. nov.**

A tree with pinnate leaves about 50 cm. long, the rachis densely ferruginous tomentose, the leaflets more or less pubescent, the margins entire or spinulose toothed, and drooping elongated panicles 60 to 70 cm. in length. Branches densely ferruginous tomentose. Leaves unevenly pinnate, about 5-jugate, the lower leaflets much smaller than the upper, spinulose toothed, the teeth distant 1 to 2 cm., 2 mm. long or less, the upper leaflets entire; common rachis about 30 cm. long, the leaflets opposite or subopposite, abruptly, sharp, short acuminate, the base rounded, or that of the terminal leaflet acute, elliptical, ovate, or obovate, 8 to 15 cm. long, 5 to 8 cm. wide, both surfaces with few scattered hairs on the reticulations, densely ferruginous pubescent on the midrib and veins; nerves 8 to 13 on each side of the midrib, anastomosing, very prominent beneath, the reticulations prominent; petiolules densely ferruginous tomentose, 1 to 1.5 cm. long.



Panicles axillary and terminal, the axis and branches ferruginous pubescent, the primary branches alternate, 25 cm. long, the secondary branches 12 cm. long or less. Flowers white, 3 mm. long, the pedicels 1 to 1.5 mm. long, thick, ferruginous pubescent, the bracteoles about 1 mm. long, ferruginous pubescent, lanceolate. Sepals 4, ovate, obtuse, 1.5 mm. long, the margins ciliate. Outer three petals broadly ovate or orbicular, glabrous, 2.5 to 3 mm. long, faintly 5-nerved, the inner two opposite the fertile stamens, about 1 mm. long, the apex coarsely three toothed. Fertile stamens 2, 2 mm. long, the anthers 1.3 mm. broad, the filaments broad, flattened, 1 mm. long; sterile filaments opposite the three outer petals, 0.8 mm. long. Ovary glabrous, 2-celled, each cell with 2 ovules.

Type specimen No. 6245 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, May, 1904. A tree 8 to 10 m. high, and 45 cm. in diameter, growing on exposed slopes at an altitude of about 2,500 m., above the sea. Apparently related to the Formosan species *Meliosma rhoifolia* Maxim., and to *M. wallichii* Planch.

## CELASTRACEÆ.

### *Evonymus benguetense* sp. nov.

A shrub or small tree with ovate, elliptical ovate, or ovate, acuminate slightly crenate, glabrous leaves, the four-parted flowers in extra-axillary 5 to 7 flowered cymes, the petals entire. Branches grayish, rough, the ultimate branchlets slender, glabrous, light gray or greenish. Leaves opposite, 3 to 7 cm. long, 1.5 to 4 cm. wide, submembranous, the base acute, the margins entire below, crenate-serrate above; nerves 4 to 5 on each side of the midrib, anastomosing, the reticulations lax, obscure; petioles glabrous, 2 to 3 mm. long. Cymes opposite, on the branchlets below the leaves, the peduncle glabrous 1 to 1.5 cm. long, the pedicels 1 cm. long or somewhat less. Flowers about 1 cm. in diameter when spread. Sepals 4, broadly ovate, obtuse, 2 mm. long. Petals 4, obovate, obtuse, 4.5 mm. long, 3 mm. wide. Stamens 4, the filament 3 mm. long, slender, glabrous, the anther 0.7 mm. long. Disk thick, about 3 mm. in diameter, fleshy. Ovary 4 celled, densely covered with short, stout tubercles; style 2 mm. long.

Type specimen No. 5977 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904.

## ELAEOCARPACEÆ.

### *Elaeocarpus argentea* sp. nov.

A small tree, about 3 m. high, with obovate or oblanceolate, glabrous, subcoriaceous leaves, the flowers about 5 mm. long, pendulous, crowded in erect, silvery pubescent racemes from the axils of the upper leaves, forming a terminal, nearly leafless inflorescence. Branches thick, brownish gray, rough, striate, the tips dark brown, glabrous. Leaves alternate, 3 to 5 cm. long, 2 to 3 cm. wide, the base cuneate, the apex acute or rather blunt, usually slightly emarginate, the margins finely crenate; veins 5 to



6 on each side, prominent beneath, ascending; petioles glabrous, 1 cm. long or less. Racemes 6 to 10 or more at the tip of each branchlet, 6 to 7 cm. long, erect, the axis, pedicels, bracts, calyx, and corolla appressed silvery pubescent, the peduncle 2 to 3 cm. long. Flowers white, the pedicel 5 mm. long, the bract 4 mm. long, lanceolate, the margins slightly toothed. Sepals 5, lanceolate, acuminate, 5 to 5.5 mm. long, 1.5 to 2 mm. wide, glabrous inside. Petals 5 mm. long, 2 to 2.5 mm. wide, the apex lacinate for 1.5 to 2 mm., on the inside pilose in the median portion and near the margins below, glabrous above, the base not cucullate. Torus thick, lobed, densely pubescent. Stamens about 30, the filaments about 1 mm. long, very sparingly pubescent, the anthers 2 mm. long, minutely and sparingly pubescent with very short hairs, the outer cell slightly exceeding the inner, but not awned. Ovary ovoid, 2 mm. long, densely silvery pubescent, 2-celled; style minutely pubescent, 3 mm. long. Young fruit ovoid or ellipsoid, rugose, pubescent, apparently 2-celled.

Type specimen No. 6237 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, May, 1904. A stunted tree with hard wood and gray, tubercled bark, growing on exposed ridges at and near the summit of the mountain at an altitude of about 2,500 m. above the sea.

***Elaeocarpus pendulus* sp. nov. § *Monocera*.**

A small shrubby tree 3 m. high or less, with lanceolate, acuminate, glabrous, subcoriaceous leaves, the flowers 12 mm. long, pendulous in small few flowered racemes which are borne on the branches below the leaves. Branches gray, rough, the ultimate branchlets glabrous, brown. Leaves alternate, 5 to 8 cm. long, 1.5 to 2.8 cm. wide, the base rounded or subacute, the apex long acuminate; nerves 6 to 8 on each side of the midrib, obscure, the reticulations lax, obscure; petioles 1.5 to 2 cm. long, slender, glabrous. Racemes few, 3 to 4 cm. long, glabrous, each with from three to six flowers, their pedicels slender, glabrous, about 1 cm. long. Flowers lanceolate, acuminate in bud. Sepals five, lanceolate, acuminate, equaling the petals, 2.5 to 3 mm. wide below, brownish red when dry, minutely appressed pubescent outside, rather densely pubescent inside, especially above and on the margins. Petals white, 5 mm. wide or less above, narrowed below, the base cucullate from the infolding of the edges and with a fleshy villous gland in the center, the apex lacinate for 5 mm. or less, glabrous above on both sides, below pilose in the median portion outside, and densely pilose inside. Torus thick fleshy, glabrous, grooved, 3 mm. in diameter. Stamens 35 to 40, the filaments 2 mm. long, pubescent, the anthers 3 to 4.5 mm. long, puberulous, the apex slightly cleft, the outer cell with a somewhat bent and curved, slender, somewhat scabrous awn 2 mm. long. Ovary ovoid, glabrous, pointed, 2.5 mm. long, 2-celled. Style slender, glabrous, 10 mm. long. Fruit elliptic, blunt at both ends, glabrous, rugose when dry, 1.5 cm. long, 1 cm. in diameter, the pulp thin, the stone strongly rugose, very hard, 1-celled, 1-seeded.

Type specimen No. 5801 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, March, 1904. This species is not common, growing only on the exposed summit of the mountain at an elevation of about 2,500 m. above the sea.

## STERCULIACEÆ.

***Sterculia crassiramea* sp. nov.**

A large tree with entire, oblong-ovate, cordate leaves, which are densely stellate-pilose beneath, and axillary many-flowered panicles, crowded with the leaves at the ends of the thickened branches. Branches grayish-brown, glabrous, the branchlets much thickened, especially at the pubescent tips. Leaves 10 to 22 cm. long, 8 to 16 cm. wide, the base broadly cordate, very slightly narrowed, the apex acute or slightly acuminate, the upper surface shining, glabrous, except for a few scattered stellate hairs, the under surface very densely light brown stellate-pilose throughout; basal nerves 5, prominent, with usually 2 additional short, obscure, marginal nerves, lateral nerves 8 or 9 on each side, prominent, straight, ascending, the reticulations rather lax, prominent beneath; petioles 3 to 7 cm. long, very densely pilose; stipules deciduous, subulate, pilose, about 1 cm. long. Panicles densely rusty-pubescent throughout, 12 to 18 cm. long, the branches spreading, about 3 cm. long. Flowers yellow, 4 mm. long. Calyx densely rusty-pubescent outside, purplish-pubescent within, 5-lobed, the lobes ovate-acute, about 25 mm. long. Staminal column slender, 25 mm. long, bearing at its cernuous apex about 8 sessile anthers.

Type specimen No. 1882 (Forestry Bureau), Ahern's collector, Bosoboso, Province of Rizal, Luzon, October 15, 1904. This is undoubtedly the species enumerated by F. Villar<sup>1</sup> as *Sterculia macrophylla* Vent. T., *Banilad*.

***Sterculia obovata* sp. nov.**

A small tree about 5 m. high, with narrowly obovate, abruptly acuminate, more or less pubescent leaves 10 cm. long or less, the inflorescence paniculate, fascicled at the tips of small specialized, leafless branchlets which are borne on the branches below the leaves. Branches light gray, glabrous, striate, the tips more or less ferruginous tomentose. Leaves 7 to 10 cm. long, 3.5 to 4 cm. wide, widest at the upper two-thirds, the apex abruptly short acuminate, tapering below to the abruptly acute or somewhat narrowly rounded base, the upper surface glabrous, except for the pubescent midrib, the lower surface with scattered stellate ferruginous hairs on the midrib, nerves, and reticulations; nerves about 8 pairs, prominent beneath, obscure above, the reticulations prominent beneath; petioles 1 cm. long, densely ferruginous tomentose; stipules lanceolate, acuminate, ferruginous pubescent, 6 to 7 mm. long. Panicles 7 cm. long or less, the axis, branches, and outside of the calyx densely rufous tomentose, the longest branches about 1.5 cm., spreading, slender, bearing two or three flowers only. Male flowers obovoid, the calyx lobes cohering by their apices, 6 to 7 mm. in diameter, the tube shorter than the lobes, the lobes densely rufous tomentose outside, whitish tomentose within, lanceolate, acute, 5 to 6 mm. long. Staminal column glabrous, 2 to 3 mm. long, the anthers 10, sessile, about 0.5 mm. long. Female flowers and fruit not seen.

<sup>1</sup>Nov. App. 27. 1883.

Type specimen No. 5999 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904, growing in thickets in gulches along streams. A small tree reaching a diameter of about 15 cm.; not common.

## THEACEÆ.

### *Adinandra luzonica* sp. nov.

A small tree 7 to 9 m. high, with subcoriaceous, oblong, acute, rarely slightly acuminate, nearly glabrous leaves, and solitary white fragrant flowers about 2 cm. in diameter. Branches dark grayish brown, striate, glabrous, the ultimate branchlets more or less appressed pubescent. Leaves 5 to 8 cm. long, 1.5 to 3.5 cm. wide, the base acute, the margins revolute, and minutely and obscurely distantly serrate, nearly entire, the upper surface glabrous except for the more or less pubescent midrib, the lower surface slightly pubescent, with few scattered hairs, becoming glabrous; nerves 14 to 15 pairs, not prominent, freely anastomosing, the secondary nerves and the reticulations nearly as prominent as the primary nerves; petioles about 3 mm. long, slightly pubescent. Flowers axillary, the peduncle pubescent, becoming glabrous, 10 to 12 mm. long. Sepals densely appressed villous outside, glabrous inside, broadly ovate, obtuse, 1 cm. long, 9 mm. wide, the two outer ones thicker, the margins thin, entire, minutely ciliate. Petals obovate, obtuse, slightly united at the base, 10 mm. long, 9 mm. wide, the median portions outside, densely appressed villous, the broad margins glabrous. Stamens epipetalous, about 50, 6 to 8 mm. long, the anthers 3 to 3.5 mm. long, villous, the filaments more or less united, villous. Ovary ovoid, densely villous, 5-celled, each cell with many ovules; style glabrous. Fruit unknown.

Type specimens: No. 446 (Whitford), growing on exposed, wind-swept ridges, Mount Mariveles, Province of Bataan, Luzon, July 21, 1904, altitude, 1,200 m.; No. 1360 (Forestry Bureau), collected by Borden, same locality, July, 1904.

A species apparently closely related to *Adinandra integerrima* T. Anders., but differing especially in its leaf characters and its obovate obtuse petals.

## DIPTEROCARPACEÆ.

*Shorea polysperma* (Blanco) Merrill, Govt. Lab. Publ. 20:22, 1905.  
(*Mocanera polysperma* Blanco, Fl. Filip. ed. 1, 448. 1837; *Dipterocarpus polyspermus* Blanco, l. c., ed. 2, 312. 1845; ed. 3, 2:213; *Hopea tangili* Blume, Mus. Bot. Lugd. Bat. 2:35, 1856; *Shorea talura* F.Vill. Nov. App. 21, 1880, non Roxb.)

A very large tree, with narrowly ovate, or ovate lanceolate, acuminate leaves, pubescent imbricate sepals, and pubescent ovary. Branches dark brown, glabrous. Leaves 8 to 11 cm. long, 3 to 5 mm. wide, shining, subcoriaceous, the base rounded, rarely somewhat acute, the apex usually rather long acuminate; nerves 10 to 12 pairs, subprominent, ascending; petioles 2 cm. long, glabrous, or at first pubescent. Panicles 20 cm. long

or less, the branches ascending, the lower ones often 15 cm. long, densely pubescent with gray hairs. Flowers small, yellowish. Sepals imbricate, broadly ovate, obtuse or subacute, 3 mm. long, 2.5 mm. wide, densely pubescent, the three outer ones inclosing the two inner. Petals 8 mm. long, 3.5 mm. wide, obtuse. Stamens 15, in two series, the filaments broad, 1 mm. long; anthers broadly ovate, 0.6 mm. long, the appendix to the connective slender, as long as the anther. Ovary pubescent, the stylopod very obscure or wanting. Style slender, 1.5 mm. long. In the fruit all the sepals are accrescent, the three outer ones being 4.5 cm. long, and 8 to 10 mm. wide, obtuse, the two inner ones about 2 cm. long or less, and 3 mm. wide.

A tree growing in the hill forests, at from 100 to 800 m. above the sea, reaching a height of 50 m. and a diameter of 1 m. more or less. It is especially common in the forests of the Province of Bataan and is universally known to the Tagalogs of that Province as *Tanguili*, and on account of its great size is much prized by them for making canoes; facts also noted by Blanco, in the original description of the species.

*Shorea polysperma* belongs in the section *Pinanga*, and is represented by the following specimens, all from the Lamao River region, Mount Mariveles, Province of Bataan, Luzon: No. 606 (Forestry Bureau), collected by Barnes, April, 1904; Nos. 734, 784, and 819 (Forestry Bureau), collected by Borden, May, 1904 (flower); No. 1410 (Forestry Bureau), collected by Borden, July, 1904 (fruit); No. 132 (Whitford), May, 1904 (flower).

Blanco's material, on which this species was based was in part from Balanga, Province of Bataan, and his description applies to the above specimens except in one or two particulars. The petioles are not particularly short, as described by Blanco, nor is the fruit more than one-seeded, it being described by Blanco as follows, "Baya? con dos? aposentos, y en cada uno algunos semillas," it being evident that either Blanco had mutilated or very imperfect fruits, or that he was not sure that his fruits were really from this tree. Inasmuch as the fruit of *Shorea polysperma* is one-seeded, and not with several seeds as described by Blanco, his specific name does not well apply to the species.

***Dipterocarpus lasiopodus*** Perkins, Frag. Fl. Philip. 22. 1904.

The fruit of this species is figured by Vidal, Sinopsis, Atlas, t. 14. f. D., under the name *Dipterocarpus pilosus* Roxb., this figure being mentioned by Brandis<sup>1</sup> sub. *Dipterocarpus affinis*, accordingly the following synonym should be added. *Dipterocarpus pilosus*, F.-Vill. Nov. App. 20. 1880; Vidal, Sinopsis, Atlas, t. 14. f. D. 1883, non Roxb.

***Hopea acuminata*** sp. nov. § *Petalandra*.

A tree reaching a height of 40 m., with broadly lanceolate, narrowly acuminate, glabrous leaves, 8 cm. long or less, and small flowers in unilateral racemes, which are arranged in terminal and axillary panicles. Branches nearly black when dry, glabrous, striate. Leaves 4 to 8 cm. long, 2 to 3 cm. wide, submembranous, shining above, the base inequilateral, rounded

<sup>1</sup> Journ. Linn. Soc. Bot. 31: 32. 1895.

at least on one side of the lamina, the apex long slender acuminate; nerves 8 to 10 pairs, rather prominent beneath; petioles 5 to 8 mm. long, rugose, glabrous. Inflorescence grayish stellate pubescent, the panicles 5 to 6 cm. long or less, the spicate branches 1.5 cm. long or less. Calyx rusty-pubescent, the sepals 5, imbricate, the outer two slightly larger than the inner. Petals slightly pubescent on the outside, falcate, 4 mm. long, 1.8 mm. wide, obtuse. Stamens 10; filaments thick; anthers 0.4 mm. long, the single appendage slender, equaling the anther in length. Ovary glabrous, 3-celled, each cell 2-ovuled; style short; stylopodium 0. Fruit glabrous, the two wings oblong, about 2 cm. long, 5 mm. wide, the apex rounded.

Specimens examined all from Lamao River, Mount Mariveles, Province of Bataan, Luzon: No. 786 (Forestry Bureau), collected by Borden, May, 1904 (flower); No. 335 (Whitford), May, 1904 (flower); No. 3864 (Merrill), and No. 1592 (Forestry Bureau), Borden, August, 1904 (fruit); Nos. 825, 1175, and 1245 (Forestry Bureau), Borden, May-June, 1904 (sterile).

A tall tree, with a slender, straight trunk, growing in the hill forests from an altitude of 100 to about 800 m. above the sea. T., *Dalindingan*.

## THYMELEACEÆ.

*Wikstroemia lanceolata*, sp. nov. § *Euwikstroemia*.

An undershrub, 1 m. high or less, with glabrous or nearly glabrous, membranous, lanceolate leaves, the branchlets and flowers pubescent. Branches slender, dark brown, glabrous, the branchlets rather densely grayish-pubescent. Leaves 3 to 5 cm. long, 8 to 15 mm. wide, often with very few scattered hairs beneath, becoming entirely glabrous, gradually narrowed above to the slightly acuminate apex, the base obtuse; nerves not prominent; petioles pubescent, 1 to 2 mm. long. Flowers in terminal, subsessile, 3 to 5 flowered fascicles, green or yellowish-green. Perianth tubular, 6.5 to 7 mm. long, appressed-pubescent outside throughout; lobes 4, 1 mm. long, rounded. Anthers yellow, 0.7 mm. long. Ovary ovoid, glabrous, except the slightly pubescent apex, 1-celled, 1-ovuled; style very short; stigma yellow, subglobose. Fruit ovoid, bright red, 8 mm. long, glabrous, except the slightly pubescent apex, the pericarp fleshy; seed 6 mm. long, shaped like the fruit, but slightly acuminate.

Type specimen No. 3931 Merrill, Mount Arayat, Province of Pampanga, Luzon, October 23, 1904. A branched, slender undershrub, common on forested slopes at an elevation of from 600 to 750 m. above the sea.

## MELASTOMATACEÆ.

*Astronia glauca*, sp. nov.

A shrub 2 to 4 m. high, with elliptical-lanceolate, glabrous, acuminate, 3 to 5 nerved leaves, which are glaucous beneath, and terminal panicles shorter than the leaves. The flowers 5-merous. Branches light gray, glabrous, striate. Leaves subcoriaceous, 10 to 15 cm. long, 3 to 5.5 cm.



wide, widest in the middle, the apex short acuminate, the base cuneate, the upper surface shining, the lower surface pale, the two outer nerves faint, the other three prominent. Petioles 2 to 4 cm. long. Panicles 6 to 12 cm. long, the axis and branches grayish or brown lepidote pubescent, the lower branches 3 to 8 cm. long. Calyx tube 3 mm. long, 2 mm. in diameter, brown or grayish lepidote, with five very short, broad, obscure teeth. Petals 5, broadly ovate, suborbicular, or subreniform, 2 mm. long. The anthers subglobose, 1.2 mm. long. Ovary 2-celled; style 3.5 mm. long; stigma capitate.

Type specimen No. 6294 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, May, 1904; also apparently No. 6055 (Elmer), same locality, March, 1904. A small shrub in thickets, with smooth grayish-white or dull yellow bark and soft, brittle wood, apparently most closely related to *Astronia rolfei* Vidal.

***Creochiton rosea*, sp. nov.**

A scandent shrub, the young branches densely furfuraceous tomentose, the leaves more or less furfuraceous tomentose on the nerves beneath, the inflorescence axillary, cymose. Branches reddish-brown, the older ones glabrous. Leaves opposite, submembranous, elliptical ovate, acute or obscurely acuminate, the base rounded, 7 to 11 cm. long, 3.5 to 5 cm. wide, the upper surface glabrous, the lower surface pale; nerves 5, the transverse reticulations quite prominent beneath; petioles 1.5 to 2 cm. long. Cymes axillary, 4 to 5 cm. long, deciduously furfuraceous tomentose, becoming glabrous, each about 3-flowered, the peduncle 2 cm. long, the pedicels 1.5 to 2 cm. long. Flowers pale pink, the inclosing bracts deciduous, membranous, slightly furfuraceous, obovate, obtuse, 10 to 15 mm. long, 7 to 10 mm. wide. Calyx furfuraceous, globose urceolate, 5 mm. long, truncate, furfuraceous. Petals 4, broadly ovate, firm, obtuse, 6 mm. long or more. Stamens 8; filaments about 5 mm; anthers about 6 mm. long, the conical appendage at the base of the anther about 1.5 mm. long. Fruit globose, about 8 mm. in diameter; seeds less than 1 mm. long.

Type specimen No. 1297 (Copeland), Todaya, District of Davao, Mindanao, April, 1904. A scandent shrub growing in forests at an altitude of about 1,200 m. above the sea. The genus has previously been known only from Java, where it is represented by two species.

***Melastoma parvifolia*, sp. nov.**

A lax spreading shrub, about 3 m. high, with elliptical lanceolate, more or less strigose, 5-nerved leaves, 5 cm. long or less, the flowers in terminal fascicles of about 5, the young flowers subtended by lanceolate bracts, the lobes of the calyx with minute alternating teeth, the lobes exceeding the calyx tube. Branches grayish-brown, rough, the branchlets slender, densely covered with imbricated, brownish scales, which are 0.8 mm. long or less, and more or less lacerate. Leaves 2.5 to 5 cm. long, 0.8 to 1.5 cm. wide, the apex acute, mucronate, the base acute, both surfaces with scattered, strigose hairs, the nerves on under surface with appressed scales, the two marginal nerves much less distinct than the other three; petioles scaly, 5 mm. long. Flowers crowded in fascicles of about 5 at the ends of the



branches. Calyx densely clothed with pale, lanceolate, acuminate, imbricated, more or less toothed scales, 1 to 2 mm. long, the tube 6 to 7 mm. long, the calyx teeth 10 mm. long, 3.5 mm. wide, lanceolate, acuminate, the alternating, narrowly lanceolate, long acuminate appendages similar to the scales, 3 mm. long. Petals pink, narrowly obovate, obtuse, 2 cm. long, 12 to 14 mm. wide, their margins ciliate. Longer stamens 2 cm., the connective 6 mm; the anthers 7 mm.

Type specimen No. 5836 (A. D. E. Elmer), Baguio, Benguet, Province of Luzon, March, 1904. A shrub with smooth bark, in thickets along streams.

*Key to the Philippine species of Medinilla.*

1. Whole plant glabrous or nearly so.
  2. Panicles or cymes axillary.
    3. Leaves verticillate.
      4. Flowers 4-merous ..... (1) *M. pendula*
      4. Flowers 5-merous.
        5. Cymes fascicled; petals 12 mm. long ..... (2) *M. verticillata*
        5. Cymes solitary; petals 15 mm. long ..... (3) *M. mindanaensis*
    3. Leaves opposite.
      4. Flowers 5-merous ..... (4) *M. coriacea*
      4. Flowers 4-merous.
        5. Inflorescence elongate, paniced ..... (5) *M. multiflora*
        5. Inflorescence fasciculate or cymose.
          6. Flowers fascicled ..... (6) *M. ramiflora*
          6. Flowers cymose ..... (7) *M. myrtiformis*
  2. Panicles or cymes terminal.
    3. Leaves verticillate.
      4. Inflorescence cymose, 5 cm. long or less .... (8) *M. megacalyx*
      4. Inflorescence paniculate, 12 to 25 cm. long.
        5. Flowers 5-merous ..... (9) *M. elmeri*
        5. Flowers 4-merous ..... (10) *M. cumingii*
    3. Leaves opposite.
      4. Flowers 4-merous ..... (11) *M. amplifolia*
      4. Flowers 5-merous.
        5. Leaves 9 to 13 nerved ..... (12) *M. magnifica*
        5. Leaves 7-nerved ..... (13) *M. astronioides*
        5. Leaves 5-nerved ..... (14) *M. intermedia*
        5. Leaves 3-nerved ..... (15) *M. whitfordi*
1. Young branches, leaves, and inflorescence more or less tomentose or stellate-tomentose.
  2. Leaves 3-nerved ..... (16) *M. cordata*
  2. Leaves 5 to 9 nerved.
    3. Leaves opposite.
      4. Floral bracts small or wanting.
        5. Petioles 1 to 2 cm. long ..... (17) *M. venosa*
        5. Leaves sessile or subsessile ..... (18) *M. laguna*
      4. Floral bracts large, persistent.
        5. Leaves 7 to 11 cm. long, membranous; calyx 4 mm. long ..... (19) *M. bracteata*
        5. Leaves 5 to 8 cm. long, subcoriaceous; calyx 3 mm. long ..... (20) *M. luzonensis*
    3. Leaves whorled ..... (21) *M. ternifolia*

(1) *Medinilla pendula*, sp. nov.

A subscandent shrub, with elliptical lanceolate, narrowly elliptical, or oblanceolate elliptical, acute, glabrous, 5-nerved, whorled leaves, the inflorescence in long peduncle axillary and terminal panicles. Branches light gray, slender, glabrous, shining. Leaves in whorls of three or four, 6 to 12 cm. long, 2 to 5 cm. wide, the base acute; petioles 1 to 2 cm. long. Panicles pendulous, 12 to 14 cm. long, ebracteolate, the peduncles, axis, and branches bright red, the peduncle slender, 6 to 9 cm. long, the branches whorled, spreading or ascending, 2 cm. long or less, the branchlets and pedicels more or less brown pubescent. Calyx truncate, 3 mm. long, about 3 mm. thick. Petals 4, pink, strongly inequilateral, orbicular, or broadly ovate, 5 to 6 mm. long. Stamens 8, the filaments deep red, the anthers 3 mm. long, the spur slightly exceeding 1 mm. in length.

Type specimen No. 6037 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904.

(2) *Medinilla verticillata*, sp. nov.

A scandent shrub about 6 m. high, with elliptical ovate, short acuminate, glabrous, verticillate, 5 to 7 nerved leaves, and axillary, fascicled, few-flowered cymes, 2.5 cm. long or less. Branches light gray, glabrous, shining. Leaves in whorls of three or four, subcoriaceous, 10 to 12 cm. long, 5 to 6.5 cm. wide, the apex abruptly short sharp acuminate, the base acute, the two outer nerves often obscure; petioles 2 cm. long. Cymes in fascicles of from 3 to 5 from the branches, the peduncles, branches, pedicels, and calyx, red, glabrous, the peduncle 1.5 cm. long or less, the pedicels 3 mm. long, the bracts 5 mm. long. Calyx 5 to 7 mm. long, 5 mm. in diameter, truncate, entire. Petals 5, rarely 4, pink, 12 mm. long, 8 mm. wide, inequilaterally ovate, or ovate-oblong, truncate. Stamens 10, five 15 mm. long, the anthers 10 mm. long, and five 22 mm. long, the anthers 12 mm. long.

Type specimen No. 6080 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904. A scandent shrub, the stem about 2 cm. in diameter.

(3) *Medinilla mindanaensis*, sp. nov.

A glabrous, scandent shrub, with elliptical ovate, membranous, 5-nerved, whorled leaves, and axillary, cymose inflorescence, the cymes about 3 cm. long, the flowers 5-merous. Branches slender, terete, light gray, glabrous, often freely rooting along the side appressed to the supporting trees. Leaves in whorls of fours or threes, 8 to 18 cm. long, 3 to 9 cm. wide, the apex abruptly short acuminate, or sometimes deformed and retuse, the base acute; petioles 0.5 to 1.5 cm. long. Cymes few-flowered, the peduncles and pedicels about 1 cm. long, the bracts minute. Calyx urceolate-campanulate, 7 mm. long, truncate. Petals 5, pink, obovate-oblong, 15 mm. long, 9 mm. wide, the apex truncate, somewhat inequilateral. Stamens 10, subequal, the anthers 10 to 12 mm. long, the spur 1.5 to 2 mm. long.

Type specimen No. 439 (Copeland), Davao, District of Mindanao, March, 1904. A vine climbing along the trunks of trees, attached by adventitious roots, thought by the collector to be myrmecophilous.

(4) *Medinilla coriacea*, sp. nov.

An epiphytic shrub, with elliptical, ovate, glabrous, petioled, opposite 5-nerved leaves, and axillary, ebracteolate, cymose inflorescence. Branches light gray, glabrous, terete. Leaves coriaceous, 6 to 9 cm. long, 3.5 to 5.5 cm. wide, the apex blunt short acuminate, the base acute; petioles 1 to 1.5 cm. long. Cymes about 2 cm. long, few-flowered, often 2 or more from the same axil, the peduncle 1 cm. long, the pedicels about 8 mm. long. Calyx urceolate, truncate, 6 mm. long. Petals 5, obliquely obovate, tapering to the base, 13 mm. long, 8 mm. wide, obtuse. Stamens 10; filaments 11 mm. long; anthers 11 to 12 mm. long, the spur and the appendages about 1 mm. long.

Type specimen No. 228 (Whitford), Mount Mariveles, Province of Bataan, Luzon, May, 1904. An epiphyte, growing at an altitude of about 1,000 m. above the sea, the leaves fleshy when fresh.

(5) *Medinilla multiflora*, sp. nov.

A glabrous, erect or subscandent shrub, 3 to 4 m. high, with opposite, 3 to 5 nerved, subcoriaceous leaves, and axillary, elongated, many-flowered panicles, about 35 cm. long, the flowers 4-merous. Branches thickened, slightly 4-angular, light gray, glabrous, densely setose at the nodes. Leaves elliptical oblong, subsessile, acute or blunt, the base tapering to the flattened, nearly obsolete petiole. Panicles drooping, pink, succulent, the branches whorled, the lower ones 6 to 8 cm. long, the upper gradually shorter; bracts lanceolate or linear-lanceolate, 5 to 6 mm. long. Flowers pale pink. Calyx 3 mm. long, truncate. Petals 4, about 5 mm. long. Stamens 8; filaments about 3 mm. long; anthers 3 mm. long, the spur very short. Fruit globose, black-purple, about 6 mm. in diameter.

Type specimen collected by Merrill, Mount Arayat, Province of Pangasinan, Luzon, May 15, 1904, without number (flower); also No. 3915 (Merrill), same locality, October, 1904 (fruit). Observed only at the summit of the mountain at an altitude of 870 m.

(6) *Medinilla ramiflora*, sp. nov.

A glabrous, erect shrub or undershrub, with ovate or ovate-lanceolate, acuminate, sessile or subsessile, 3-nerved, opposite leaves, the flowers in axillary fascicles on the branchlets or on the larger branchlets below the leaves. Branches grayish-brown, striate, the ultimate branchlets glabrous brownish-red, terete. Leaves 4 to 7 cm. long, 1.5 to 3 cm. wide, subcoriaceous, the apex long slender acuminate, the acumen blunt or retuse, the base somewhat rounded, minutely cordate, the three nerves prominent beneath, often also two very obscure submarginal nerves; petioles 1 mm. or wanting. Flowers pedicelled or nearly sessile, fasciculate on protuberances from the branches, 3 to 8 flowers in a fascicle, the pedicels in fruit 5 mm. long or less. Calyx red, 3 mm. long, the 4 teeth acute, about 1 mm. long. Petals four, pink, ovate-lanceolate, acute or somewhat acuminate, 6 mm. long, 2.5 mm. wide. Stamens 8, subequal, filaments 3 mm. long; anthers 3 mm. long, acuminate. Style filiform, 7 mm. long. Fruit ovoid, 5 mm. in diameter, bright red; seeds less than 1 mm. long.

Type specimen: No. 148 (Whitford), Mount Mariveles, Province of Bataan, Luzon, May, 1904 (flower); from the same locality, No. 3222 (Merrill), October, 1903 (fruit); No. 1590 (Forestry Bureau), collected by Borden, August, 1904 (fruit), and No. 267 (Copeland), January, 1904 (fruit); Mount Santo Tomas, Province of Benguet, Luzon, No. 6546 (Elmer), June, 1904 (fruit); Mount Banahao, Province of Tayabas, No. 935 (Whitford), September, 1904; Mount Apo, District of Davao, Mindanao, No. 1027 (Copeland), April, 1904 (flower).

A undershrub or shrub, 1 to 2 m. high, very common on exposed forested ridges on Mount Mariveles, from an altitude of about 900 m. to the summit of the mountain. Apparently related to *Medinilla myrtiformis* Triana, but differing in its fasciculate, not cymose, inflorescence.

- (7) ***Medinilla myrtiformis*** Triana, Cogn. in DC. Monog. Phan 7:583. 1891. Luzon, Cuming No. 753, not seen; Mindanao, Mount Apo, Copeland, No. 1028. Amboinia.

- (8) ***Medinilla megacalyx***, sp. nov.

A scandent shrub, with coriaceous, glabrous, whorled, obovate or elliptical-ovate, 3-nerved, petioled leaves, and short, terminal few-flowered cymes, the flowers 5-merous, the calyx 1 cm. long. Branches light gray, glabrous, terete, the ultimate branchlets dark brown, glabrous. Leaves in whorls of fours or threes, 5 to 9 cm. long, 2 to 4 cm. wide, the apex abruptly acuminate, the base cuneate; petioles 1 to 1.5 cm. long. Cymes terminal, about 5 cm. long, few-flowered, the peduncles 2.5 to 3 cm. long, the pedicels stout, 2 to 3 mm. long. Calyx yellowish-brown and minutely rugose when dry, about 7 mm. in diameter, urceolate, truncate. Petals 5, obliquely oblong, obtuse, 2 cm. long, 1 cm. wide. Stamens 10, the filaments about 8 mm. long, the anthers 13 mm. long.

Type specimen No. 1514 (Forestry Bureau), Ahern's collector, Mount Mariveles, Province of Bataan, Luzon, July-August, 1904.

- (9) ***Medinilla elmeri***, sp. nov.

A much-branched, subscent shrub, about 3 m. high, with glabrous, whorled, elliptical lanceolate, 5-nerved, petioled leaves and terminal, elongated panicles. Branches light gray, glabrous. Leaves in whorls of three or four, 7 to 11 cm. long, 2.5 to 3.5 cm. wide, the apex acute or acuminate, the base acute; petioles about 1 cm. long. Panicles pendulous, 12 to 25 cm. long, the peduncle often 10 cm. long, the branches whorled, spreading or ascending, 2.5 cm. long or less, the bracts lanceolate, 4.5 mm. long. Calyx truncate, 3 mm. long, 2.5 mm. wide. Petals 5, irregularly obovate, 7 mm. long, 5 to 6 mm. wide, pink. Stamens 10, 6 to 7 mm. long, the filaments deep pink, 3.5 mm. long, the anthers azure blue, 3 to 3.5 mm. long. Style 6 mm. long. Fruit globose, 6 to 7 mm. in diameter, black. Seeds many, narrowly ovoid, 1 to 1.2 mm. long.

Type specimen No. 5848 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, March, 1904.

A much-branched shrub along water courses.

- (10) ***Medinilla cumingii*** Naud., Cogn. l. c., 592, Luzon, Cuming, No. 836, not seen.

(11) ***Medinilla amplifolia***, sp. nov.

A clambering shrub, about 3 m. high, with glabrous, coriaceous, 5 to 7 nerved, elliptical ovate, or broadly elliptical, shortly and abruptly acuminate leaves, about 22 cm. long and 11 to 18 cm. wide, the flowers 4-merous. Branchlets thickened, light gray, glabrous, 4-angled, the angles narrowly winged. Leaves opposite, the base somewhat cordate, the marginal nerves obscure, the other five prominent. Panicles terminal, about 20 cm. long, the axis and branches red, glabrous, branches few, opposite or whorled, the longer ones 10 cm. long, the bracts about 1 cm. long, ovate-acuminate. Calyx blue, truncate, 5 to 6 mm. long, about 3 to 4 mm. in diameter. Corolla pink, the petals 4, obovate-oblong, obtuse, inequilateral, narrowed below, 14 mm. long, 6 to 8 mm. wide. Stamens 8; filaments 8 mm. long, the anthers about 10 mm. long.

Type specimen No. 6112 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904. A clambering shrub in ravines, etc.

(12) ***Medinilla magnifica*** Lindl., Cogn. l. c., 593. Baco River, Mindoro, No. 4046 (Merrill), March, 1905.(13) ***Medinilla astronioides*** Triana, Cogn. l. c., 594. Philippines, Cum-ing, No. 758, not seen. Luzon, Mount Mariveles, Province of Bataan, No. 3895, Merrill, August, 1904.(14) ***Medinilla intermedia*** Blume, Cogn. l. c., 597.

A species apparently represented by No. 3965 (Merrill): No. 2405 (Meyer) and No. 125 (Whitford), all from Mount Mariveles, Province of Bataan, Luzon, flowering January to May. Java.

(15) ***Medinilla whitfordi***, sp. nov.

An erect, glabrous shrub, 3 to 5 m. high, with opposite, 3-nerved, coriaceous leaves and terminal, single, or at most, 3-flowered inflorescence and 5-merous flowers. Branches slender, glabrous. Leaves opposite, 4 to 6 cm. long, 1.5 to 2 cm. wide, elliptical oblong, tapering to the acute base, the apex short acuminate; petiole flattened, 2 mm. long or less. Cymes terminal, very short. Calyx glabrous, truncate, 8 to 10 mm. long, 5 to 6 mm. thick. Petals 2.5 cm. long, about 1.2 cm. wide, obtuse, inequilaterally oblong, obovate. Stamens 10, equal; filaments 10 mm. long or slightly less; anthers 6 mm. long. Style about 18 mm. long. Fruit unknown.

Type specimen No. 961 (H. N. Whitford), Mount Banahao, Province of Tayabas, Luzon, September 19, 1904. A species evidently closely related to *Medinilla megacalyx*, differing in its opposite leaves, growing only at and near the summit of one of the peaks, at an elevation of about 1,700 m., forming dense thickets with *Homalanthus populneus* and two species of *Rhododendron*.

(16) ***Medinilla cordata***, sp. nov.

A spreading or subscandent shrub, 2 to 3 m. high, with elliptical, ovate, opposite, subcoriaceous, 3-nerved, more or less pilose leaves, which are cordate or rounded at the base, abruptly short acuminate, and terminal, erect panicles 5 to 6 cm. long. Branches light gray, shining, glabrous, the branchlets more or less densely pilose. Leaves 4 to 8 cm. long, 2 to 4 cm. wide, when young densely pilose, becoming nearly glabrous; basal nerves three. Panicles more or less pilose, the axis and branches slender, the



latter verticillate, 1 to 2 cm. long, the bracts persistent, ovate, lanceolate, acute or acuminate, 8 to 10 mm. long, the bracteoles smaller. Calyx 4 mm. long, truncate. Petals 4, pink, inequilaterally broadly obovate, obtuse, 6 to 7 mm. long, 5 to 6 mm. wide. Stamens 8, the filaments 3 mm., the anthers 2 mm.; style slender, 7 mm. long.

Type specimen No. 5805 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, March, 1904; also No. 937 (Forestry Bureau), collected by Barnes, same locality, May, 1904.

The structure of the hairs in this species is very peculiar; none of them exceed 1 mm. in length, being thickened and subplumose.

(17) *Medinilla venosa* Blume, Cogn., 1. c., 600. Luzon (Cuming), not seen. Moluccas and Ternate.

(18) *Medinilla lagunæ* Vidal, Cogn. 1. c., 600. Baguio, Province of Benguet, Luzon, No. 6291 (Elmer), May, 1904.

(19) *Medinilla bracteata* Blume, Cogn., 1. c., 601.

This species is represented by No. 4035 Merrill, Baco River, Mindoro, March, 1905, and No. 1487 Cuming, Philippines, in Herb. Govt. Lab. Cogniaux describes the species as having axillary racemes, but both numbers cited above have terminal racemes. New Guinea.

(20) *Medinilla luzonensis* Hook f. Cogn. 1. c., 602. Luzon, Lobb, not seen.

(21) *Medinilla ternifolia* Triana, Cogn. 1. c., 602. Luzon, Jager, not seen.

## CLETHRACEÆ.

### *Clethra luzonica*, sp. nov.

A shrub with elliptical ovate or somewhat obovate acute subcoriaceous leaves, the young branches, under surface of the leaves, panicles, and calyx densely ferruginous stellate pubescent. Branches grayish brown, striate, glabrous except the ultimate branchlets. Leaves 2.5 to 6 cm. long, 1.5 to 3 cm. wide, the base rounded, the margins above slightly serrate, the upper surface with scattered stellate hairs, sometimes nearly glabrous; nerves 10 to 12 on each side of the midrib, prominent beneath and especially densely stellate pubescent; petioles stout 5 mm. long. Inflorescence a terminal panicle, 6 to 8 cm. long, the branches racemose, spreading, the lower ones 5 to 6 cm. long. Calyx, in fruit, 3 mm. long, the lobes lanceolate or ovate, acute. Petals slightly united at the base, 3.5 mm. long, 1.8 mm. wide, obtuse, glabrous. Stamens 10, not exerted, the filaments flattened at the base, 2.8 mm. long, the anthers 0.5 mm. long. Capsule globose, densely pubescent, 3 mm. in diameter, the persistent style glabrous, 2 mm. long.

Type specimen No. 5810 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, March, 1904. A small stunted shrub growing on the exposed summit of the mountain at an altitude of about 2,500 m. above the sea; in fruit, March, 1904, but with few subpersistent corollas. A species apparently most closely related to *Clethra lancifolia* Turez., but differing from that species in its smaller, differently shaped leaves, and its peculiar stellate pubescence.



## ERICACEÆ.

*Vaccinium apoanum*, sp. nov.

A tree reaching a height of 10 m. with elliptical-oblong, sharply acuminate leaves, the flowers in axillary bracteate fascicles of from 3 to 6 in a fascicle. Branches reddish brown, glabrous. Leaves 7 to 11 cm. long, 3.5 to 6 cm. wide, glabrous, coriaceous, the base acute, 5 to 7 nerved from near the base, the outer pair of nerves obscure, the inner ones very prominent, especially beneath, sharply ascending; petioles 1 cm. long. Fascicles axillary, the peduncles glabrous, 1 cm. long, the bracts imbricate, ovate, rusty pubescent on the outside. Calyx cylindrical, 4 mm. long, 3 mm. in diameter, truncate, glabrous, the teeth small. Corolla 13 mm. long, pubescent, tubular-campanulate, the lobes about 3 mm. long, rounded, reflexed. Stamens 10, the filaments thick, 2.5 mm. long, the anthers 3 to 4 mm. long. Fruit unknown.

Type specimen No. 1103 (Copeland), Mount Apo, District of Davao, Mindanao, April, 1904. A tree reaching a height of 10 m. and a diameter of 30 cm., the wood white. The vegetative characters are very similar to those of *Vaccinium barandatum* Vidal.

## THE PHILIPPINE SPECIES OF RHODODENDRON.

The genus *Rhododendron* in the Philippines is apparently confined entirely to the higher mountains, and accordingly the early botanical collectors in the Archipelago failed to secure specimens of this interesting genus, although Cuming, between the years 1836 and 1840, collected a single species of the genus, probably on Mount Banahao, Province of Tayabas, Luzon, the species not being described, however, until the year 1886.

The first Philippine *Rhododendrons* described were the two species *R. kochii* and *R. apoanum* by Stein in *Gartenflora*, 1885, although the latter had previously been figured by Vidal. In 1883 Vidal figured two species of *Rhododendron* in his *Sinopsis*, but without specific names, and in the same year Fernandez-Villar, in his *Novissima Appendix to the Flora de Filipinas*, erroneously credited to the Philippines three species of the genus, *Rhododendron javanicum* Blume, *R. retusum* R. Br., and *R. jasminiflorum* Hook. f., these three species erroneously identified by F. Villar undoubtedly being referable to the species indicated in the following consideration. In 1886 Vidal enumerated six species of Philippine *Rhododendron* in his *Revision de Plantas Vasculares Filipinas*, of which three, *R. quadrasianum*, *R. verticillatum*, and *R. rosmarinifolium*, were described as new. In the same year Rolfe, finding the specific name *verticillatum* preoccupied, proposed the new name, *Rhododendron vidalii* for Vidal's *Rhododendron verticillatum*. In 1896 Rendle, in the *Journal of Botany*, described three species of Philippine *Rhododendron* from Whitehead's collections, *R. subscissile*, *R. lussoniense*, and *R. whiteheadii*, and credited to the Philippines a fourth species, previously known only from Borneo. In 1905 Warburg described a single species, *R. schadenbergii*, from northern Luzon. In the following consideration fourteen species are enumerated

from the Philippines, of which four are proposed as new. Of these fourteen species, so far as is known to-day, thirteen are endemic to the Philippines, a single species, *Rhododendron cuneifolium*, being known from outside the Archipelago, this species having originally been described from specimens collected on Mount Kinabalu, British North Borneo.

*Artificial key to the Philippine species of Rhododendron.*

1. Leaves acute or acuminate.
  2. Leaves and branches setose ..... (1) *R. subsessile*
  2. Leaves and branches glabrous, or at least only lepidote.
    3. Flowers 3 cm. long or less.
      4. Flowers 1.5 to 2 cm. long, red; leaves 6 cm. long. An erect shrub..... (10) *R. apoanum*
      4. Flowers 3 cm. long, white or pink; leaves 4.5 to 5.5 cm. long. An erect shrub..... (8) *R. lussoniense*
      4. Flowers 3 cm. long, yellow; leaves 8 to 10 cm. long. An epiphytic shrub.. (4) *R. xanthopetalum*
    3. Flowers 4 to 6 cm. long.
      4. Flowers 5 to 6 cm. long, red..... (6) *R. spectabile*
      4. Flowers 4 to 4.5 cm. long, white.
        5. Leaves acute or only slightly acuminate, 8 to 11 cm. long..... (2) *R. schadenbergii*
        5. Leaves slender acuminate, 12 to 18 cm. long ..... (3) *R. kochii*
1. Leaves obtuse, rounded or emarginate.
  2. Flowers 3 to 4.5 cm. long, white.
    3. Flowers 3 cm. long; leaves 2.5 to 4.5 cm. long ..... (9) *R. vidalii*
    3. Flowers 4 cm. long, campanulate; leaves 6 to 8 cm. long..... (5) *R. mindanaense*
    3. Flowers 4.5 cm. long, tubular; leaves 4 to 6 cm. long..... (7) *R. copelandii*
  2. Flowers 1 to 2.5 cm. long, red.
    3. Flowers 2.5 cm. long; leaves 2.5 to 4.5 cm. long ..... (11) *R. whiteheadii*
    3. Flowers 1.5 cm. long or less.
      4. Leaves mostly 5 to 9 mm. wide; flowers 1.5 cm. long..... (12) *R. quadrasianum*
      4. Leaves mostly 2 to 4 mm. wide; flowers 1 cm. long.
        5. Pedicels densely lepidote ..... (14) *R. cuneifolium*
        5. Pedicels pubescent ..... (13) *R. rosmarinifolium*

(1) *Rhododendron subsessile* Rendle, Journ. Bot. 34:357. 1896.

A species related to *Rhododendron ledifolium* G. Don., represented by No. 5799 (Elmer), and No. 922 (Forestry Bureau) collected by Barnes, both numbers from Mount Santo Tomas, Province of Benguet, Luzon, March and May, 1904 (flower). A shrub reaching a height of 3 m., previously known only from the District of Lepanto, Luzon.

(2) *Rhododendron schadenbergii* Warb. in Perk. Frag. Fl. Philip. 172. 1905; *R. javanicum* Vidal, Synopsis, Atlas, t. 60, f. F. 1883; Rev. Pl. Vasc. Filip. 170. 1886; F. Vill. Nov. App. 353. 1883, non Blume.

This species recently described from specimens collected in the Province of Abra, Luzon, is apparently represented by the following specimens, all from the Island of Luzon: Province of Benguet, Baguio, No. 6519 (Elmer), June, 1904 (flower); Province of Bataan, Mount Mariveles, No. 3255 (Merrill), October, 1904 (flower); No. 450 (Whitford), July, 1904 (flower); No. 6856 (Elmer), November, 1904 (flower); Mount Banahao, Province of Tayabas, Luzon, No. 958 (Whitford), October, 1904 (flower). The species (in fruit), represented by Vidal's Synopsis, *t. 60, f. F.* 1883, and later identified by him as *Rhododendron javanicum*, was from Mount Banahao, and is probably referable to the form here considered to represent *Rhododendron schadenbergii*.

- (3) ***Rhododendron kochii*** Stein. Gartenflora, **34**:193. *t. 1195.* 1885:  
Vidal, Rev. Pl. Vasc. Filip. 172. 1886.

A species known to the author only from the original description and plate cited above, which, judging from the figure and description is closely related to *Rhododendron schadenbergii*.

- (4) ***Rhododendron xanthopetalum***, sp. nov.

A glabrous epiphytic shrub, 80 cm. high or less, with a stout, simple or but slightly branched stem, coriaceous, scattered, alternate, slightly acuminate or merely acute, oblong-elliptical leaves, the flowers yellow, 3 cm. long, 3 or 4 in a terminal fascicle. Stem 1 cm. in diameter below, the bark light gray, glabrous, the younger parts reddish brown. Leaves 9 to 12 cm. long, 3.5 to 5 cm. wide, the base acute, the upper surface glabrous, the lower surface somewhat paler, glandular-punctate, the margins revolute, the midrib very stout and prominent; petioles very stout, 1.5 cm. long. Peduncles glabrous, 1.5 cm. long. Calyx reduced to an obscure disk. Corolla 5-lobed, campanulate, 3 to 3.4 cm. long and about as wide, the tube 1.5 cm. long, 5 mm. in diameter below, the lobes 1.5 cm. long, rounded. Stamens 10, the filaments pubescent below, 18 mm. long, the anthers 4 mm. long. Ovary 8 mm. long, lepidote, 5-celled; style 12 mm. long, glabrous.

Type specimen No. 322 (Whitford), Mount Mariveles, Province of Bataan, Luzon, May, 1904. A small shrub growing on mossy tree trunks at an altitude of 1,200 m. Apparently rare, as only a single specimen was found.

- (5) ***Rhododendron mindanaense***, sp. nov.

A shrub about 1 m. high, with glabrous, coriaceous, oblong-obovate obtuse leaves, the white flowers 4 to 4.5 cm. long, crowded in fascicles at the apices of the branches. Branches reddish or somewhat grayish, the ultimate branchlets sparingly lepidote. Leaves crowded at the upper nodes and at the apices of the branchlets, 5 to 7 cm. long, 2 to 3.5 cm. wide, tapering below to the cuneate base, the apex obtuse, often slightly emarginate, beneath with few scattered, obscure glands; petioles about 1 cm. long, sparingly lepidote. Flowers many, the peduncles 2 cm. long, lepidote, the deciduous bracts 2 to 3 cm. long. Calyx reduced to an obscure disk. Corolla 4 to 4.5 cm. long, narrowly campanulate, the tube 2.5 cm. long, 5 mm. in diameter below, very slightly enlarged above, the

limb 3 to 3.5 cm. in diameter, 5-lobed, the lobes erect-spreading, obovate, obtuse, 2 cm. long. Stamens 10, the filaments pubescent below, glabrous above, 2.5 cm. long, the anthers 3 mm. long. Ovary densely velvety yellowish brown pubescent, 6 mm. long. Style pubescent below, glabrous above, 2 cm. long.

Type specimen No. 1042 (Copeland), Mount Apo, District of Davao, Mindanao, April, 1904; also No. 73 (DeVore and Hoover), same locality, May, 1903, erroneously localized as from the Island of Basilan. A shrub growing at the summit of the mountain at an altitude of 3,100 m. above the sea.

(6) *Rhododendron spectabile*, sp. nov.

A glabrous shrub about 1 m. high, with coriaceous, elliptical-ovate to elliptical-oblong, scattered, alternate, acuminate or merely acute leaves, and large, red odorless flowers, 5 to 5.5 cm. long, in terminal 3-flowered fascicles. Branches glabrous, the ultimate ones reddish brown. Leaves 7 to 9 cm. long, 3.5 to 4.5 cm. wide, glabrous above, glandular-punctate beneath, the base acute or somewhat rounded, the midrib very prominent; petioles very stout, 1 to 1.5 cm. long. Peduncles glabrous, 2.5 cm. long. Calyx reduced to an obscure disk. Corolla campanulate, the tube 2 cm. long, 6 mm. in diameter below, the limb spreading, 5 to 6 cm. in diameter, 5-lobed, the lobes 2.5 cm. long, elliptical-ovate, rounded. Stamens 10, the filaments sparingly pubescent below, 2.5 cm. long, the anthers 5 mm. long. Ovary glabrous, oblong, 8 mm. long; style glabrous, 2.5 cm. long.

Type specimen No. 1438 (Copeland), Mount Apo, District of Davao, Mindanao, October, 1904; also No. 369 (in part) (DeVore and Hoover), same locality, May, 1903. A shrub growing in ravines at an altitude of 2,500 m., apparently closely related to *Rhododendron javanicum* Blume.

(7) *Rhododendron copelandi*, sp. nov.

A glabrous shrub 1 to 2 m. high, with narrowly obovate to oblanceolate coriaceous, obtuse or slightly acute, verticillate leaves, and many flowered terminal fascicles of white, fragrant tubular flowers 4 cm. long. Branches reddish brown, glabrous, the branchlets verticillate. Leaves in whorls at the nodes and apices of the branchlets, 4 to 6 cm. long, 1 to 2 cm. wide, glandular-punctate beneath, the apex abruptly acute or rounded, the base cuneate, tapering gradually to the stout petiole which is 8 mm. long. Peduncles 18 mm. long, sparingly brown lepidote and minutely pubescent. Calyx a small crenate disk 2 mm. in diameter. Corolla tube, 4 cm. long, tubular, 4 mm. in diameter, not enlarged or inflated above, the limb abruptly spreading, 1.5 cm. in diameter, 5-lobed, the lobes obovate, obtuse, 5 to 6 mm. long. Stamens 10, the filaments filiform, glabrous, 4 cm. long, the anthers 1.5 mm. long. Ovary oblong, 5 to 6 mm. long, densely pubescent with short spreading hairs; style slightly pubescent throughout, 3.8 cm. long.

Type specimen No. 1439 (Copeland), Mount Apo, District of Davao, Mindanao, October, 1904; also from the same locality, all specimens in flower, No. 1034 (Copeland), April, 1904, and Nos. 292, 382 (DeVore and Hoover), May, 1903. A shrub 1 to 2 m. high, growing at an altitude of from 2,500 m. to the summit of the mountain, 3,100 m.

- (8) **Rhododendron lussoniense** Rendle, Journ. Bot. 34:356. 1896.

A species known only from the original collection by Whitehead, district of Lepanto, Luzon, the type at the British museum.

- (9) **Rhododendron vidalii** Rolfe, Journ. Bot. 24:348. 1886. (*R. verticillatum* Vidal, Rev. Pl. Vasc. Filip. 171. 1886, non Low.)

This species, previously known only from the district of Bontoe, Luzon, is represented by the following specimens, all from Mount Mariveles, Province of Bataan, Luzon: No. 2743 (Merrill), January, 1904 (fruit); No. 3868 (Merrill), August, 1904 (flower); No. 452 (Whitford), July, 1904 (flower); No. 1591 (Forestry Bureau), collected by Borden, August, 1904 (flower).

- (10) **Rhododendron apoanum** Stein, Gartenflora 34:194. pl. 1196. 1885: Vidal, Rev. Pl. Vasc. Filip. 172. 1886; *Rhododendron* sp. affine *R. retuso* Benn., Vidal, Sinopsis, Atlas, t. 53. f. E. 1883; *R. jasminiflorum* F.-Vill., Nov. App. 353. 1883, non Hook.

A characteristic endemic species known only from Mount Apo, District of Davao, Mindanao, represented by the following specimens: Nos. 293, 375 (DeVore and Hoover), May, 1903; No. 1045 (Copeland), April, and No. 1440 (Copeland), October, 1904. A shrub extending from an altitude of 2,500 m. to the summit of the mountain, 3,100 m.

- (11) **Rhododendron whiteheadii** Rendle, Journ. Bot. 34:356. 1896.

A species known only from the original collection by Whitehead, district of Lepanto, Luzon, the type at the British museum.

- (12) **Rhododendron quadrasianum** Vidal, Rev. Pl. Vasc. Filip. 170. 1886; *R. retusum* F.-Vill., Nov. App. 353. 1883, non R. Br.

This species, previously known only from Mount Manahao, Tayabas Province, Luzon, and Mayon Volcano, Albay Province, Luzon, is represented by the following specimens: Luzon, Province of Bataan, Mount Mariveles, No. 3215 (Merrill), October, 1903; No. 278 (Whitford), May, 1904; No. 6765 (Elmer), November, 1904; No. 2090 (Forestry Bureau), collected by Borden, Nov., 1904; Province of Tayabas, Mount Banahao, No. 872 (Forestry Bureau), collected by Klemme, June, 1904; No. 804 (Cunning), 1836-40, in Herb. Govt. Laboratory; Mindanao, District of Davao, Mount Apo, No. 287 (DeVore and Hoover), May, 1903; No. 1036 (Copeland), April, 1904—all specimens in flower, and some with mature fruit.

- (13) **Rhododendron rosmarinifolium** Vidal, Rev. Pl. Vasc. Filip. 172. 1886.

A characteristic species represented by Nos. 5798 and 6377 (Elmer), Province of Benguet, Luzon, the former from Mount Santo Tomas and the latter from Baguio, both specimens in flower. A species previously known only from the district of Bontoe, Luzon. Dr. O. Stapf has kindly compared specimens of No. 5798 Elmer with the type of the species at Kew.

- (14) **Rhododendron cuneifolium** Stapf, Trans. Linn. Soc. Bot. II. 4:198. pl. 15. f. B. 3. 1894.

This species was described from material collected on Mount Kinabalu, British North Borneo, and has been reported from the Philippines by



Rendle,<sup>1</sup> Mount Dulangan, Mindoro, collected by Whitehead. It is closely related to the preceding species, and is the only species of *Rhododendron* known from the Philippines that is also found outside of the Archipelago, all the other species enumerated above being endemic so far as is known at present.

## MYRSINACEÆ.

### *Embelia bataanensis*, sp. nov. § *Pattara*.

A scandent shrub 2 to 3 m. high, with glabrous, submembranous, elliptical-lanceolate leaves, short, axillary racemose inflorescence and 5-merous flowers. Branches brownish, striate, the branchlets more or less densely dark brown puberulous. Leaves 5 to 7 cm. long, 2 to 2.5 cm. wide, the base acute, the apex obscurely acuminate, the tip blunt, the margins entire or slightly suberenate above; nerves about 12 on each side of midrib, not prominent, freely anastomosing; petioles 5 mm. long, densely dark brown puberulous. Racemes axillary, puberulous, 2 cm. long or less, the pedicels slender, 3 mm. long, the bracteoles about 1 mm. long. Flowers pink, odorless, 2 mm. long. Calyx 5-cleft, the lobes narrowly ovate, obtuse, 0.8 mm. long, densely glandular, the margins minutely ciliate. Petals 5, free, oblong-obovate, 1.8 mm. long, with few glands above, the apex rounded. Stamens (male flowers) inserted near the base of the petals; filaments 1.7 mm. long; anthers 0.5 mm. long, the rudimentary ovary glabrous.

Type specimen No. 3207 (Merrill), Mount Mariveles, Province of Bataan, Luzon, October 21, 1903. Not common, on forested, exposed ridges at an altitude of about 1,000 m. above the sea.

## SAPOTACEÆ.

### *Sideroxylon coriaceum*, sp. nov.

A small tree with obovate, or oblanceolate, coriaceous, glabrous, obtuse, rarely subacute leaves 11 cm. long or less, the flowers in fascicles of from 6 to 23 in the axils of the leaves or in the axils of fallen leaves, the staminodes nearly obsolete. Branches brown, glabrous, striate, the ultimate branchlets minutely and obscurely pubescent. Leaves alternate, 9 to 11 cm. long, 3 to 4.5 cm. wide, the base cuneate, the apex usually rounded, rarely subacute, the upper surface smooth and shining, the lower surface pale, glabrous; nerves 8 to 12 on each side of the midrib, not prominent; petioles 1 to 1.5 cm. long, glabrous or nearly so. Flowers dull white, their pedicels rusty pubescent, 5 to 6 mm. long. Sepals broadly ovate, obtuse, 4 mm. long, 3 to 3.5 mm. wide, appressed rusty pubescent below. Corolla glabrous, the lobes ovate, obtuse, 4 mm. long, 3 mm. wide. Filaments 3 mm. long, the anthers 1.5 mm. long, 1 mm. thick. Staminodes very small, linear, less than 1 mm. long, or sometimes in part wanting. Ovary 5, or by abortion 4-celled, glabrous above, pubescent below.

Type specimen No. 6071 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904. A small tree in dry thickets, apparently belonging

<sup>1</sup> Journ. Bot. 34:355. 1896.



to the genus *Sideroxylon*, although the very small, or often aborted staminodes, and the pubescent base of the ovary are characters that tend toward the genus *Chrysophyllum*.

## SYMPLOCOCACEÆ.

### *Symplocos depauperata*, sp. nov.

A shrub about 3 m. high, with small, ovate, serrate leaves, and axillary simple, racemose inflorescence, 3 cm. long or less, and white flowers, the ovary pubescent. Branches dark reddish brown, more or less pubescent, becoming glabrous, the ultimate branchlets densely appressed ferruginous pubescent. Leaves subcoriaceous, 1.5 to 4 cm. long, 1.8 cm. wide or less, the base acute, the apex acuminate, margins finely serrate, or entire near the base, the upper surface glabrous except for the pubescent midrib, the lower surface with few scattered hairs, each hair from a small dark colored papilla, the midrib rather densely pubescent; nerves obscure, not more prominent than the reticulations; petioles densely pubescent, 2 to 3 mm. long. Racemes axillary, densely ferruginous pubescent, 10 to 15 flowered. Flowers white, 7 to 8 mm. in diameter, the bracts pubescent, broadly ovate, acute, slightly exceeding 1 mm. in length, the pedicels 1 to 2 mm. long, pubescent. Calyx tube 1.5 mm. long, glabrous or with very few scattered hairs, the lobes ovate, subobtuse, about 1.2 mm. long, the margins minutely ciliate, the median portion more or less pubescent, otherwise glabrous. Corolla lobes 4 mm. long, 2 to 2.5 mm. wide, elliptical-ovate, obtuse. Stamens many, the filaments glabrous, the longer ones 4 mm. long, very slightly united at the base; anthers 0.8 mm. in diameter. Ovary 3-celled, pubescent; style about 3 mm. long. Fruit glabrous, ovoid, 4 to 5 mm. long.

Type specimens: No. 5909 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March 4, 1904 (flower); No. 6508 (Elmer), same locality, June, 1904 (fruit); No. 10 (Topping), same locality, February, 1903 (immature fruit).

A small shrub growing in the open plain region along streams, evidently most closely related to *Symplocos luzoniensis* Rolfe, differing from that species in its smaller leaves, longer, more numerous flowered spikes, pubescent ovary, and nearly glabrous calyx.

## APOCINACEÆ.

*Choneomorpha macrophylla* G. Don. (*Tabernaemontana elliptica* Blanco, Fl. Filip. ed. 1, 115; ed. 2, 83.; ed. 3, 1:152; F. Vill. Nov. App. 132.)

This species has recently been collected in the Philippines, Bosoboso, Province of Rizal, Luzon, No. 1141 (Forestry Bureau), Ahern's collector, June, 1904; also No. 2704 (Merrill), the same locality, June, 1903, its previously definitely known range having been from the Himalayan region to Ceylon, Malayan Peninsula, Andaman Islands, and Java. Blanco's *Tabernaemontana elliptica* is certainly referable to this species, its identification with this genus having been suggested by Fernandez-Villar.

## GYNOPOGON Forst.

(Alyxia R. Br.)

In the second edition of his Flora de Filipinas, Blanco described four species of *Brabejum*, of which three, *Brabejum concatenatum*, *B. lucidum*, and *B. pinnatum*, are certainly referable to the genus *Gynopogon* (*Alyxia*), and were reduced by F.-Villar<sup>1</sup> respectively to *Alyxia laurina* Gaud., *A. stellata* R. et S., and *A. odorata* Wall., which reductions are certainly erroneous, none of these species extending to the Philippines. Of Blanco's species, one only, *Brabejum lucidum*, is at present definitely known, this certainly being a synonym of *Alyxia monilifera* Vidal. F.-Villar also enumerates *Alyxia torresiana* Gaud., a species of the Marianne Islands, as a Philippine plant, which is undoubtedly erroneous.

Key to the Philippine species of *Gynopogon*.

1. Leaves opposite, 7 to 10 cm. long..... *Brabejum pinnatum*
1. Leaves whorled.
  2. Leaves in whorls of threes, about 5 cm. long;  
calyx subtended by two bracts..... *Gynopogon monilifera*
  2. Leaves in whorls of fours or fives; calyx subtended  
by five or more bracts.
    3. Leaves 10 cm. long ..... *Brabejum concatenatum*
    3. Leaves 2.5 cm. long or less..... *Gynopogon parvifolia*

***Gynopogon monilifera*** (Vidal). (*Brabejum lucidum* Blanco, Fl. Filip. ed. 2, 40. 1845, ed. 3, 1:74, non *Alyxia lucida* Wall.; *Alyxia stellata* Vidal, Sinopsis, Atlas, t. 67, f. B. 1883; F.-Vill. Nov. App. 129, non R. et S.; *Alyxia monilifera* Vidal, Rev. Pl. Vasc. Filip. 183. 1885.)

This species is represented by No. 3857 (Merrill), Mount Mariveles, Province of Bataan, Luzon, August, 1904 (fruit); also No. 224 (Whitford), same locality, May, 1904 (flower). The type material of Blanco's *Brabejum lucidum* was from Cebu, while that of Vidal's *Alyxia monilifera* was from Mount Banahao, Province of Tayabas, Luzon, No. 461 (Vidal).

***Gynopogon parvifolia*, sp. nov.**

A scandent shrub with whorled, coriaceous leaves 2.5 cm. or less in length, and axillary solitary flowers about 12 mm. long. Branches yellowish gray, pustular, glabrous, the ultimate branchlets sharply angled. Leaves in whorls of from three to five, elliptical lanceolate, 1 to 2.5 cm. long, 0.5 to 10 mm. wide coriaceous, glabrous, the apex and base acute or subacute, the upper surface dark when dry, shining, the lower surface pale, the nerves nearly obsolete; petioles glabrous, 2 to 3 mm. long. Flowers white, solitary in the axils of the leaves, short pedicelled, subtended by a double whorl of ovate acute, pubescent bracts, 4 or 5 bracts in a whorl, and about one-half as long as the calyx. Calyx about 3.5 mm. long, deeply 5-lobed, the lobes ovate lanceolate, acute, pubescent. Corolla glabrous, about 10 mm. long, the tube cylindrical, about 8 mm. long, slightly enlarged above, the limb spreading, 5-lobed, the lobes ovate, acute, 4 mm. long. Stamens 5, inserted near the apex of the tube, the filaments about

<sup>1</sup> Nov. App. 129.

0.5 mm. long, the anthers ovate lanceolate, 1.5 mm. long, included. Ovary ovoid, pubescent, of 2 distinct carpels, the style filiform, glabrous, slightly thickened above, 4 mm. long. Disk wanting.

Type specimen No. 5800 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, March, 1904. A small, scandent shrub, fragrant when dry, growing at and near the summit of the mountain at an altitude of about 2,500 m. above the sea.

A fifth species of *Gynopogon* is represented by No. 614 (Merrill), Island of Culion, December, 1902, differing from the other Philippine species of the genus in its subglobose, not jointed, fruits. Flowers are necessary in order to accurately identify the species.

***Kopsia longiflora*, sp. nov.**

A tree about 9 m. high, with narrowly oblong, lanceolate to elliptical-lanceolate, glabrous leaves, and terminal cymes of elongated, white flowers. Branches brown, glabrous. Leaves opposite, 10 to 18 cm. long, 3 to 6 cm. wide, submembranous, shining, the base acute, the apex slightly blunt acuminate; nerves 16 to 18 on each side of the midrib, not prominent; petioles 5 to 10 mm. long. Cymes peduncled, the peduncle 1 to 3 cm. long; bracts ovate, blunt, or acute, about 2 mm. long, the margins ciliate. Flowers short pedicelled, bracteolate. Calyx segments ovate, blunt, about 2 mm. long, eglandular inside, but with glandular tips, glabrous. Corolla tube very slender, 2.5 cm. long, villous at the throat inside, the lobes spreading, 1.5 cm. long, 5 mm. wide, blunt. Stamens inserted near the top of the tube, included, the anthers less than 2 mm. long. Ovary of 2 distinct glabrous carpels united by the style, the disk of 2 alternating glands; style filiform; stigma cylindrical, 1 mm. long. Ripe carpels usually solitary, 2-seeded, narrowly ovoid, about 1.5 cm. long, 7 to 9 mm. thick, glabrous, blue when mature.

Type specimen No. 611 (Forestry Bureau), collected by Borden, Mount Mariveles, Province of Bataan, Luzon, April, 1904, (flowers and fruit); also from the same locality, No. 1448 (Forestry Bureau), Ahern's collector, August, 1904, (fruit); and No. 1802 (Forestry Bureau), collected by Ahern's collector, September, 1904 (fruit).

A tree reaching a height of 9 m. and a diameter of 10 to 12 cm., with light gray, scaly bark, growing in the hill forests at about 250 m. above the sea.

## VERBENACEÆ.

***Callicarpa longipetiolata*, sp. nov.**

A small tree 6 to 7 m. high, with elliptical lanceolate, acute or slightly acuminate, long petioled leaves 8 cm. long or less, the upper surface shining, nearly glabrous, the under surface very densely and uniformly pale ferruginous stellate-lepidote pubescent, the cymes 4 to 5 cm. long. Branches brownish gray, striate, lenticellate, becoming glabrous, the ultimate branchlets very densely pale ferruginous lepidote-stellate pubescent, as are the petioles and inflorescence. Leaves 4 to 8 cm. long, 1.5 to 2 cm. wide, the margins entire, the base acute, the upper surface dark when dry, with few scattered lepidote-stellate scales, especially on the midrib,

the lower surface pale, the areolæ between the reticulations very densely lepidote stellate, the glands entirely obscured; nerves prominent, beneath, 7 to 8 on each side of the midrib, curved, ascending, at first pale and densely lepidote-stellate, later dark colored and nearly glabrous; petioles 1.5 to 1.8 mm. long. Cymes in the axils of the upper leaves, their peduncles 2 cm. long, the bracteoles 3 to 5 mm. long. Flowers white. Calyx stellate-lepidote, 1.5 mm. long, the teeth short, acute. Corolla glabrous, 3.5 mm. long, the lobes 1 mm. long, rounded, the tips slightly lepidote on the outside. Stamens 4, the filaments 4 mm. long, the anthers about 1 mm. long. Style 6 mm. long. Fruit unknown.

Type specimen No. 6266 (A. D. E. Elmer), Mount Santo Tomas, Province of Benguet, Luzon, May, 1904. A tree growing in the forests with very hard yellowish wood and thick yellowish-white, irregularly checked bark.

***Premna oblongifolia*, sp. nov.**

A subscandent nearly glabrous shrub with glabrous, oblong, acute or slightly acuminate leaves 9 cm. long or less, the calyx regularly 4-toothed, the corolla regularly or slightly irregularly 4-lobed. Branches brownish, glabrous, the ultimate branchlets very sparingly puberulous. Leaves membranous, opposite, elliptical oblong, the base often slightly irregular, rounded, the margins entire, both surfaces glabrous, shining, 5 to 9 cm. long, 2.5 to 4 cm. wide; nerves prominent on both surfaces, dark brown, sharply ascending, 4 to 5 on each side of the midrib; petioles glabrous or nearly so, 1.5 to 2 cm. long. Corymbs 4 to 6 cm. in diameter, the axis and branches minutely ferruginous pubescent, the bracts lanceolate, nearly glabrous, 1 cm. long or less. Calyx 1.8 mm. long, glabrous or nearly so, 4-toothed, the teeth short, obtuse or subacute, their margins minutely ciliate. Corolla 4 mm. long, greenish white, the throat densely pilose, otherwise glabrous, 4-lobed, the lobes subequal, 1.5 to 2 mm. long, rounded. Stamens four, the filaments subequal, 3 mm. long, the anthers 0.4 mm. long, wider than long. Ovary glabrous or nearly so, the style 3.5 mm. long. Stigma bifid.

Type specimen No. 5990 (A. D. E. Elmer), Baguio, Province of Benguet, Luzon, March, 1904. A subscandent shrub reclining on cliffs and bluffs, the stem 6 or 7 cm. in diameter, with soft, brittle wood and yellowish, smooth bark.

## BIGNONIACEÆ.

***Radermachera elmeri*, sp. nov.**

A small tree about 6 m. high, with bipinnate glabrous leaves, and pendant paniculate inflorescence, the pink flowers 5 cm. long, the branchlets, axis of the inflorescence, and leaf rachis glabrous, usually with many small white excrecences. Leaves about 35 cm. long, the leaflets elliptical lanceolate, glabrous, long acuminate, the base acute, 6 to 10 cm. long, 3 to 5.5 cm. wide; nerves about 10 pairs, not prominent, the reticulations lax, obscure; petiolules 5 to 10 mm. long, glabrous. Panicles about 30 cm. long, the branches opposite, spreading, 5 to 6 cm. long, dichotomously branching, few flowered. Flowers few, the pedicels slender, about 1.5 cm. long. Calyx campanulate, glabrous, 1.5 to 1.8 cm. long, 3 to 4 toothed, the

teeth broadly ovate, acute or subobtuse or sometimes rounded, 4 to 5 mm. long, 5 to 10 mm. wide. Corolla 6 cm. long, subcampanulate, the portion inclosed in the calyx tubular, 1 cm. long, then dilated, the mouth 5 to 6 cm. wide, entirely glabrous except near the insertion of the stamens where it is more or less ferruginous pubescent inside, the margins minutely ciliate, 5-lobed, the lobes rounded, about 2 cm. wide, 1.5 cm. long, subequal. Stamens inserted in the tube near the top of the tubular portion of the corolla, the filaments about 2 cm. long, glabrous above, more or less ferruginous pubescent below with capitate hairs. Ovary glabrous, the disk annular, thickened, the style glabrous, 2.5 cm. long. Capsule (immature) cylindrical, about 40 cm. long, 4 mm. in diameter, glabrous. Seeds including wings 8 mm. long, 2 mm. wide.

Type specimen No. 6179 (A. D. E. Elmer), Sablan, Province of Benguet, Luzon, April, 1904. Growing in the hill forests.

## CAPRIFOLIACEÆ.

### *Lonicera rehderi*, sp. nov.

A low prostrate shrub with subcordate, ovate-oblong, acute leaves, which are glabrous above, except on the midrib, and sparingly strigose-pubescent beneath, and yellow flowers about 2 cm. long, the corolla setosely pilose. Branches light brown, densely pubescent. Leaves 3 to 4.5 cm. long, 1.5 to 2 cm. wide, ovate oblong; nerves 5 to 6 on each side of the midrib, the reticulations distinct, nearly as prominent as the secondary nerves; petioles 3 to 4 mm. long, densely pubescent. Flowers in axillary pairs, crowded toward the ends of the branches, the bracts subulate. Calyx oblong-ovoid, 3 mm. long, the tube glabrous, the five erect lanceolate teeth setosely pilose, about 1 mm. long. Corolla yellow, marked with pale yellow, setosely pilose, the tube slender, 10 to 12 mm. long, nearly cylindrical, the limb about 10 mm. long, 2-lipped, the upper lip broad, 4-lobed, the lobes oblong ovate, obtuse, 3 mm. long. Stamens and style pilose, the corolla tube pilose within. Ovary 3-celled.

Type specimen No. 6601 (Elmer), Baguio, Province of Benguet, Luzon, June, 1904, a rather common prostrate shrub on limestone outcroppings at an approximate altitude of 1,800 m.

This species was first identified as *Lonicera lourciri* DC., but as the specimens did not agree entirely with the available descriptions of that species, material was sent to Mr. Alfred Rehder, who has recently published a synopsis of the genus.<sup>1</sup> Mr. Rehder kindly examined the specimens and states that although the species is allied to *Lonicera loureiri* and *L. acuminata*, it is a distinct, undescribed species, which is here dedicated to that author. According to Mr. Rehder, the present species differs from both *Lonicera lourciri* DC., and *L. acuminata* Wall., in its yellow, not red, corolla, which is much more densely setose than in those species, more slender, nearly cylindrical tube, smaller, acute, not acuminate, leaves which are glabrous above, except on the midrib, not appressed pilose throughout, also

<sup>1</sup> Rept. Mo. Bot. Gard. 14:27-232, 1904.



differing from *L. loureiri* in its oblong-ovate subcordate leaves. It also shows some affinity to *Lonicera glabrata* Wall., but is readily distinguished from that species by its setosely pilose corolla. A species of the section *Nintooa*, subsection *Breviflorae*.

No specimen of *Lonicera* is credited to the Philippines in Rehder's recent synopsis of the genus, and although several species have been previously reported from the Philippines, such references to Philippine *Loniceras* need verification. F.-Villar<sup>1</sup> credits to the Philippines four species, namely, *Lonicera chinensis* Wats., *L. confusa* DC., *L. macrantha* Spreng., and *L. javanica* DC. The first three species enumerated were observed by that author in cultivation in Manila and Cavite, and whether or not the identifications were correct, the species can be excluded from the Philippine flora as being cultivated only, having been introduced. Regarding the fourth species enumerated by F.-Villar, *Lonicera javanica*, this author cites a specimen in Vidal's Herbarium, from the Caraballo Sur Mountains (North Central Luzon). This specimen is not mentioned by Vidal,<sup>2</sup> but is cited by Ceron,<sup>3</sup> as an undetermined species citing No. 3026 Vidal. Vidal's Herbarium in Manila has been destroyed, and as Rehder does not cite this specimen in his synopsis of the genus, it probably does not exist in the Kew Herbarium, the *Lonicera* material in that herbarium having been examined by Rehder. F.-Villar's identification was undoubtedly erroneous, for had it been correct, the species would have been cited in Ceron's later work. The specimen identified by Villar as *Lonicera javanica* DC., may have been identical with the species here described, or it may have been a distinct species. Future collections from the Caraballo Sur Mountains may settle this point, but at least until such material is secured *Lonicera javanica* DC., can safely be excluded from the Philippine flora.

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<sup>1</sup> Nov. App. 104, 1882.

<sup>2</sup> Revision de Plantas Vasculares Filipinas, 1886.

<sup>3</sup> Catalogo de las Plantas del Herbario 91, 1892.



## II. THE SOURCE OF MANILA ELEMI.

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By ELMER D. MERRILL, *Botanist*.

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Manila Elemi has been known in commerce for many years, and especially in Europe, is considerably used in the practice of medicine, yet its source has previously never been definitely determined, although the fact has been known for some years that it is secured from a species of *Canarium*, growing in the Philippines, closely related to *Canarium commune* Linn. Recently much material has been received in this office, consisting of botanical specimens in fruit and flower, and also samples of "brea," as Manila Elemi is locally known, from the same trees from which the botanical material was secured. The specimens of Manila Elemi have been secured chiefly through the efforts of Dr. H. N. Whitford of this office and Mr. W. W. Clark and Mr. W. Klemme of the Forestry Bureau. At the present time Dr. A. M. Clover of this Bureau, in connection with his work on gums, oils, and resins, is making an exhaustive chemical investigation of the various kinds of "brea," as Manila Elemi is locally known, and from his investigations of the material recently secured and a careful examination of the corresponding botanical material in this office, we are able definitely to determine the source of this interesting product.

Trimen and Bently,<sup>1</sup> after a thorough discussion of the source of Manila Elemi, conclude that it is secured from a species of *Canarium*, closely related to *Canarium commune* Linn. The product is discussed by these authors under *Canarium commune*, a figure of this species being given, as well as one drawn from fragmentary material supplied by Mr. H. Ricketts, then British consul at Manila, which was supposed to represent the species yielding Manila Elemi of commerce. From the material and data at hand, including the specimens and information supplied by Mr. Ricketts, as well as drawings and notes which were made by Camell more than two hundred years ago and still preserved in the British Museum, they

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<sup>1</sup> Medicinal Plants, 1: pl. 61, 1880.

reached their conclusion regarding the source of Manila Elemi, which has been provisionally accepted by most later authors. Watt <sup>1</sup> confuses *Icica abilo* Blanco and *Canarium commune* Linn., as the source of Manila Elemi. Schneider and Vogl <sup>2</sup> give a summary of the previous attempts to trace the source of this product, but their conclusions are indefinite, citing *Icica abilo* Blanco as the probable source of the product, but also citing Jagor as authority that it is secured from a species of *Canarium*. The United States Dispensatory <sup>3</sup> conjecturally gives *Canarium commune* Linn., as its source. Sawyer <sup>4</sup> follows Trimen and Bently and reproduces the figure of the latter authors, drawn from the Luzon specimen. Beilstein, <sup>5</sup> although discussing the sources of *Elemiharz* and giving the identifications of the tropical American trees yielding substances similar to Manila Elemi, does not attempt to give the identity of the species yielding the Philippine product. Cordemoy <sup>6</sup> follows Blanco and erroneously gives the source of Manila Elemi as *Canarium album* Ræusch. Weisner <sup>7</sup> confuses *Icica abilo* Blanco and an undetermined species of *Canarium* as its source. Tavera <sup>8</sup> gives its source as *Canarium commune* Linn., citing *Canarium album* Blanco and *Canarium luzonicum* Miq., as synonyms. Hirsch <sup>9</sup> gives as its probable source *Canarium commune* Linn.

*Canarium commune* Linn., according to Engler, <sup>10</sup> extends from the Malayan Peninsula to Java and North Celebes and so far has not been discovered in the Philippines. The specimen from Mindanao, identified by the author as *Canarium commune* Linn., <sup>11</sup> is not that species, but is referable to *Canarium ovatum* Engl. The distribution of *Canarium commune* precludes the possibility of this species being the source of the Manila Elemi of commerce. The species from which it is secured is, however, closely related to *Canarium commune* Linn., and, so far as known, has not been

<sup>1</sup> Dictionary of the Economic Products of India, 2:94, 1889.

<sup>2</sup> Commentar zur österr. Pharmakopöe, 447, 1892.

<sup>3</sup> 18th ed., p. 1643.

<sup>4</sup> Odorographia, 2d series, 182, 1894.

<sup>5</sup> Handbuch der Organischen Chemie, 3:556, 1897.

<sup>6</sup> Gomme, Resines d'origine exotique, 195, 1900.

<sup>7</sup> Die Rohstoffe des Pflanzenreichs, 238, 1900.

<sup>8</sup> Medicinal Plants of the Philippines, English edition, 73, 1901.

<sup>9</sup> Universal Pharmakopöe, 1:224, 1902.

<sup>10</sup> DC. Monog. Phan. 8:112, 1883.

<sup>11</sup> Forestry Bureau, Bull. 1:27, 1903.

discovered outside the Philippine Islands. As no complete description of the species was published until very recently, previous authors have been justified in concluding, from the data and material available, that Manila Elemi was probably secured from *Canarium commune* Linn. The confusion of *Icica abilo* Blanco as the source or one of the sources of this product arose, not from a lack of a knowledge of the Spanish language on the part of later authors, as suggested by Tavera, but from the fact that one or two American species, described in the same genus (*Icica*=*Protium*), yield a substance similar in its properties to Manila Elemi; and these later authors were justified in presuming Blanco's generic identification for *Icica abilo* to be correct and that a species growing in the Philippines would be expected to yield products similar to those of the American species of the same genus. Blanco, however, does not credit his *Icica abilo* as yielding Manila Elemi, and his species, moreover, is not one of *Icica* (*Protium*), but belongs to the genus *Garuga*.

From a careful examination of all data and material available, it is evident that the source of the Manila Elemi of commerce is *Canarium luzonicum* A. Gray, a species apparently closely related to *Canarium commune* Linn. It is certainly the most common and widely distributed species of *Canarium* in the Philippines and the only one which yields in any quantity the pitch locally known as "brea" or "brea blanca" and known in commerce as Manila Elemi. The tree is commonly cultivated in cocoanut plantations in southern Luzon. Considering the fact that there are now no less than twenty-one species of the genus *Canarium* at present known from the Philippines, the native names for this species are remarkably constant, the standard native names "pili" or "pisa" rarely being applied to species other than *Canarium luzonicum*. The synonymy is as follows:

***Canarium luzonicum*** (Blume) A. Gray, Bot. Wilkes U. S. Explor. Exped. 374. 1854; Miq. Fl. Ind. Bat. 1:pt. 2:651. 1859; Engler in DC. Monog. Phan. 8:150. 1883; *Pimela luzonica* Blume, Mus. Bot. Lugd. Bat. 1:220. 1849-51; *Canarium album* Blanco, Fl. Filip. ed. 1, 793; ed. 2, 546. 1845; ed. 3, 3:201. 1879, non Racusch.; *Tercbinthus luzonis altera*, Camell in Ray Hist. Pl. 3: Appendix, 60. 1704; *Almendras ó Piles*, Mercado, Libro de Medic., etc., 25. 1880; *Canarium commune* F.-Vill., Nov. App. 40. 1883, and other authors mentioned above, non Linn.; *Canarium carapifolium* Perkins, Frag. Fl. Philip. 92. 1904; *Canarium indicum* Wight, Contr. U. S. Nat. Herb. 9:210. 1905, non Stickman.

Specimens examined: Luzon—Province of Tayabas, Pitoga, No. 2135 (Merrill), in fruit April, 1903, T., *Pili*; Pagbilao, Nos. 1898, 1894, 1915, 1610 (Merrill), in fruit April, 1903, T., *Pili*, *Belis*; Gumaca, No. 858 (Whitford), in fruit, September, 1904, T., *Pili*; Province of Camarines, Pasacao, No. 63 (Ahern), T., *Malapili*; Province of Rizal, Bosoboso, No. 2624 (Merrill), in flower in June, 1903, T., *Pisa*; No. 1160 (Forestry Bureau), Ahern's collector, in flower in June, 1904, T., *Pisa*; Province of Bataan, Lamao River, No. 1753 (Forestry Bureau), collected by Borden, in flower in August, 1904. Mindoro, Pinamalayan, No. 2146 (Merrill), in fruit in May, 1903, T., *Pili*. Ticao Island No. 1070 (Forestry Bureau), collected by Clark, in fruit in May, 1904, V., *Pili*; Masbate, No. 2615 (Merrill), in flower in June, 1903, V., *Pili*.

The earliest consideration of this species is by Camell, and his *Terebinthus luzonis altera* is undoubtedly identical with the species here considered. The next consideration is by Mercado, *Almendras ó Piles*, but, although his notes were written in the last third of the seventeenth century, his work was not published until the year 1880. Blanco gives the first description, which is as follows:

"*Canarium album*, *Canario blanco*, *Arbolcs* dioicos. \**Machos*. *Hojas* opuestas aladas con impar. *Hojuelas* unos cuatro ó cinco pares, aovadas, alargadas, aguzadas, enteras y lampiñas. *Pecíoles* mui cortos. Flores axilares en panoja. *Cal.* \* \* \* *Cor.* \* \* \* *Estam.* como in la especie anterior (*Canarium commune* Blanco, non Linn. "Cor. de tres hasta cinco petalos. Cal. persistente, cilíndrico, con tres dientes obtusos. Estam. cinco hasta ocho.") \**Hembras*, Flores axilares en racimos. *Cal. y cor.* como en la especie anterior. *Drupa* como en la especie anterior, con la diferencia de ser carnosa, mucho mas grande, y algo aguzada por los dos extremos. = Arboles mui communes en todos los bosques de las Islas, y cuyo fruto es del tamaño de una ciruela grande. El zumo, ó resina líquida que destilan, es blanco, á diferencia del otro (*Canarium commune* Blanco, non Linn.), cuyo resina es negruzca. La blanca es que regularmente se vende en el comercio, para calafatear las embarcaciones y alumbrarse los Indios: en este ultimo caso se amasa con la cascara de arroz, y lo envuelven todo con una hoja de *Buli*. Es mui olorosa y se llama brea de piles. Algunos mezclan su fruta, que tiene sabor de almendra con el chocolate, y por tanto trae á Manila. Su aceite es excelente y equivalente de la de almendras dulces. Los emplastos de brea á los pies son útiles en la hinchazon de las piernas. Aplicada la brea (derretida antes y no en crudo) al estomago, sirve de astomaticon, y puesta en las espaldas y quita las toses rebeldes. *Flor. en Dic.\* T., Pisa, Pilauí; Y., Anten.* Nota: Es el género que Linneo llama *Canarium*, y *Loureiro Pimella*. Estos árboles de Filipinas siempre los he encontrado *dioicos*, y el caliz nunca de dos piezas, sino con tres dientes. Tienen afinidad con la *Bursera*."

The descriptions given by Blume and Miquel are very short, being adapted from Blanco's description given above. Engler's description is also entirely adapted from Blanco's, and the species is included in his monograph of the *Burseraceæ* as a doubtful one. Perkins considers that Miquel's name is a *nomen nudum*, and apparently that Blanco's description

is not sufficient to be considered a publication, although she suggests that her *Canarium carapifolium* may be the same as *Canarium luzonicum*. However, *Canarium luzonicum* is a transfer of *Pimela luzonica* to *Canarium*, and *Pimela luzonica* Blume is only a new name for *Canarium album* Blanco. Dr. Perkins gives the first complete description of the species.

The author is of the opinion that Blume's name should be retained and that Blanco's characterization, together with the properties assigned by him to his species, are sufficient to enable us to identify his species without a shadow of doubt. The species here considered agrees with Blanco's *Canarium album*, so far as his description goes, and, as noted by him, it is very common in the Philippine forests. The Tagalog names are the same, *Pisa* in the regions contiguous to Manila, from which Blanco drew his material, and *Pili* in other provinces, and these names are almost invariably applied to this one species. Blanco credits to his species the white, very fragrant "brea de piles," one of the local names of Manila Elemi, and an intimate knowledge of many species of *Canarium*, as they grow in the Philippine forests, leads us to conclude that this species is the only one, of the many which are now known from these Islands, that yields the white, fragrant Manila Elemi of commerce. The local uses of "brea" are the same to-day as they were in Blanco's time, it being extensively utilized in calking boats and in making torches. The seeds are edible and are commonly sold in the markets, while the oil extracted from them is somewhat utilized, as noted by Blanco.

While it is true that several other species of *Canarium* produce substances known as "brea" in the Philippines, yet each individual species of this genus yields a pitch with characteristic physical and chemical properties, and very little, if any, of the "brea" from species other than the one here considered finds its way into the market as a constituent of Manila Elemi. Specimens of Manila Elemi from some of the definitely identified trees cited above, agree perfectly in all characters, physical and chemical, with the specimens of this product purchased in the open markets of Manila. Among the other species of *Canarium* producing "brea" may be mentioned *Canarium cumingii* Engl., which produces a small quantity of dark-colored pitch, known locally as "brea negra," but which has little or no commercial value. *Canarium pachyphyllum* Perkins yields a certain amount of white brea, but its chemical composition is very different from that of *Canarium luzonicum*. *Canarium connarifolium* Perkins yields a very small amount of dark-colored "brea," as does also *Canarium polyncuron* Perkins. *Canarium bersamifolium* Perkins yields a considerable quantity of an oil-like substance, not at all pitchy, and which is scarcely or not at all utilized by the natives. *Canarium stachyanthum* Perkins yields a "brea" used by the natives for torches. Certain species probably yield no pitch or oil, one of these being *Canarium radlkoferi* Perkins. We have no definite information as to whether or not other species of Philippine *Canarium* yield "brea," but so far *Canarium luzonicum* is the only species known to us which yields the Manila Elemi of commerce, and it is believed that this name should be retained.





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No. 30.—MARCH, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES  
CHEMICAL LABORATORY

I. AUTOCATALYTIC DECOMPOSITION OF  
SILVER OXIDE

II. HYDRATION IN SOLUTION

BY

GILBERT N. LEWIS, PH. D.

MANILA  
BUREAU OF PUBLIC PRINTING  
1905

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(Continued on third page of cover.)



No. 30.—MARCH, 1905

DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES  
CHEMICAL LABORATORY

I. AUTOCATALYTIC DECOMPOSITION OF  
SILVER OXIDE

II. HYDRATION IN SOLUTION

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BY

GILBERT N. LEWIS, PH. D.

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1905



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,  
*Manila, P. I., March 25, 1905.*

SIR: I have the honor to transmit herewith and to recommend for publication articles entitled (1) Autocatalytic Decomposition of Silver Oxide, (2) Hydration in Solution, by Gilbert N. Lewis, Ph. D., Physical Chemist.

Very respectfully,

RICHARD P. STRONG,  
*Director Biological Laboratory,  
Acting Superintendent Government Laboratories.*

HON. DEAN C. WORCESTER,  
*Secretary of the Interior, Manila, P. I.*



## AUTOCATALYTIC DECOMPOSITION OF SILVER OXIDE.

---

By GILBERT N. LEWIS, Ph. D., *Physical Chemist.*

---

In the course of an investigation to determine the equilibrium pressure at a given temperature in the system  $2\text{Ag}_2\text{O} = 4\text{Ag} + \text{O}_2$ , a singular phenomenon appeared. The experiment consisted simply in heating silver oxide at a constant temperature of  $335^\circ \text{C.}$ , the stout glass tube which contained the oxide being connected with a manometer. After heating several hours the manometer gave no evidence that any decomposition had occurred. This occasioned some surprise, since  $250^\circ \text{C.}$  is frequently given as the temperature at which silver oxide begins to decompose. As I was about to stop the experiment in order to test the tightness of the joints I detected a slight deflection of the manometer. This increased considerably during the next hour, and I noticed that the greater the pressure became the greater became the rate of its increase, until finally the pressure had reached 20 atmospheres and was increasing at the astonishing rate of between 3 and 4 atmospheres per hour. At this point the cement joining the tube and the manometer began to give way and the experiment had to be discontinued. It had progressed far enough, however, to stimulate considerable curiosity as to the explanation of so unusual a behavior.

The gradual acceleration in the decomposition which was observed could only be attributed to one of the following causes: (1) The increasing pressure; (2) the increasing concentration of oxygen; (3) the accumulation of metallic silver; (4) some change in the silver oxide, such as the slow agglomeration of its grains. Of these four the first two were eliminated at once by a rough experiment carried on at atmospheric pressure, which showed the same phenomenon of accelerating decomposition. It seemed

worth while to study more carefully this decomposition under atmospheric pressure, and for this purpose the following apparatus and methods were devised:

#### EXPERIMENTAL METHOD.

The apparatus finally adopted for the experiments is sketched in fig. 1. For the thermostat a mixture of sodium and potassium nitrates was used, contained in a cylindrical vessel of enameled iron ("agate ware"), about 30 centimeters in diameter and 25 centimeters in height. (A in fig. 1.) This vessel rested on a tripod and was heated from below by two Bunsen burners. The heating efficiency and the constancy of the thermostat were surprisingly increased by a sheath of asbestos (B) surrounding the bath and projecting 10 or 15 centimeters below it. This sheath was separated about one-half centimeter from the side of the vessel by a number of corrugated brass strips not shown in the figure. An annular space was thus left between the asbestos and the bath through which the hot gases from the burners could pass freely and thus heat the thermostat from the sides as well as from below. The careful adjustment of this sheath seemed to be almost essential to the satisfactory operation of the thermostat.

The stirrer was made very simply without the use of solder, combining the ordinary method of stirring with the centrifugal, and it was so effective that the different parts of the bath never differed by more than one or two hundredths of a degree.

The temperature regulator was simply a large mercury thermometer made of a spiral of thin glass sealed to a vertical capillary (C). Into this capillary two fine platinum wires were sealed so that when the expansion of the mercury brought it into contact with the upper wire an electric current from a storage battery was made, which, passing through a telegraph instrument, shut off a thin rubber tube supplying gas to one of the burners.

This regulator was in fact the only part of the apparatus that caused the slightest inconvenience. The spiral being made of thin glass and holding nearly a kilogram of mercury was very fragile, and, being weakened further by the continued high temperature, broke several times and had to be replaced. If a regulator of the same type could be made of some suitable metal, which would also have the advantage, because of its high conductivity, of responding more rapidly to changes in the temperature, a very



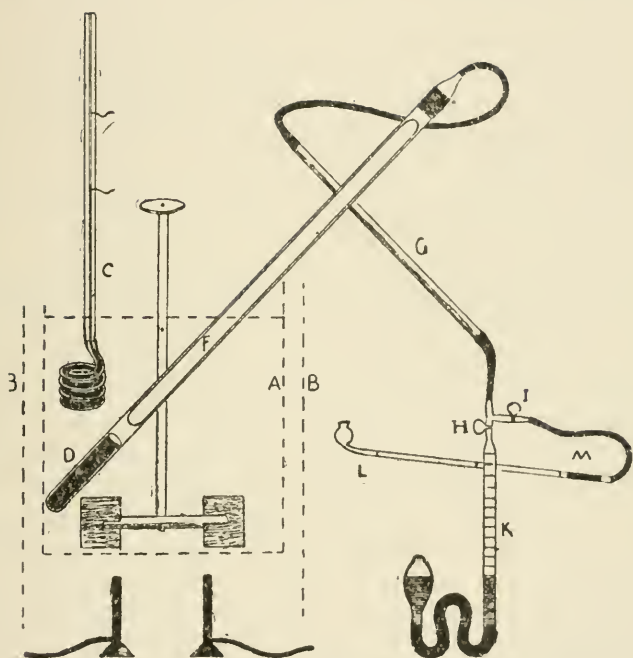


FIG. 1.



great constancy might be attained, for a thermostat working at this temperature has two great advantages over the common water thermostat—it is influenced very slightly by changes in the room temperature and there is no loss of heat by evaporation. It must, however, like all thermostats, be protected from drafts of air.

The mixture of potassium and sodium nitrates proved to be an ideal bath liquid. When pure it is as clear as water and as mobile. Well-annealed glass apparatus and thermometers may be plunged directly into the liquid again and again without breaking.

The vessel of enameled ware seemed to suffer no deterioration whatever, even after several months of contact with the molten salt.

The apparatus for containing the silver oxide and measuring its rate of decomposition is also sketched in fig. 1. The glass tube (D), about 1 meter long, was filled with carefully dried silver oxide to a height of about 10 centimeters, and the powder was shaken compactly into the end. This was covered with a thin layer of glass wool and the remainder of the tube was filled with a loose-fitting glass rod (F), the object of which was merely to diminish as far as possible all air space subjected to changes of temperature, and thus to avoid fluctuations in volume. The end of the tube containing the oxide was immersed deeply in the thermostat, and the other end was connected by rubber tubing to a long brass tube (G), in passing through which the evolved oxygen was cooled to the temperature of the room. The end of this brass tube was connected with a gas burette (K) and to the recorder (L). This latter was simply a glass tube about 2 millimeters in diameter marked off at such intervals that the volume from one mark to the next was exactly 1 cubic centimeter. A small column of water (M) served as an index. With stopcock H closed and I open the small water column advanced along the recording tube, and the time taken by the forward meniscus in moving from one mark to the next was read with a stop watch. When the reaction was very fast, the recording meniscus was allowed to run through several centimeters in order to permit a more accurate measurement of the time. Thus it was possible to measure accurately the rate of evolution of oxygen, whether 1 cubic centimeter in an hour or 1 cubic centimeter in ten seconds, the latter being the greatest velocity measured. After determining the reaction velocity the water indicator could be brought back to its initial position by cautiously opening the stopcock H. I was then closed and H

left open, thus allowing the gas to collect in the burette until the velocity was again measured. In this way the velocity at any moment, and the total volume of gas that had been evolved, could be measured independently. However, after the first few experiments, the burette was done away with and only the velocity was measured, as it was found that in the few cases where a knowledge of the total volume was desired it could be ascertained with sufficient accuracy from the time-velocity curve.

This simple apparatus gave complete satisfaction, cleanliness in the recording tube being the only precaution necessary for its success.

### THE COURSE OF THE REACTION.

In the first experiment with the apparatus 4.4 grams of silver oxide was used, the temperature was  $327.5^{\circ}$  C., and the measurements of the reaction velocity were made for twenty-four hours at intervals of one-half to one hour. For several hours the decomposition was inappreciable; at the end of 10 hours the rate was 1 cubic centimeter of oxygen evolved per hour; after 13 hours, 1 cubic centimeter in 27 minutes; after 14 hours, 1 cubic centimeter in 18 minutes; after 16 hours, in 4 minutes; after 18 hours, in  $1\frac{1}{2}$  minutes, and at this point the velocity was increasing rapidly. After 20 hours the rate was 1 cubic centimeter in 1 minute and rapidly falling, showing that between the last observation and this a point of maximum velocity had been reached. After  $20\frac{1}{2}$  hours the rate of evolution was 1 cubic centimeter in 2 minutes; after 21 hours, 1 cubic centimeter in  $3\frac{1}{2}$  minutes; after  $21\frac{1}{2}$  hours, in 7 minutes, and before 24 hours had passed all action had ceased.

This experiment gave a general idea of the course of the reaction. At the beginning the velocity is very small, increasing more and more rapidly to a maximum, then falling—rapidly at first, later more slowly—until finally the reaction is complete. This decomposition has the general character of an explosion, and in fact it is nothing more or less than an explosion which is slow enough so that its velocity can be measured, and differing from the ordinary explosion only in that in the latter case a reaction progresses with accelerating velocity because of increasing temperature, due to the heat given off by the reaction, while the decomposition we are studying takes place at constant temperature and is in fact an endothermic reaction.

To find the cause of the acceleration in this case was the next problem. Two possible explanations were left. The phenomenon might be due to a gradual physical change in the silver oxide, such as to bring it into a more and more reactive condition, or it might be due to the presence of the silver produced in the reaction. The latter supposition could fortunately be tested directly by experiment, for if the silver formed by the reaction were a catalyzer, then unquestionably silver prepared in the same way and mixed with the oxide before the experiment would produce a similar effect. Therefore, the preceding experiment was repeated, using instead of the pure silver oxide a mixture of 5.5 grams of oxide and 0.1 gram of the powdered metallic silver obtained from the last experiment. These were rubbed together until very intimately mixed.

Noticeable decomposition began as soon as the mixture was put into the thermostat. The rate of evolution of oxygen after 2 hours was 1 cubic centimeter in 5 minutes; after 5 hours, in 3 minutes; after 7 hours, in  $1\frac{1}{2}$  minutes. After about 8 hours the maximum of 1 cubic centimeter per minute was reached, and in 12 hours the reaction was over. In the previous experiment the reaction at the end of 12 hours was just beginning to have a measurable velocity. This difference between the two experiments seemed to point conclusively to catalytic action by the silver, yet it was not inconceivable that it might be due to some difference in the treatment of the two samples of silver oxide. In order to remove this doubt the following experiment was tried later under new conditions with a different preparation of silver oxide and at a different temperature:

Three portions of silver oxide were taken, each weighing 3.3 grams. To the first (A) 1.1 grams of silver powder was added, to the second (B) 0.55 of a gram of silver, and the third (C) was left pure. All three were subjected to precisely the same treatment of rubbing and stirring, and introduced in separate tubes simultaneously into the thermostat. At the end of three-quarters of an hour 1 cubic centimeter of gas was evolved from A in 72 seconds, from B in 85 seconds, and from C in 215 seconds; at the end of an hour from A in 42 seconds, from B in 56 seconds, and from C in 210 seconds. The velocity reached its maximum for A in 88 minutes, for B in 110 minutes, and for C in 160 minutes.

This experiment demonstrated the catalytic influence of the silver and showed that this influence increases with the quantity of silver. More precise quantitative results were not looked for, as it was assumed that the action of the decomposed silver would be dependent upon the degree of fineness, the intimacy of its mixture with the oxide, and possibly upon other conditions which could not be made entirely uniform. It seemed likely that a careful study of the form of the reaction curve for the pure oxide would yield more trustworthy information as to the law and mode of action of this catalysis.

A series of experiments was therefore carried out, similar to the one already described, but with more frequent and more accurate determinations of the velocity. A considerable number of such series was made at different temperatures, and of these I have chosen the four most complete and satisfactory for further discussion. These were made at  $327.0^{\circ}$  C.,  $332.5^{\circ}$  C.,  $352.2^{\circ}$  C., and  $353.3^{\circ}$  C., and may be designated by A, B, C, and D, respectively.

The results are represented in fig. 2, the reaction velocity being plotted vertically and the time horizontally. Instead of the time when the experiment began, the time of maximum velocity is taken as zero. Thus, the maxima of all the curves fall on the same vertical line. The velocity is expressed as the fraction of the whole quantity of oxide which is decomposed per second. This can, of course, be readily found from the rate of evolution of oxygen when the temperature and pressure and the weight of silver oxide are known. If  $x$  represents the fraction of the original oxide that has been decomposed, the velocity is  $\frac{dx}{dt}$ .

An inspection of these curves shows, as was to be expected, that the maximum velocity is greater and, the whole time of the decomposition less, the higher the temperature of the experiment. Further, we are struck by the great regularity of the curves and by their very evident similarity to one another. They appear to belong to a single family of curves such as may be represented algebraically by a single equation with one variable parameter. It seemed likely that if these curves were reduced to the same scale they might nearly coincide.

This was attempted by plotting each experiment with a different unit of time, so chosen as to make each maximum velocity equal



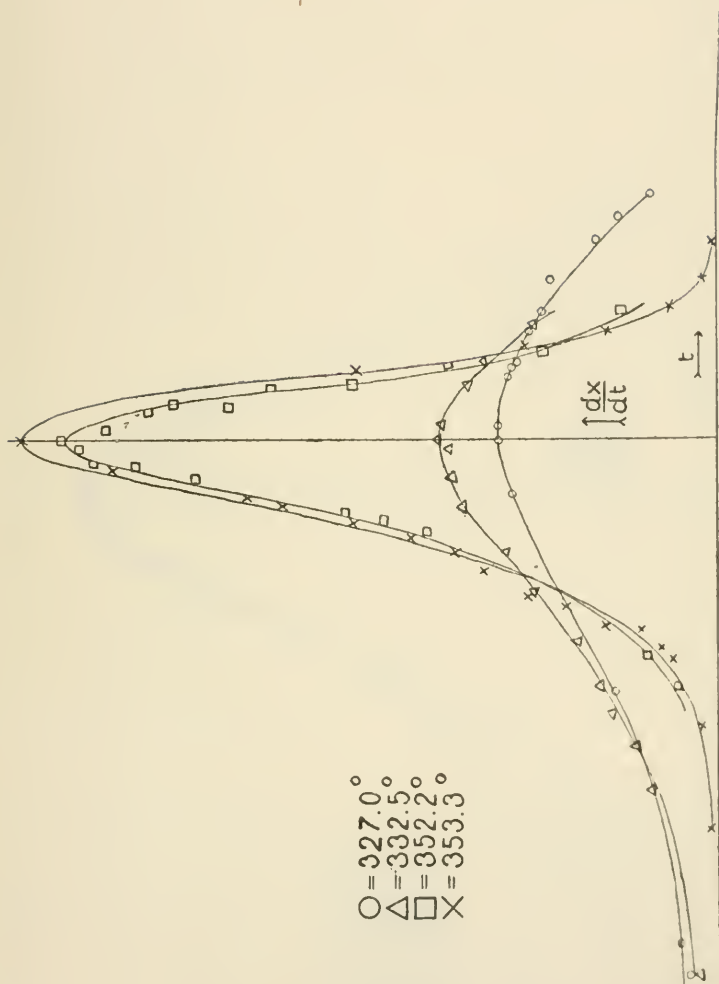


FIG. 2.



to unity, hence the unit of time in each case is the time which would be required for complete decomposition if the whole reaction progressed at a uniform rate equal to the maximum velocity. In other words, the units of time chosen are inversely proportional to the maximum velocities, which, therefore, in the new scale become numerically equal and fall on a single point.

The four curves thus plotted in fig. 3 come astonishingly near to coincidence; in fact, they do coincide within the limits of experimental error.

Among all the cases in which reaction velocity has been studied the present phenomenon occupies a wholly unique position. Exceedingly few autocatalytic reactions have been quantitatively investigated. In a homogeneous system the study of the reaction of oxalic acid and permanganate by Schilow<sup>1</sup> may be mentioned; in heterogeneous systems the study of the action of acids on sodium thiosulphate by Fousseureau<sup>2</sup> and the decomposition of hydrogen arsenide, hydrogen selenide, and hydrogen antimonide, respectively, by Cohen,<sup>3</sup> Bodenstein,<sup>4</sup> and Stock and Guttmann.<sup>5</sup> In all these cases in heterogeneous systems a reaction in a liquid or gaseous phase is catalyzed by a solid product. Bodenstein,<sup>6</sup> recalculating the work of Stock and Guttmann, points out the surprising simplicity and regularity of the decomposition studied by them. But how much more surprising it is that in our present case the decomposition of one solid is catalyzed even more regularly by the presence of another solid with which, in the very nature of solid substances, it can not be in very intimate contact. The decomposition behaves, indeed, almost like a simple homogeneous reaction.

In a homogeneous catalytic reaction the simplest case is that in which, for a given volume, the reaction velocity is proportional to the quantity of the reacting substance and to the quantity of the catalyzer. Let us see how nearly the decomposition of silver oxide conforms to these conditions.

<sup>1</sup> *Ber. Chem. Ges.*, 36, 2735 (1903).

<sup>2</sup> *Ann. Chim. Phys.*, (6) 15, 533 (1888).

<sup>3</sup> *Zeit. Phys. Chem.*, 25, 483 (1898).

<sup>4</sup> *Zeit. Phys. Chem.*, 29, 429 (1899).

<sup>5</sup> *Ber. Chem. Ges.*, 37, 901 (1904).

<sup>6</sup> *Zeit. Phys. Chem.*, 49, 41 (1904).

If we assume that the velocity of reaction is proportional to the quantity of silver oxide and of silver, we may write the equation,

$$\frac{dx}{dt} = Kx(1-x) \quad (1)$$

Where  $\frac{dx}{dt}$  measures the velocity,  $x$  is the fraction of oxide decomposed and is therefore proportional to the amount of silver.  $1-x$  is the fraction remaining unchanged and is therefore proportional to the amount of silver oxide.  $K$  is a constant.

An inspection of the equation shows that it would be represented by a rising and falling curve, with a maximum of velocity at the point where just one-half the silver oxide is decomposed. In order to compare the assumptions we are making with our experimental results we must obtain the velocity as a function of  $t$  rather than of  $x$ . From equation 1, by integration,  $\ln \frac{x}{1-x} = Kt + C$ , where  $\ln$  stands for a natural logarithm and  $C$  is the integration constant. If we count  $t$  from the point of maximum velocity, then at that point  $Kt=0$ . Also, since  $x=(1-x)$ ,  $\ln \frac{x}{1-x} = 0$ , and therefore  $C=0$ . Therefore our equation stands

$$\ln \frac{x}{1-x} = Kt, \quad \text{or } \frac{x}{1-x} = e^{Kt}, \quad \text{or } x = \frac{e^{Kt}}{1 + e^{Kt}} \quad (2)$$

differentiating this equation

$$\frac{dx}{dt} = \frac{Ke^{Kt}}{(1 + e^{Kt})^2} \quad (3)$$

This is the equation sought, and in order to plot its curve on a suitable scale for comparison with those of fig. 3 we must choose in this case also such a unit of time as to make the maximum velocity equal to unity. At this maximum, then,  $\frac{dx}{dt} = 1$ , but, as previously shown,

$$x = \frac{1}{2} \text{ and } 1-x = \frac{1}{2},$$

whence by equation 1,

$$1 = K \frac{1}{2} \frac{1}{2}, \text{ and } K = 4,$$

whence equation 3 becomes

$$\frac{dx}{dt} = \frac{4e^{4t}}{(1 + e^{4t})^2}$$

The continuous curve shown in fig. 3 is obtained by plotting this equation. Its great similarity to the experimental curves is obvious. Still, it is not quite identical with them. The experimental curves all lie nearer to one another than they do to the theoretical, and all show a certain asymmetry which the theoretical does not. In the case of the experimental curves it is evident that the apex comes at a point where more than one-half of the silver oxide is decomposed. Still the theoretical and experimental curves fall much nearer together than was to have been predicted, and it is possible that the existing difference may be due to faults in the experimental method; thus, for example, it is not impossible that near the point of maximum velocity the reaction may take place so rapidly that heat can not be absorbed from the bath rapidly enough to maintain a constant temperature, a condition which would destroy the symmetry of the curve. Still it is hardly probable that this was the case, for if it had been there would have been a wide difference between the curves for the highest and the lowest temperatures, since at the latter the maximum velocity is only one-third or one-fourth as great as at the former.

#### THE STUDY OF DIFFERENT VARIETIES OF SILVER OXIDE.

In the experiments hitherto described the same silver oxide was used, namely, a preparation by Merck labeled "highest purity." When this was exhausted the experiments were continued with an oxide made by Eimer & Amend. However, it was soon found that with this substance no results could be obtained comparable with the preceding. The reaction velocity was far more rapid than with the old oxide. Thus, at  $340^{\circ}$  the maximum velocity was passed in less than an hour, and in three hours all action had ceased. Furthermore, the decomposition was irregular, so that under the same conditions inconstant results were obtained. This sample of oxide was therefore abandoned and another bottle of Merck's procured. This was of the same grade and bore the same label as that used in the previous experiments, but it too decomposed with great rapidity. Thus, the velocity at  $352^{\circ}$  reached a maximum in thirty-seven minutes and the reaction was over in three hours, whereas with the original sample at this temperature the maximum came at the end of four hours. The great irregularities shown by the Eimer & Amend samples, however, did not appear. Such irregularities most probably are due to lack of uniformity in the oxide.

The great difference in the rapidity of decomposition of different samples of oxide made it desirable to study the influence of the method of preparation of the oxide upon its decomposition. It seemed probable that the difference between samples was either due to varying quantities of impurities or to variations in the physical state; for example, in the fineness of division of the powder. Pure silver oxide was therefore prepared for study in three different ways. For all these preparations silver nitrate purified by several recrystallizations was used. In the first case sodium carbonate was added. The precipitated carbonate was washed repeatedly by decantation, the last washings occupying twenty-four hours each. It was then dried and heated at  $240^{\circ}$  for twenty-four hours to drive off as completely as possible the water and the carbon dioxide. The second and third preparations were made by treating the silver nitrate with a clear solution of barium hydroxide, in one case with both solutions at room temperature, in the other with both at  $100^{\circ}$ . All the solutions were very dilute and the reaction was carried on with the exclusion of carbon dioxide. The precipitates were carefully washed, and dried at  $240^{\circ}$ .

It was expected that the silver carbonate would yield a very finely divided oxide and, therefore, one that would rapidly decompose, but as a matter of fact it proved to react much more slowly than any which had previously been tried. The samples prepared with barium hydroxide decomposed more slowly still—more than four times as slowly as the oxide used in the earlier experiments. Contrary to expectation the oxide prepared in the cold decomposed rather more slowly than the other.

Therefore, it would appear from these few experiments that the rapid reaction of some of the samples was caused by the presence of impurities. Still, my experiments were hardly sufficient to make this conclusion certain, especially as certain observations led me to suspect that the rapidity and temperature of drying had some influence on the rate of decomposition. Unfortunately, however, my experiments at this point had to be brought to an abrupt close, and it is therefore necessary to leave this question open.



## TEMPERATURE COEFFICIENT OF THE REACTION VELOCITY.

The influence of temperature on the reaction velocity may be found from the four experiments, the results of which are plotted in figs. 2 and 3, since they were all made with the same sample of oxide. We must choose for comparison the reaction velocities at corresponding points in the several experiments. The apices of the curves constitute such a series of corresponding points. The maximum velocities at the four temperatures,  $327^{\circ}$ ,  $332.5^{\circ}$ ,  $352.2^{\circ}$ ,  $353.3^{\circ}$ , were, respectively, 0.0106, 0.0134, 0.0316, and 0.0335 per cent per second. If we plot the logarithms of these four numbers on the one hand and the corresponding temperatures on the other the resulting points lie almost precisely on a straight line whose slant is given by the equation

$$\frac{d \log_{10} v}{dT} = 0.0185,$$

Or, by the integrated form,

$$\log_{10} \frac{v_1}{v_2} = 0.0185 (T_1 - T_2).$$

It is customary to express the influence of temperature upon reaction velocity by means of the quotient of the velocity at one temperature divided by the velocity at a temperature  $10^{\circ}$  lower. This quotient can be easily found in the present case from the above equation. Since  $T_1 - T_2 = 10$ ,

$$\frac{v_1}{v_2} = \log 0.185 = 1.53.$$

In other words, when the temperature rises  $10^{\circ}$  the velocity increases by about 50 per cent. This increase is less than that of most reactions, but corroborates the idea of Van't Hoff,<sup>1</sup> who writes concerning this quotient:

Bedeutend weniger als Verdoppelung zeigt nur die Zerlegung von Phosphor- und Arsenwasserstoff. Das hängt aber vielleicht mit der hohen Beobachtungstemperatur zusammen, denn in der grossen Mehrheit der bis jetzt beobachteten Fälle nimmt das Geschwindigkeitsverhältnis für  $10^{\circ}$  mit steigender Temperatur ab.

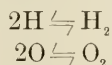
<sup>1</sup> *Vorlesungen ueber Theor. u. Phys. Chem.*

## THE NATURE OF THE CATALYTIC ACTION.

At first sight the explanation of the catalytic action of the silver would seem to be like that which is sometimes offered for the development of a photographic plate, namely, that the silver as it is produced becomes supersaturated and finally reaches such a concentration as to stop the reaction except where silver is already present upon which it may deposit. If this explanation is correct the phenomenon we are studying closely resembles the simple process of crystallization from a supersaturated solution. In fact, I may point out that every case of such crystallization is a case of autocatalysis, and that here also the reaction velocity rises and falls as the crystallization continues—rises as the surface of the crystal increases, falls as the degree of supersaturation decreases.

Striking as the analogy is, it must be borne in mind that in this case we are dealing with the action of one solid upon another, and the great regularity of the reaction seems hard to reconcile with all the other facts known concerning reactions in solid phases.

As a result of other studies I have been inclined to entertain an entirely different explanation of the phenomenon. In the course of researches, some of which will shortly be published, I have been led to believe in the great importance to chemistry of the two following reactions:



These two reactions have frequently been discussed in connection with the theory of the nascent state, but little attention seems to have been paid to the immense importance of the *velocity* of these reactions in a large number of processes, such as the union of oxygen and hydrogen, combustions in general, reduction by hydrogen, spontaneous decomposition of oxydizing and reducing agents, and especially in the phenomenon of galvanic polarization. Here, however, this larger problem concerns us only as it offers a possible explanation of the autocatalysis of silver oxide. When we consider the probable mechanism of the decomposition it is evident that instead of the one reaction  $2\text{Ag}_2\text{O} = 4\text{Ag} + \text{O}_2$  we may write with at least equal probability the two reactions  $\text{Ag}_2\text{O} = 2\text{Ag} + \text{O}$  and  $2\text{O} = \text{O}_2$ . If in fact the decomposition takes place in these two stages the important question is, Which is the

reaction of which we are measuring the velocity?—that is, Which is the slower reaction?

We have many reasons to believe that the reaction  $O_2 = 2O$  is an extraordinarily slow one. For example may be cited the inactivity of oxygen and the preponderating tendency in slow oxidation at ordinary temperatures for the oxygen to enter into the resulting compounds as the radical ( $O_2$ ), forming the unstable peroxides. We may assume that to an extremely small extent oxygen gas is dissociated, that in ordinary  $O_2$  there is a small concentration of  $O$  in equilibrium with it. If when the equilibrium is destroyed by removing some monatomic oxygen it is restored with great slowness, then it will be true also that if the equilibrium is destroyed in the opposite direction the recovery, according to the reaction  $2O = O_2$ , will likewise be slow.

It is not unlikely that this latter reaction is the one whose velocity we have been studying and that it is the one which is catalyzed by the presence of the silver. In fact, silver is known to catalyze many gaseous reactions.

The above line of reasoning would apply equally to other reactions in which oxygen is evolved. Let us consider two cases as different from this one as possible, namely, the decomposition of hydrogen peroxide and of potassium chlorate. Both of these reactions may be accelerated by catalyzers; the catalysis of the latter by manganese dioxide and of the former by manganese dioxide, platinum, and other substances is familiar to all chemists. If in these cases also we assume that the union of two atoms of oxygen is the reaction the slowness of which retards the decomposition, then this reaction is the one which is catalyzed by platinum and by manganese dioxide. Therefore, these substances, if our assumptions are correct, should aid the decomposition of silver oxide as silver does. We have thus the means of testing our suppositions by direct experiment.

Two tubes, each containing 5 grams of silver oxide, to one of which 0.25 gram of pure platinum black was added, were put into the thermostat simultaneously. The one containing platinum began to give off oxygen at once. At the end of two hours it was evolving 1 cubic centimeter in twelve seconds, while the other was evolving 1 cubic centimeter in ten minutes.

A similar experiment was made with another preparation of silver oxide, in which case the silver oxide containing platinum

was entirely decomposed in twenty-four hours and the other not until after three days. In a similar experiment manganese dioxide, which had been previously heated to redness, was used in place of the platinum and it also showed marked catalyzing power.

These results speak strongly in favor of the truth of the assumptions which we have made. It is true that catalysis of silver oxide and hydrogen peroxide by platinum may be specifically different, but let us consider a few of the reactions, where oxygen is a factor or a product, which are catalyzed by platinum; the combustion of gases such as hydrogen, methane, ammonia, vapor of methyl alcohol; the decomposition of oxidizing agents such as hydrogen peroxide; the electrochemical solution of oxygen at the cathode and its separation at the anode. Certainly there seems to be ground for believing that in all these cases, while several reactions occur together, an important, and in many cases the only, factor in determining the speed of the whole reaction, is the speed in one direction or the other of the intermediate reaction,  $2O \rightleftharpoons O_2$ , and that this reaction is catalyzed by platinum and by a number of other substances, of course as well in one direction as in the other.

At least we may conclude in regard to the decomposition of silver oxide that since there are substances besides silver which act as catalyzers the autocatalysis is not of the same nature as that of precipitation from a supersaturated solution, and further, that there is some ground for believing that the velocity which we measured is either that of the reaction  $2O = O_2$  or that of the diffusion of the factors or products of this reaction, to or from the catalyzing substance.

We should expect the catalytic power of the silver to be proportional to the extent of its surface, while we have found it to be proportional to the amount of silver. But probably these two quantities are very nearly proportional since the silver is produced as a slightly cohesive mass which readily falls into a fine white powder. If the grains are of fairly uniform size the surface exposed is proportional to their number, or, in other words, to their mass.

#### SUMMARY.

A satisfactory thermostat for high temperatures is described, together with a method of measuring the velocity of decomposition of silver oxide.

This velocity of decomposition at constant temperature increases as the reaction proceeds, passes through a maximum, and falls gradually to zero.

The phenomenon is due to autocatalysis, and the catalyzing agent is metallic silver.

The reaction proceeds with great regularity and the curve of reaction velocity comes very close to the curve of the equation  $v = \frac{K e^{kt}}{(1 + e^{kt})^2}$ , which is the equation of the simplest case of autocatalysis.

The influence of the purity and the method of preparation of the silver oxide upon its decomposition is discussed.

The temperature coefficient of the reaction velocity is determined.

Evidence, both experimental and theoretical, is offered in favor of a comprehensive theory of such catalytic action.





## HYDRATION IN SOLUTION.

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By GILBERT N. LEWIS, Ph. D., *Physical Chemist.*

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The experiments which will be described in this paper, although of the simplest character, have so direct a bearing on the important question of hydration in solution as to merit a brief notice.

It is a remarkable fact that while inorganic reactions have been studied chiefly in aqueous solution, we have no knowledge as to whether, or to what extent, the solutes enter into chemical combination with the water. It is true we have many independent reasons for suspecting that such union occurs with a considerable number of salts, especially those which dissolve with the evolution of heat and which are noticeably hygroscopic—that is to say, which lower to an abnormal degree the vapor pressure of the solvent. However, no conclusive proof of such union has been found, nor any means of determining quantitatively what per cent of the solute molecules are combined or how many molecules of water unite with each.

The only attempt at such a quantitative determination of the extent of hydration has been made by Jones and Getman.<sup>1</sup> They base their calculations on the assumption that even in solutions as concentrated as three times molecular-normal there are no deviations from the laws of dilute solution, the apparent deviations being due to hydration, which without changing the total number of solute molecules changes the number of free solvent molecules.

Such an assumption lacks plausibility in any case, but especially as it leads the authors to a conclusion which is inconsistent with the fundamental principles of chemistry. This conclusion is that in many cases the degree of hydration increases with the concentration of the solute. Suppose that the hydration occurs according

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<sup>1</sup> *Zeit. Phys. Chem.* 49, 385 (1904).

to the reaction,  $S + n \text{ H}_2\text{O} = S(\text{H}_2\text{O})_n$ . According to the mass law,  $\psi_1\psi_2^n = K\psi_3$ , where  $\psi_1$  and  $\psi_3$  represent what is sometimes called the "active mass" of the unhydrated and hydrated solute, respectively,  $\psi_2$  that of the water.  $\psi_1$  and  $\psi_3$  are nearly proportional respectively to the concentration of S and of  $S(\text{H}_2\text{O})_n$ ,  $\psi_2$  to the vapor pressure of water. Since the latter decreases with increasing concentration of the salt,  $\psi_1$  must increase faster than  $\psi_3$ —that is, the degree of hydration must decrease with increasing concentration. If instead of one a number of hydrates are formed, this same argument would apply to each reaction. The only case in which hydration could increase with the concentration would be the case in which polymerization accompanies hydration. But in the experiments of Jones and Getman there is no evidence of such polymerization, the presence of which would in any case invalidate their calculations.

Although we can not accept all the conclusions of these authors, nevertheless their experimental data, regarded as evidence in favor of the general idea of hydration, are of great value, and, while probably incapable of any such exact quantitative application as the authors have attempted, still serve to give us a very good idea of the probable relative hydration of different salts.

The method of Jones and Getman is not the only one which has been employed in attacking this problem, and the various methods all give evidence of the existence of hydration, and usually agree also as to which salts are to the highest degree hydrated. All these attempts have been brought together in an excellent monograph by Baur.<sup>1</sup>

I wish to approach the subject of hydration from a different point of view, by a study of the colors of certain salts in solution, namely, chloride of cobalt and the chloride and bromide of copper. These substances have different colors when in concentrated and in dilute solution. Cobaltous chloride changes from purple to a clear red, cupric chloride from an olive green to blue, and cupric bromide from a dark brown through varying shades of brown and green to blue. These changes were in 1887 attributed by Wiedemann<sup>2</sup> to gradual hydration of the salts. However, this explanation has been succeeded by another, according to which the change of color is due to the electrolytic dissociation of the

<sup>1</sup> Ahrens Samml. Chem. Vorträge. 8, 456 (1903).

<sup>2</sup> Report Brit. Assoc. for 1887, p. 346.

salt, the undissociated molecules and the ions being supposed to have different colors. As far as one can judge by the eye, all the intermediate colors which occur during the dilution of these solutions in every case can be considered mixtures in different proportions of two colors. In the case of cobaltous chloride the two are blue and red, of cupric bromide yellowish brown and blue. The theory is that the undissociated cupric bromide, for example, is brown, the cupric ion blue. As the solution is diluted the degree of dissociation increases until finally all trace of brown disappears and the color is the pure blue of cupric ion. This theory is further borne out by the fact that the addition of a bromide, which would be expected to push back the dissociation of cupric bromide, does in fact turn a blue solution to green or even brown.

I was first led to distrust the adequacy of this explanation by a research of Prof. H. M. Goodwin, read before the Boston Physico-Chemical Club, and as far as I know not yet published, in which he showed, by a quantitative study of the absorption spectra of copper salts in solution, that the greatest change in color which occurs on dilution does not come where the change in dissociation is the greatest, but at a much higher concentration, and that in some cases little change in the absorption spectrum accompanies the further dilution of a solution which is still to a large extent undissociated.

These experiments force us to seek another explanation of the color change, and the simplest is that of Wiedemann previously mentioned, according to which the change of color is due to change in the degree of hydration. There is much evidence in favor of this view. Anhydrous cobalt compounds are in general blue—for example, the borate and the silicate. The solid chloride of cobalt changes from red to blue on losing its water of crystallization. Unquestionably hydration is almost universally accompanied by an evolution of heat, wherefore by the principle of Le Chatelier the degree of hydration in solution should decrease with increasing temperature, and in fact a red solution of cobaltous chloride turns blue on heating. According to the other theory this change of color would have to be attributed to an enormous diminution in electrolytic dissociation. The experiments of Isaachsen<sup>1</sup> render this improbable.

<sup>1</sup>*Zeit. Phys. Chem.* 8, 145 (1891).

However, if we are to give up the theory that the phenomenon is due to ionization, how shall we explain the change of color when other chlorides are added to cupric and cobaltous chlorides and when other bromides are added to cupric bromide?

In order to find what the actual facts in the case are, solutions were prepared of a large number of acids and salts, comprising bromides, chlorides, nitrates, and sulphates, all of the same strength, namely, thrice molecular-normal. These were made up in a number of ways and care was taken only that they should not be in error by more than 1 per cent. To equal volumes of these solutions the same small quantity of cupric bromide was added. The resulting solutions ranged from blue to green, except in the cases of the four bromides used, in which the solutions were all of an olive brown. Similar experiments were tried with copper and cobalt chlorides, using all the solutions except the bromides. The cupric chloride was green in the chloride solutions, blue in all the others. The cobaltous chloride was a bluish red in the chlorides, a pure red in the others.

If the differences of color are due to differences in hydration, we should, at first thought, expect foreign salts to have no effect on the color, except as through their own hydration they might deprive the colored salt of the water combined with it. We should therefore expect that the strongest dehydrating agents would have the most effect on the color, rather than substances with a common ion. However, as a matter of fact, such hygroscopic substances as sulphuric acid and calcium nitrate seem to have little if any greater effect than other salts.

Let us examine the matter more closely, and suppose that during the dilution one or several reactions of the following type take place:  $\text{CuBr}_2 + n\text{H}_2\text{O} = \text{CuBr}_2(\text{H}_2\text{O})_n = \text{Cu}^+(\text{H}_2\text{O})_n^+ + 2\bar{\text{Br}}^-$ .

As a matter of fact, the color change may be due chiefly not to a change from the anhydrous salt to a hydrated one, but from one with less water to one with more, or the ions may exist in any degree of hydration, but whatever the actual reactions are, we may assume the above reaction merely for the sake of concreteness. Let us further assume that the brown color is due to the  $\text{CuBr}_2$  and the blue to the  $\text{CuBr}_2(\text{H}_2\text{O})_n$  and the  $\text{Cu}^+(\text{H}_2\text{O})_n^+$ .

Anything which would make the reactions run from right to left would cause the brown color to increase at the expense of the blue.

According to the equation there should be, with a given concentration of copper salt, two simple methods of bringing about such a displacement of equilibrium, namely, by increasing the concentration of the bromide ion and by decreasing the "active mass" of the water. The addition of any other bromide to a solution of cupric bromide would make the solution browner in both ways, for it would not only increase the concentration of the bromide ion but it would also decrease the "active mass" of the water, since it lowers the vapor pressure.

When salts other than bromides are added to the cupric bromide this second influence alone is at work and we find that a relatively slight change of color is produced. Indeed we should expect from the above equation that the first influence would be much the more powerful unless  $n$  is a very large number. The question is, What will the result be of adding to equal quantities of cupric bromide different solutions with the same concentration of bromide ion but with different vapor pressures? In order to answer this question the following experiment was made:

The same quantity of cupric bromide was added to 10 cubic centimeters of a thrice-normal solution of each of the following bromides: KBr,  $\text{NH}_4\text{Br}$ , NaBr, LiBr. In these solutions the concentrations of bromide ion are nearly alike, being somewhat greater in the case of KBr, somewhat less in the case of LiBr. If this were the only factor determining the color we should expect the solution in KBr to be the most brown, that in LiBr the least.

The facts are just the opposite. The  $\text{NH}_4\text{Br}$  and NaBr solutions have nearly the same color, that of KBr is less brown, while the LiBr solution is very much browner. In all these solutions the blue is so faint as compared with the brown that the relative brownness of the solutions can be found by means of a colorimeter. Columns of LiBr, NaBr, and KBr solutions, respectively 14, 18.5, and 20 millimeters thick, appeared equally brown.

These experiments were repeated several times, a different quantity of cupric bromide being used in each instance. The results were the same. A small change in the concentration of cupric bromide in any solution changes only the density of the color but not its character.

It is obvious that something influences the color besides the concentration of the bromide ion. When we examine the vapor pressures we find a very considerable difference in the four solu-



tions, sufficient to account in a most satisfactory manner for the observed color differences. As a measure of the depressions of the vapor pressure we may use the lowering of the freezing point. The data used in the following discussion are obtained from the work of Jones and Getman,<sup>1</sup> sometimes by means of extrapolation. When this extrapolation is carried over a considerable range the number is indicated as doubtful by the mark  $\pm$ .

The freezing-point depressions of the four bromide solutions are, approximately, KBr,  $12^\circ$ ;  $\text{NH}_4\text{Br}$ , probably between NaBr and KBr; NaBr,  $13\frac{1}{2}^\circ$ ; LiBr,  $19^\circ$ .

Similar experiments were made with cupric chloride and solutions of the five chlorides, KCl,  $\text{NH}_4\text{Cl}$ , NaCl, LiCl, and HCl. Here the colors are not so pronounced as in the previous case. All the solutions are green. No difference could be detected in the first three, but the LiCl solution was decidedly greener and the HCl solution still more so. The freezing-point depressions are, respectively,  $11.1^\circ$ ,  $11.7^\circ$ ,  $12.2^\circ$ ,  $15.0^\circ$ , and  $18.1^\circ$ .

Since solutions of the chlorides of the bivalent metals have much lower vapor pressures than those of the univalent ones, it was expected that they would have a much greater influence on the color.  $\text{SrCl}_2$ ,  $\text{CaCl}_2$ ,  $\text{MgCl}_2$ ,  $\text{BeCl}_2$  were used. The solutions were in fact much greener than in the preceding case, having an olive tint. They arranged themselves by color in the order given, the last being greenest, and between each solution and the next there was a very marked difference in color. The freezing-point depressions are, approximately,  $\text{SrCl}_2$ ,  $30^\circ \pm$ ;  $\text{CaCl}_2$ ,  $40^\circ$ ;  $\text{MgCl}_2$ ,  $48^\circ \pm$ ; and  $\text{BeCl}_2$ , unknown. Similar experiments were made with one and one-half molecular-normal solutions of these substances, and  $\text{BaCl}_2$  was added to the list. Here the color differences were slight but the solutions could be repeatedly arranged by color in the above order both by myself and by others,  $\text{BaCl}_2$  assuming its proper place before  $\text{SrCl}_2$ . The freezing-point depressions are, approximately,  $\text{BaCl}_2$ ,  $9^\circ \pm$ ;  $\text{SrCl}_2$ ,  $10^\circ$ ;  $\text{CaCl}_2$ ,  $11^\circ$ ;  $\text{MgCl}_2$ ,  $12^\circ$ .

Of course these one and one-half normal solutions, on account of less dissociation, have a smaller concentration of chloride ion than the thrice-normal solutions of the chlorides of the first group, but the  $1\frac{1}{2}n$   $\text{BeCl}_2$  had the same color as the  $3n$  KCl.

Finally aluminum chloride,  $3n$ , was tried. As was to be

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<sup>1</sup>l. c. and *Zeit. Phys. Chem.* 46, 244 (1903).



predicted from its great freezing-point depression, which is at least  $90^{\circ}$ , it gave a deep olive-brown color.

All these experiments were repeated, using cobaltous chloride in place of cupric. The color differences here are less marked. The solutions of the chlorides of the first group all had practically the same red color with a tinge of blue. But in the second group the solutions were a more decided purple and arranged themselves in the same order as before—that is,  $\text{BeCl}_2$  gave the solution with most blue in it.  $\text{AlCl}_3$  gave a deep purple, and a four-times-normal solution of  $\text{AlCl}_3$  gave a pure blue.

All these facts speak for the truth of the above explanation of the color changes, and give strong evidence of the hydration of the three substances  $\text{CoCl}_2$ ,  $\text{CuCl}_2$ , and  $\text{CuBr}_2$ . It may be remarked that these substances, according to the work of Biltz,<sup>1</sup> give unusually large depressions of the freezing point.

I believe that a quantitative study of these color changes by means of a spectro-radiometer might throw a great deal of light on the whole question of hydration, although any attempt to determine the formulas and the amounts of hydrates in solution is rendered difficult by the probability of the simultaneous existence as a rule of several different hydrates in each solution.

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<sup>1</sup> *Zeit. Phys. Chem.* 40, 198 (1902).



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No. 31.—MAY, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES  
BIOLOGICAL LABORATORY

I. NOTES ON A CASE OF HÆMATOCHYLURIA

TOGETHER WITH SOME OBSERVATIONS ON THE  
MORPHOLOGY OF THE EMBRYO NEMATODE  
FILARIA NOCTURNA

By WM. B. WHERRY, M. D., AND JOHN R. McDILL, M. D.

II. A SEARCH INTO THE NITRATE AND NITRITE  
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WITH SPECIAL REFERENCE TO ITS INFLUENCE ON THE  
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CHOLERA-RED REACTIONS

By WILLIAM B. WHERRY, M. D.

MANILA  
BUREAU OF PUBLIC PRINTING  
1905

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(Continued on third page of cover.)



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1905



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,  
*Manila, P. I., May 19, 1905.*

SIR: I have the honor to transmit herewith and to recommend for publication "I. Notes on a Case of Hæmatochyluria, together with Some Observations on the Morphology of the Embryo Nematode *Filaria Nocturna*," by Dr. William B. Wherry, Bacteriologist, Biological Laboratory, and Dr. John R. McDill, Manila, P. I., and "II. A Search into the Nitrate and Nitrite Content of Witte's 'Peptone,' with Special Reference to its Influence on the Demonstration of the Indol and Cholera-Red Reactions," by Dr. William B. Wherry, Bacteriologist, Biological Laboratory.

Very respectfully,

RICHARD P. STRONG,  
*Director Biological Laboratory,  
Acting Superintendent Government Laboratories.*

HON. DEAN C. WORCESTER,  
*Secretary of the Interior, Manila, P. I.*



# I. NOTES ON A CASE OF HÆMATOCHYLURIA.

TOGETHER WITH SOME OBSERVATIONS ON THE MORPHOLOGY OF THE EMBRYO  
NEMATODE *FILARIA NOCTURNA*.

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By WM. B. WHERRY, M. D., *Bacteriologist, Biological Laboratory*, and  
JOHN R. McDILL, M. D., *Manila, P. I.*

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The diagnosis of many cases of filariasis in which the adult parasites are inaccessible must depend upon the identification of the embryo nematodes. Most of the published pictures of *Filaria nocturna* have been drawn apparently from stained preparations, and all the high-power photomicrographs we have seen, depict the parasite in a greatly degenerated condition and do not present the morphological details observed in a fresh preparation. The study of a case of hæmatochyluria during the past six months and the accessibility of a Zeiss photomicrographic apparatus have given us the opportunity of presenting the accompanying illustrations together with an abstract of our notes on the case.

## ABSTRACT OF CLINICAL HISTORY.

On May 30, 1904, O Saya, a Japanese girl, 22 years old, came under our observation. She came to Manila four years ago from a village near Nagasaki. The patient was emaciated, pale, and weak and complained of passing bloody and milky urine and of attacks of abdominal pain referred chiefly to the right lumbar region. The abnormal urine was first noticed in August, 1903. This disappeared spontaneously in three months and she had no further trouble until the present attack. She claimed to have always drunk boiled water or tea and she gave a history of previous good health. The patient was placed in the Manila Civil Hospital, where during the evening and at night she was protected by a mosquito net.

Upon admission she was passing a considerable amount of milky,

peach-colored urine, sometimes quite bloody, which upon cooling contained large and small clots of reddish and yellowish jelly-like material. These fibrinous clots were sometimes passed through the urethra and occasioned some pain. In the centrifugal precipitate a number of filaria-like organisms were found, but as none could be observed in the peripheral circulation during the day or at night, the patient was put on tonics and boric-acid bladder irrigations until the end of June, when urotropin, 1 gram three times a day, was given and the douches changed to bichloride of mercury 1-10,000, while morphine was administered hypodermatically for the pain.

At 9 p. m. July 23 filaria, resembling those occurring in the urine, were found in the blood from a finger. The patient was kept in a bed, the foot of which was elevated, and received just enough food, without fats, and liquid to sustain life, and a very weak solution of adrenalin chloride was injected into the bladder and allowed to remain.

From August 1 to 15 the adrenalin was given by mouth, in doses of 10 to 15 drops of a 1-1,000 solution every four hours during the daytime, 40 to 50 drops per day. On August 15 this treatment was stopped. At this time some swelling of the right thigh developed but subsided after a few days. The patient remained in the elevated bed until the middle of October.

On August 29 methylene blue, 0.12 gram every four hours, was given by mouth. This was stopped on September 4 on account of the occurrence of violent emesis.

At the suggestion of Dr. W. E. Musgrave we attempted to "sensitize" the adult parasites by the administration of quinine followed by the exposure of the body of the patient, through the lumbar region, to the X-rays. She was given 80 to 90 grains of quinine sulphate during forty-eight hours, followed by X-ray exposures of five minutes, with the tube 18 inches away. Quinine having been administered daily, these exposures were performed from 2 to 3 p. m. on September 8, 10, 11, 12, 14, 16, 17, 18, and again, after cinchonizing as before, at 9 p. m. on September 28 and 30.<sup>1</sup>

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<sup>1</sup>Unfortunately we are unable to state the exact hardness of the X-ray bulbs. In order to obtain a clear radiograph of the bones of the pelvis with this apparatus an exposure of fifteen minutes with the bulb at a distance of 5 inches from the skin surface is necessary. Filarial embryos in a thin layer of blood, collected after cinchonizing, exposed to the rays for five minutes with the bulb 16 inches away are not killed, but they squirm about in a very excited manner.



On October 2 the skin over the chest and abdomen became reddened and hot. A chill and left pleurisy developed. Paracentesis produced about 600 cubic centimeters of straw-colored fluid on October 8. Skin scarlet all over body. All this time the urine remained thick and bloody, but on October 10 became normal and has remained so. The temperature throughout, except during the attack of pleurisy, remained about normal— $97^{\circ}$  to  $99.4^{\circ}$  F. in the morning and  $98^{\circ}$  to  $99.4^{\circ}$  F. in the evening.

Until the pleuritic attack the patient had gained 25 per cent in weight and general appearance, and, although an evening temperature of  $1^{\circ}$  to  $3^{\circ}$  F. persisted until October 22, she regained strength so rapidly that on October 29 and 30 the X-ray was again applied for fifteen minutes, after quinine, with the bulb 5 inches away.

Although the patient has been at home and walking about for the past two months, her chyluria has not returned. The living embryos still persist in her blood, and hence it is altogether likely that the treatment had no effect upon the adult parasites.

#### SPECIAL FEATURES OF THE CASE.

(1) *The urine.*—The analyses of the urine have yielded the usual findings in such cases, excepting our failure to extract fatty matters in appreciable quantities. The bloody, milky urine never altered its appearance on prolonged shaking with ether, even after making it alkaline with sodium hydroxide, and the evaporation residue seemed to consist of other than fatty extractives, though in one instance a trace of fat was found by testing for glycerine. Its milky appearance may have been partly due to the considerable number of leucocytes it contained. The amount of albumin varied between 0.33 and 0.6 per cent. For example, an analysis by Mr. C. L. Bliss, physiological chemist of the Bureau, on August 26, gave: Quantity, 675 cubic centimeters; specific gravity, 1.026; reaction acid but turning, kept at  $30^{\circ}$ ; albumin, 0.33 per cent, average of five tests by Esbach's method; fat, trace, by glycerine test.

(2) *The blood.*—Four days after admission a blood count gave 3,100,000 reds and 6,000 whites. The anemia almost disappeared as the general condition of the patient improved, during the period when she was at rest with the hips elevated. The excessive loss of blood did not continue for a long time and the anemia did not reach the grave character of such cases as Herriek (1) described as due to repeated losses of blood from hemorrhoids.

On July 30, the number of parasites per cubic centimeter in the patient's peripheral circulation was calculated. In order to obtain drops of blood of known volume, the method of collecting it and estimating the number of parasites per cubic centimeter used by Lathrop and Pratt was employed. Three equal-sized drops of blood were taken every two hours, beginning at 10 a. m. and ending at 6 a. m. on the following day. The average number of parasites present was then determined by counting the stained filaria on a mechanical stage. The following chart shows the rise and fall in the number of filaria per cubic centimeter present during the different times of the day and night:

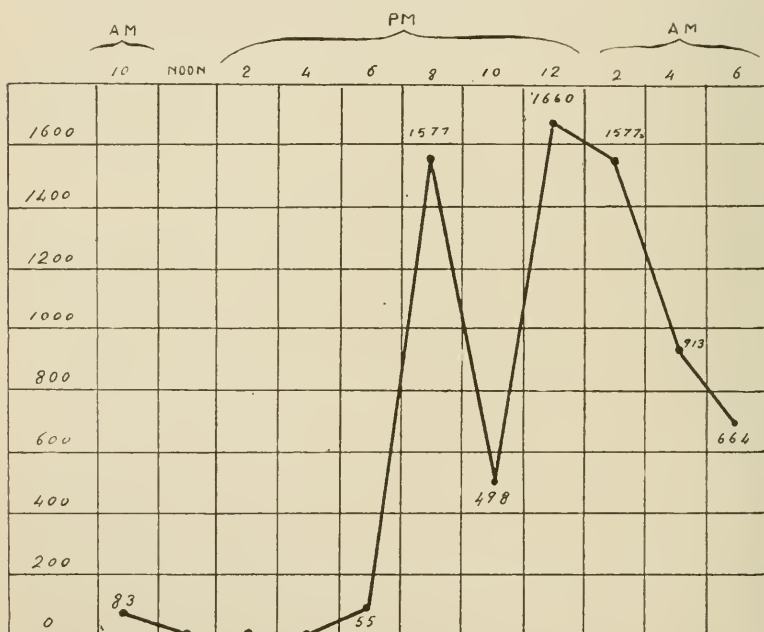


Chart showing the rise and fall in the number of filaria in the patient's peripheral circulation during different times of the day and night. The figures in the left-hand column arbitrarily represent the number of filaria per cubic centimeter of blood, while those within the ruled squares indicate the calculated number of filaria per cubic centimeter of blood.

Strong, (2) in 1901, reported the first case of infection in the Philippine Islands with *Filaria nocturna* in a European who had resided in Iloilo for two years. A differential count of the leucocytes showed 3 per cent of eosinophiles.

In 1902, Calvert, (3) working in Manila on Filipino prisoners of war, found four cases of filariasis—lymphatic varices and hydrocele. No description of the parasites is given, but they were of the nocturnal variety and probably the embryos of *Filaria bancrofti*. By means of extensive blood counting in three cases he showed the presence of a decided eosinophilia, which was most marked at the time when the embryos were absent from the peripheral circulation. Trichinosis was excluded, but apparently no examination was made for uncinaria.

In our case not so many counts were made. The eosinophiles varied from 6 per cent (10 a. m.) to 12 per cent (12 p. m.) and were most numerous in the peripheral circulation at the time when the embryos occurred in greatest numbers, as follows:

*July 28, 10 a. m.*

[Reds, 4,340,000; whites, 11,000.]

	Per cent.
Polynuclear and transitional leucocytes.....	55
Eosinophiles.....	6
Basophiles.....	4
Large mononuclears.....	22
Small mononuclears.....	13
Total.....	100

One hundred leucocytes counted; 1 normoblast and no filaria seen.

*August 9, 8 p. m.*

[Reds, 4,290,000; whites, 6,000.]

*Differential.*

	8 p. m.	12 p. m.
	Per cent.	Per cent.
Polynuclear and transitional leucocytes.....	72	71.50
Eosinophiles.....	10.50	12
Basophiles.....	1.50	1.50
Large mononuclears.....	3.50	5
Small mononuclears.....	12.50	10
Total.....	100	100

Two hundred leucocytes counted.

*Number of filaria per cubic centimeter.*

[Calculated from the average number in two slides.]

8 p. m.....	489
12 p. m.....	1,079

On the morning of August 10 the patient was given an ounce of magnesium sulphate and her stool carefully examined for signs of intestinal parasites. Nothing but a few ova of *Trichocephalus dispar* was found. We believe that trichinosis can be excluded and are not aware that the eosinophilia can be influenced by the *Trichocephalus dispar* which the patient harbors.<sup>1</sup>

According to Manson (6) the presence of blood in the urine in such cases is not due to the rupture of blood vessels but to "the formation of blood corpuscles in the lymph long retained in the varicose vessels." Our failure to alter the sanguineous character of the urine by the administration of adrenalin, locally and by the mouth, seems to support this idea. On the other hand, the development of anæmia and the presence of a few normoblasts in the peripheral circulation would seem to indicate that at least a portion of the loss occurred through capillaries torn during the rupture of dilated lymph vessels, as is suggested by Scheube (7).

(3) *The embryo nematode* has been well described by Manson, and our own study has been greatly influenced by his excellent descriptions. A brief description made on July 30 may be inserted here:

A fresh preparation was made at 10 p. m., ringed with vaseline and a filaria watched for some time. It underwent the usual movements of coiling, uncoiling, and sliding forward and backward within its sheath. At about the junction of the middle and posterior thirds there could be seen an irregularly elongated viscus-like organ, which seemed to be composed of a granular

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<sup>1</sup>Remlinger (4) (Constantinople) has recently noted an eosinophilia of 48 per cent in a case of multiple infection with the Medina worm. He says: "Elle est également à rapprocher de l'éosinophilie observée la *Filaria sanguinis hominis*, la *Filaria Loa*, la *Filaria Immitis*, du Chien, etc."

Manson (5) has expressed the belief that a large number of filarial embryos in the peripheral circulation indicates a multiple infection with adult parasites. Apparently there is no definite information as to the fate of the embryos, but Bancroft computes their life duration at a few months. To our knowledge they have not been observed in the dead condition in the blood of man except when killed by some form of medication, as in Scheube's case, which was treated with picric-nitrate or potash. It seems possible that they may accumulate in the blood, and, if so, large numbers would merely indicate that the case was of long standing. The grade of eosinophilia, together with an enumeration of the embryos by the method of Lathrop and Pratt, especially if supported by a post-mortem or post-operative search for the adult parasites, would throw light on this point.

tissue that was almost whitish by transmitted light. In about two hours the motions were reduced to very slight squirming movements. The outer contour of the filaria was clear cut, but within its lateral borders the serrated edges of the transverse fibers of the musculo-cutaneous layer could be traced. A little more than halfway between the anterior end and the viscus-like organ there was a refractile V-shaped papilla with its apex turned toward the lateral border of the filaria. With the one-twelfth oil immersion and compensation ocular No. 8, the head end was observed and at its extreme tip a notched retractile lip could be seen. Owing to the rapidity of the retractile movements the number of notches was indistinguishable. In addition there was a short, refractile, needle-like process, which was seen to be projected and withdrawn. A few minutes later, when the movements had become slower, the lip, when retracted, showed at least three refractile tooth-like projections, and the needle-like spicule was seen to be projected at about the level of the middle tooth. (See Figs. B and C, Pl. II.)

By watching carefully and noticing what was revealed during the contractions and relaxations of the circular muscular fibers, three narrow, refractile, and sinuous duct-like threads could be traced backwards until they united with the anterior end of the viscus-like organ. (See fig. 2, Pl. I, and Fig. B, Pl. II.) The exact manner in which they terminated anteriorly could not be made out. No particular structure could be distinguished posterior to the viscus-like organ, excepting a refractile, V-shaped papilla, like the anterior one, and situated on the same side of the body at a place slightly posterior to a point halfway between the hind end of the viscus and the tip of the tail. The loose, transparent sheath could be seen projecting beyond the posterior but not beyond the anterior end of the parasite. In six hours ecdysis was not complete, the viscus-like organ had disappeared, and refractile granules began to make their appearance in the protoplasm. The parasite was measured just before granular degeneration set in and was found to be: Length, 0.31 millimeter; greatest breadth, 0.0075 millimeter; from anterior tip to anterior end of viscus, 153  $\mu$ ; length of viscus, 49.5  $\mu$ ; from posterior end of viscus to tip of tail, 114.75  $\mu$ . (Zeiss one-twelfth ocular micrometer 3.) The average of four measurements is 0.327 by 0.0074 millimeter.

We have no new morphological details to add, excepting the three duet-like threads which connect the viscus-like organ with the head of the embryo. These must be looked for as soon as the motions of the parasite become slow enough to permit the use of an oil-immersion lens, for the granular degeneration, which sets in soon after motion ceases, obscures all finer details.

(4) *Photographing the embryo*.—It is quite difficult to obtain good high-power photographs of the live filaria, and Mr. Martin's success followed only the most persistent efforts. The ray filter must be dispensed with and the photograph taken very soon after the embryo is exposed to the rays of the electric arc, as it undergoes rapid granular degeneration and its motions cease much sooner than when subjected to ordinary daylight.

#### PREVALENCE OF THE DISEASE IN THE PHILIPPINE ISLANDS.

There seems to be little positive information as to the extent to which the disease prevails in these Islands. Strong's case, as mentioned, had resided in Iloilo for two years. Calvert's cases came from northern and southern Luzon. Scheube, in his map showing the geographical distribution of filariasis, included this island but none of the southern islands of the group. We have not had time to go into this side of the subject thoroughly, but inquiry shows that physicians who have been in Manila for from ten to forty years have only rarely encountered cases of chyluria or chylocele. Elephantiasis seems to be absent and filarial lymphangitis and varicose lymph glands may have been overlooked in the past. One other case of chyluria was seen in a Filipino this year by Dr. Bartels, but the patient left for the provinces before his blood could be examined. Several English physicians say they have seen cases of filariasis at Iloilo.<sup>1</sup>

It seems that the disease may be imported into localities where the conditions for its transmission are apparently unfavorable. Our patient has been living with four other Japanese during four, three, three, and two years, respectively. An examination of these four and of a number of other Japanese living in their neighborhood was made late at night with negative results. This is rather surprising when one considers that *Culex fatigans*, the

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<sup>1</sup>Since the above was written Mr. Hare of this Laboratory has encountered one case of filarial lymph scrotum in a Filipino residing in Manila. The embryos were found in the peripheral circulation.—R. P. S.



mosquito which acts as a favorable intermediate host in many parts of the world, is one of the commonest species of mosquito found in Manila. However, it should be remembered that, notwithstanding the existence of some very strong presumptive evidence, the exact manner in which filariasis is transmitted is still an open question. The brilliant observations of Manson and Bancroft showing the metamorphosis of *Filaria nocturna* in the bodies of certain mosquitoes, and the further confirmation and extension of their views by the more recent work of Low (8) and James, (9) all tend to convince one that the disease is transmitted by the bite of certain mosquitoes.<sup>1</sup> But the facts that a number of persons can live for years with a filariated patient, when apparently a favorable intermediate host is present throughout the year, without their acquiring the disease, as in our case, and the similar cases cited by Maitland, (10) and the "relative immunity" of Europeans and others who are careful with regard to their food and drink, raise the old question whether Manson may not have been correct in his original assumption that the filaria escape from the mosquito to some watery medium and then gain entrance to their definitive host.

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<sup>1</sup>In the older literature on the transmission of filariasis, *Culex ciliaris* L. was named as the intermediate host, but in recent years our knowledge of the *Culicidæ* has been greatly extended, and it has been shown by Theobald (11) that *C. ciliaris* L. is identical with *C. pipiens*, and further, that in all probability Manson's original work in China and Bancroft's later work in Australia was not done on *C. pipiens* L. but on *C. fatigans* Wied. (12). This widespread species is a voracious night feeder and occurs in large numbers in Manila. According to Low, (13) "it is the chief spreader of filarial disease in the West Indies, acting as an intermediate host for *F. nocturna*. \* \* \* It is inefficient for *F. demarquaii*." That the intermediate host is not restricted to one genus or species of mosquito is shown by the feeding experiments of James, (9) in which *Anopheles rossii* Giles and possibly a species of *Culex*—*Culex microannulatus* Theob. and *Stegomyia scutellaris* Walk.—were shown to be suited for the metamorphosis of *Filaria nocturna*.

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## DESCRIPTION OF PLATES.<sup>1</sup>

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PLATE I. Fig. 1. *Filaria nocturna* (X about 390, double exposure), showing the general morphology and the viscus-like organ at the junction of the middle and posterior thirds of the parasite.

Fig. 2. Head end of *Filaria nocturna* (X about 880). The sheath, the three duct-like threads connecting the anterior end of the viscus-like organ with the head end of the embryo, and the transverse striations of the musculo-cutaneous layer may be seen.

II. (Figures redrawn by T. Espinosa, anatomical artist of the Laboratory, from originals.)

Fig. A. Represents a dead filaria showing granular degeneration.

Fig. B. Drawn from a filaria just before granular degeneration set in. Proportions about correct as seen with the Zeiss one-twelfth oil immersion compensation ocular No. 8. Length, 0.330 millimeter; breadth, 0.00765 millimeter. The distance between the anatomical markings were as follows: A-B, 97.92  $\mu$ ; B-C, 53.55  $\mu$ ; C-D, 61.20  $\mu$ ; D-E, 64.26  $\mu$ ; E-F, 53.55  $\mu$ ; total, 330.48  $\mu$  or 0.33 millimeter.

Fig. C. Head end of filaria showing retracted lips and spicule.

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<sup>1</sup>Photomicrographs by Chas. Martin, photographer of the Laboratory.



PLATE I.



FIG. 1.

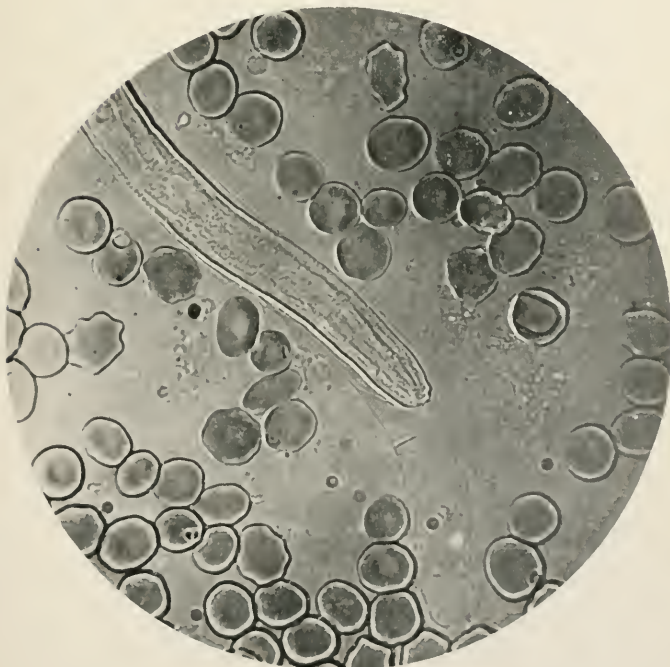
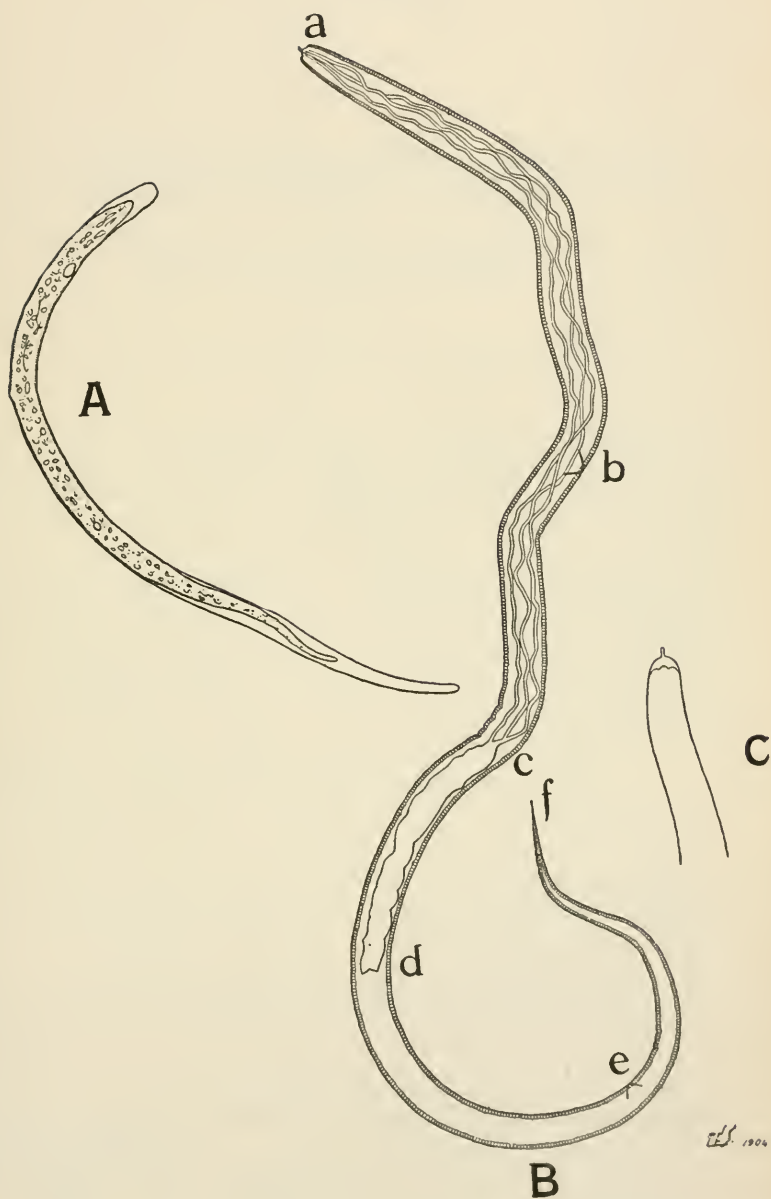


FIG. 2.





PLATE II.





## II. A SEARCH INTO THE NITRATE AND NITRITE CONTENT OF WITTE'S "PEPTONE."

WITH SPECIAL REFERENCE TO ITS INFLUENCE ON THE DEMONSTRATION OF  
THE INDOL AND CHOLERA-RED REACTIONS.

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By WM. B. WHERRY, M. D., *Bacteriologist, Biological Laboratory.*

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In a previous publication from the laboratory<sup>1</sup> I concluded, by rather rough experimental methods and deductions, that the cholera spirillum is not a nitrifying organism and that the successful demonstration of the cholera-red reaction in a culture grown in a solution of Witte's "peptone" depends upon the reduction of a trace of nitrates. I was unaware at the time my experiments were performed that Petri<sup>2</sup> and Bleisch<sup>3</sup> had already performed quite extensive and conclusive experiments upon this point. The latter worker also pointed out that the presence of an excess of nitrates or nitrites in the medium interfered with the reaction and that the nitrate content of ordinary bouillon is so inconstant as to make it valueless for diagnostic purposes.

Some peculiar results in testing for indol, during the study of some bacteria from a case of irregular fever, emphasized for me the urgent necessity of adopting methods of preparing and testing media which would indicate the presence or absence of certain chemical constituents influencing such a biochemical test. This led to an investigation into the manner in which nitrates and nitrites may gain an entrance to media, and on the influence of such variations on the demonstration of indol and cholera-red reactions.

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<sup>1</sup>*Bulletin No. 19 (1904)*, Biological Laboratory, Bureau of Government Laboratories, Manila, P. I.

<sup>2</sup>*C. B.* 1889, 5, 561.

<sup>3</sup>*Zeit. für Hyg. u. Infekt.*, 1893, 14, 103.

It does not seem to me that the distinct difference between the indol and cholera-red reactions has been sufficiently emphasized in the past. By reference to the before-mentioned publication it will be seen that I did not fully appreciate this difference myself for reasons which will be evident. Salkowski and Nencki<sup>1</sup> mistook the *purple*-colored indol reaction for the cholera *red*, and although Petri and Bleisch undoubtedly produced the cholera-red reaction, they do not dwell on the difference between it and the indol reaction. Kolle<sup>2</sup> says that "on adding small quantities of concentrated, chemically pure sulphuric or hydrochloric acid to bouillon or peptone cultures of cholera vibrios a violet or burgundy-wine-red color appears as was shown by Poehl and later by Bujwid and Dunham." Now there is a very distinct difference between the violet or purple colored indol reaction and the vermilion-colored cholera-red reaction when these tests are performed under carefully controlled conditions; and since both tests are of value in the differentiation of species, it seems advisable to define further the conditions under which they must be performed.

Further, my experiments have convinced me that the cholera spirillum does not produce nitrites in Dunham's peptone solution, made from Witte's "peptone" dialyzed free from nitrites, and that the apparent production of nitrites can be explained by the testing of uninoculated controls.

#### (1) RESULTS OF A SEARCH FOR NITRATES AND NITRITES IN SOME INGREDIENTS USED IN PREPARING MEDIA.<sup>3</sup>

In testing for nitrogen, as nitrites, the naphthylamine-hydrochloride and sulphanilic-acid test was used in the manner usually employed in Nesslerizing for ammonia, excepting that for purposes of comparison the reactions were performed in culture test tubes. In practice 1 cubic centimeter of each test solution was added to 10 cubic centimeters of the fluid to be tested. Where nitrates were sought for, the phenol-sulphonic-acid test was used and the reactions performed in 3-inch porcelain evaporating dishes.

The preliminary examination of a number of bottles of distilled

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<sup>1</sup> Vide the article by M. Bleisch, loc. cit.

<sup>2</sup> *Handbuch der Pathogenen Mikroorganismen*, Kolle u. Wasserman, 1903, 3, 21.

<sup>3</sup> I am indebted to Mr. C. L. Bliss, physiological chemist of the Bureau, for valuable advice during the course of the experiments.

water furnished by the Government ice plant showed that this water sometimes contained nitrites in considerable quantities. So water was redistilled from potassium permanganate, collected in a perfectly clean manner, and tested to prove the absence of nitrites and nitrates before use.

Several samples from a bottle of Kahlbaum's chemically pure sodium chloride were found free from nitrates and nitrites. This was employed throughout the following experiments.

In testing "peptones" 0.1 gram was dissolved in 10 cubic centimeters of pure water, thus 10 cubic centimeters of a 1 per cent peptone solution were obtained. In this way all our stock of Witte's "peptone"—eight bottles—and in addition one bottle of Grübler's pepton depur. sicc., were tested for nitrites. Some of the tests were repeated more than once, as indicated in Table I, and in the last analysis, when the reactions were sufficiently marked, they were compared with the standard sodium nitrite colorimetric scale usually employed in the quantitative estimation of nitrites.

TABLE I.

"Peptone."	Number of bottles.	Nitrites. (In 0.1 gram "peptone.") (In 10 cubic centimeters water.)	Nitrates. (In 0.1 gram "peptone.")
Witte's peptonum siccum -----	1	{(1) Trace ----- (2) 0.0000005 gram nitrogen -----	} None.
Witte's peptonum siccum, pro bacteriologic.	2	{(1) 0 ----- (2) 0 ----- (3) 0 -----	} Do.
Peptonum siccum -----	3	{(1) Distinct reaction ----- (2) 0.0000005 gram nitrogen -----	} Not tested.
Do -----	4	{(1) Distinct reaction ----- (2) Trace -----	} Do.
Peptonum siccum, pro bacteriologic.	5	{(1) Trace ----- (2) Distinct reaction ----- (3) 0 -----	} None.
Peptonum siccum -----	6	{(1) Trace ----- (2) Trace -----	} Not tested.
Do -----	7	{(1) Trace ----- (2) Distinct, but less than 0.0000005 gram nitrogen -----	} Do.
Do -----	8	{(1) 0 ----- (2) Trace ----- (3) Trace -----	} Do.
Pepton depur. siccum Grübler. --	9	{(1) Trace ----- (2) Trace -----	} Do.

These are the only records I have of a considerable number of such tests, but they suffice to show that nitrites occur in some "peptones" in varying and often considerable quantities.

They further show that nitrites may be distributed irregularly throughout the mass of "peptone," for when one sample, for instance, from the surface reacts to the test, another from a deeper

portion of the bottle may be free from nitrites, or vice versa. This, together with further evidence to be presented, plainly indicates why the indol reaction may be obtained with one lot of media by the addition of chemically pure sulphuric acid alone while with another the addition of nitrite is necessary.

All these "peptones" give a strong Biuret reaction, but only one was tested for the presence of peptones. Ten grams from bottle No. 5 were dissolved in pure water and placed in a parchment dialyzer with all due precautions against introducing nitrites. After six hours at 28° the diffusate (about 150 cubic centimeters) was tested. It did not give the Biuret reaction, and 10 cubic centimeters gave a reaction for nitrites equal to 0.0000005 gram nitrogen.

Further, it was necessary to wash filter paper free from nitrites—e. g., a filter paper (Schleicher and Schülls) was washed with 200 cubic centimeters nitrite-free water; 10 cubic centimeters of the filtrate gave a reaction for nitrites corresponding to about 0.0000005 gram nitrogen.

The sulphuric acid used throughout these experiments was tested to prove the absence of nitrites.

## (II) EXPERIMENTS ON THE DEMONSTRATION OF THE INDOL AND CHOLERA-RED REACTIONS IN DUNHAM'S PEPTONE SOLUTION.

### (I) IN UNDIALYZED PEPTONE SOLUTION.

Dunham's peptone solution, containing 1 per cent Witte's "peptone" (bottle No. 5) and 0.5 per cent sodium chloride, in redistilled water, was prepared with special precautions to avoid introducing nitrates and nitrites.<sup>1</sup>

Half of the medium was distributed in test tubes (10 cubic centimeters per tube) and marked "peptone solution only." To the other half was added 0.01 per cent of a freshly prepared solution of sodium nitrate, and this was then distributed in a similar manner. Both sets were autoclaved for half an hour at 120°. Final reaction, 0.5 per cent acid to phenolphthalein. A tube of

<sup>1</sup>A large glass beaker was found to be especially convenient for boiling medium, as one can more easily mark the initial height of the latter and watch the completeness of solution than when the cooking is performed in an agate-ware boiler. The albumoses do not all go into solution in the presence of 0.5 per cent sodium chloride.



each of the media tested for nitrites gave a reaction equal to about 0.0000005 gram nitrogen.

(a) One tube of each medium was inoculated with cholera 579.<sup>1</sup> After eighteen hours' growth at 36° to 37°, 0.5 cubic centimeter of pure sulphuric acid was added to each culture. The culture marked "peptone solution only" yielded an immediate *purple*-colored indol reaction. The culture marked "peptone solution only +0.01 per cent NaNO<sub>3</sub>" did not give an immediate reaction, but in about half an hour developed an intense *red* color (cholera-red reaction).

(b) That this "peptone solution only" is eminently suitable for the production of indol by *B. coli* 577<sup>2</sup> is shown by the following experiment:

Three tubes were inoculated each day for eight successive days and the cultures kept at 36° to 37°. Bearing in mind the observation of A. W. Peckham,<sup>3</sup> that with different cultures of *Bacillus coli* the maximum amount of indol could be decided only by corresponding variations in the proportions of nitrites and acid used, I experimented to see whether a similar variation in the amount of nitrites and acid was necessary to elicit the maximum indol reaction in cultures of the same organism—for example, of two and eight days' growth.

To each series of three tubes, then, one-half, 1, and 2 cubic centimeters of a 0.01 per cent sodium nitrite solution and corresponding amounts of pure sulphuric acid were added. Throughout the series the most intense reaction was elicited by using 0.5 cubic centimeter of the test solutions, with the exception of the seven-day-old series, where 1 cubic centimeter yielded the best reaction.

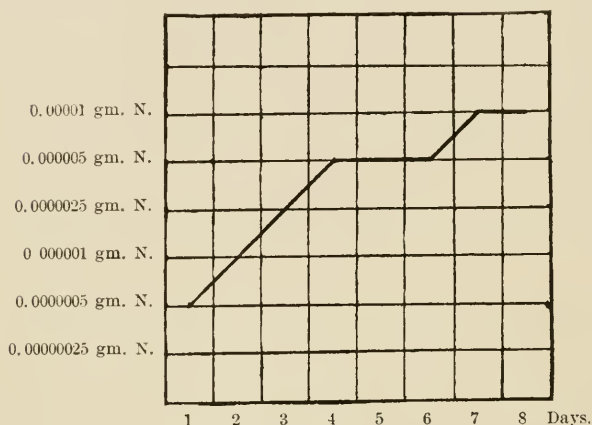
Two cubic centimeters invariably yielded enough nitrous acid to obscure the reaction. It may be of interest to plot the gradual

<sup>1</sup>Unfortunately I have been unable to test all the cholera cultures described in *Bulletin 19* of this Bureau, owing to the accidental death of nearly all my stock cultures. This strain of culture, 579, was reclaimed by plating Dr. W. E. Musgrave's amoeba culture 11524 grown in pure symbiosis with this spirillum. Later, when I found there were other cultures of the cholera spirillum in the laboratory, I did not have opportunity to perform these tests with them.

<sup>2</sup>A culture kept in stock for two years, the fermentation tests of which are given on page 24, *Bulletin 19, Biological Laboratory, Bureau of Government Laboratories, Manila*, P. 1.

<sup>3</sup>*Jour. Exper. Med.*, 1897, 2, 560.

increase of indol as shown in the following chart, where the reactions of greatest intensity are compared with the colorimetric scale of standard sodium-nitrite dilutions:



Throughout the following experiments the test for indol was made by adding 0.5 cubic centimeter of a freshly prepared 0.01 per cent solution of sodium nitrite and 0.5 cubic centimeter of pure sulphuric acid. Cholera red was tested for by adding 0.5 cubic centimeter of pure sulphuric acid.

(c) Such an albuminous medium, moreover, seems to absorb nitrites from the laboratory atmosphere much more rapidly than distilled water does, for this "peptone" solution, which at first gave reactions for nitrites corresponding to about 0.0000005 gram nitrogen, after two weeks at 18° to 28° gave reactions corresponding to about 0.0000025 gram nitrogen—an increase quite sufficient to yield an indol reaction when pure sulphuric acid alone is added to a twenty-four-hour culture of *B. coli* 577.

This increase of nitrites was not due to an increase in the concentration of the medium, for the initial level of the medium had been marked on each tube and very little evaporation had taken place. Further, this increase in the amount of nitrites in the medium containing nitrates is sufficient to obscure somewhat the bright vermilion-red color of the cholera-red reaction.

## (II) IN DIALYZED PEPTONE SOLUTION (NITRATE AND NITRITE FREE).

As there was very little "peptone" left in bottle No. 2, 10 grams from bottle No. 5 were dissolved by boiling in about 200 cubic centimeters of pure water. It was then dialyzed through parchment with due precautions against introducing nitrates or nitrites or any other foreign substance. As mentioned, no peptones were found in the first diffusate (six hours), which gave a reaction for nitrites. The process was continued for twenty-four hours during two days, the contents of the dialyzer being removed, concentrated by boiling, and sterilized at necessary intervals. At this time 10 cubic centimeters of the contents of the dialyzer gave no reaction for nitrites. Dunham's peptone solution was then made up as in the experiments with undialyzed "peptone"—one set being marked "nitrite-free peptone" and the other "nitrite-free peptone +0.01 per cent  $\text{NaNO}_3$ ." After autoclaving, the "nitrite-free-peptone" solution gave no reaction for nitrites or nitrates, while the other gave no reaction for nitrites but quite a distinct reaction for nitrates. The final reaction of this dialyzed medium was 0.1 per cent alkaline to phenolphthalein, showing the removal of substances capable of reacting acid to phenolphthalein to the extent of 0.6 per cent.

A series of tubes inoculated with cholera 579 was tested after seventeen hours at  $36^\circ$  to  $37^\circ$ , with the following results:

TABLE II.

Medium.	Culture.	Hours at $36^\circ$ to $37^\circ$ .	Nitrites.	Cholera red.	Indol.	Nitrites in uninoculated controls.
Nitrite-free peptone.	579	17	No reaction.	No reaction----	Deep purple color immediately.	No reaction.
Nitrite-free peptone +0.01 per cent $\text{NaNO}_3$ .	579	17	Intense reaction.	Light-red color after several hours, $36^\circ$ to $37^\circ$ .	-----	Do.

In about ten days, however, this dialyzed medium had absorbed enough nitrites to give a distinct reaction, and without the use of uninoculated controls one might have assumed that the nitrites

were produced through the activity of the cholera spirillum, as may be seen in Table III:

TABLE III.

Medium.	Culture.	Days at 36° to 37°.	Nitrites.	Nitrites in uninoculated controls.	Cholera red.	Indol.
Nitrite-free peptone.	Cholera 579.	<div> <div>1</div> <div>2</div> <div>3</div> </div>	<div> <div>Faint reaction: all three of equal intensity.</div> </div>	<div> <div>Faint reaction equal to that in tubes inoculated with cholera 579 and of equal intensity when compared with each other.</div> </div>	<div> <div>No reaction.</div> </div>	<div> <div>Deep purple color.</div> </div>
Do.-----	Coli 577----	1	-----	-----	-----	No reaction
Do.-----	-----do-----	2	-----	-----	-----	Faint.
Do.-----	-----do-----	3	-----	-----	-----	Marked reaction.

It will also be noted that the faint trace of nitrites absorbed from the atmosphere was not sufficient to yield any reaction, when sulphuric acid alone was added, but that the addition of nitrite and sulphuric acid produced a very distinct indol reaction.

In the dialyzed medium containing 0.01 per cent sodium nitrate, the cholera spirillum almost completely reduces the nitrates to nitrites in twenty-four hours, as shown in Table IV:

TABLE IV.

Medium.	Culture.	Days at 36° to 37°.	Nitrites.	Nitrates.	Cholera red.	Indol.
Nitrite-free peptone +0.01 per NaNO <sub>3</sub> .	Cholera 579.	<div> <div>1</div> <div>2</div> <div>3</div> </div>	<div> <div>Marked reaction.</div> </div>	<div> <div>Faint reaction.</div> <div>Negative ----</div> <div>(Not tested) -</div> </div>	<div> <div>Yellowish --</div> <div>Reddish-yellow.</div> <div>Distinct, marked red color with none of the purple color of indol reaction.</div> </div>	<div> <div>Yellowish.</div> <div>Reddish-yellow.</div> <div>Distinct, marked red color with none of the purple color of indol reaction.</div> </div>
Do.-----	Coli 577----	1	-----	-----	As per cholera 579, but of lesser intensity.	-----
Do.-----	-----do-----	2	-----	-----	-----	-----
Do.-----	-----do-----	3	-----	-----	-----	-----

Here an immediate and distinct cholera-red reaction was not obtained until the organism had grown for three days at  $36^{\circ}$  to  $37^{\circ}$ . This experiment (which is one of a number) also shows that, when growth takes place in the presence of 0.01 per cent sodium nitrate, even if a trace of nitrite be also originally present, something (an oxidation product of indol?) is produced which is demonstrable as "cholera red,"<sup>1</sup> whether sulphuric acid alone or sulphuric acid and nitrite are added subsequently, though such a further addition of nitrite may obscure the reaction.

On the other hand, a few days' growth in the presence of sufficient nitrite to yield the indol reaction does not influence the character of the indol formed; but if a considerable amount of nitrite be present in the medium, the further addition of nitrite yields enough nitrous acid to obscure the indol reaction.

#### SUMMARY AND CONCLUSIONS.

(1) Nitrites, and probably nitrates also, may gain entrance to artificial media from various sources—certain waters, "peptones," and filter papers—yielding distinct reactions for nitrites with naphthylamine hydrochloride and sulphanilic acid.

(2) A sufficient quantity of nitrites may be further absorbed, in a few days, from the laboratory atmosphere, to yield a distinct indol reaction upon the addition of 0.5 cubic centimeter of chemically pure sulphuric acid to, for example, a culture of *B. coli* 577 grown for twenty-four hours at  $36^{\circ}$  to  $37^{\circ}$  in 10 cubic centimeters of Dunham's peptone solution, which originally contained insufficient nitrite to yield such a reaction.

(3) The cholera spirillum does not produce nitrites in nitrate and nitrite-free "peptone" solution, prepared from Witte's "peptone" dialyzed free from nitrites; and when nitrites are apparently formed their presence may be explained by the simultaneous testing of uninoculated controls. In this I disagree with Bleisch, who believed that small quantities of nitrites could be

<sup>1</sup> According to Kolle (loc. cit.) "cholera red" was isolated in a pure state by Brieger, who considered the cholera-red reaction as nothing more than the nitroso-indol reaction—the nitrous acid set free combining with the indol to produce a new substance, the cholera red. Brieger's original articles (*Deut. Med. Woch.* 1887, Nos. 15 and 22), while ordered for the library, are not within reach, so I can not discuss this point.

formed, and agree with Petri, who considered the existence of such a nitrifying power as unproved as well as improbable.

(4) The vermilion-colored "cholera-red reaction" must be distinguished from the purple-colored "indol reaction."

(5) The production of "cholera-red," by the cholera spirillum or *B. coli*, takes place only, under the conditions of these experiments, during the reduction of a trace of nitrate, and when formed is demonstrable as such, whether pure sulphuric acid alone or sulphuric acid and nitrite are added, although an excess of nitrite furnishes enough nitrous acid to obscure the reaction.

(6) The growth of *B. coli* or the cholera spirillum in the presence of sufficient nitrite to yield the indol reaction on the addition of a pure acid alone does not influence the character of the indol formed, but if a considerable amount of nitrite be present in the medium the further addition of nitrite yields enough nitrous acid to obscure the indol reaction.

(7) The cholera-red reaction is not specific.

(8) It is recommended that media used in testing for the production of indol or cholera red be examined for nitrates and nitrites before use.









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<sup>1</sup>The first four bulletins in the ornithological series were published by the Ethnological Survey under the title "Bulletins of the Philippine Museum." Future ornithological publications of the Government will appear as publications of the Bureau of Government Laboratories.



No. 32.—JUNE, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

BIOLOGICAL LABORATORY

I. INTESTINAL HEMORRHAGE AS A FATAL  
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BIOLOGICAL AND SERUM LABORATORIES

III. THE PATHOLOGY OF INTESTINAL  
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MANILA  
BUREAU OF PUBLIC PRINTING  
1905

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1905



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,  
*Manila, P. I., May 25, 1905.*

SIR: I have the honor to transmit herewith and to recommend for publication, "I. Intestinal Hemorrhage as a Fatal Complication in Amœbic Dysentery and Its Association with Liver Abscess;" "II. The Action of Various Chemical Substances upon Cultures of Amœbæ," by Dr. J. B. Thomas, attending physician to the Civil Sanitarium, Benguet; "III. The Pathology of Intestinal Amœbiasis," by Dr. Paul G. Woolley, Director of the Serum Laboratory, and Dr. W. E. Musgrave, Pathologist, Biological Laboratory.

Very respectfully,

RICHARD P. STRONG,  
*Director Biological Laboratory,  
Acting Superintendent Government Laboratories.*

HON. DEAN C. WORCESTER,  
*Secretary of the Interior, Manila, P. I.*



## INTESTINAL HEMORRHAGE AS A FATAL COMPLICATION IN AMOEBIC DYSENTERY AND ITS ASSOCIATION WITH LIVER ABSCESS.

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By RICHARD P. STRONG, M. D., *Director Biological Laboratory.*

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Death may occur in amœbic dysentery from the gravity of the intestinal lesions; from exhaustion in protracted cases; from severe complications, particularly such as peritonitis due to the perforation of an ulcer in the large intestine or appendix or an abscess of the liver or lung; from a terminal infection sometimes entering through the ulcerations in the large bowel; from intercurrent disease, and from severe intestinal hemorrhage. The last is of unusual occurrence and is a particularly rare fatal complication.

While the presence of more or less blood in the stools in this variety of dysentery is in fact a common symptom of the disease, and while at times the discharges consist almost entirely of blood and mucus, it is obviously not to these conditions that I wish to refer in this paper; instead it is to the copious intestinal hemorrhage in which several hundred cubic centimeters of fresh blood are passed—such as one sometimes sees, for example, in typhoid fever and from which patients may succumb—that I wish here to invite attention.

Upon reviewing the literature I find that but little notice has been attracted to this complication. Of the recent text-book articles on the subject Scheube,<sup>1</sup> in his description of gangrenous dysentery, states that occasionally large quantities of pure blood are passed and even death may result from bleeding. Manson<sup>2</sup> calls attention to the fact that whenever, in gangrenous dysentery, sloughs separate, hemorrhage is always possible and that sudden collapse may occur from this cause even in otherwise mild cases. Sodre<sup>3</sup>

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<sup>1</sup> *Die Krankheiten der Warmen Länder.*

<sup>2</sup> *Manual of Tropical Diseases.*

<sup>3</sup> *Twentieth Century Practice of Medicine*, Vol. XVI.

mentions that in some cases of acute and chronic dysentery an abundant hemorrhage of the intestine may be observed. When it supervenes in an individual already weakened by former losses or by many days of disease, death may result from it, the patient dying in collapse. None of these authors, however, refer particularly to hemorrhages in amœbic dysentery. Kruse and Pasquale<sup>1</sup> in their extensive monograph do not mention severe hemorrhage in amœbic enteritis, and Harris,<sup>2</sup> in a summary of his own thirty-five cases of the amœbic variety and of seventy-eight others collected by him in the United States, also does not refer to this complication. Osler,<sup>3</sup> however, calls attention to it in acute amœbic dysentery, and states that, of the cases admitted to his wards during the past twelve years, there were seven in which hemorrhage occurred from the bowel. The only direct reference I have been able to find in the literature of amœbic dysentery in which the patient appeared to succumb from the loss of blood is one reported by Loeffler.<sup>4</sup> In this case only 125 cubic centimeters of clotted blood were passed from the rectum. The author states that here a diphtheritic inflammation of the intestine was added to the amœbic infection. It was the only instance of this nature observed by Loeffler.

The following cases of amœbic dysentery are the only ones which have come under my notice which have succumbed to the hemorrhage and therefore they seem worthy of report:

CASE NO. 1. AMŒBIC DYSENTERY; LIVER ABSCESS; SEVERE MULTIPLE  
INTESTINAL HEMORRHAGES; DEATH; AUTOPSY.

The patient, a well-to-do merchant, aged 36 years, had resided in Manila for the past two years. On February 4, 1902, he consulted the author, complaining of a dysentery of several weeks' duration. An examination of the stools showed the disease to be of the amœbic variety, the fæces containing considerable blood and mucus and many actively motile amœbæ, some inclosing red blood cells. He was advised to enter the hospital for treatment, which he did. On admission the subcutaneous fat was everywhere very abundant. The tongue was lightly coated and the conjunctivæ of good color. The examination of the heart and lungs revealed

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<sup>1</sup> *Zeitsch. für Hygiene*, 1894.

<sup>2</sup> *American Journal Med. Sciences*, 1898.

<sup>3</sup> *Practice of Medicine*.

<sup>4</sup> *Allbutt's System of Medicine*, Vol. II.



nothing abnormal. The spleen was not palpable and the liver not enlarged. The abdomen was not distended and there was no pain on pressure. The temperature registered  $99^{\circ}$  and the pulse 72. The examination of the urine showed nothing pathological. The patient was placed upon liquid diet, and given one-half ounce Rochelle salt. Local treatment consisting of high enemata of quinine solution (1-5,000) was then begun and administered daily, the strength of the solution being gradually increased to 1-500 and the amount of fluid employed from 1 to 2 liters. Under such treatment, and with occasional saline purges, he gradually improved. The tenesmus and irritability of the large bowel gradually decreased and the blood and mucus almost entirely disappeared from the fæces, so that after three weeks' treatment the bowel movements became reduced to one or two per day and the patient was up and about, though still under treatment. The case seemed to be progressing favorably.

However, on February 25 the temperature, which had not been above  $99.5^{\circ}$ , rose to  $103^{\circ}$ , and the patient complained of headache and some pain in the chest. There was one bowel movement on this date. On February 26 the temperature remained in the neighborhood of  $102^{\circ}$ , but the patient complained of no pain. The bowels did not move for twenty-four hours. On the morning of the 27th a blood examination of a fresh smear revealed some increase of the white blood cells and a blood count showed 25,000 leucocytes. He was given one-half ounce of Rochelle salt, and an examination of the fluid stool passed shortly after revealed no blood. On microscopical examination a fair number of amœbæ and some epithelial cells and leucocytes were present. On February 28 the morning temperature registered  $102^{\circ}$ . The conjunctivæ were slightly tinged with yellow. There was still complaint of some pain in the right side of the chest, but most of the pain was referred to the right inguinal region. The edge of the liver was not palpable. A blood count showed 28,000 leucocytes. A diagnosis of liver abscess was made and the patient was transferred to the surgical side of the hospital. The bowels moved but once on this date. On March 1 the temperature ranged between  $102^{\circ}$  and  $103^{\circ}$  and on March 2 it touched  $104.2^{\circ}$ .

On March 3 he was operated upon. An incision was first made over the right hypochondriac region just below the costal margin and the lower portion of the right lobe of the liver exposed. An attempt

was then made to locate the abscess through aspiration of the various portions of the liver with a long needle. This, however, failed, and the liver was stitched to the abdominal wall and the patient returned to the ward.

On March 2 and 3 there were no bowel movements, but on the 4th the bowels moved four times during the day. The stools were thin and yellow, but only the first contained a little blood. On March 5 there were three bowel movements at night. These were yellow, formed, and contained no blood. It should be mentioned that the local treatment with enemata had been discontinued since February 26. The fever still continued. On March 6 there were six bowel movements of greenish-yellow color containing some milk curds and other undigested food.

The patient was seen again by the author on March 7. He then complained of pain in the region of the operation wound. While asleep there was considerable muttering and marked twitching of the hands. The temperature was  $103.4^{\circ}$ , the pulse 110. There was very slight jaundice of the conjunctivæ. The abdomen was slightly distended. A blood count showed 18,000 leucocytes. There were three bowel movements on this date, one containing a little blood and mucus. A microscopical examination showed many amœbæ, some inclosing red blood cells. A diagnosis of typhoid fever was suggested by one of the staff in consultation and was particularly urged, as the abscess had not been located, but arguing against such a diagnosis were the facts that the spleen was not palpable and there were no rose spots. Moreover the serum failed in the afternoon of this day to give an agglutinative reaction with *Bacillus typhosus*. It was suggested that the local treatment with quinine enemata be resumed and that another attempt be made to locate the abscess. Accordingly aspiration was again performed by the surgical staff through the abdominal wound, but still unsuccessfully. On March 8 there were two bowel movements after the enema of quinine solution, and on the 9th four. The movements were dark and thin, but macroscopically contained no blood. The temperature ranged between  $102^{\circ}$  and  $103.6^{\circ}$ .

On March 10, at 2.45 a. m., a large hemorrhage of about 500 cubic centimeters of fresh-looking blood and containing four or five large clots were passed from the rectum. The pulse shortly after counted 140. The temperature was unfortunately not taken until two hours later, when it registered  $102.6^{\circ}$ . The pulse then

counted 134. The patient complained of great thirst, but apparently suffered no pain. On the morning of March 10 he was again seen. The subsultus of the hands was marked and there was some muttering delirium. The pulse was 120, of high tension but not dicrotic. His condition at this time suggested typhoid fever—a diagnosis, in fact, adhered to by one of the hospital staff—yet upon a careful analysis of the symptoms of the case the diagnosis of typhoid hardly seemed justifiable, and the serum again gave no Widal reaction. At 11.30 a. m. of this day a second intestinal hemorrhage occurred, about 300 cubic centimeters of dark blood being passed. On the following day the intestinal symptoms seemed a little improved, but the leucocytosis and fever continued. On March 12, at 3.30 p. m., 400 cubic centimeters of fresh blood was passed from the rectum. The temperature dropped to 101° and the pulse became very weak and counted 140. An hour later another hemorrhage of about 200 cubic centimeters occurred. At 6.30 p. m. a large amount of clotted blood was passed. The patient complained of great exhaustion and weakness. At 8 p. m. another large hemorrhage occurred and at midnight and again at 12.30 a. m. smaller hemorrhages were passed. The pulse gradually weakened and increased in rapidity. Finally it no longer could be counted. The patient became very delirious and died during the night. Shortly before death there was a dark-brown watery stool.

At autopsy a large abscess measuring 12 centimeters in diameter was found in the right lobe of the liver situated superiorly and near the posterior surface. The liver was not enlarged. The gall bladder and ducts were normal. The spleen also showed no pathological change. The walls of the large intestine were not particularly thickened and there was no excessive cedema of the submucous coat. In the ascending, transverse, and upper portions of the descending colon there were about fifty or sixty ulcers scattered here and there, generally with even margins and with clean bases. Their edges were very slightly undermined. They measured from about 3 to 12 millimeters in diameter and about  $1\frac{1}{2}$  to 2 millimeters in depth. Approximately 5 centimeters below the cæcum was an ulcer filled with a lightly adherent clot. On removal of the clot a freshly thrombosed vessel could be detected. At the edge of the ulcer the vessel was injected and could be traced with the naked eye for about 1 centimeter in the submucosa. There was no

diphtheritis in the large bowel. The mucous membrane between the ulcers was pale in color. The ulcers were clean, and nothing in their appearance suggested a fatal issue for the disease other than that of the one containing the blood clot. The ileum appeared normal. There were no evidences of typhoid fever.

The second case to which I wish to refer was seen in consultation with Dr. Otto Bartels, of Manila.

CASE NO 2. AMŒBIC DYSENTERY; LIVER ABSCESS; MULTIPLE SEVERE  
INTESTINAL HEMORRHAGE; DEATH; AUTOPSY.

The patient gave a history of having had several attacks of diarrhea during the past year, but had not noticed any blood in his stools. Since his entrance to the hospital, one week before, he had been complaining particularly of headache and restlessness. At times he had slight delirium. There was some constipation during this period, and purgatives and enemata were prescribed for him upon several occasions. Amœbæ were present in his stools. His temperature for four days previous to the time I first saw him, April 8, had varied between  $99.4^{\circ}$  and  $102.6^{\circ}$ . There was no distinct jaundice. Owing to the pain in the right hypochondriac region, to the fever, and leucocytosis of 23,000, a diagnosis of liver abscess was made and an operation advised. The patient, however, would not consent to an operation.

On April 8 there was one bowel movement, but none on the following day. On the 10th, 11th, and 12th the bowels moved once each day. The stools contained some mucus, and on microscopical examination, in addition to a few red blood cells, a number of motile amœbæ were observed. On April 11 hicough appeared and persisted for several hours. At 5 p. m. April 13 a hemorrhage occurred from the bowel of about 200 cubic centimeters of fresh blood. The pulse remained good, but the temperature fell from  $101.5^{\circ}$  to  $98^{\circ}$  two hours later. Early on the following morning the patient complained of pain in the abdomen, and shortly afterwards a large amount of fresh and partially clotted blood was expelled from the intestine. Two hours later there occurred another hemorrhage of about 400 cubic centimeters of bright red blood. The pulse became considerably weaker after the second hemorrhage and the temperature fell nearly four degrees in three hours. The patient suffered from nausea and vomiting at intervals through the day and gradually became weaker. On the following day the pulse became very feeble. The vomiting continued until within a few

hours of his death, which occurred on the following morning. There were no more hemorrhages or bowel movements.

At autopsy there was a large abscess measuring about 14 centimeters in diameter situated in the right lobe of the liver. The left lobe contained a small abscess measuring about 7 centimeters in diameter. The liver tissue was very fatty. The gall bladder and ducts were normal. The large intestine contained many shallow ulcerations, some of which were in the healing stage. The large bowel contained some dark clotted blood. After a careful search I was unable to locate any specific point from which the hemorrhage had occurred. Scrapings from the intestinal ulcers and from the walls of the abscess showed many motile amœbæ, some containing red blood cells.

The question suggests itself of why severe intestinal hemorrhage is not of more frequent occurrence in amœbic dysentery, particularly when one considers the extensive lesions of the submucosa which are present in most of the advanced cases. However, the additional points in the pathology of the infection which would tend to prevent hemorrhage must be recalled, viz, the thrombosed condition of the blood vessels in the zone of infiltration and œdema which surrounds the ulcers, the infiltration of the walls of the arteries, and the more or less marked evidence of endarteritis as the progress is rapid or slow. In chronic cases one may see at times the lumina of the arteries entirely occluded by this process.

On the other hand, the frequent occurrence of smaller amounts of blood in the stools may be explained from the fact that the walls of the veins are early infiltrated with round cells, followed by softening and complete disorganization; also from the fact that amœbæ may penetrate the wall of a vein. However, thrombosis of the veins is not infrequent.

As a rule the blood in the stools in amœbic dysentery probably arises not from one but from many ulcers about which the capillaries are usually considerably distended, frequently forming a network at the bases and margins of healing ulcers. At post-mortem, when one removes the upper layer of the mucosa in the vicinity of an ulcer, one frequently finds small hemorrhages in the upper portion of the submucosa. When the overlying mucosa becomes necrosed and sloughs, the blood from these vessels finds its way into the lumen of the intestine and appears later in the stools. However, in the cases which we have mentioned above the hemorrhage probably arose from a single ulcer involving a blood vessel.



Since the foregoing observations were recorded to the Manila Medical Society in 1902, F. Haasler,<sup>1</sup> in the same year, in an article treating of the complications of amœbic dysentery and reviewing 600 cases of the disease occurring in China, mentions three of severe intestinal bleeding, in two of which the hemorrhage was considered the cause of death. In one of the cases about 4 liters of blood was passed and the author was able to find at necropsy a thrombosed vessel from which the bleeding occurred. A most interesting fact in connection with these cases and one emphasized by the author is that, in both of the fatal instances in which death was due to the hemorrhage, liver abscess coexisted.

Woodward<sup>2</sup> in 1879 also reported two cases of dysentery in which profuse hemorrhage occurred and in which large liver abscesses also existed. In the first instance death resulted immediately from the hemorrhage. Though the cases were not diagnosed as those of amœbic dysentery, there can be little doubt from the histories and autopsies that they were indeed instances of this variety of the disease.

During the past two years I have encountered two more fatal cases of amœbic dysentery with severe multiple hemorrhage in both of which large liver abscess was present. In the last one the time of coagulation of the blood was not complete until nine minutes. There was no marked jaundice present. These cases may here be briefly recorded:

CASE NO. 3. CHRONIC AMŒBIC DYSENTERY; MULTIPLE LIVER ABSCESS;  
SEVERE INTESTINAL HEMORRHAGES; DEATH; AUTOPSY.

The patient, age 27 years, was first seen in October, 1903. At this time his general physical condition was fair, but he was already suffering with a well-advanced case of amœbic dysentery of about two months' duration. The stools were numerous and contained large amounts of blood-stained mucus. He was placed upon local treatment of high quinine enemata and pursued this treatment daily for nearly four months. During this time his general condition gradually improved. On several occasions, for one or two weeks at a time, the stools became fairly normal, one or two per day, and contained no amœbæ and no mucus or blood; but notwithstanding the fact that the local treatment was continued, the disease always broke out afresh and amœbæ and mucus and blood reappeared in the stools.

<sup>1</sup> *Deutsche Medicin Wochenschr.*, 1902.

<sup>2</sup> *Medical and Surgical History of War of the Rebellion*, II Med. Vol., pp. 164 and 209.



However, in January he felt sufficiently improved to leave Manila for Japan, where he remained for about three months. During some of this time he neglected treatment entirely. For the first month he reported himself to be fairly well, but shortly afterwards an acute exacerbation of the dysenteric symptoms appeared and he was compelled to enter a hospital. As soon as his condition temporarily improved he returned to Manila. He was seen again by the writer on April 9; at this time he was considerably emaciated and his face was drawn. He complained of an aching sensation in the right shoulder. The liver was distinctly palpable for several fingers' breadth below the costal margin. The temperature registered  $100^{\circ}$  and there was a leucocytosis of 15,000. His pulse counted 112. The question of an operation for liver abscess was considered, but was not immediately urged. Owing to the chronic character of the dysentery and the general condition of the patient, it was decided that an attempt should first be made to ameliorate the dysenteric symptoms. Therefore he was again placed upon quinine enemata with occasional doses of Dover's powder and was given, in addition, stimulants with the hope that in a few days his condition might so improve as to warrant an operation. His diet consisted only of liquids. The temperature ranged for the next two days between  $100.2^{\circ}$   $103.2^{\circ}$ . The bowel movements numbered three or four per day and usually contained considerable mucus. On April 12, at 9 a. m., his daily quinine enema was administered. During the day there were two bowel movements, the last at 3 p. m. At 7 p. m., a large intestinal hemorrhage occurred, nearly a pint of fresh blood being passed. At 9 a. m. a second hemorrhage, smaller in amount but of the same character, occurred. At 12.30 a. m. a large amount of dark blood was passed. Morphia was administered hypodermically, and later, ergot. Finally a hot enema of tannic acid was given, but apparently no favorable results were obtained. Between 12.30 and 8 o'clock the next morning there were five small hemorrhages. At the latter hour the temperature registered  $99^{\circ}$  and the pulse 138. The patient gradually sank. There were no more large hemorrhages from this time up to that of his death, which occurred at 7 a. m. the following morning, but the movements which occurred and were passed into a bedpan, consisted almost entirely of clotted blood.

At *autopsy* the large intestine showed extensive ulcerations throughout. The ulcers were as a rule shallow, usually undermined, and with smooth or slightly uneven reddened margins. In the cæcum deeper ulcerations were present and between these lesions portions of the mucosa were covered with pseudomembrane. Some of the ulcers in the cæcum were gangrenous. The contents of the large bowel consisted of dark-reddish masses of fluid and partially clotted blood, together with some mucus.

The lower end of the ileum for about 15 centimeters above the valve also showed ulceration. No distinct point from which the hemorrhages arose could be detected anywhere in the entire intestine.

There were six abscesses of the liver situated in both the right and left lobes and measuring from 5 to 10 centimeters in diameter. A number of the hepatic veins contained thrombi.

CASE NO. 4. AMŒBIC DYSENTERY; LIVER ABSCESS; SEVERE INTESTINAL HEMORRHAGE; DEATH; AUTOPSY.

The patient, a Spanish sailor, was first seen after an alcoholic debauch. At this time he was dull and stupid. He complained of acute dysentery. A companion stated that he had been bleeding extensively from the rectum during the previous day. At the time of my visit his temperature registered 99°, and the pulse counted 114. No distinct history of previous dysentery could be obtained. The patient refused to enter a hospital. A portion of a bowel movement, consisting of reddish-brown masses of blood and mucus, was secured, and a microscopical examination showed numerous amœbæ and red blood cells, and considerably altered blood pigment. Later in the day a blood count showed 9,000 leucocytes per cubic millimeter. The coagulability of the blood was tested and found to be complete only after nine minutes. The liver dullness was distinctly increased upward in the right axillary line above the fifth rib. The patient complained of slight pains below the right axillary region. The conjunctivæ were slightly jaundiced. Morphia, calcium chloride, and absolute rest were prescribed. The patient was seen again on the evening of the same day. At this time his pulse counted in the neighborhood of 150 and was weak and thready. The extremities were cold. He was already unconscious. His companion stated that he had passed three or four large hemorrhages from the bowels during the day. The sheet upon which he was lying partially disclosed this fact, being in places soaked with fresh blood. He gradually sank and died during the night. A complete autopsy could not be performed, but an incision was made over the right hypochondriac region, the liver drawn down, and the diagnosis of abscess in the right lobe confirmed.

On recalling the infrequency of fatal hemorrhage in amœbic dysentery it seemed to me that some reason other than the anatomical situation of the ulcer might exist in the eight cases referred to above and which might account for the persistence of the bleeding and for their unfavorable outcome. Since in all of the cases large liver abscess co-existed, the connection between intestinal hemorrhage and the hepatic condition has suggested itself very strongly to me. The idea that the destruction of such large amounts of liver tissue may sometimes bring about serious functional disturbance in this organ and lead to a condition which predisposes to hemorrhage must certainly be considered. James Finlayson,<sup>1</sup> as long ago as 1873, in discussing a case of liver abscess in which intestinal hemorrhage had occurred, argued that hepatic abscesses by interfering mechanically with the portal circulation may produce congestion of the mucous membrane of the colon and thus favor

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<sup>1</sup> *Glasgow Medical Journal*, Feb., 1873. p. 171.

the development of hemorrhage. The relation between hemorrhage and various other diseases of the liver, such as acute atrophy, syphilis, cancer, and affections of the biliary passages, particularly when jaundice is present, is well known. However, it is true that in typhoid fever severe and fatal intestinal hemorrhage may occur independently of any extensive lesion of the liver, though it has even been claimed that when such a result takes place it depends chiefly upon a diminished coagulability of the blood<sup>1</sup> or to special bacterial activity.<sup>2</sup> Therefore, while it obviously is probable that more extensive observations will show that fatal intestinal hemorrhage in amœbic dysentery may occur independently of liver abscess, the cases to which I have referred would seem to point out that at least when hemorrhage occurs in cases complicated with such hepatic disease, it is likely to be very severe and that the bleeding is likely to recur.

It is also possible that the occurrence of multiple intestinal hemorrhages in amœbic dysentery may occasionally be of some importance in the diagnosis of liver abscess. In my last case as noted above there was no fever and no leucocytosis, and although the liver was slightly enlarged and abscess was suspected, I did not feel by any means certain of such a diagnosis. However, when the intestinal hemorrhages appeared, reasoning from my knowledge of the conditions in the other five cases, I felt confident of the existence of hepatic abscess, a diagnosis which, as already mentioned, was confirmed at autopsy. In this connection I was recently much interested to find in Woodward's article on dysentery in the *Medical History of the War of the Rebellion*, 1879, the statement that "hemorrhage from the bowels is another occasional symptom of liver abscess and sometimes is the immediate cause of death." This statement seems to have received no attention in the literature on amœbic dysentery.

We are about to undertake by Wright's method a study of the coagulability of the blood in our cases of amœbic dysentery, for the purpose of ascertaining if any changes occur either during the course of the uncomplicated disease or in those cases in which liver abscess or hemorrhage develop.

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<sup>1</sup>Wright and Knapp, *Lancet*, 1902. Vol. II, pp. 16, 1533.

<sup>2</sup>Nicholls and Learmonth, *ibid.*, 1901, Vol. I, p. 305.



## THE ACTION OF VARIOUS CHEMICAL SUBSTANCES UPON CULTURES OF AMOEBAE.

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In considering the subject of the local treatment of amœbic dysentery one encounters a long list of drugs recommended by individual experimentors and clinicians, but the one proposed in some form or other by the large majority of the medical profession is quinine. It is employed in solutions varying in strength from 1-5,000 to 1-3,000, from one-half to 1 liter, two or three times a day, as recommended by Councilman and Lafleur in their classical monograph published in 1891, all the way up to the excessive concentration of 1-100 advised by J. H. Ford in a recent number of the *Journal of Tropical Medicine*. Osler recommends a warm solution of quinine 1-5,000, 1-2,000, 1-1,000, and states that it has been used with great benefit in the wards of the Johns Hopkins Hospital.

Councilman and Lafleur summarize their experience with quinine enemas as follows:

Quinine injections do destroy amœbæ in the bowel, but it is questionable if they reach the amœbæ in the tissues. Such treatment is serviceable in early cases and those where the rectum, sigmoid flexure, and descending colon are the limit of the disease.

Among the drugs less commonly advised for the local treatment of amœbic dysentery we find the following: Bichloride of mercury 1-5,000 to 1-3,000; nitrate of silver 1-500; dilute nitric acid (by H. A. Lafleur in *Allbutt's System of Medicine*).

Cold water enemas (by Tuttle).

Potassium permanganate 1-1,000 to 1-2,000; eucalyptol 1-1,000; sodium bicarbonate 1-100 (by J. H. Ford).

Tannin 1-200; ichthyol 1-250, in combination with salts of bismuth (by Hemmeter).

However, it will probably be admitted by those who treat large numbers of amœbic dysentery cases that the ideal substance for local treatment has not yet been discovered. Weak solutions of quinine fail to destroy the amœbæ, which frequently persist in the intestine

in spite of two or three large injections daily; strong solutions are often too irritating to be practical or, in the case of susceptible subjects, may reduce the patient to a state of chronic cinchonism by the absorption of the drug from the bowel. This last condition is more apt to occur where the practice prevails of giving several concentrated injections a day.

The stronger antiseptics are likely to be irritating or dangerous on account of their toxic properties.

The perfection of the technique of growing the amœbæ in pure strains in symbiosis with a single variety of bacteria attained by Musgrave and Clegg has made it possible to observe with a considerable degree of accuracy the action of chemical substances on the amœbæ, and it is with the results of a series of such experiments conducted by myself in the Biological laboratory of the Bureau of Government Laboratories during December, 1904, and January, 1905, that this report is concerned.

The standard amœba used in these tests is described as follows by Musgrave and Clegg in *Bulletin No. 18, Biological Laboratory*, of the Bureau of Government Laboratories, published in October, 1904:

Amœba 11524 was isolated from a dysentery stool. The patient, an American nurse, had been suffering with intestinal amœbiasis (amœbic dysentery) for about one year and amœbæ had repeatedly been found in her stools during that time. \* \* \* The course of the disease was a usual one, with very chronic tendencies and with frequent, and sometimes quite severe, exacerbations. Our first cultures were made during such an exacerbation and at a time when there could be no reasonable doubt as to the correctness of the diagnosis. \* \* \* Growth was found to be very satisfactory for a long time on a medium composed of 2 per cent agar and one-half per cent beef extract (1 per cent alkaline), the development decreasing only when a marked diminution in the number of bacteria, which is usual with this medium, occurred. Microscopically this protozoön as obtained from culture is indistinguishable from those seen in the stools of the patient, and it is a true dysenteric amœba. Its measurements in the round stage in the stool were 25 to 35  $\mu$ , and those in the cultures generally correspond with these figures, but they varied greatly, owing no doubt to environment and the phase of the life cycle at the time of the examination. In our collection there now are cultures of this amœba which were started from a single parasite. They are in pure culture with four different bacteria. \* \* \* *B. coli*, *Spr. cholera* and two different pigment-producing saprophytes. The protozoa grow well with all these organisms, and, by methods already given, have been changed from one to the other, and vice versa.

In one instance, dysentery in man followed the ingestion of three gelatin



capsules filled with scrapings from the surface of cultures of this amœba in symbiosis with a harmless bacterium. Dysentery has also been produced in monkeys by similar cultures as well as by others where the bacterium in symbiosis was a pathogenic one.

This amœba in symbiosis with the cholera spirillum was used in the experiments to be described. The culture medium employed was the special agar one recommended by Musgrave and Clegg and described in the above quotation. The amœbæ, in the encysted state, are much more resistant to the action of drugs by virtue of their impervious shells. In order as far as possible to eliminate these encysted forms from the experiments, I made many observations on cultures of the amœbæ at varying periods of their growth, and determined that when they are cultivated on the special agar medium at room temperature in Manila, the amœbæ reach their maximum activity in about forty-eight hours, by which time practically all were free and motile. In a few hours more, many have begun to encyst and by the end of seventy-two hours a large proportion of them have completely done so. Consequently, after the first few preliminary experiments, the forty-eight-hour cultures were used as a matter of routine.

The first series of experiments was made by pouring the solutions to be tested over the surface of forty-eight-hour slant cultures of Amœba No. 11524, and at the end of ten, twenty, thirty, or sixty minutes pouring off the solution, washing the surface lightly with sterile water to remove all traces of the antiseptic, and then making transplants from the surface to fresh media. Control transplants were made from every tube containing the amœba cultures, before adding the solution to be tested.

The following results were obtained by the above-described method:

TABLE A.

Antiseptic.	Dilution.	Antiseptic applied.	Growth of amœbe after exposure to antiseptic.	Growth of symbiotic bacteria.
		<i>Minutes.</i>		
Benzoyl acetyl peroxide (acetozone) <sup>1</sup> -----	1-1,000	10	None -----	No.
Do -----	1-1,000	30	None -----	No.
Do -----	1-1,000	60	None -----	No.
Do -----	1-500	30	None -----	No.
Do -----	1-500	60	None -----	No.

<sup>1</sup> The solutions of benzoyl acetyl peroxide and of acid succinic peroxide were so prepared as to contain equal amounts of *active oxygen*. In order to obtain solutions of 1-1,000 based on active oxygen there must be dissolved of pure crystals of benzoyl acetyl peroxide 1.10 grams and of pure acid succinic peroxide 1 gram in 1 liter of water.

TABLE A—Continued.

Antiseptic.	Dilution.	Antiseptic applied.	Growth of amœbæ after exposure to antiseptic.	Growth of symbiotic bacteria.
		<i>Minutes.</i>		
Acid succinic peroxide (alphozone).....	1-1,000	10	Very few -----	No.
Do -----	1-1,000	30	do -----	No.
Do -----	1-1,000	60	do -----	No.
Do -----	1-500	30	do -----	No.
Do -----	1-500	60	do -----	No.
Acid, tannic -----	1-100	10	Very many -----	Yes.
Do -----	1-100	20	do -----	Yes.
Do -----	1-100	30	do -----	Yes.
Copper sulphate -----	1-1,000	10	do -----	Yes.
Do -----	1-1,000	20	do -----	Yes.
Do -----	1-1,000	30	Many -----	Yes.
Do -----	1-2,000	20	Very many -----	Yes.
Do -----	1-2,000	30	do -----	Yes.
Ichthyol -----	1-250	10	do -----	Yes.
Do -----	1-250	20	Many -----	Yes.
Do -----	1-250	30	do -----	Yes.
Oil of cassia -----	1-5,000	10	Very many -----	Yes.
Do -----	1-5,000	20	Many -----	Yes.
Do -----	1-5,000	30	do -----	Yes.
Do -----	1-10,000	30	do -----	Yes.
Potassium permanganate -----	1-2,000	30	do -----	?
Quassia infusion -----	W. S. P.	30	Very many -----	?
Quinine sulphate -----	1-500	20	do -----	Yes.
Do -----	1-500	30	Many -----	Yes.
Do -----	1-250	10	Very many -----	Yes.
Do -----	1-250	20	Few -----	Yes.
Do -----	1-250	30	do -----	Yes.
Silver nitrate -----	1-500	30	do -----	Very few.
Thymol -----	1-5,000	10	Many -----	Yes.
Do -----	1-5,000	20	do -----	Yes.
Do -----	1-5,000	30	do -----	Yes.
Do -----	1-10,000	20	Many -----	Yes.
Do -----	1-10,000	30	do -----	Yes.

It was thought that by treating the amœbæ in surface growth as described in the foregoing table, where the lower strata are protected by the upper ones of amœbæ and bacteria, the conditions encountered would be fairly analogous to those existing in the intestines, where the amœbæ are protected by mucus and fecal matter. Cases in which the amœbæ have burrowed beneath the surface epithelium will not be taken into consideration in this connection, as no form of local treatment would probably avail against such conditions.

The foregoing table is therefore of interest as suggesting the relative action of several chemicals on artificially grown amœbæ under conditions unfavorable to the complete effect of the antiseptic substances and therefore somewhat like the conditions encountered in the practical use of the chemicals in treating the disease locally in the intestine itself.

It will be noted that quinine 1-500 had but a moderate effect

on the amœbæ in thirty minutes and 1-250 a decided one in twenty minutes.

Nitrate of silver, thymol, benzoyl acetyl peroxide, and acid succinic peroxide in moderate strength exercised a marked effect on the amœbæ, whereas sulphate of copper, permanganate of potassium, tannic acid, infusion of quassia, ichthyol, and oil of cassia had but a slight one.

In order to determine more accurately the effect of these and other substances on the unprotected amœba, another series of tests was undertaken on the amœbæ suspended in fluid, and in order to determine whether the deleterious action of each substance was due to a specific action on the amœbæ or to the destruction or attenuation of its symbiotic bacteria, synchronous transplants were made from the treated culture to sterile agar plates and to others previously inoculated with the cholera spirillum.

Uniform suspensions of the amœbæ were made by pouring 4 cubic centimeters of distilled, sterile water over the surface of a forty-eight-hour slant agar culture of the amœba and cholera spirillum, scraping off the surface growth, mixing with the water by means of a platinum wire, and pouring the resultant suspension into a sterile test tube. Four cubic centimeters (in double strength) of the antiseptic solution to be tested were then added to the 4 cubic centimeters of suspension of amœbæ, thus making a fairly uniform solution of 8 cubic centimeters of liquid to one forty-eight-hour slant culture, the mixture containing a definite amount of the chemical to be tested. The suspension was next thoroughly shaken and allowed to stand for the desired lengths of time, and then transfers of one loop of the suspension were made to Petri dishes containing the special agar medium, and allowed to develop for forty-eight hours. At the end of such time the plates were carefully examined for amœbæ and bacteria. As stated before, similar transplants were made at the same time to plates previously inoculated with the cholera spirillum. To minimize the concentration of the small quantity of antiseptic carried over with the loop of suspension, the droplet was spread over a circular area about one-half inch in diameter in the center of the agar plates.

The following table epitomizes the results of such experiments as were carried out with a maximum degree of uniformity and accuracy. Many more tests besides those tabulated were made with each substance, substantiating in the main the results set forth in

the table, but it has not been thought necessary to include them in this report. By always using the same medium, the same strain of amœbæ and symbiotic bacteria, checking every culture and every transplant with controls, using cultures of uniform age (forty-eight hours), cultivating transplants for the same length of time (forty-eight hours), and making the amœba suspensions of uniform concentration (8 cubic centimeters water to one slant culture forty-eight hours old), the relative results are probably as accurate as possible under the circumstances:

TABLE B.

Antiseptic.	Dilution.	Anti-septic applied.	Growth of amœbæ after exposure to antiseptic.	Growth of amœbæ on plates inoculated with cholera.	Growth of symbiotic bacteria.	Growth of control.
		<i>Min.</i>				
Benzoyl acetyl peroxide <sup>1</sup>						
Acid, boric	1-50	15	Rich	Rich	Yes.	Yes.
Do	1-50	30	do	do	Yes.	Yes.
Do	1-50	60	Fair	Fair	Yes.	Yes.
Do	1-25	60	do	do	Yes.	Yes.
Do	1-25	( <sup>2</sup> )	do	do	Yes.	Yes.
Acid, tannic	1-100	15	Very slight <sup>3</sup>	do	No.	Yes.
Do	1-100	30	do	do	No.	Yes.
Acid, succinic peroxide	1-1,000	15	do	Rich	No.	Yes.
Do	1-1,000	30	do	Fair	No.	Yes.
Do	1-1,000	60	None	Very slight	No.	Yes.
Do	1-2,000	30	Slight	Fair	Yes.	Yes.
Argyrol	1-100	15	Very slight	do	No.	Yes.
Do	1-100	30	do	do	No.	Yes.
Do	1-100	60	None	do	No.	Yes.
Do	1-500	15	Very slight	do	No.	Yes.
Do	1-500	30	do	do	No.	Yes.
Copper sulphate	1-1,000	30	None	Rich	No.	Yes.
Do	1-1,000	60	do	Very slight	No.	Yes.
Do	1-1,000	( <sup>2</sup> )	do	do	No.	Yes.
Do	1-2,000	30	Slight	Slight	Yes.	Yes.
Do	1-2,000	60	None	Very slight	No.	Yes.
Do	1-10,000	60	Fair	do	Yes.	Yes.
Eucalyptol (emulsion)	1-2,000	60	do	do	Yes.	Yes.
Ichthyol	1-500	60	Slight	do	Yes.	Yes.
Oil of cassia (emulsion)	1-2,000	30	Fair	do	Yes.	Yes.
Do	1-2,000	60	Slight	do	Yes.	Yes.
Protargol	1-500	60	Very slight	do	No.	Yes.
Do	1-100	30	do	Very slight	No.	Yes.
Do	1-100	60	do	do	No.	Yes.
Potassium permanganate	1-2,000	15	None	None	Yes.	Yes.
Do	1-2,000	30	do	do	No.	Yes.
Do	1-4,000	15	Fair	Fair	Yes.	Yes.
Do	1-4,000	30	Very slight	do	Yes.	Yes.

<sup>1</sup>No experiments were performed with this chemical to obtain comparative results on this table, because it had already been proven by other experiments performed in this laboratory that amœbæ were always killed by benzoyl acetyl peroxide in the usual dilutions.

<sup>2</sup>Two hours.

<sup>3</sup>It is not meant to imply either in this table or in the previous one that where a "very slight" growth of amœbæ on the sterile plate is recorded and no growth of the symbiotic bacteria, that a pure cultivation of the amœbæ without bacteria, has been obtained. A very few bacteria may still be present (perhaps adherent to the protozoa) which are sufficient to nourish the amœbæ and cause a moderate reproduction of them. In transplanting amœbæ another source of error may arise, in regard to their reproduction, where the growth of amœbæ is "very slight," unless the number inoculated on the plate has been counted.—R. P. S.

TABLE B—Continued.

Antiseptic.	Dilution.	Anti-septic applied.	Growth of amœbæ after exposure to antiseptic.	Growth of amœbæ on plates inoculated with cholera.	Growth of symbiotic bacteria.	Growth of control.
		<i>Min.</i>				
Quassia infusion -----	W. S. P.	60	Very rich---	Rich-----	Yes.	Yes.
Quinine sulphate -----	1-500	30	None -----	-----	No.	Yes.
Do <sup>1</sup> -----	1-1,000	15	Fair -----	Fair-----	Yes.	Yes.
Do <sup>1</sup> -----	1-1,000	30	Very slight	Very slight	No.	Yes.
Do <sup>2</sup> -----	1-1,000	15	do -----	Rich-----	Yes.	Yes.
Do <sup>2</sup> -----	1-1,000	30	do -----	do -----	No.	Yes.
Quinine bisulphate <sup>2</sup> -----	1-1,000	15	None -----	Slight-----	Yes.	Yes.
Do <sup>2</sup> -----	1-1,000	30	do -----	Fair-----	No.	Yes.
Silver nitrate -----	1-500	30	do -----	-----	No.	Yes.
Do -----	1-500	60	do -----	-----	No.	Yes.
Do -----	1-2,000	15	Very slight	Very slight	No.	Yes.
Do -----	1-2,000	30	do -----	do -----	No.	Yes.
Thymol -----	1-5,000	30	Fair -----	Slight-----	Yes.	Yes.
Do -----	1-5,000	60	None -----	None -----	Yes.	Yes.
Do -----	1-2,500	15	do -----	do -----	Yes.	Yes.
Do -----	1-2,500	60	do -----	do -----	Yes.	Yes.

<sup>1</sup> HCl 1-5,000.<sup>2</sup> HCl 1-2,500.

In examining the foregoing table the following results will be noted:

Boric-acid solution as strong as 1-25 had practically no effect on the amœba or the cholera spirillum after an exposure of two hours.

Tannic acid 1-100 after thirty minutes had a moderate effect on the viability of the amœba apparently by destroying almost all of the cholera spirilla in the culture.

Succinic peroxide acid exercised a marked deterrent effect on the growth of the amœba by destroying most of the spirilla, as was demonstrated by the fact that the transfers to cholera plates always contained a much larger proportion of amœbæ than did the synchronous transfers to sterile agar plates. For benzoyl-acetyl peroxide see preceding table.

Nitrate of silver showed a marked destructive effect both on amœbæ and on bacteria, 1-2,000 applied for fifteen minutes destroying the bacteria and leaving a very slight growth of amœbæ on both sterile and cholera plates; 1-500 destroyed both amœbæ and spirilla in thirty minutes.

Among the colloidal silver salts tested, argyrol as weak as 1-500 applied fifteen minutes exercised an effect similar to that of succinic peroxide acid and protargol; 1-500 applied for one hour left almost no surviving spirilla and very few amœbæ.



Eucalyptol emulsion 1-2,000 (with bicarbonate of soda), ichthyol 1-500, and oil of cassia in emulsion 1-2,000 all permitted a fair growth of amœbæ and cholera spirilla after an hour's application.

Permanganate of potassium 1-4,000 had but slight effect in fifteen minutes and 1-2,000 stopped all growth of amœbæ after an exposure of fifteen minutes, though failing to destroy the spirilla.

Infusion of quassia really seemed to stimulate the growth of the amœbæ, perhaps supplying some nutritive substance from the wood fibers. Quassia was tried because of its former reputation as an injection for *Oxyuris vermicularis*, and upon the supposition that the bitter principle might exert a harmful effect on the amœba.

Sulphate of quinine 1-500 destroyed amœba and spirilla in thirty minutes; 1-1,000 (acidified with HCl 1-5,000) had a slight deterrent effect in fifteen minutes and marked destructive effect in thirty minutes; 1-1,000 (HCl 1-2,500) had the same effect as the solution of half that acidity, except that the growth of amœbæ on the cholera plates was richer in the former. This action was probably due to the accidental transplanting of an unusual number of amœbæ, as the increased acidity would certainly not favor the growth of amœbæ.

Bisulphate of quinine did not differ appreciably in its action from that of the sulphate when tested in solutions of equal strength and acidity.

Thymol 1-2,500 exercised a marked effect on the amœba in fifteen minutes but failed to destroy the spirillum in an hour. A number of other experiments with thymol even diluted as high as 1-5,000 demonstrated this specific effect on the amœba and a failure to destroy the symbiotic cholera spirillum. The specific action of thymol suggests a combination of substances for the local treatment of amœbiasis in which thymol would form the anti-amœbic ingredient and one of the silver salts benzoyl acetyl peroxide or succinic peroxide acid the antibacterial ingredient. Theoretically such a combination as this or the alternate use of the solutions suggested should give the best possible results. The possibility of absorbing thymol in toxic amounts in such high dilutions is remote; however, its local effect on the bowel must be tested clinically.

Sulphate of copper 1-1,000 stopped the growth of amœbæ in thirty minutes by destroying the cholera spirilla, and 1-2,000 exercised a similar but weaker action in the same length of time.



In view of the general scientific interest awakened as to the use of sulphate of copper in high dilutions as a purifier of water reservoirs, following G. T. Moore's bulletin<sup>1</sup> on that subject, a special series of experiments was undertaken with high dilutions of sulphate of copper on various suspensions of amœbæ. The importance of the subject in connection with the amœba-infected water supply of Manila is very apparent and was long since recognized by the Board of Health for the Philippine Islands. In compliance with a request from Maj. E. C. Carter, Commissioner of Public Health, I reported the results of my experiments with high dilutions of copper sulphate to Dr. R. P. Strong, the Director of the Biological Laboratory, under date of January 30, 1905. The results are in part as follows: After an application of a solution of cupric sulphate 1-5,000 for one hour, many amœbæ and a few spirilla grew on the transplants; after 1-10,000 for two hours, many amœbæ and a few spirilla grew; after 1-100,000 for forty-eight hours, many amœbæ and a few spirilla grew. At a later date the above test was repeated under practically the same conditions, except that control transplants were made to cholera plates, and both the amœbæ and the spirilla grew equally well after exposure for forty-eight hours to copper solutions 1-100,000 and 1-200,000.

All the tests mentioned thus far were conducted with amœba suspensions of 8 cubic centimeters of fluid to one forty-eight-hour slant agar culture of amœbæ and spirilla. Another set of tests was carried out to compare the effects of the copper solutions on amœbæ suspensions of varying concentration. At the same time controls of the suspensions of amœbæ were made, using precisely the same dilutions as those treated with copper and making transplants from these controls and the suspensions treated with copper, at periods varying from twenty-four to ninety-six hours. It was thus possible to determine by comparison to what extent the destruction or attenuation of amœba suspensions might be due to an unfavorable medium, diminished nourishment, etc. The following were results obtained by treating for ninety-six hours three different concentrations of amœba suspensions with copper sulphate 1-100,000:

Eight-cubic centimeter suspension: Transplants developed rich growth of amœbæ and fair growth of spirilla.

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<sup>1</sup> *Bulletin No. 64, Bureau of Plant Industry, U. S. Dept. of Agriculture.*

Sixteen-cubic centimeter suspension: Transplants same as 8-cubic centimeter suspension.

Thirty-two-cubic centimeter suspension: Transplants developed few amœbæ and few spirilla.

The 16-cubic centimeter control suspensions with copper omitted, gave practically the same results as did those containing the copper, except that the cholera spirillum grew rather feebly in those treated with copper but freely in those untreated.

In the 32-cubic centimeter suspensions without copper the growth of amœbæ and spirilla was distinctly better than in those treated with copper. The transplants from the suspensions treated with copper to cholera plates developed a rich growth of amœbæ.

We may fairly make the following deductions from the foregoing experiments: First, that high dilutions of eupric sulphate have practically no effect within ninety-six hours, upon concentrated suspensions of amœbæ (8-cubic centimeter solution to one forty-eight-hour slant agar culture); second, that copper solutions as dilute as 1-100,000 have little, if any, specific effect on the amœbæ, though they inhibit the growth of the cholera spirillum to an appreciable extent after an exposure of ninety-six hours, in dilutions as high as 32 cubic centimeters of copper solution to one forty-eight-hour slant culture, and thus impede somewhat the development of the amœbæ. However, it is very doubtful whether this inhibiting action on the spirilla is of sufficient potency, even in dilutions of 1-100,000, to exercise any practical effect on the development of amœbæ in large bodies of water.

After presenting several tables of experimental data as to the action of "colloidal solutions of copper" on the colon bacillus, the cholera spirillum, and other bacteria, Moore makes the following statement in *Bulletin No. 64* mentioned above:

It is evident that the amount of surface exposed in any ordinary copper tank would far exceed the amount demanded for the above results, and it is likewise certain that after standing from six to eight hours at room temperature in a clean copper vessel water becomes safe to drink even though it may have contained cholera and typhoid germs. It remains to be seen whether or not the application of these facts to conditions in the Tropics, where cholera is abundant, will be of any value. It would seem that the construction of canteens and other water vessels from copper might serve as an additional safeguard, if not an actual preventive of this disease, and would prove of considerable value where distillation or efficient filtration apparatus is not at hand.

In accordance with the above suggestions suspensions of amœbæ and cholera spirilla of varying degrees of concentration were poured into clean copper crucibles, covered, and allowed to stand at room temperature in Manila for five days. At the termination of nineteen hours and of five days, transplants were made in the usual manner with the following results:

Suspension A (4 cubic centimeters to one slant agar culture) developed a good growth of amœbæ and spirilla from transplants made after standing nineteen hours in the copper crucible, and a fair growth on cholera plates after five days, though none on sterile agar plates.

Suspension B (8 cubic centimeters to one slant agar culture) developed a slight growth of both amœbæ and spirilla on sterile agar plates from transplants made after standing five days, and a rich growth on cholera plates.

Suspension C (12 cubic centimeters to one slant agar culture) gave results identical with those of suspension A.

It would appear from the preceding results that it would be disastrous to rely on the action of copper containers to purify water infected with amœbæ or cholera spirilla and that Moore's claim quoted above can not be substantiated, at least as far as it relates to the organisms used in my experiments.

As previously stated in this report, amœba No. 11524 was chosen as a standard because of its proven pathogenicity and its sturdy resistance to unfavorable conditions. It was taken for granted that any chemical substance which would destroy amœba 11524 would destroy most of the others, and the few experiments I had time to carry out in that connection justified the assumption.

The amœbæ employed in these control experiments were No. 39888, a small intestinal amœba isolated by Dr. Musgrave from a case of intestinal amœbiasis and cultivated in symbiosis with the cholera spirillum, and amœba tap "A," isolated by myself from the Manila water supply, drawing the water from the laboratory tap. The latter amœba was cultivated in pure strain from a single individual, in symbiosis with two or three varieties of water bacteria among which a yellow pigment-forming bacillus predominated almost to the complete exclusion of the others.

These two amœbæ were tested with sulphate of quinine 1-1,000 (HCl 1-5,000), thymol 1-5,000, acid succinic peroxide 1-1,000

and nitrate of silver 1-2,000, for periods of fifteen, thirty, and sixty minutes, with the result that the destructive effect of these chemical substances was decidedly more marked than in the experiments in which *Amœba* 11524 was the organism employed.

Experiments on encysted cultures of No. 11524, one month old, conducted at the same time as the above and with the same solutions, demonstrated the self-evident fact that encysted amœbæ are much more resistant to chemical action than are the free and active forms.

I regret that time did not permit me to pursue my investigations with a larger variety of chemicals and with other strains of amœbæ in symbiosis with various bacteria. However, it may safely be assumed that the results with thymol solutions would be unaffected by such tests as far as they relate to symbiotic bacteria, and it is improbable that any of the common intestinal bacteria usually found in symbiosis with the amœba would resist the action of the silver salts, benzoyl acetyl or acid succinic peroxide to a sufficient extent to alter the deductions that may be drawn from the above experiments in which cholera spirilla and water bacteria were the only symbiotic organisms employed. It should be borne in mind that the entire series of tests was severe on account of the concentration of the amœba suspensions employed, the organisms being present in greater proportion than in the intestinal fluids of severe cases of infection.

#### RECAPITULATION.

Boric acid, eucalyptol, ichthyol, oil of cassia, and infusion of quassia had slight if any effect on the amœbæ.

Tannic acid 1-100, sulphate of copper 1-2,000, permanganate of potassium 1-4,000, and sulphate of quinine 1-1,000 had a distinct, moderate effect on the growth of the amœbæ and spirilla within thirty minutes.

Benzoyl acetyl peroxide, acid succinic peroxide 1-1,000, permanganate of potassium 1-2,000, sulphate of quinine 1-500, nitrate of silver 1-2,000, argyrol 1-500, and protargol 1-500 exercised a very marked effect on the growth of the cultures within thirty minutes, and in the case of the silver salts and the acid succinic peroxide the action was plainly due to the destruction or inhibition of the growth of the symbiotic cholera spirillum.

Thymol 1-2,500 applied for fifteen minutes had the unique effect in some of the experiments of destroying the amœbæ while exercising only a moderate effect on the cholera spirilla.

There is no specific treatment for amœbic dysentery, but, if the test-tube results detailed above are a fair index of the behavior of the substances in the actual local treatment of the disease, the clinician can add to his therapeutic armamentarium a few more agents of a value equal or superior to quinine. Such a choice will be appreciated by physicians practicing in the Tropics when they encounter patients intolerant of quinine, or otherwise failing to benefit by its local action.





## THE PATHOLOGY OF INTESTINAL AMOEBIASIS.

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In former papers, one of us (Musgrave), *Bulletin No. 18*, has dealt with the subject of the cultivation and etiological significance of amœbæ. The following remarks will be limited to the pathology of the intestinal amœbic disease:

It may be well to state at the outset that we can see no valid reason for departing from the nomenclature of Lösch. He described a pathogenic amœba and called it *Amaba coli*. Why this term should be applied to a supposititious nonpathogenic organism it is difficult to say. We shall in referring to the cause of intestinal amœbiasis use the name introduced by Lösch.

Among the many articles in the literature of amœbiasis there are but few which are of special value from the pathologic side. Chief among these are those of Councilman and Laffeur (*Johns Hopkins Hospital Reports*, 1891, II, 395), Harris (*Amer. Jour. Med. Sc.*, 1898, CXV, 384), Howard (*Buck's Reference Handbook*, 1900), and Rogers (*Brit. Med. Jour.*, 1903, I, 1315). Taken together, these works give a very complete picture of the disease as we have seen it.

*Material*.—This has been obtained from various sources, among which have been the First Reserve Hospital, Bilibid Prison, and the Civil Hospital, all in Manila. Other material has been obtained from the service of Dr. Strong and the private practices of Drs. McDill and Musgrave, also of Manila.

*Methods*.—Bits of tissue from autopsies were fixed in Zenker's solution, in absolute alcohol, Flemming's solution, and Kaiserling, and ultimately imbedded in paraffin.

Sections from alcohol tissues were stained by Mallory's thionin and oxalic method, those from Flemming's solution in safranin and

safranin-picro-indigo-carmin, those from Zenker's in magenta-picro-indigo-carmin (Borrel), gentian-violet-picro-indigo-carmin, eosin-methylene-blue, eosin and toluidin blue, hematoxylin and eosin, hematoxylin and picro-fuchsin (van Gieson), chloride of iron hematoxylin (Mallory), and Heidenhain's iron hematoxylin.

After some preliminary staining it was evident that for simple diagnosis from alcohol tissues, the eosin-toluidin-blue and thionin-oxalic-acid methods were most satisfactory in the order given; for other (sublimite or chrome) tissues, hematoxylin and eosin were most useful. However, it was evident that for careful examination and cytologic study the best results could be obtained with Heidenhain's iron hematoxylin and Borrel's stain, or in the case of Flemming's solution sections with safranin-picro-indigo-carmin. Borrel's method may be modified by using gentian violet in the place of magenta with excellent results.

Borrel's staining gives most brilliant results in sublimate tissues, producing very clear, distinct pictures, which are only surpassed in clearness and delicacy by Heidenhain's iron hematoxylin. Both of these stains have the additional advantage of revealing the bacteria, when differentiation is properly carried out.

Hematoxylin and eosin is a very satisfactory routine method for demonstrating the amœbæ, although the contrasts are not so distinct and the finer elements can not be so well demonstrated.

Harris's method, when applied to sections of the intestine, gives a considerable contrast between the amœbæ and other cells. By its use the organisms are easily found with the lower powers of the microscope.

Kaiserling tissues respond best to hematoxylin and eosin, but are of little comparative value for detail, and have been used almost exclusively to demonstrate the lesions in a gross microscopic way. From such tissues serial sections have been made of various types of lesions and their form and extent studied in that way.

*Gross lesions.*—Many writers say that the macroscopic lesions of intestinal amœbiasis are pathognomonic. While in certain cases—perhaps in the majority—this is true, there are others in which the picture may be very deceptive. We have seen cases from whose appearance at autopsy we could not say definitely whether or not we were dealing with amœbiasis, tuberculosis, or some other ulcerative condition, and others, few to be sure, in which the majority of the ulcers were not of the classical undermined type, the

undermining being either incipient or obscured by the process of healing. However, and this is not uncommon, a truly pathognomonic picture is presented when the mucous membrane shows all the types of lesions, and in which the walls of the gut are thickened and œdematous.

The various lesions may not be sharply distinguished, for the process is a progressive one, and one type shades into another very gradually, so that only for purposes of convenience in description we shall arbitrarily designate the various stages of the gross process.

I. *Preulceration*.—This stage is characterized by the presence of the “small raised dots” of Rogers, which vary in size from 0.5 to 2 millimeters in diameter and are intensely congested. As a matter of fact, when studied macroscopically, they are seen to be composed of one or more capillary hemorrhages into the intraglandular tissue. Usually associated with this condition is one of erosion of the superficial layers of the mucous membrane. However, these erosions may be encountered in the absence of any marked congestion, although a moderate injection, at least, is the rule. With both of these processes there is little of the marked thickening of the submucosa which is so constantly seen in the more active ulcerative stages of the disease. These early lesions may be seen in any portion of the affected gut. By using the sigmoidoscope we have demonstrated them low down in the rectum within a couple of inches of the anus. They are most frequently encountered and are most numerous in the more acute cases, but may also be seen in chronic ones.

II. *Ulceration; (a) type of Harris*.—These lesions, though rarer than the classic type, are nevertheless not uncommon. They are possibly the result of the process of erosion mentioned above and are primarily confined entirely to the mucous membrane. As Harris says, they “generally reach into the submucosa and rarely to the circular muscle, but never deeper.” They probably commence as a very circumscribed erosion and spread laterally as rapidly as they do downwards. Macroscopically the edges are abrupt, sometimes giving the ulcer a “punched-out” appearance. They are round or oval in form and their edges are usually thickened and marked by intense congestion. Their bases are comparatively clean, grayish, and œdematous. They are often situated on the apices of intestinal folds and have a tendency to increase in the direction of the short axis of the bowel. This type of ulcer has a general distribution and may be encountered in any part of the bowel. It is

less frequently seen in the more advanced and very chronic stages. The fact that it is most common in those bowels showing the pre-ulcerative lesions speaks for its being intermediate between the very early petechial lesions and the undermined ulcer. This is the type most common in the ileum.

(b) *Classic or undermined ulcers.*—These are seen in an early stage, as minute yellowish or grayish spots in the mucosa of the bowel, frequently at the centers of the petechiæ spoken of as the preulcerative stage of the disease, and are usually surrounded by a zone of congestion more or less well marked, as the case may be. These spots represent the mouths, filled with necrotic material, of passages leading to larger or smaller cavities in the submucosa, which are also filled with the same material. As the process extends, the pocket in the submucosa is enlarged parallel with the surface in all directions, and although the necrobiosis eventually involves all the coats of the bowel, the muscular layers and the mucous membranes suffer less rapidly, so that there results an ulcer with its base on the circular muscle and with overhanging edges of mucous membrane. Such ulcers may be of sizes varying from that of a pinhead up to that of the palm of the hand, and may occur in any part of the large intestine and even in the lower part of the ileum, though in the latter they are smaller.

During the process of ulceration, the submucosa becomes generally thickened and œdematous, as may also the muscular layers and the peritoneal coats.

During extension, such ulcers may coalesce beneath or upon the surface, and it is no rare thing to find even small submucous pouches communicating with each other by tunnels, while the mucous membrane may show no more than a catarrhal condition.

In many of the larger lesions, the circular muscle fibers are exposed, forming the base of an ulcer, and shreds of this may be seen nearly separated from the rest and may be removed by gently scraping. In still more extensive ulceration the muscular layer may become necrosed or even perforated and the ulcer may then be bounded externally by the peritoneum or omentum.

There are, perhaps, few diseases in which the omentum plays so imported a protective part as in the one under discussion. Very early in the ulcerative stages this membrane may be found plastered upon the peritoneal surface of the gut in preparation for the accidents which may follow.

Because of this function of the omentum, localized suppurations are common. Ulcers may also perforate into the subperitoneum at almost any point, the abscess as a usual thing remaining circumscribed, although it may burrow widely. One case of this class of burrowing abscesses had perforated in the retroperitoneum in the cæcal region and had extended upward and perforated into the right pleural cavity.

III.—*Healing*.—As healing takes place, the mucous membrane gradually extends from the margins, so that in the early stages the ulcer seems to be lined with epithelium, except upon its base. In the case of very small ulcers there may be complete repair, in other more advanced cases there is considerable formation of scar tissue which may lead to contractions. This we have not seen. The commonest outcome in cases of long duration, especially in those not treated systematically and continuously, is the establishment of a chronic catarrhal condition with subsequent atrophy—a condition of *enteritis chronica atrophicans*. This is recognized in various parts of the world as sprue or psilosis. It is not a result of amæbiasis only, although it may be so in imperfectly treated cases. The gross features of the bowel in such a condition are thinness, absence of normal folds, atrophy of the mucous membrane, and increased length. Combined with this atrophic condition may be one of localized hypertrophy, resulting in the formation of more or less well-developed polypi.

*Epitome of the gross appearances*.—In a general way the process studied is as follows: In the early stages of the disease there occurs a catarrhal condition of the mucous membrane with hypertrophy and cystic and mucoid degeneration. At various points, from the lower part of the ileum to the lower part of the rectum, small raised hemorrhagic spots occur, which later lose their mucous coverings and resemble erosions, and later still ulcerate. If abscesses have formed in the submucosa, they rupture into the bowel and produce the early step of undermined ulcers. The ulcers resulting from simple erosions are not, as a rule at least, of the undermined type, but they may become so. Undermined ulcers are usually, while the cause persists, progressive.

When secondary infections occur the processes of the disease may be modified by diffuse congestion, hemorrhagia, diphtheritis, or gangrene. Perforations may occur in the course of the ulcerative



stages of the disease with resulting localized or general peritonitis, retroperitoneal abscess, etc.

The healing of small lesions may take place with complete repair, or of large lesions with the formation of scar tissue and with subsequent contractions. Peritonitis may result in the formation of adhesions. Complete cure may be the eventual outcome, or a condition of chronic atrophic enteritis or chronic catarrhal enteritis may result.

Generally, and probably always in active cases, the intestine is thickened. This increase may be due to edema of all the layers, but chiefly to that of the submucosa. It may also be caused by the presence of the abscesses and sinuses which are so common in that layer. In very active cases the subperitoneal coat may be very much thickened, mostly from œdema. The mucous membrane between the ulcers in uncomplicated cases usually appears normal.

*Distribution of the lesions.*—There seems to be only a partial unanimity regarding the extent and localization of the lesions in the disease. To quote recent remarks on the subject, Fletcher (*Journal of the American Medical Association*, 1904) says the rectum in a majority of cases is not involved or is so, only to a slight extent. Harris (loc. cit.) remarks that in fully half the cases the lesions do not extend above the beginning of the transverse colon, and Rodgers (loc. cit.) writes that almost invariably the lesions are more marked in the cæcum and ascending colon and frequently limited to these areas.

In considering the presence of lesions above the ileocæcal valve, Fletcher says that in two of 119 cases slight superficial ulceration was present in the last few centimeters of the small intestine. Rodgers concludes that "the process never invades the ileum, which is contrary to frequent results in other forms of dysentery." Many writers speak of the more or less frequent involvement of the appendix. Such observations taken from literature might be multiplied many times, but these serve to show how different are the results of careful and accurate observations based upon studies carried out in different countries and even in different parts of the same country.

Our statistics are based upon two series of cases, each of which comprehends 100.

Series A: Composed of cases that received either unsystematic treatment by enemas or none at all. This series is one in which the cases were received in the pathological service of Dr. R. P. Strong at the First Reserve Hospital and Army Pathological Laboratory, and in which the necropsies were performed by Drs. Strong and Musgrave. Dr. Strong kindly turned over to us the autopsy records for examination and study.

Series B: Composed of cases treated by rectal injections.



## SERIES A.

Entire large bowel involved (except extreme lower part of rectum).....	87
Lesions confined to cæcum and ascending colon.....	5
Lesions confined to transverse colon.....	1
Lesions confined to descending colon, sigmoid, and rectum.....	0
Not recorded .....	7
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Total.....	100
Appendix ulcerated (with large intestine).....	6
Ileum ulcerated (with large intestine).....	2

## SERIES B.

Entire large bowel involved.....	72
Cæcum and ascending colon.....	18
Descending colon, sigmoid, and rectum.....	9
Transverse colon .....	1
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Total.....	100
Appendix involved (with large intestine).....	8
Ileum involved (with large intestine).....	5

The variations shown in the two series, and those in literature as well, perhaps, may be at least partly explained. The factors to be considered are the duration of the disease at the time of death, the kind of treatment, its duration, and the stage of the disease in which the patient was when treatment was commenced.

If we take the Johns Hopkins Hospital series as an example, we may be reasonably sure that the majority, if not all, of them were treated by irrigations per rectum, as in our cases of Series B. A rational consequence of this might be that in many cases the lower lesions in the bowel had healed, and at autopsy only those that were inaccessible to treatment or which irrigations had not reached would be seen. This undoubtedly accounts, in part, for the variations manifested in our series and this dissimilarity would undoubtedly be more prominent had a larger number been properly, consistently, and persistently treated.

The duration of the disease at the time of death is unquestionably an exceedingly important factor in untreated cases and in those in which irrigation has been neglected. It may be said that without treatment the greater the duration of the disease the more extensive is the distribution of the lesions.

For the reason indicated above and for other obvious ones it may be said that the findings at necropsy can not be taken as a guide to

the distribution of the lesions at any period save that immediately preceding death.

We have selected from our series twenty-five cases in which death occurred from intercurrent disease early in the amœbic process and find that among these there is an increased proportion of cases showing ulceration confined to a portion of the intestine and a coincident decrease in the number showing ulceration throughout the large gut:

Ulceration confined to the cæcum and ascending colon.....	11
Ulceration confined to the descending colon, sigmoid, and rectum.....	8
Ulceration throughout the bowel.....	6
Total.....	25

Lesions of the small intestine, in our experience, have always been confined to the lower ileum and have been the apparent result of direct extension from the cæcum, which is usually severely ulcerated in these cases. We have had one in which ulceration extended 32 centimeters above the ileocaecal valve, but ordinarily the lesions consist of one or a few ulcers immediately above, or within 5 centimeters of, the Bauhinian valve. However, when there is a diphtheritis of the cæcum, the membranous exudate more often extends above the valve for a longer or shorter distance, but without ulceration. In such cases amœbæ have not been demonstrated and consequently they have not been included in our statistics.

As with the small intestine, so with the appendix, only cases with distinct ulcerative processes, in which amœbæ were demonstrated, have been included in our statistics. In many necropsies this organ was found clinically diseased from causes other than amœbiasis and it occasionally showed an acute process which could not be proved to be due to amœbæ. All such cases have been excluded from the tables.

*Histology.*—In general, it may be said that the mucous membrane between the ulcers is but little changed. In many places no deviation from normal can be noted. However, in the immediate neighborhood of the lesions there is a tendency to hypertrophy with mucoid degeneration and even cyst formation. The latter is less common in the cases we have studied than in those reported by Councilman and Lafleur. The most common change in the mucosa is in the immediate vicinity of the lesions and is shown by a tendency to more diffuse staining than is seen in normal epithelial

cells; and whenever this, perhaps a sign of incipient coagulative necrosis, is visible, there is usually some distortion of the glands beneath the surface. Such changes are most frequently seen in the very early stages. In many cases the cells lining the glands are separated from the basement membrane and lie singly or in clumps in the lumen. Under such circumstances it is not uncommon to see amœbæ in the glands, lying among the desquamated cells or forcing their way between the epithelia and the basement membrane.

The most marked feature of the early lesions is congestion, often combined with capillary hemorrhages which are most noticeable immediately beneath the mucosa. This congestion may extend even to the submucosa, in which layer there is also a certain degree of thickening, chiefly due to œdema. Together with congestion, there is an increase of cellular elements of the lymphoid type in the interglandular tissue. The muscularis mucosa at this stage of the disease may show no changes or only a slight œdema.

The most interesting feature of this early process lies in the distribution of the amœbæ. Not only may they be seen in the glands, as described above, but they may also be present, sometimes in large numbers, in the interglandular tissues and blood vessels, in the muscularis mucosa, and in the dilated veins of the submucosa, and this, with changes scarcely perceptible, if only the low powers of the microscope are used. In such lesions bacteria are very few in number and often can not be found even after prolonged search, and none can be demonstrated in the amœbæ. The latter, even in the blood vessels, show the peculiar rod-shaped or crystalline bodies which stain intensely with magenta and hematoxylin, the radiate structure of the ectoplasm and ingested cells.

In sections from lesions slightly more advanced and showing a more extensive, though still superficial necrosis, the glands immediately surrounding them are hypertrophied and the cells show mucoid degeneration. There is the same lymphoid infiltration, with, if anything, a greater congestion. In the congested area each gland mouth seems to be surrounded by a zone of hemorrhages. The cells of the necrotic mucous membrane are incorporated, with occasional leucocytes, granular detritus, amœbæ, and bacteria, into a more or less well-formed membrane. There is a more extensive separation of the glandular cells, and in such glands amœbæ can usually be seen either in the lumens or between the cells and the basement membrane. Within the interglandular connective tissue

amœbæ may also be seen in the blood vessels and lymph spaces. As the process progresses and as the lesions become more advanced the effect upon the submucosa is more marked. The congestion is augmented, the edema is increased and the number of amœbæ is greater. There is usually also an increase in the mucoid changes of the epithelium surrounding the lesion. In a few cases we have seen a very low, atrophic mucous membrane and a comparatively thin-walled gut, although there were extensive ulcerations. It is reasonable to suppose that we were dealing in such cases with an infection of a bowel previously the seat of a chronic enteritis. In all the cases we have studied, regardless of the state of the mucous membrane or submucosa, we have seen an extensive lymphoid cell infiltration and at least a moderate hypertrophy of the lymphoid apparatus.

In all lesions, whether early or late, the character of the cellular infiltration is the same in uncomplicated cases. It seems, if amœbæ can be demonstrated in the tissues and if at the same time there is a polymorphonuclear infiltration, that bacteria are playing an active part in the process, especially if with the infiltration there is any degree of nuclear fragmentation. In certain cases infiltration with polymorphous leucocytes may be seen about the margins of the ulcers, although at the base of the lesions and in the submucosa they were present in but inconsiderable numbers. In some cases, although there were some or even many, bacteria present, there was no process which seemed to be directly attributable to these. It is possible that in such cases these were simply the nonpathogenic, harmless commensals of the amœbæ. In others, bacteria seemed to play at least as important a rôle as the amœbæ, noticeably in those in which there was diphtheritis and gangrene. It may be that the bacteria play an important part in determining whether or not hemorrhages shall occur, for it is certain that in uncomplicated cases thrombosis is a common and early occurrence. In many very early stages the interglandular vessels of the submucosa may be seen generally thrombosed. If an ulcer is filled with a diphtheritic slough which is carried away suddenly, the chances of the hemorrhages are much increased, as is the case in typhoid.

Usually the necrotic process extends for some distance beyond the ulceration and often beyond the amœbæ, but in many instances amœbæ seem to be present in healthy tissue, notably in the early

lesions. It is a question whether this necrobiosis is the result of some secretion of the amœbæ or whether it depends more upon thrombus formation. In some places the latter seems to be the predominating factor, in others the former, while in still others neither appears to influence the process. It is, however, certain that the thrombosis assists the amœbæ in extending their zone of action, as it may likewise assist the bacteria.

Necessarily the contents of the ulcers vary according to the degree of ulceration and to the character of the bacteria present. In uncomplicated cases, which microscopically show a rather clear, yellowish, gelatinous material in the opening, the ulcer contents are composed of a granular base of albuminous character, in which cells in various stages of degeneration are imbedded, together with amœbæ, bacteria, and usually a few red blood corpuscles.

In all the lesions the amœbæ vary widely in size. Measured with a Zeiss schrauben micrometer they range between 4 and 35  $\mu$ .

In the earliest stages of the amœbic invasion, the œdema effects the submucosa. In the later ones the subperitoneal coat is also involved and adds considerably to the thickness of the gut. Eosinophiles are not uncommon in either the modified or unmodified amœbic process. They occur for the most part in tissues at some distance from the lesions, usually in the neighborhood of blood vessels, and are not uncommonly encountered in the subperitoneal connective tissue, when that layer has become œdematous. These are perhaps more numerous in the secondary infections, as are also mast cells. Plasma cells are frequently seen in the submucosa. In the most extensive ulcerations the picture is modified only by the extent of the process. Whether the ulcers are undermined or not, there is always the same appearance of coagulative necrosis, with lymphoid infiltration, congestion, and thrombosis, and comparatively little polymorpho-leucocytic invasion.

The two most evident features of the intestinal lesions, when viewed with a comparatively low power of the microscope, are the necrobiosis and the relative infrequency of leucocytes, features which suggest the important rôle of the amœbæ, for ordinarily in bacterial infection there is an associated local leucocytosis of varying intensity. A point of some importance is brought out by the fact that in the very early lesions, the preulcerative ones, the amœbæ may be encountered not merely in the glands but beneath the epithelium



and within the lymph spaces and blood vessels of the interglandular tissue and the submucosa.

*The character of the amabæ in sections.*—In toluidine blue and eosin the estosare stains fairly definitely and the vacuoles of the protoplasm show well. The bacteria also stain, as do the encysted bodies and fragments. The nucleus is very definitely stained and surrounded by a more or less distinct perinuclear space. The nuclear membrane colors a clear deep blue. The nuclear protoplasm appears pink and contains one or several deep blue-black bodies, or perhaps none. There may be several dark-stained thickenings in the nuclear membrane. As a rule, in well-stained sections the amœbæ, where they do not contain much extraneous material such as bacteria and nuclear detritus, are less deeply stained than the cells of the intestinal mucous membrane. The protoplasm of those which are deep in the tissues is less intensely colored than that of the ones in the mucous membrane, and it may be that this phenomenon is due to the fact that in the more superficial layers the organisms have taken up more mucous material. That there is some reason for this supposition is shown by the fact that this stain is much less useful in studying the organisms in liver abscesses, where of course there is no mucus.

Perhaps the most brilliant stain for amœbæ in tissues is that of Borrel. This consists of—

- I. Saturated aqueous solution magenta red.
  - II. Saturated aqueous solution picric acid.
- Saturated aqueous solution indigo carmin aa.

Stain with No. I for twenty minutes and wash.

Stain with No. II for five minutes, wash, and differentiate with alcohol, xylol, and balsam.

With this, the amœbæ are not so readily distinguished by the low powers of the microscope as with the thionin or eosin toluidine-blue stain, but the finer organization is much more easily studied with high powers. Generally with this stain the amœbæ are less deeply colored than the surrounding tissues, being a rather pale bluish or purple, or, in well-decolorized specimens, of a greenish hue. The edge of the organisms shows as a fine blue line, which is more distinct about the body of the parasite and less so about the pseudopodia. The ectoplasm appears as a finely reticular or almost hyaline substance, the fibrillar or granular part of which is stained a very faint blue. The endosarc appears as a granular material



more deeply stained than the ectosarc, and purplish, bluish, or greenish, according to the degree of decolorization. Within this are spaces which remain uncolored, though in thick sections they have a bluish tint due to the underlying stained material. Bacteria may also be in the endosarc. The rods of which Councilman and Lafleur speak, which are not seen in all cases, occurring in those in which there is more extensive sloughing or diphtheritis, may also be seen. It may be that these are crystalline, derived from the blood, or Charcot-Leyden crystals, which are occasionally found in leucocytes in certain conditions and which Askanazy says are oxyphilic (*Munch. Med. Woch.*, 1904, LI, 1945).

The nucleus may be surrounded entirely or in part by a clear perinuclear space. The general color of the nucleus is violet or purplish. The outline is sharp, and, if the section is not too decolorized, should assume a clear crimson tint, in the form of a more or less incomplete ring, or it may be nodulated on its inner surface corresponding to thickenings in the chromatin. There are also occasionally crimson granules within the nucleus and sometimes one perfectly round mass corresponding to the nucleolus.

Ingested cells, such as red blood corpuscles, leucocytes, etc., may also be seen within the protoplasm in various stages of degeneration, the stain depending upon the extent of the process.

In sections so decolorized that the magenta is all removed, the nucleus appears of a blue color, deeper than the tint of the rest of the cell and with the chromatin material still more deeply stained.

Heidenhain's iron hematoxylin is as excellent a stain for amœbas as it is for other tissues, although not so brilliant as the magenta-picro-indigo-carmin. In carefully manipulated sections the nucleus of the amœbæ is somewhat more deeply stained than the cystoplasm and ordinarily appears as a dense blue-black ring, in the center of which is the round black nucleolus. The nuclear plasma is usually merely of a blue tint and is divided by a mesh of delicate dark reticulum. There may be other deeply stained chromatic elements or granules within this. The radial striæ of the cytoplasm is well shown and the crystalline bodies are, when present, an intense black. The spongioplasm appears as a network of dark lines and the cell boundary is sharply differentiated. Red cells, when present, stain according to the state of degeneration, those most recently ingested being black; those least so, yellowish. Bacteria, when present, stain sharply and distinctly when not too far degenerated or digested.

Amœbæ grown in cultures from amœbic ulcers, when stained by Borrel's method, show somewhat different reactions.

Cover-glass impressions may be made in the following way:

A cover glass is placed upon the growths on agar plates, removed quickly, and instantly plunged into a very hot saturated solution of mercuric bichloride. It is then washed in Gram's solution or a weak tincture of iodine and rinsed in 80 per cent alcohol, after which it is washed in water. The stain is then applied in the usual way. After this process the preparations are differentiated in alcohol, cleared in xylol, and mounted in xylol-damar. The amœbæ are seen in various conditions, as they were in the culture, and of various shapes and sizes. In many the pseudopodia have not been withdrawn and can be well seen. Under these circumstances the ectosarc has a pale, diffuse blue color, or is perhaps very finely granular and has a very sharply differentiated limiting line. However, usually this is not well seen and the whole organism has a sharply circumscribed, blue, granular appearance. The contractile vacuole shows clearly as an unstained ovoid or oval space, usually near the surface of the organism but occasionally near the nucleus.

The nucleus is composed of a round, central, deep purple body, surrounded by a narrow, pale-bluish, homogeneous zone, and this in turn is surrounded by a denser, blue, granular one. About this in turn is ordinarily a second more or less faintly stained zone. The whole nuclear body is round or slightly oval. The nucleolus is always round.

Comparing the amœbæ in such preparations with those in sections, we can readily see that the relative size of the nucleus is the same, as is also the relation between the protoplasm and nucleus; but in the tissues the contractile vacuole is usually not so distinct and the nucleus does not present the same appearance. This may be due to the fixation or it may be due to the different degree of decolorization. The dissimilar nutritive conditions may also affect the microchemical staining reactions.

The small amœbæ, having the size of an erythrocyte or smaller, should show the same relation in the size of nucleus and cell body.

The distinguishing features of the amœbæ are their generally irregular or oval shape (though they are often round), their relatively small, round nucleus, and the larger amount of granular or vacuolated protoplasm, which often contains foreign bodies.

*Relation of the amœbæ to the tissues.*—The mucous membrane: It is not known whether the amœbæ are able to attack or pass through an intact mucous membrane; in fact, it seems probable that in order for them to enter the deeper layers of the intestine there is some change from the normal (Schaudin). It is possible that catarrhal conditions, however slight, are accompanied by erosion, or necrosis of even a few of the superficial cells, and would offer the necessary conditions for invasion. It is at any rate certain that the amœbæ have less influence on the epithelial cells than on the supporting tissue in many glands. That this is true may be demonstrated repeatedly. The amœbæ may be seen either in the lumen or between the lining cells and the basement membrane. As a rule in these cases the epithelium detached has lost no more of its normal character than might be expected, and if adherent it seems more healthy than would be imagined in the presence of an organism whose power of causing cellular destruction is as great as it is in the case of the amœba. Generally speaking, epithelium seems to have as great resistance to the amœba as has muscular tissue.

*Muscle:* In all works on amœbiasis attention has been called to the lack of resistance the connective tissue offers to the progress of the organisms. Attention has been repeatedly called to the fact that the extensive ulcerations are in form and situation dependent upon this quality in the submucosal layer of the intestinal wall. The preliminary feature of the changes in this position is œdema, which, after invasion by the amœbæ, is followed by swelling of the fibers and cells, infiltration with round cells, and lymphocytes, sometimes accompanied by fibrin formation. The nuclei of the swollen cells become paler, the appearance of fibrillation is lost, and the tissue becomes hyaline or necrobiotic. A further feature of the process is that new tissue is found early and this has the appearance of granulation tissue. Suppuration, as previously indicated, probably does not occur in the uncomplicated disease.

*Blood vessels:* Just how the organisms enter the blood vessels can not be satisfactorily stated. In some sections they are seen in large numbers, in the same or others they may be in the perivascular lymph spaces, or they may appear immediately beside the endothelium of the capillaries. It is possible that they enter directly through the capillary walls by virtue of their inherent

power of progression, in much the same way as the leucocytes wander in and out. There is the possibility that in the process of tissue destruction the vessel walls are so changed as to make this process more practicable, or that, following capillary hemorrhages and before coagulation has occurred, the organisms may enter the vessels and make their way along. Certain it is that they do not necessarily cause thrombosis by their presence, although this appearance is by no means uncommon in tissues, and especially in the vessels of the interglandular tissues. So far as the blood cells are concerned, the amœbæ are able to ingest and destroy apparently healthy erythrocytes and leucocytes.

*Relation of amœbæ to the cells.*—It was shown by Councilman and Lafleur, and forcibly insisted upon by Howard, that leucocytic infiltration is not a feature of amœbiasis. On the contrary, it is stated that the process is more in the nature of a subacute or chronic inflammation, in that the cells predominating in the infiltration are formative ones and lymphocytes. In addition to these last-mentioned cells there is often a considerable number of eosinophiles, though this is not the rule. However, if the condition is a chronic inflammatory one, then this is the type of infiltration we should expect, for lymphocytes and eosinophiles are the cells which, par excellence, occur in such pathologic states (*Muir. Brit. Med. Jour.*, 1904, ii, 585).

In one series of sections we saw considerable numbers of mast cells, which occurred chiefly in the glandular layer of the bowel. Upon what conditions the presence of these depend we can not say, except to note that in the bowel from which the sections were made there was considerable diphtheritis.

Plasma cells are not uncommonly seen in the submucosa, as Councilman and Lafleur state. If these are of lymphoid origin, we should expect them to be frequently met with in subacute or chronic inflammation in which there is a proliferation of, and invasion with, lymphoid cells.

*Relation of amœbæ to bacteria.*—From our experience it can not be said that the presence of bacteria limit the field of activity of the amœbæ. As a matter of fact, the organisms seem to be about as numerous in cases complicated by bacterial superinfections as in uncomplicated ones, unless it be in those in which pyogenic cocci are present. In one case so complicated there were certainly fewer

amœbas in the lesions and there was very active leucocytic infiltration with marked coincident karyorhexis, a very uncommon picture for amœbiasis.

When amœbæ are found in exudates rich in bacteria they show evidence within their bodies of a very active phagocytosis.

#### CONCLUSIONS.

I. Intestinal amœbiasis is a peculiar ulcerative condition of the intestine caused by *Amœba coli* (Lösch), usually confined to the large intestine, though occasionally (7 in 200 cases) the ileum is affected and more often (14 in 200 cases) the appendix is involved.

II. In the majority of cases the condition affects the entire bowel (159 in 200 cases), though it may be limited to one or more portions, most commonly the cæcum and ascending colon (23 in 200 cases).

III. The ulcers show a tendency to be undermined, due to the lack of resistance on the part of the submucous layer of the bowel.

IV. The organisms may enter the blood vessels very early in the disease and may be transported to the submucosa without lesions of the muscularis mucosa.

V. The disease is a subacute chronic inflammatory process, as shown by the character of the exudate and infiltration, by the early formation of granulation tissue, and by the absence of leucocytic infiltration.

VI. Complete healing may be accomplished, or a condition of chronic atrophic enteritis or chronic catarrh may persist, which is known as sprue or psilosis.



## ILLUSTRATIONS.<sup>1</sup>

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- PLATE I. Colon. Thin-walled gut, with shallow ulcers, some slightly undermined, others punched out.
- II. Sigmoid. Irregular ulceration with diphtheritis.
- III. Colon. A moderately thickened gut with various types of ulcers.
- IV. Cæcum. Marked degree of disorganization of the bowel with shreds of muscularis and submucosa. Perforation.
- V. Rectum. Extensive ulceration and diphtheritis. Thick-walled gut.
- VI. Colon. Various stages of ulceration.
- VII. Colon. Extensive distribution of punched-out ulcers, some slightly undermined.
- VIII. Colon. Thickened bowel with some large ulcers and some very early ones.
- IX. Early intestinal lesion. Shows superficial necrosis, glandular distortion, and round-cell infiltration. Borrel's stain. (Zeiss objective AA, compensation ocular No. 4, bellows at 30 centimeters.)
- X. Early lesion. Extending necrosis, destruction of glandular epithelium, invasion of amœbæ, and round-cell infiltration. Borrel's stain. (Zeiss objective AA, compensation ocular No. 4, bellows at 50 centimeters.)
- XI. Submucosa in an early lesion. Borrel's stain. (Zeiss objective AA, compensation ocular No. 4, bellows at 30 centimeters.)
- XII. Thrombosis of blood vessels of the mucous membrane of the colon. Borrel's stain. (Zeiss objective DD, compensation ocular No. 4, bellows at 50 centimeters.)
- XIII. Amœbæ in the muscularis mucosa. The section is the same as that shown in Plate X. (X 500.)
- XIV. Amœbæ in an area of hemorrhage in the submucosa. Borrel's stain. (X 500.)
- XV. Amœbæ in a blood vessel. (X 500.) Heidenhain's iron hematoxylin.
- XVI. Amœbæ in a blood vessel. Borrel's stain. (X 500.)
- XVII. Amœbæ in the lymph spaces of the submucosa. Borrel's stain. (X 500.)
- XVIII-XXI. Amœbæ in tissues. Borrel's stain. (X 1400.)
- XXII. Amœbæ from a culture. Impression preparation. Borrel's stain. (X 500.)
- XXIII. Ibid. (X 1400.)

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<sup>1</sup>The photographs and photomicrographs were made by Mr. Martin, the photographer of the Bureau.





PLATE I.





PLATE II.



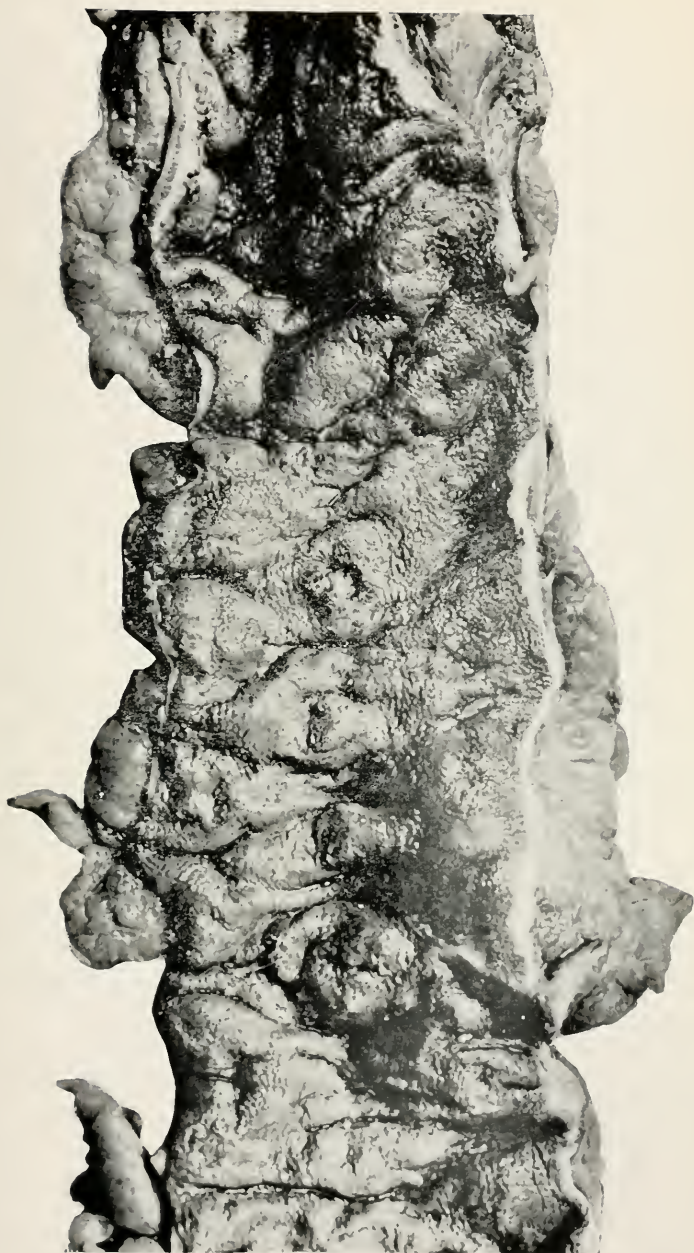


PLATE III.







PLATE IV.



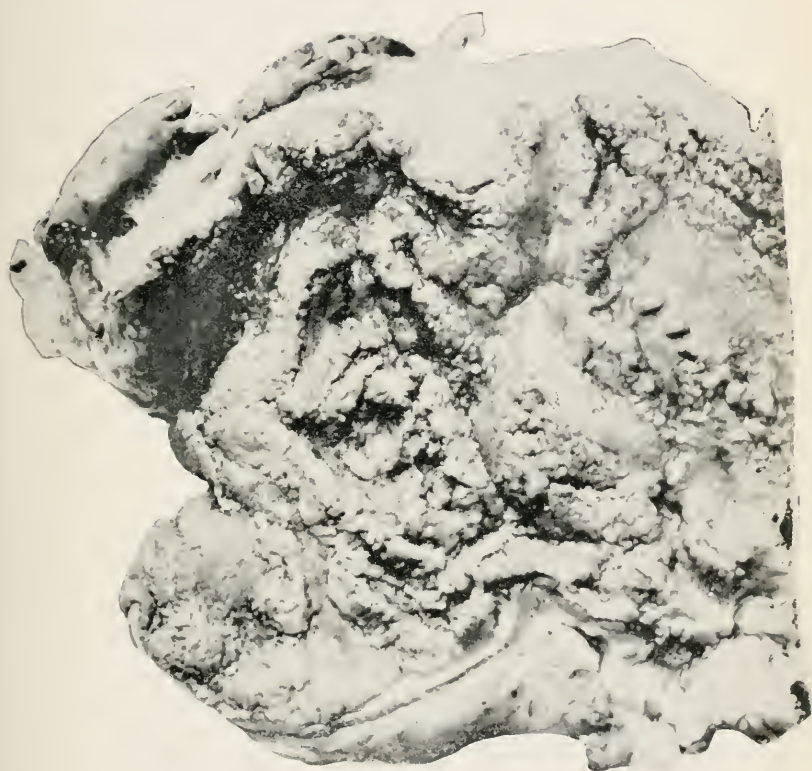


PLATE V.





PLATE VI.





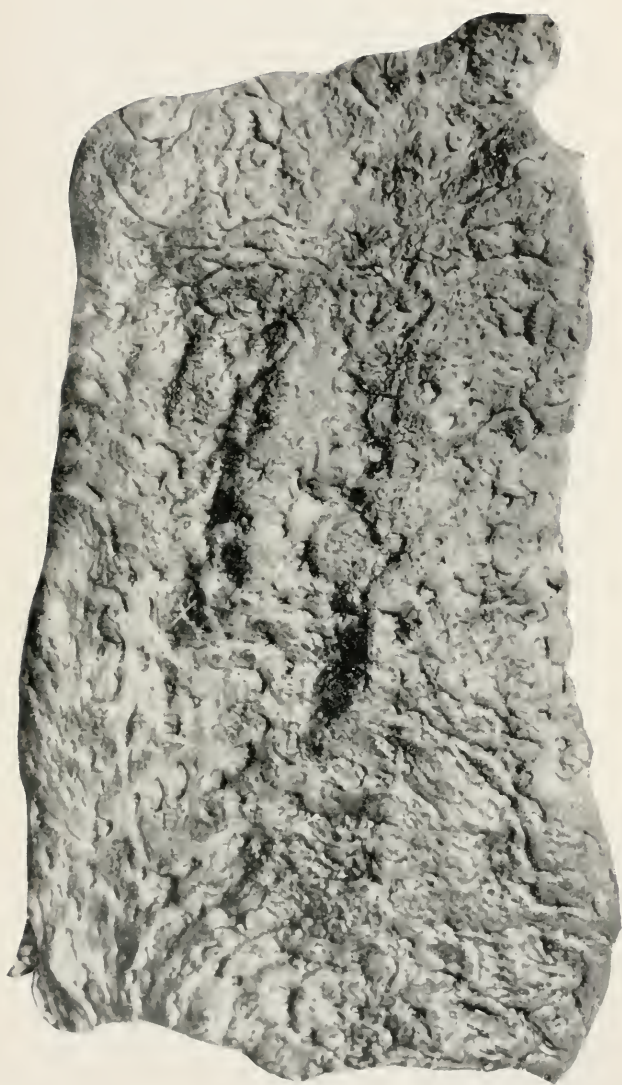


PLATE VII.





PLATE VIII.





PLATE IX.







PLATE X.



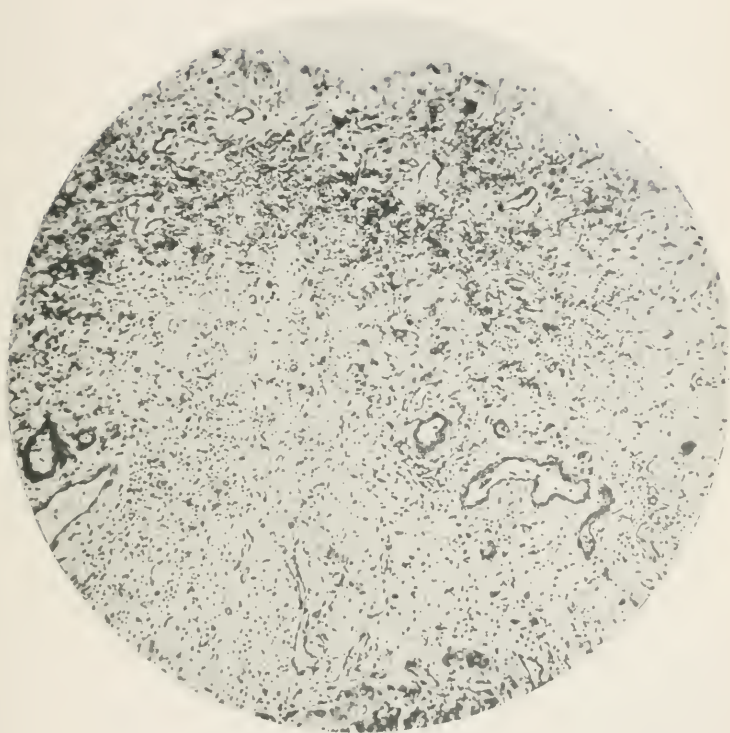


PLATE XI.



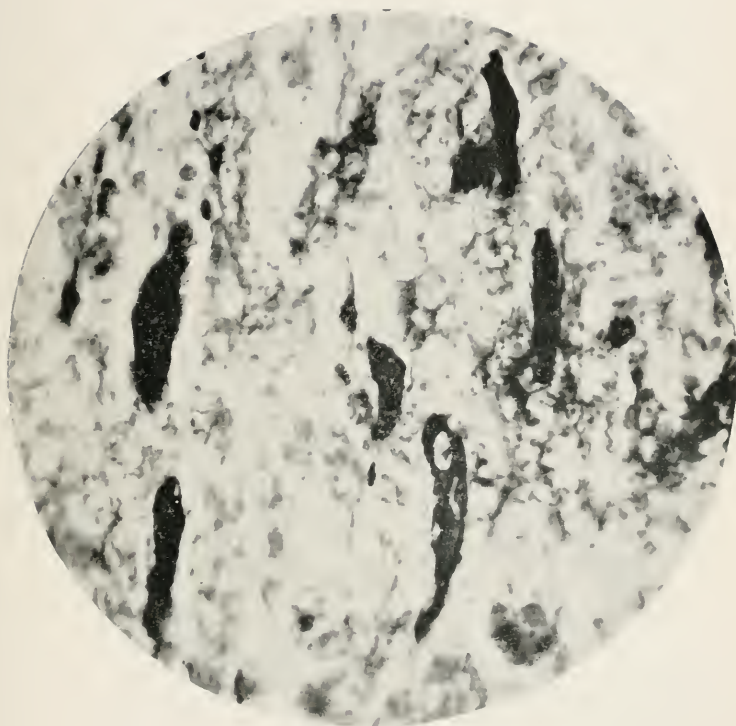


PLATE XII.





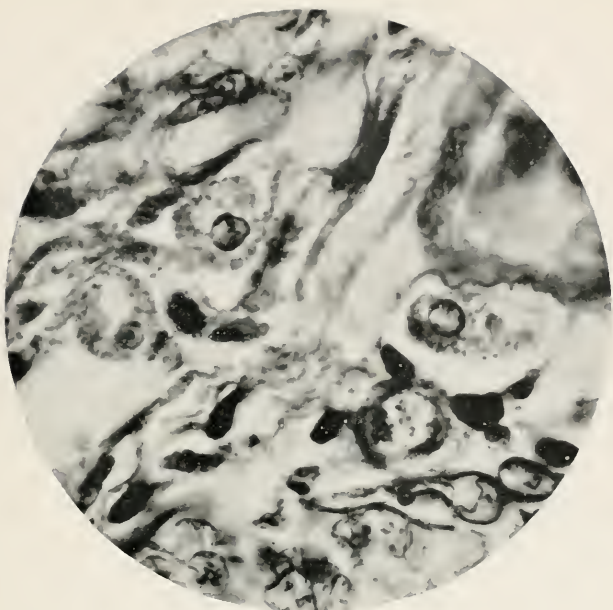


PLATE XIII.

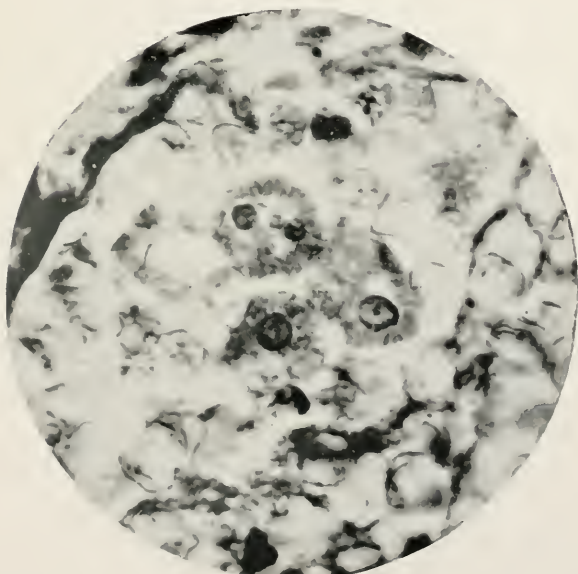


PLATE XIV.



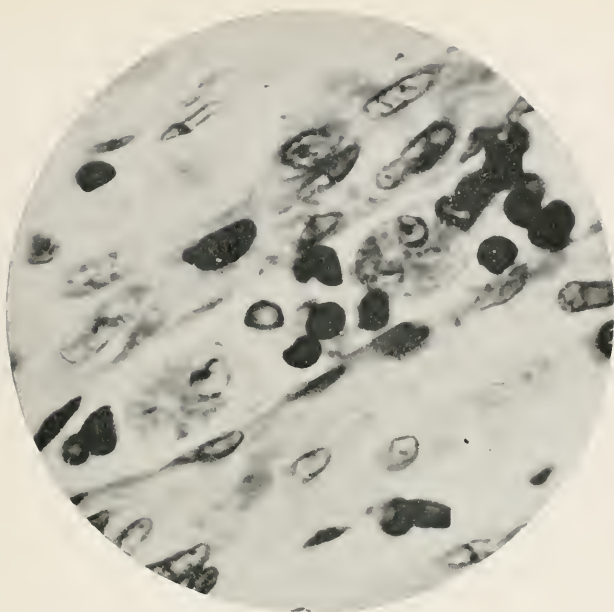


PLATE XV.

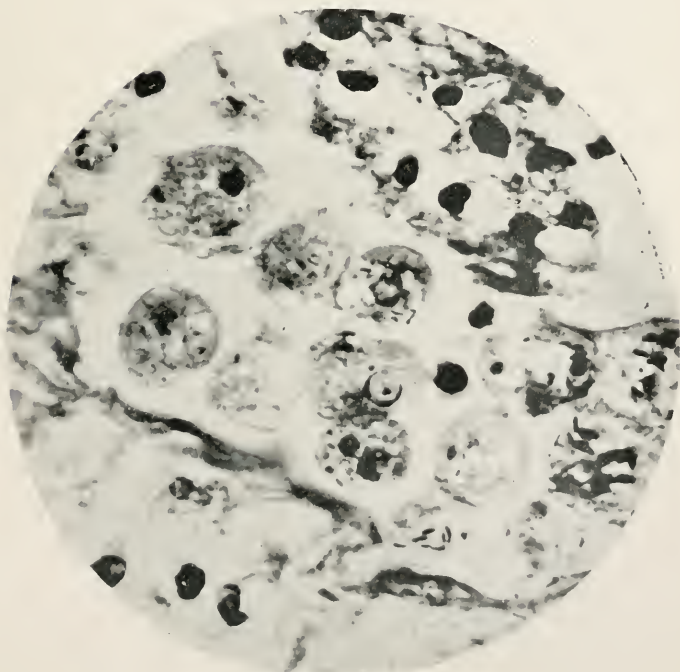


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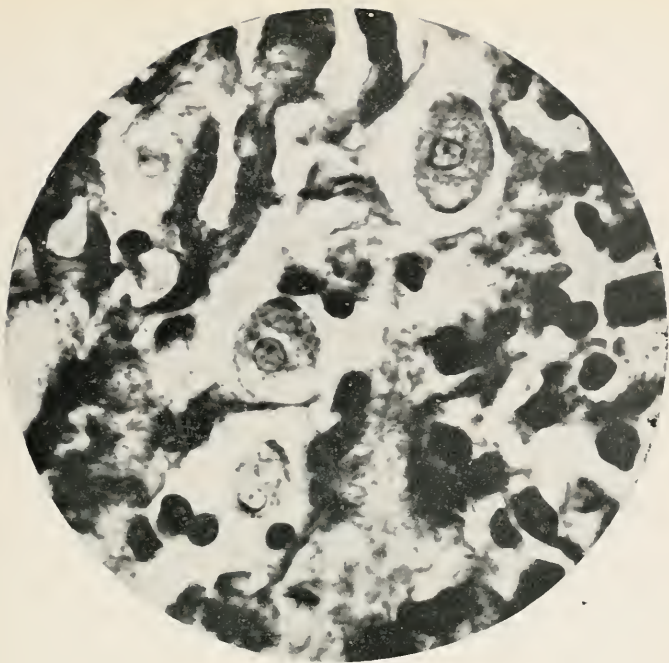


PLATE XVII.

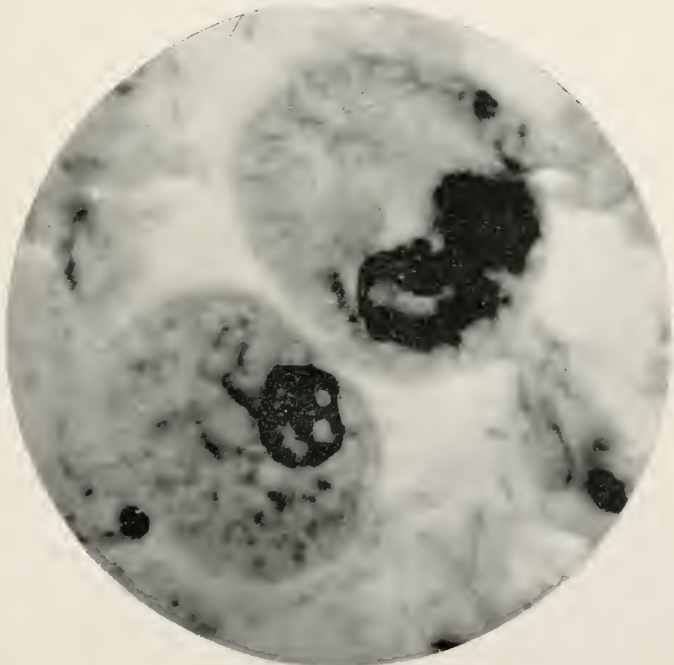


PLATE XVIII.





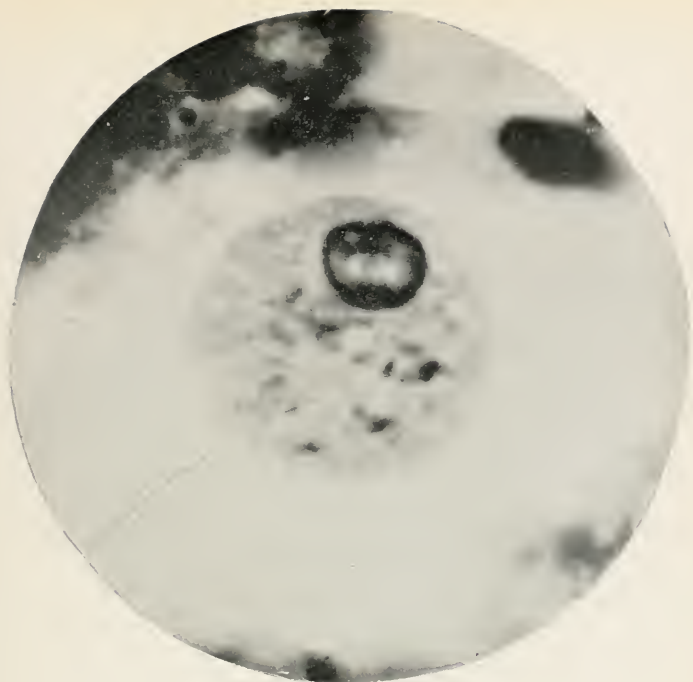


PLATE XIX.



PLATE XX.



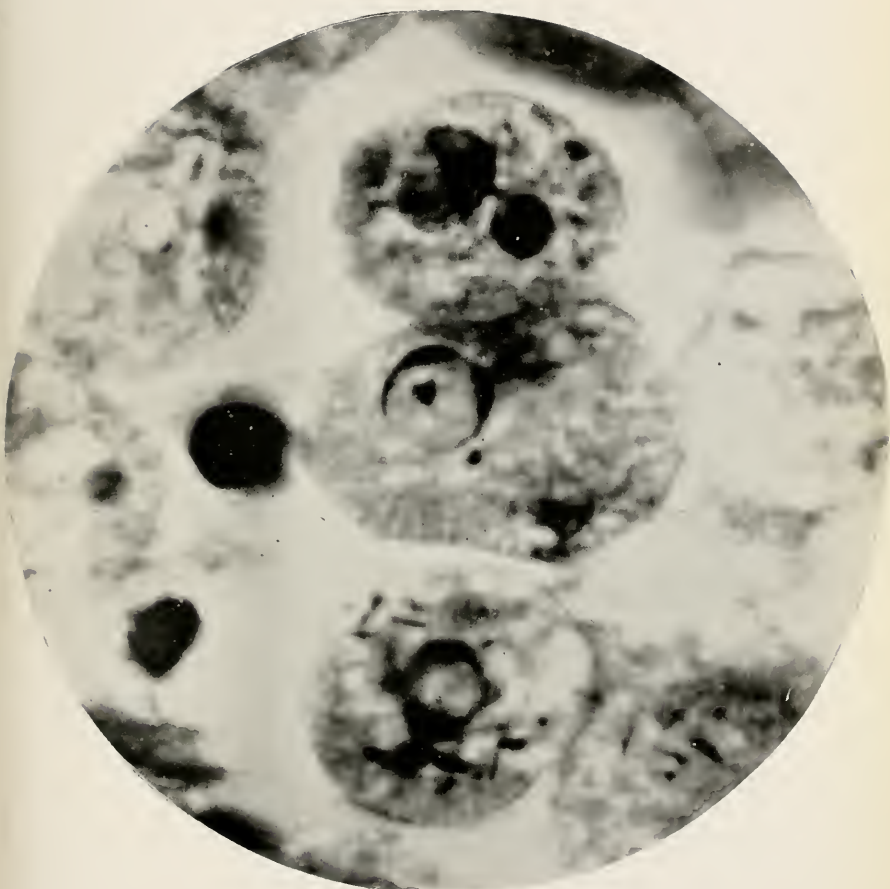


PLATE XXI.



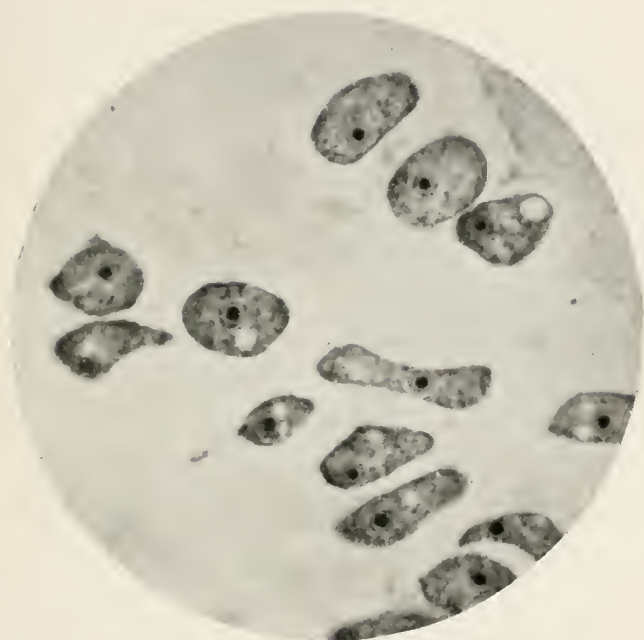


PLATE XXII.







PLATE XXIII.



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(Continued from second page of cover.)

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<sup>1</sup>The first four bulletins in the ornithological series were published by the Ethnological Survey under the title "Bulletins of the Philippine Museum." Future ornithological publications of the Government will appear as publications of the Bureau of Government Laboratories.



No. 33.—JUNE, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES  
BIOLOGICAL LABORATORY

FURTHER OBSERVATIONS ON FIBRIN THROM-  
BOSIS IN THE GLOMERULAR AND OTHER  
RENAL VESSELS IN BUBONIC PLAGUE

BY

MAXIMILIAN HERZOG, M. D.

MANILA  
BUREAU OF PUBLIC PRINTING  
1905

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(Continued on third page of cover.)



No. 33,—JUNE, 1905

DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES  
BIOLOGICAL LABORATORY

FURTHER OBSERVATIONS ON FIBRIN THROM-  
BOSIS IN THE GLOMERULAR AND OTHER  
RENAL VESSELS IN BUBONIC PLAGUE

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1905



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES.

*Manila, June 8, 1905.*

SIR: I have the honor to transmit herewith and recommend for publication "Further Observations on Fibrin Thrombosis in the Glomerular and Other Renal Vessels in Bubonic Plague," by Dr. Maximilian Herzog, Pathologist, Biological Laboratory.

Very respectfully,

RICHARD P. STRONG,  
*Director Biological Laboratory.*  
*Acting Superintendent Government Laboratories.*

Hon. DEAN C. WORCESTER.

*Secretary of the Interior, Manila, P. I.*



## FURTHER OBSERVATIONS ON FIBRIN THROMBOSIS IN THE GLOMERULAR AND OTHER RENAL VESSELS IN BUBONIC PLAGUE.

---

By MAXIMILIAN HERZOG, M. D., *Pathologist Biological Laboratory.*

---

A short time ago the writer called attention to the frequency of hyaline fibrin thrombi in the glomerular capillaries and in other renal vessels in bubonic plague. In the introduction to Bulletin No. 23, Biological Laboratory, Bureau of Government Laboratories, Manila, October, 1904, entitled "The Plague: Bacteriology, Morbid Anatomy, and Histopathology," on page 10 the following reference to these histopathologic changes was made:

In studying the histopathology of plague a highly interesting change was found in the kidneys, namely, extensive and frequently occurring hyaline fibrin thromboses in the glomerular capillaries. As it appears that this change has not been described in the study of the microscopic anatomy of the disease, it has been considered somewhat at length.

At the time the above was written, the histopathologic change under discussion had been found in seven out of twenty cases examined. When these investigations were undertaken, as was stated in Bulletin No. 23, the important publications of the Austrian Plague Commission were not accessible in Manila. Only after the bulletin was in print did they arrive from Europe. From the Austrian commission's publications it is evident that Albrecht and Gohn had indeed previously encountered the same changes and had even reproduced them in one of their drawings, but it is equally clear that they have entirely misinterpreted and wrongly described them. It is obvious that the material from which the description and illustrations were derived had been improperly fixed, and hence its examination led to the faulty interpretation of the changes which had actually occurred. This interpretation has been repeated again and again and quoted by subsequent writers in the description of the histologic changes in plague. Everywhere do we read of the

hyaline degeneration of the vessel walls, and nowhere are the thrombotic processes clearly and unmistakably described or their frequent occurrence and importance sufficiently emphasized.

Albrecht and Gohn (Vol. II, p. 546, of their report) describe the kidney changes in plague in the following words:<sup>1</sup>

In plague, as in many infectious diseases, the kidneys, both macro- and microscopically, exhibit in a most pronounced manner the signs of parenchymatous and fatty degeneration. Histologically one sees in them not only the changes of cloudy swelling and simple fatty degeneration but also loss of nuclei and necrosis.

Multiple cortical hemorrhages in the shape of typical glomerular hemorrhages are very frequent. In many plague kidneys one finds a very striking glomerular change. The individual capillary loops are transformed into cords (*stränge*), which stain well with eosin, are still sharply differentiated, and which consist of "beam" or thread-like appearing coagula (*gerinseln*). In this manner these glomeruli, deeply stained and well preserved in their shape, contrasting with the remainder of the poorly stained cortex, form a very striking picture. Between such a glomerulus and its capsule there is never any exudate. The vasa afferentia leading to the glomeruli often show the same picture of coagulation (*gerinnungsbilder*), and the latter is not only found in the vascular lumen but also involves the vessel wall. (See Table XI, fig. 1.<sup>2</sup>) In general these pictures are completely identical with those which we observe in multiple splenic foci and in genuine plague pneumonia.

Here also we are dealing with coagulations in the blood, in the tissue juices, in the elements of the vessel wall itself, *which can not be stained according to Weigert's fibrin method*<sup>3</sup> and which when stained by the Van Gieson stain assume a light yellow tint.

Such glomerular changes are found only in such cases in which very numerous bacilli are circulating in the blood. The bacilli then are found densely crowded in the capillaries and small vessels of the cortex and they can also be seen abundantly between the cord- and net-work of the vascular lumina.

Such is the description of the vascular changes of the kidneys as given by Albrecht and Gohn. In this connection we must point

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<sup>1</sup> This quotation has been translated from the original as literally as possible.

<sup>2</sup> According to their explanation of the tables, fig. 1, Table XI, a colored drawing, was prepared from material fixed in the Mueller-Orth formalin mixture and then stained with hæmalum and eosin. As stated in another part of the present report, such a method of fixation is absolutely worthless for the microscopic study of the thrombosed vessels. Indeed, after its use one obtains very misleading pictures simulating vessel changes, which are in fact not present. See microscopic description of our case No. 20.

<sup>3</sup> Italics our own.



out the fact that we are not dealing with capillaries which have been changed into eosin-staining cords, but with vessels obliterated by a material which has all the morphologic and tinctorial properties of fibrin. Whenever these thrombi are not exceedingly dense and solid, it is easy to demonstrate vessel walls in thin sections which to all appearances are morphologically intact. It is generally also very easy to demonstrate this fact with reference to all vessels of the cortex, which are of a somewhat larger size, as well as to those of the medulla.

Duerck has just published an extensive contribution to the pathologic anatomy and histopathology of plague. In his summary of the microscopic changes he does not mention the thrombotic ones under discussion, but simply makes the following statement:

The so-called parenchymatous organs, the liver and the kidneys, in all cases, even in those in which the disease has lasted a few days only, show those profound degenerative changes which are found also in other infectious diseases after a fatal issue. We see all degrees of cloudy swelling and beginning fatty degeneration. \* \* \* In the kidneys, aside from the general toxic effect, the glomeruli appear to be the points especially vulnerable to the attacks of the plague virus. Even macroscopically one recognizes their enlargement and the great injection of the loops. Microscopic examination shows blood extravasation and epithelial desquamation, as well as the invasion of numerous plague bacilli. In six cases examined for this purpose the invasion of the glomeruli by plague bacilli was demonstrable. Occasionally this invasion leads to inflammatory changes combined with profound degeneration and hemorrhages, which produce, in the glomeruli especially, changes as we only find them in the most deleterious forms of post-scarlatinal or septic nephritis. (Table XV, figs. 29, 30, 31.)

The illustrations to which the author calls attention show hemorrhagic glomerulo-nephritis, but without any thrombosis. However, thrombotic processes are referred to in the description of case No. 14 in the following words:

Almost all of the glomeruli are much enlarged, the capsules of Bowman dilated; the capillary loops, however, only partially fill the capsular space; they are generally reduced in size and partially obliterated by hyaline or leucocytic thrombi. Besides the loops in the capsular space, are found numerous red-blood corpuscles, mixed with desquamated capsular and reflected epithelia. \* \* \* Homogeneous exudates are occasionally found in the capsules.

The preceding very recent contribution to the histopathology of plague does not do justice to the important thrombotic processes in

the kidney in this disease: nor does the description of Hamdi (who worked under Marchand) mention it at all. Hamdi had at his disposal material from seven plague cases and pieces of kidney from five. His description of the renal changes reads as follows:

In our cases of plague the glomeruli vary in appearance. They are generally large, show many nuclei, and then fill the capsular space completely. Their capillaries are dilated and engorged with blood. Occasionally bacilli are diffusely distributed in these loops. In other cases, however, the glomeruli are small and the capillaries contain little blood. If this is the case and if the capillaries are collapsed, the capsular space contains a coagulated amorphous mass or a hyaline-like (*hyalinartige*) substance or blood, the latter being found also between the loops.

Since reporting the investigation of twenty cases of bubonic plague, and since becoming acquainted with the above-quoted publications, the writer has examined eleven more typical, fatal pest cases. We can now not only confirm our former statements as to renal vessel changes in plague but can further support them by additional observations and by additional staining methods employed in the investigation of the material.

The statement of Albrecht and Gohn, that the renal vessel changes which they have seen, but which they have misinterpreted, are to be found only in those cases in which numerous plague bacilli are circulating in the blood, we must contest, because our own investigation shows, as previously stated (Bulletin No. 23), that the presence or absence of bacterial metastatic emboli and the occurrence of hyaline fibrin thrombi do not entertain toward each other the relation of cause and effect. These two factors are indeed independent of each other, though they may be present simultaneously. A number of our cases demonstrate this beyond question. We saw very profound renal thrombotic processes without bacterial invasion and very extensive bacterial emboli in the absence of thrombi. Duerek likewise reports cases in which he speaks of the bacterial inundation of the kidneys without mentioning thrombosis. Of his case No. 7 he reports: "Everywhere in the capillary loops of the glomeruli and in other vessels numerous plague bacilli were found." Case No. 9: "Most glomeruli inundated by plague bacilli." Case No. 11: "Bacterial stains show an enormous inundation with plague bacilli: many glomeruli appear as if they had been injected with bacteria; likewise other renal vessels." In none of these cases are thrombotic processes proper mentioned.

However, so far as Duerck's case No. 11 is concerned, there is some suspicion that what this author describes as a bacterial injection of the vessels may indeed be a hyaline thrombosis. Such thrombi, in sections stained intensely with alkaline methylene blue, retain the blue and might, if densely fibrous in structure, be mistaken for crowded masses of bacteria.

#### ANALYSIS OF OUR 31 CASES.

An analysis of the 31 cases of plague examined by us shows that the total number comprises—

Group I. Primary uncomplicated bubonic plague.....	16
II. Primary bubonic plague with secondary plague septicopyemia .....	7
III. Primary bubonic plague with secondary plague pneumonia ..	2
IV. Primary uncomplicated plague pneumonia.....	3
V. Primary pneumonia with secondary septicopyemia.....	1
VI. Primary plague septicæmia.....	2
Total .....	31

Twenty-five of these were of the bubonic, four of the pneumonic, and two of the primary septic type. Of the bubonic cases there were—

Inguinal buboes .....	19
Axillary buboes .....	1
Cervical buboes.....	5

Of the total number of 31 cases there occurred in—

Native Filipinos .....	19
Chinese .....	11
Caucasians (native-born American).....	1
Males .....	24
Females .....	7

According to age the distribution is as follows:

From 1 to 10 years.....	3
From 11 to 20 years.....	9
From 21 to 30 years.....	11
From 31 to 40 years.....	5
From 41 to 50 years.....	1
From 51 to 60 years.....	1
From 61 to 70 years.....	1
Total.....	31

Hyaline fibrin thrombi in the glomerular capillaries and in other renal vessels were found in cases Nos. 2, 11, 13, 14, 15, 16, 17, 18, 20, 23, 30, 31—that is, in 12 out of 31 cases, or in 38.71 per cent of the material investigated. These 12 cases are distributed among the six pathologic groups as follows:

Group.	Total number of cases.	Renal fibrin thrombi.	Percentage.
I. Primary uncomplicated bubonic plague-----	16	6	37.50
II. Primary bubonic plague with secondary plague septico-pyemia-----	7	4	57.14
III. Primary bubonic plague with secondary plague pneumonia-----	2	-----	-----
IV. Primary uncomplicated plague pneumonia-----	3	-----	-----
V. Primary pneumonia with secondary septico-pyemia-----	1	-----	-----
VI. Primary plague septicæmia-----	2	2	100
Total-----	31	12	-----
Average per cent-----	-----	-----	38.71

The methods used in the histologic examination of our material were as follows:

Pieces of tissue from the plague bubo and from the internal organs in each case were immediately fixed in Zenker's solution during the autopsy. In a few cases other fixing fluids were used as a control, viz, Mueller's fluid, the Mueller-Orth formalin mixture, and others. Subsequently, the material was dehydrated in alcohol and embedded in paraffin. The sections were stained with hematoxylin-eosin, eosin-alkaline methylene blue, according to Weigert's fibrin method (preliminary carmin stain), Mallory's anilin-blue for connective tissue fibers, dilute carbol-fuchsin, and Wright's modification of Romanowski's stain. The best method in the study of the thrombotic processes in plague is furnished by Weigert's fibrin stain after fixation in Zenker's solution. Fixation in Flemming's solution or in Mueller's or Mueller-Orth's fluid is absolutely inadmissible for the study of the thrombotic processes. According to Disse the methods to be recommended in the fixation of renal tissues are very limited. Chromic acid and its salts, alcohol, and many other means frequently employed are inadmissible; but Zenker's solution, which acts like saturated corrosive sublimate, is to be recommended.

In all of the cases in which we found hyaline thrombi in the kidneys, sections were also stained by Van Gieson's method. The hyaline thrombotic material always stains yellow, never pink or

orange. The vessel walls themselves do not show any infiltration with a material staining pink or orange; hence a hyaline degeneration of the vessel wall in the strict sense of the term is not demonstrable. In fact, Van Gieson's stain is very well adapted to show the good state of preservation of the cellular elements of the vessel walls.

Sections from the 12 cases with renal thrombosis were further examined for amyloid. This was done because Duerck in his case No. 16 observed amyloid in the renal sections. However, the author does not attribute the presence of amyloid in this case to the pest infection, but to other chronic causes of long standing. We did not find amyloid material.

The following is an abstracted description of the 31 cases of human plague. A full description of 20 of these appeared in Bulletin No. 23. In the present report we are concerned exclusively with the presence or absence of hyaline thrombi and of bacterial metastatic emboli in the renal tissue:

#### GROUP 1. PRIMARY UNCOMPLICATED BUBONIC PLAGUE.

##### CASE No. 1. LEFT INGUINAL BUBO.

(Necropsy Protocol No. 1009. Postmortem examination July 27, 11 o'clock a. m., about eighteen hours after death, on the body of C. S., a male Chinese, 36 years old, from 217 Santo Cristo. Died July 26 at 4 o'clock p. m.)

*Anatomical diagnosis.*—Hypertrophy of the heart; congestion and fatty degeneration of the kidneys; fatty infiltration and degeneration of the liver; hemorrhagic inflammation and hypertrophy of the left inguinal, femoral, iliac, and retroperitoneal glands; hypertrophy, softening and congestion of the lymph glands in general; multiple subserous and submucous hemorrhages. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

##### CASE No. 2. RIGHT INGUINAL BUBO.

(Necropsy Protocol No. 989. T. C., a male Chinese, from Heng Heng Street, San Nicolas, 29 years of age. Died June 20, 1904. Postmortem examination nine hours after death.)

*Anatomic diagnosis.*—Hemorrhagic left inguinal bubo; general lymphadenitis; multiple hemorrhages into the serous and mucous membranes; congestion and parenchymatous degeneration of the kidneys; congestion and fatty degeneration of the liver; bubonic plague.

*Microscopic examination.*—In a majority of the glomeruli the capillaries are closed by hyaline fibrin thrombi, while here and there a Malpighian tuft is entirely free and nonoccluded. The

thrombi are generally solid, though some are distinctly tubular with an open lumen in the center. Occasionally one sees a thrombus extending from a Malpighian tuft into an afferent or efferent vessel, or even as far as an interlobular one. A few thrombi are also present in the small vessels of the medulla and likewise in the subcapsular glomeruli-free zone of the cortex. Changes of the vascular endothelium of the thrombosed vessels are not demonstrable. All through the renal tissue fairly numerous large bacilli, which retain Gram's stain, are found. These micro-organisms clearly represent a postmortem invasion frequently found in Manila in bodies upon which the postmortem examination can not be made immediately. Plague bacilli are not seen in the renal sections.

#### CASE NO. 3. LEFT INGUINAL BUBO.

(Necropsy Protocol No. 940. S. Y. S., male Chinese, 25 years old, from 70 Santo Cristo, Binondo. Ill six days. Died April 14, 1904, at 5.30 o'clock a. m. Postmortem examination six hours after death.)

*Anatomic diagnosis.*—Hypertrophy and hemorrhagic inflammation of the left inguinal and iliac glands; passive congestion and parenchymatous degeneration of the kidneys; congestion and oedema of the lungs; multiple subserous and submucous hemorrhages; moderate hypertrophy of the heart; old epicardial cicatrices; atheroma of the aorta; splenomegaly. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 4. RIGHT INGUINAL BUBO.

(Necropsy Protocol No. 932. F. H., young male Filipino, from 20 Alma Street, Tondo. Died March 20, 1904, at 2 o'clock p. m. Postmortem examination made March 21 at 10 o'clock a. m., twenty hours after death.)

*Anatomic diagnosis.*—Large granulating ulcer on the right heel. Congestion and oedema of the lungs. Passive congestion of the liver and kidneys. Parenchymatous degeneration of the kidneys. Oedema, general hypertrophy, and congestion of the lymph nodes, particularly of those of the right inguinal region. Multiple subserous and submucous hemorrhages. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 5. RIGHT INGUINAL BUBO.

(Necropsy Protocol No. 977. O. C., Chinese male, 25 years old, from 214 San Jacinto Street. Died after an illness of two days on May 25, 1904, at 9.15 p. m. Postmortem examination fifteen hours after death.)

*Anatomic diagnosis.*—Congestion of the lungs; congestion and parenchymatous degeneration of the kidneys; fatty degeneration of the liver;



multiple subserous and submucous hemorrhages; multiple hemorrhagic lymphadenitis. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any other renal vessels.

#### CASE No. 6. RIGHT INGUINAL BUBO.

(Necropsy Protocol No. 998. Postmortem examination performed on July 3, 1904, twelve to eighteen hours after death, upon the body of V. D., from 17 Azcarraga Street, Tondo; a male Filipino, 17 years old.)

*Anatomic diagnosis.*—Congestion of the lungs; congestion and parenchymatous degeneration of the kidneys, splenomegaly, interstitial hepatitis with fatty degeneration, hemorrhagic lymphadenitis of the right inguinal glands. General hypertrophy and congestion of the lymph glands. Subserous and submucous hemorrhages. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE No. 7. RIGHT INGUINAL BUBO.

(Necropsy Protocol No. 1000. July 5, 1905. Postmortem examination, thirty-nine hours after death, on the body of G. A., from No. 43 Valderama Street, San Nicolas; a Filipino boy about 10 years old.)

*Anatomic diagnosis.*—Hemorrhagic lymphadenitis of the right inguinal glands; multiple lymphadenitis with great congestion and softening; congestion of the kidneys and parenchymatous nephritis; fatty degeneration of the liver. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE No. 8. INGUINAL BUBO.

(Necropsy Protocol No. 965. R. F., native, female, 45 years old, from No. 33 Calle Victoria, Intramuros. Died May 7, 1904, at 11.45 o'clock p. m.; said to have been sick four days. Admitted to San Lazaro Hospital on May 7 at 11.30 o'clock p. m., and died fifteen minutes later. Postmortem examination eleven hours after death.)

*Anatomic diagnosis.*—Splenomegaly (primary?); perisplenitis; cirrhosis of the liver with moderate fatty degeneration; congestion and parenchymatous degeneration of the kidneys; congestion of both lungs; Banti's disease. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE No. 9. LEFT FEMORAL HEMORRHAGIC BUBO.

(Necropsy Protocol No. 1081. A. M., male Filipino, 19 years old, from 352 Timbugan Street, Santa Cruz. Sick for two days. Died January 30, 1905. Postmortem examination thirty-two hours after death.)

*Anatomic diagnosis.*—Left femoral hemorrhagic bubo; multiple subserous and submucous hemorrhages; parenchymatous nephritis; congestion and edema of the lungs. Bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 10. LEFT INGUINAL AND FEMORAL HEMORRHAGIC BUBO.

(Necropsy Protocol No. 1115. O. K., male Chinese, 38 years old, from 84 Calle Nueva, Binondo. Died February 20, 1905, after an illness of a few days. Postmortem examination eighteen hours after death.)

*Anatomic diagnosis.*—Left inguinal and femoral hemorrhagic bubo; congestion of the lungs; acute parenchymatous nephritis; softening and enlargement of the spleen; bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 11. RIGHT HEMORRHAGIC FEMORAL BUBO.

(Necropsy Protocol No. 1143. W. C., male Filipino, 53 years old, from No. 89 Lavezares Street, San Nicolas. Died March 18 at 1 o'clock p. m. Postmortem examination performed March 20, 1905, at 10 o'clock p. m.)

*Anatomic diagnosis.*—Right hemorrhagic femoral bubo; hemorrhagic inflammation of the right iliae glands; congestion and œdema of the lungs; acute parenchymatous nephritis; enlargement of the spleen; bubonic plague.

*Microscopic examination.*—The thrombosis in the glomerular and other small renal vessels is of a rather moderate degree. A majority of the glomeruli (perhaps two-thirds in the sections examined) are free from thrombi. In these free Malpighian tufts we generally see a considerable number of dilated and engorged capillaries. No completely thrombosed glomerulus is found, but in those in which obliteration has occurred it is generally of a rather moderate, though occasionally of greater, extent. The thrombi are usually not very dense, but rather loose and incomplete, being composed of bands and strands and sometimes of reticula of fibrin. However, quite solid, dense, and uniformly homogeneous thrombi are likewise encountered, though not very frequently. In some of the glomerular and interlobular capillaries the incomplete obliteration depends merely upon the presence of a fine, wavy or angular filament of fibrin. However, the thrombosis, though of moderate degree, is not confined to the cortex; and small, more or less completely obliterated vessels are seen in the medulla. In the latter we see several longitudinally cut, dilated, and greatly engorged small veins, in which a considerable number of leucocytes and a few filaments of fibrin arranged longitudinally are present. More solid and more or less completely obliterating thrombi are likewise seen in the medullary vessels. *Morphological changes in the walls of either intra- or extra-glomerular vessels are not demonstrable.* Plague bacilli are not

seen anywhere in the renal sections, which, however, show diffuse invasion of the large cylindrical postmortem bacillus mentioned before. A study of the renal sections of this case shows clearly and unmistakably that the fibrin thrombosis is independent of any demonstrable morphologic vessel-wall changes. If such is found in advanced cases with extensive thrombosis, it is secondary to the primary obliteration.

There are present in some parts of the sections changes such as an increase of the connective tissue of the capsules of Bowman, fibrosis of the glomerulus, and increase of the interlobular connective tissue in general, which clearly point to an early chronic interstitial nephritis, which was present previous to the pest infection and entirely independent of it.

#### CASE NO. 12. RIGHT HEMORRHAGIC FEMORAL BUBO.

(Necropsy Protocol No. 1150. S. H., 35 years old, male Chinese, from 119 La Coste Street, San Nicolas. Died March 24, 1905, 2 o'clock p. m. Postmortem examination made March 25 at 10 o'clock a. m.)

*Anatomic diagnosis.*—Right hemorrhagic femoral bubo; acute parenchymatous nephritis; multiple subserous and submucous hemorrhages; bubonic plague.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 13. RIGHT INGUINAL BUBO.

(Necropsy Protocol No. 1183. D. C., male Filipino, 19 years old, from 162 Barcelona Street, San Nicolas. Died May 12, 1905, at 6.30 p. m. Postmortem examination seventeen hours after death.)

*Anatomic diagnosis.*—Right inguinal, slightly hemorrhagic, bubo; congestion and edema of the lungs; hemorrhagic parenchymatous nephritis; multiple subserous and submucous hemorrhages; congestion and edema of the brain. Bubonic plague.

*Microscopic examination.*—Most of the glomeruli exhibit vessels obliterated by hyaline fibrin thrombi. In some of the Malpighian tufts the thrombosis is quite extensive, in others it is moderate, and in still others it is quite insignificant. However, glomeruli entirely free from obliteration are seen only rarely. Practically all of the thrombi encountered are made up of reticula and bands of fibrin. Completely solid and dense fibrin plugs in the glomerular vessels are not seen in this case. An extension of the thrombi into the afferent and efferent vessels occurs here and there. One also

occasionally sees a thrombus in an interlobular artery or in a vas rectum. The thrombotic processes are almost exclusively confined to the cortex, but a few thrombi are encountered in the medulla. The vessels of the latter are enormously dilated and engorged. The extreme glomeruli-free, subcapsular zone of the cortex does not contain any thrombi. Bacillar metastatic emboli are not found in the renal sections.

#### CASE NO. 14. RIGHT CERVICAL BUBO.

(Necropsy Protocol No. 928. C. S., Filipino, age 5 years, from 170 Estero San Nicolas. Ill five or six days; three days in San Lazaro Hospital. Died March 18, 1904, at 11 o'clock p. m. Postmortem examination three hours after death.)

*Anatomic diagnosis.*—Perforating ulcer on the right side of the soft palate; general hypertrophy; congestion and hemorrhagic œdema of the general lymph glands of the body; œdema and congestion of the lungs; congestion and parenchymatous degeneration of the kidneys; œdema of the gall bladder wall; multiple subserous and submucous hemorrhages; syphilis hereditaria tarda. Bubonic plague.

*Microscopic examination.*—A moderate number of glomerular vessels show hyaline (fibrin) thrombi. Nowhere is this thrombosis very extensive or at all complete; it affects only a minor part of the vessels of one glomerulus. The renal vessels in general are very much congested, and a very few areas of blood extravasation are found. The few bacilli which are visible are found in connective tissue lymph clefts or in the capsular space of a glomerulus, but not inside of blood vessels.

#### CASE NO. 15. CERVICAL BUBO.

(Necropsy Protocol No. 910. C. S., a Filipino girl, 9 years of age, from Anda Street, Intramuros, Manila. Postmortem examination five hours after death, on Saturday, March 5, 1904, at 4 o'clock p. m.)

*Anatomic diagnosis.*—Hemorrhagic, acute, parenchymatous nephritis; congestion and œdema of the lungs; moderate fatty degeneration of the liver; hemorrhagic inflammation, hypertrophy and softening of the cervical glands on both sides; more or less general hypertrophy of most of the lymph glands. Bubonic plague.

*Microscopic examination.*—The renal tissue presents a most striking picture. Sections from both kidneys, treated by Weigert's fibrin method, appear as if the vessels had been injected with a violet-stained gelatin. There is not a normal glomerulus to be seen. All the sections show a more or less complete obliteration by hyaline thrombi. In most of the Malpighian bodies the hyaline

thrombosis of the capillaries is so perfect that both the main branches of the afferent vessel and the smaller capillaries given off from the larger loops are sharply outlined. Some of the thrombi appear perfectly solid; others are hollow in the center, as can be seen both in transverse and in longitudinal sections; and still others are made up of fibers and filaments. The endothelial lining of the thrombosed vessels is well preserved. Where the thrombi are comparatively thin, one can see, both in transverse and in longitudinal sections, endothelia which are apparently perfectly normal. Nowhere do the thrombosed vessels show a loss of endothelia to any extent. Therefore, the thrombosis can not be attributed to a denudation of the vessels of their endothelial lining. The capsules of Bowman are likewise normal, though a few of them show a very moderate degree of thickening; their lining epithelium exhibits no marked changes. In some places the hyaline thrombi are continued not only into the vasa afferentia but even into the interlobular arteries. Quite commonly there are seen between the uriniferous tubules parts of such small vessels filled with hyaline thrombi. However, none are found in the larger arteries or veins, in some of which finely granular fibrin and desquamated endothelial cells are present. The vessel walls themselves show no damage aside from a minor degree of denudation of the intima. There is in particular no extension of the fibrin through the vessel walls, nor is there any evidence of mesophlebitic or periphlebitic or arteritic processes. Nowhere do any of the renal blood vessels show a large number of bacilli; a few are possibly seen inside some vascular lumina, but even these are not definite. A moderate number of bacilli are seen in the lymph clefts between the tubules and around the Malpighian bodies. A few slender, long bacilli, which retain Gram's stain, are occasionally found in the tubules; they represent a postmortem invasion.

#### CASE NO. 16. RIGHT INGUINAL BUBO.

(No necropsy protocol kept. Male Chinese, 26 years old, who died after an illness of seven days.)

*Microscopic examination.*—Sections of the kidneys show hyaline fibrin thrombosis of the glomerular capillaries, with an extension into the afferent and efferent vessels as well as into the intertubular capillaries and small veins. There is general vascular dilatation and engorgement of the renal vessels.



## GROUP II. PRIMARY BUBONIC PLAGUE WITH SECONDARY PLAGUE SEPTICO-PYEMIA.

### CASE NO. 17. RIGHT INGUINAL BUBO WITH SECONDARY PLAGUE SEPTICO-PYEMIA.

(Necropsy Protocol No. 1011. M. N., male Filipino, 40 years old, from 77 Sacristia Street, San Nicolas. Ill six days; died early July 29, 1904. Postmortem examination about six hours after death.)

*Anatomic diagnosis.*—Congestion and œdema of the lungs; hemorrhagic, acute, parenchymatous nephritis; parenchymatous and fatty degeneration of the liver; hemorrhagic inflammation of the right inguinal and many other lymph glands; extensive subserous, submucous, and interstitial hemorrhages. Bubonic plague; plague septico-pyemia.

*Microscopic examination.*—All the renal vessels, including the glomerular capillaries, are much dilated and engorged. Hyaline fibrin thrombi are found in a few of the glomeruli. The thrombosis of the glomerulus is, as a rule, not complete and only a part of the tuft is closed by fibrin. The thrombi are sometimes continued into the vasa afferentia and efferentia and beyond them. A few thrombi are also present in the vasa recta of the medulla. The capsular epithelium shows a minor degree of degenerative, but no proliferative, change. Sections from the kidneys show an extensive infection with plague bacilli, which is mostly localized in the glomerular capillaries. Both in the open and in the thrombosed capillaries numerous bacilli may be seen in loose groups or sometimes even in dense masses. In the thrombosed vessels the bacilli are sometimes between the thrombus and the vessel wall. The organisms occasionally extend beyond the glomerulus into the vasa interlobulares. Here and there, bacilli are found at quite a distance from a glomerulus and occasionally in the capsular space and in the uriniferous tubules.

### CASE NO. 18. LEFT FEMORAL HEMORRHAGIC BUBO.

(Necropsy Protocol No. 1127. G. P., male Chinese, 35 years old, from 182 Calle Camba. Died March 6, 1905. Postmortem examination performed three hours after death.)

*Anatomic diagnosis.*—Left femoral hemorrhagic bubo; acute hemorrhagic nephritis; fatty degeneration of the liver. Bubonic plague; plague septico-pyemia.

*Microscopic examination.*—The thrombosis of the glomerular capillaries in this case is very extensive—in fact, it is found in every glomerulus in the numerous sections examined. In general the



obliteration of the capillaries is not complete, most of the thrombi being of the tubular variety, with an open lumen in the center. However, there are also seen many perfectly solid and dense, completely obliterating thrombi. In a fair number of places the fibrin thrombi in the glomeruli are of such size that they have greatly distended the vessels in the transverse diameter and stretched them in a longitudinal direction, so that they have a sausage-like appearance. The afferent and efferent vessels frequently show an incomplete thrombosis in the shape of an open fibrin reticulum. This network may be continued into the main branches of the afferent vessel and is occasionally found even in the finest glomerular capillaries. Here and there, but rarely only, one sees fibrin filaments which have penetrated through the vessel wall into the perivascular tissue. From the afferent vessels the thrombosis can sometimes be followed into the arteriæ interlobulares. On the other hand, thrombi are likewise found in the small interlobular capillaries, into which the vasa efferentia break up. In the sub-capsular glomeruli-free zone, in terminal branches of arteriæ interlobulares which do not supply glomeruli, and in interlobular capillaries of such arteries, as also in small branches of the stellate veins, obliterating fibrin plugs are likewise encountered. It is thus seen that almost all of the smaller vessels of the cortex are affected by the process of fibrin thrombosis. However, all of the different sets of vessels are not involved to the same extent, the greatest amount of obliteration being found in the glomerular capillaries and in their afferent and efferent vessels. In the medulla and also in the medullary rays the extent of the thrombosis is quite moderate, when compared with that which is seen in the cortex, but here and there one observes a thrombosed smaller vein, artery, or capillary. However, the much-engorged capillary network surrounding the straight tubules is almost without exception free from fibrin.

It is difficult and often impossible to study the endothelial lining in those vessels in which the thrombi are quite dense, solid, and have completely obliterated the lumina. Where this is not the case—where we are dealing with thinner tubular wall thrombi or with fibrin reticula, or even with solid thrombi which have become somewhat shrunken or retracted—one can generally see well-preserved, apparently unchanged, vascular endothelia. In somewhat larger vessels the muscle fibers present a normal appearance. Mallory's special stain shows the delicate fibers of the glomerular

as well as the other vessels. Neither the capsular nor the reflected glomerular epithelia show any proliferative changes.

Loose groups of plague bacilli are found here and there in the small renal vessels and also in the uriniferous tubules.

#### CASE NO. 19. LEFT HEMORRHAGIC INGUINAL BUBO.

(Necropsy Protocol No. 1132. A. A., male Filipino, 17 years old, from 75 Principe Street, San Nicolas. Died March 7, 1905, p. m. Postmortem examination made on March 8, twelve hours after death.)

*Anatomic diagnosis.*—Left hemorrhagic inguinal bubo; parenchymatous nephritis; multiple subserous and submucous hemorrhages. Bubonic plague; plague septico-pyemia.

*Microscopic examination.*—The microscopic examination does not show any hyaline glomerular thrombosis, but metastatic bacterial emboli are found in these structures. Here and there a hyaline cylinder is seen in a tubule. (These hyaline casts do not give the tinctorial fibrin reaction.)

#### CASE NO. 20. LEFT HEMORRHAGIC INGUINAL BUBO.

(Necropsy Protocol No. 1157. T. B., a female Filipina, 21 years old, wife of a Chinese from Lavazares Street, San Nicolas. Died March 31, 1905. Postmortem examination made April 1, a. m.)

*Anatomic diagnosis.*—Left hemorrhagic inguinal bubo; hemorrhagic inflammation of the left pelvic, iliac, and retroperitoneal glands; hemorrhagic parenchymatous nephritis; œdema and congestion of the lungs and also of the brain; uterus gravis, menses I to II; bubonic plague and plague septico-pyemia.

*Microscopic examination.*—This is one of the cases in which very extensive thrombotic processes in the kidneys, particularly in the glomerular vessels, are present. Here we find perfectly solid, heavy, completely obliterating thrombi, tubular wall thrombi with an open lumen in the center, and also loose fibrin reticula, the latter especially in the vasa efferentia. In the glomerular vessels which are not completely, but only partly, thrombosed, an œdematous or homogeneous swelling of the vessel wall is noticeable. The glomerular epithelium shows proliferative changes, the nuclei within the glomeruli are decidedly increased in number, and the Malpighian corpuscles as a whole appear quite solid with little or no open capsular space left.

Thrombi are comparatively scanty in the subcapsular glomeruli-free zone, in the medulla, and in the medullary rays. In one glomerulus, in which the capillaries contain both fibrin thrombi and bacterial emboli, a peculiar condition is seen. Watery fluid had

evidently forced its way between the capsule proper and the epithelial lining of the former. The capsular epithelium in a complete intact layer had become desquamated, and a cyst, lined on one side by over one-half of the capsule proper and on the other side by the capsular epithelium, had compressed the Malpighian tuft into one corner of the capsular space. The tuft with its thrombosed capillaries is seen as a compressed, somewhat crescent-shaped mass in one extremity of the capsule opposite the cyst.

The kidneys show an extensive infection by metastatic emboli, composed of dense or loose masses of plague bacilli. These are found in the glomerular vessels, in the intertubular capillaries, and in small arteries and veins. Interglomerular vessels sometimes show both hyaline fibrin thrombi and bacterial emboli, but the number of the latter is very much smaller than that of the former. In other words, we see hyaline thrombi in almost all of the glomerular capillaries, but bacterial invasion only here and there. Bacilli are also found in the perivascular and in the interlobular lymph spaces. The thrombotic processes are evidently independent of the bacterial invasion, and much of the latter in this case is undoubtedly due to postmortem growth, since the kidneys as well as all organs show numerous large, cylindrical, Gram-staining bacilli, which are commonly found in Manila in necropsies which are made a considerable time after death.

It might also be mentioned here that in sections fixed by Zenker's fluid and stained according to Weigert's fibrin method, plague bacilli often retain the gentian violet. That this is indeed the case may be confirmed by the use of other stains and by comparing alternating sections of short series. In sections from blocks of tissue fixed in the Mueller-Orth mixture the fibrin has lost its characteristic tinctorial reaction, and when treated by Weigert's method it appears so hazy that it is entirely unrecognizable, neither its homogeneous hyaline appearance nor its fibrous character in other places showing well. If such sections, from material fixed in Mueller formalin, are stained with hematoxylin and eosin, the obliterated glomerular vessels do not furnish a clear picture. The boundaries of the thrombi are indistinct and the coagula appear continuous with the vessel walls. The latter themselves create the impression of being in a state of swelling and hyaline degeneration. Sections fixed in corrosive-sublimate solution and colored with a variety of stains, including carmin-Weigert, eosin-methylene-blue,

Van Gieson, Mallory, etc., clearly show that a hyaline degeneration of the vessel walls does not exist, but is one simulated by the faulty method of fixation.

A somewhat superficial examination of the placenta in this case failed to show any invasion by the plague bacillus. This result is in accord with the observation of the German Plague Commission on several foeti from females dead from plague.

#### CASE NO. 21. LEFT SUBMENTAL BUBO.

(Necropsy Protocol No. 1027. F. C., a Filipina, 14 years old, from 195 Plaza Leon XIII, Tondo. Died after a short illness of unknown duration on September 7, 1904, at 7.10 o'clock p. m. Postmortem examination made on September 8 at 3 o'clock p. m.)

*Anatomic diagnosis.*—Congestion and parenchymatous degeneration of the kidneys; congestion and œdema of the lungs; one necrotic focus of the liver with congestion and fatty degeneration; multiple subserous and submucous hemorrhages; left submental hemorrhagic bubo. Bubonic plague and plague septico-pyemia.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 22. RIGHT CERVICAL BUBO WITH SECONDARY PLAGUE SEPTICO-PYEMIA.

(Necropsy Protocol No. 889. E. J., a male Filipino, 63 years old, from 142 Caballeros Street, San Nicolas. Died February 18, 1904, at 1 o'clock p. m. Ill five days; cause of death unknown. Postmortem examination made February 19 at 8.45 o'clock a. m., about twenty hours after death.)

*Anatomic diagnosis.*—Congestion and œdema of the lungs; congestion and parenchymatous degeneration of the kidneys; subserous and submucous hemorrhages; right cervical bubo. Bubonic plague and plague septico-pyemia.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 23. RIGHT AXILLARY BUBO.

(Necropsy Protocol No. 973. F. A., male Filipino, age 28 years, from 661 Calle Bilibid, Santa Cruz. Died May 9, 1904, at 11 o'clock p. m. Postmortem examination made fifteen hours after death.)

*Anatomic diagnosis.*—Congestion and œdema of the lungs; parenchymatous degeneration of the kidneys; right axillary hemorrhagic bubo; general swelling, hypertrophy, and congestion of the lymph glands. Bubonic plague and plague septico-pyemia.

*Microscopic examination.*—In the kidneys all the vessels are much dilated and engorged, particularly the glomerular capillaries. Here and there in the glomeruli an incomplete fibrin thrombosis is met

with. Groups of plague bacilli are found in the glomerular and intertubular vessels, some of them amounting to fairly dense masses of bacteria. A very few isolated bacilli are seen here and there in the uriniferous tubules.

### GROUP III. PRIMARY BUBONIC PLAGUE WITH SECONDARY PLAGUE PNEUMONIA.

#### CASE NO. 24. AMBULATORY PLAGUE, TERMINATING BY EMBOLISM OF THE PULMONARY ARTERY. INGUINAL BUBO.

(Necropsy Protocol No. 901. Filipino, male, 17 years old, from 185 Misericordia Street. Died February 27, 1904, at 2 o'clock p. m. Postmortem examination thirteen hours after death.)

*Anatomic diagnosis.*—Congestion and œdema of the lungs; parenchymatous degeneration of the kidneys; embolism of the pulmonary artery; inguinal buboes. Bubonic plague and plague pneumonia.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 25. LEFT HEMORRHAGIC FEMORAL BUBO.

(Necropsy Protocol No. 1141. A. L., male Filipino, 19 years old, from 101 Principe Street, San Nicolas. Died March 16, 1905, p. m. Postmortem examination performed March 17, 1905, twenty hours after death.)

*Anatomic diagnosis.*—Left hemorrhagic femoral bubo; small lobular focus in the lower lobe of the right lung; general pulmonary congestion and œdema; enlargement and softening of the spleen, congestion of the kidneys, and parenchymatous nephritis; bubonic and pneumonic plague. (Smears from the pulmonary lobular focus show numerous plague bacilli, as do also smears from the bubo and from the spleen.)

*Microscopic examination.*—In this case the kidneys do not show any hyaline thrombosis or any metastatic bacterial emboli, but, without regularity as to distribution, all through the tissues is found the cylindrical postmortem bacillus before mentioned. An interesting pathologic change seen in this case is a proliferation of the glomerular epithelium. The proliferated capsular epithelium proper on the inner surface of Bowman's capsule forms crescentic masses, which frequently fill out the capsular space. The reflected epithelium is likewise increased and the glomerular vessels are greatly dilated and engorged.

### GROUP IV. PRIMARY UNCOMPLICATED PLAGUE PNEUMONIA.

#### CASE NO. 26. PRIMARY UNCOMPLICATED PLAGUE.

(Necropsy Protocol No. 970. A. Q., Chinese, male, 30 years old, a shopkeeper from 67 Tetuan Street, Santa Cruz. Ill six days. Died May 18, 1904, at 10.30 o'clock p. m. Postmortem examination made thirteen hours after death.)

*Anatomic diagnosis.*—Parenchymatous degeneration of the kidneys; fatty

and parenchymatous degeneration of the liver; multiple subserous and submucous hemorrhages; lobular pneumonia of the right lung. Plague pneumonia.

*Microscopic examination.*—No hyaline thrombi found in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 27. PRIMARY UNCOMPLICATED PLAGUE PNEUMONIA.

(Necropsy Protocol No. 971. C. C., Chinese, male, 27 years old, from 67 Tetuan Street, Santa Cruz. Ill six days. Died May 18, 1904. Postmortem examination fourteen hours after death.)

*Anatomic diagnosis.*—Parenchymatous degeneration of the kidneys and liver; multiple subserous and submucous hemorrhages; pneumonia; acute adhesive fibrinous pleurisy. Plague.

*Microscopic examination.*—No hyaline thrombi are found in the glomerular capillaries or in any of the other renal vessels.

#### CASE NO. 28. PLAGUE PNEUMONIA.

(Necropsy Protocol No. 1116. J. W. H., male, American (Caucasian), 28 years old, from Intramuros. Died February 20, 1905, after an illness of two days. Postmortem examination fifteen hours after death.)

*Anatomic diagnosis.*—Lobular pneumonia of the right lower lobe; great congestion and œdema of both lungs; acute parenchymatous nephritis; fatty degeneration of the liver.

*Microscopic examination.*—No hyaline thrombi in the glomerular capillaries or in any of the other renal vessels.

### GROUP V. PRIMARY PLAGUE PNEUMONIA WITH SECONDARY PLAGUE SEPTICO-PYEMIA.

#### CASE NO. 29. PRIMARY PLAGUE PNEUMONIA WITH SECONDARY SEPTICO-PYEMIA.

(Necropsy Protocol No. 962. F. S., Filipina, female, 30 years old, from 148 Anda Street, Intramuros, Manila. Died May 7, 1904, at 5.30 p. m. Cause of death unknown. Plague suspected. Postmortem examination made sixteen hours after death.)

*Anatomic diagnosis.*—Lobular pneumonic foci; congestion and beginning diffuse red hepatization of both lower lobes; general congestion of the lungs; subpleural hemorrhages; congestion and parenchymatous degeneration of the liver and kidneys; submucous hemorrhages in the gastric and intestinal mucosa; hemorrhagic endometritis; microcystic degeneration and congestion of the left ovary. Plague pneumonia and septicæmia.

*Microscopic examination.*—The most striking histologic change in the kidneys are metastatic emboli in the glomerular capillaries, completely filling some of the loops of the tufts. However, such



emboli are found in a limited number of glomeruli only; nor are any tufts seen where all the capillaries are obliterated. The embolic closure is generally confined to one lobe of a glomerulus. Sometimes the embolic bacterial mass extends into the afferent or efferent vessel (it is impossible to decide which of the two is affected). In the neighborhood of such thrombosed vessels there are small microscopic areas of blood extravasation, in which few bacilli are found. All the renal vessels are much engorged, particularly the small vessels, and the interstitial tissue is quite œdematous. Small microscopic areas of blood extravasation are encountered all through the sections. A few bacilli are often seen in such areas as well as in the tubules, the lymph clefts, and even occasionally in the small arteries and veins. The tubular epithelium shows profound cloudy swelling and fatty degeneration. Hyaline fibrin thrombi are not present in the renal tissue.

#### GROUP VI. PRIMARY PLAGUE SEPTICÆMIA.

##### CASE NO. 30. PRIMARY PLAGUE SEPTICÆMIA.

(Necropsy Protocol No. 983. L. T. T., Chinese, male, 28 years of age, from 211 Santo Cristo Street, San Nicolas. Ill for ten days. Died June 4, 1904, at 1 o'clock p. m. Postmortem examination made fifteen hours after death.)

*Anatomic diagnosis.*—Congestion and œdema of the lungs; fatty degeneration of the liver; acute parenchymatous nephritis; multiple subserous and submucous hemorrhages (lungs, heart, kidneys, ureters, bladder, stomach, intestines). Plague septicæmia.

*Microscopic examination.*—The histologic changes in the kidneys are very profound. There is universal cloudy swelling and fatty degeneration of the tubular epithelium. The tubules are generally filled with granular detritus, and in many instances sharply outlined hyaline casts are found. These hyaline masses are composed of a homogeneous material (staining with eosin and somewhat with methylene blue); however, this does not give the tinctorial fibrin reaction. The glomerular capillaries are generally not much altered, but here and there a partial hyaline (fibrin) thrombosis can be seen. Occasionally one observes an intertubular thrombosed vessel. Plague bacilli are found in small groups in some of the glomeruli; they are also observed both in the capillaries and between them. A very few isolated organisms are encountered in the interstitial connective tissue between the tubules.

## CASE NO. 31. PRIMARY PLAGUE SEPTICÆMIA.

(Necropsy Protocol No. 1082. T. B., Filipina, female, 13 years of age, from 346 Cabildo Street, Intramuros. Ill two days. Died January 30, 1905. Postmortem examination made twenty-four hours after death.)

*Anatomic diagnosis.*—Multiple subserous and submucous hemorrhages; parenchymatous nephritis; congestion and œdema of the lungs. Plague septicæmia. (Smears from the spleen, which is moderately enlarged, show many plague bacilli; those from the liver, the kidneys, and the glands show a few.)

*Microscopic examination.*—Some capillary loops in a few glomeruli and some extraglomerular vessels show hyaline fibrin thrombi. Loose, isolated groups of plague bacilli are found in the tubules, the capsular spaces, and the renal blood vessels.

#### SUMMARY OF OBSERVATIONS ON THE VASCULAR CHANGES IN THE KIDNEYS.

Upon reviewing the results of the examination of 12 cases in which hyaline fibrin thrombi were found in the glomerular capillaries and in other renal vessels, we arrive at the following general conclusions:

The thromboses may be of a moderate degree and may be found only in a small proportion of the renal vessels; or they may be of a most extensive character, involving a large number. In general it may be stated that the thrombosis is always most profound in the cortex, and much less so in the medulla. However, the latter is never entirely free. As a rule, to which none of our cases were an exception, the thrombosis is always most profound in the glomerular capillaries and in the afferent and efferent vessels. Next in order of frequency stand the interlobular vessels and the intertubular capillaries of the cortex. In case of a moderate thrombosis, only a few of the glomerular capillaries are occluded. The rest are free and are then generally more or less engorged with blood; however, they occasionally may be empty and collapsed, but great engorgement of the renal vessels is generally the rule in plague. In more severely affected cases a greater proportion of the glomerular vessels is occluded, and the afferent and efferent vessels are likewise obliterated. In the ones where the highest degree of thrombosis occurs, it may be difficult to find a single glomerulus in which this has not occurred to a greater or less extent. In such cases thrombi are in fact present in all the different sets of vessels of both cortex and medulla. We find them in the subcapsular glomeruli-free zone, in

the capillaries, and in the terminal branches of the interlobular arteries. They are seen in the glomerular capillaries, the afferent and efferent vessels, the interlobular arteries, and the intertubular capillaries of the cortex. In such cases we also find quite a number of vasa recta of the medulla obliterated. In favorable sections we may occasionally be able to follow the thrombosis from a larger artery into the smaller branches and into the capillaries. The thrombi vary much in degree of density. We may encounter perfectly solid, heavy ones, which even in the thinner sections appear as hyaline structureless masses, which have greatly extended the vessel and stretched it, both in a transverse and in a longitudinal direction, so that it appears very much like a sausage contained in a thin skin; or, on the other hand, we may find tubular wall thrombi with open lumina in the center, or a solid thrombus, which, however, does not completely fill the vessel, but leaves a circular lumen between itself and the vessel wall. We also see thrombi which are distinctly fibrous in structure, being composed of longitudinally and reticularly arranged filaments. Or again, we encounter thrombi made up of a very loose reticulum. The vessel walls, as a rule, show no appreciable morphologic changes. The intima and its endothelium are well preserved, and in the small arteries we see well-preserved muscle fibers. However, if the thrombi are quite solid and dense, then the vessel walls generally show a minor degree of injury, and their cellular structural elements can not be clearly distinguished. In most of the cases in which we found hyaline thrombi in the renal vessels, bacterial emboli were not encountered. However, in other instances, such emboli are present either as dense bacterial masses or as loose groups of plague bacilli. In such cases in one place in the section there may be seen a bacterial embolism and in another a hyaline thrombosis, and occasionally one may encounter thrombi and invading bacteria in the same area. But it is perfectly clear, as a careful examination will reveal, that the bacterial invasion is not the cause of the thrombus formation, because the latter, as a rule, occurs quite independently of the former. Among our 31 cases there are instances with profound thrombosis but without bacterial invasion of the kidneys, and on the other hand, of extensive metastatic bacterial emboli without hyaline thrombi. As a general rule, where we find extensive hyaline thrombosis in the primary bubo and in the spleen, we also encounter it in the kidneys.

We have asked ourselves: Where in the kidneys do the vascular thrombotic processes begin and how do they spread? We are unable to give an entirely satisfactory answer to this question. It is evident that the glomerular capillaries and the afferent and efferent vessels are most generally and most profoundly involved, but even where we find in these sets of vessels only a very moderate involvement, we also find at least some fibrin obliteration in the capillaries of the tubuli contorti, which are the branches of the vasa efferentia. It appears quite probable that the process begins in the glomerular capillaries and spreads simultaneously along the afferent and efferent tracts, reaching the interlobular arteries of the former and the vasa recta spuria of the latter. In both mild and severe cases of renal thrombosis some thrombi are also found in the medulla and in the medullary rays, in places quite remote from the glomeruli. Here there probably occur some foci of the thromboses, which arise independently of the earliest ones in the glomerular capillaries. We are firmly of the opinion that the formation of the renal hyaline thrombi occurs independently of the presence of the plague bacillus and that it is due to toxins of this micro-organism circulating in the blood, but exactly how these toxins give rise to the thrombus formation is a question which we are at present unable to answer. Very probably they may have a deleterious influence upon the vascular endothelium, but certainly they do not ordinarily produce a manifest, demonstrable morphologic change either in the intima or in the renal vessel walls in general.

According to the intensity of the process, the 12 cases in which thrombosis in the renal vessels was encountered may be divided into three groups, viz:

Thrombosis of a moderate degree: Cases Nos. 11 (1143), 14 (928), 17 (1011), 23 (973), 30 (983)—5 cases.

Thrombosis of a higher degree: Cases Nos. 2 (989), 13 (1183), 16, 31 (1082)—4 cases.

Thrombosis of a very high degree: Cases Nos. 15 (910), 18 (1127), 20 (1157)—3 cases.

Extensive and frequently occurring hyaline fibrin thrombosis of the glomerular capillaries and of the other renal vessels has not often been found in human infectious diseases, at least not in a high percentage of the larger series of cases examined, and in animal diseases only in the example cited by Welch (swine plague).

A review of the literature on the subject of glomerular thrombosis was published in Bulletin No. 23.

### CONCLUDING REMARKS.

In conclusion we wish to emphasize again the frequent occurrence of renal hyaline fibrin thrombosis in bubonic plague. We have found this histopathologic change in nearly 40 per cent of our cases, viz, in seven out of the first series of twenty and in five out of the second series of eleven. As the familiarity of the observer with this condition increases, his ability of finding it macroscopically becomes greater. In those cases in which we find very profound thrombosis, this process probably extends over the entire cortex; but in those of moderate intensity it is found, it appears, only here and there throughout the cortical tissue. Therefore in such cases as the latter one must be critical in the selection of the microscopic material. Quite generally the congestion and engorgement of the kidneys in plague is very great, and the enlarged glomeruli stand out as dark-red points on a contrasting background of cloudy and grayish-yellow convoluted tubules, but the glomeruli obliterated by fibrin thrombi themselves assume a granular, shining, grayish-white appearance, and they may, after a little practice, easily be recognized with the naked eye.

Our plague material, which is in no way an exceptional one, but on the contrary an average typical collection of cases, justifies the conclusion that plague in man is, among all human diseases in general, the one in which highly characteristic hyaline thrombotic processes in the glomeruli and in the renal vessels at large are most frequently encountered. These important processes have heretofore not been sufficiently considered, wrongly interpreted, and generally have been altogether overlooked. In the literature of plague a hyaline degeneration of the vessel walls in the kidneys and in other organs is frequently mentioned, but, as pointed out by the author in this publication and in previous ones, we are not concerned at all with such a condition, but with primary hyaline thrombotic processes presenting in the elements of the vessel wall themselves only occasional and comparatively very insignificant secondary degenerations. Likewise in the plague bubo we are generally encountering primarily a true hyaline thrombosis, and only later, after general tissue necrosis in consequence of enormous bacterial invasion, do we find extensive degeneration and complete necrosis of the vessel walls.

It is of course impossible to derive any enlightenment as to the initial changes in the vessels from the profoundly necrotic tissue of the plague bubo, as the condition encountered represents the final product of a most destructive process. The kidneys form a much more favorable material for the study of the initial changes in the vessel in the thrombotic processes, because death occurs before such profound alterations as are found, as a rule, in the original plague bubo take place.

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## LIST OF ILLUSTRATIONS.<sup>1</sup>

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FIGURE 1. Thrombosis of interlobular and afferent vessel and of interglomerular capillaries. A bend, cut transversely, indicates the place where the afferent vessel is given off from the interlobular one. From case No. 15 (910).

2. Thin, filamentous fibrin thrombus in the afferent vessel of a glomerulus. From case No. 2 (989).
3. Thrombosed glomerulus. Section stained with Mallory's connective-tissue anilin-blue stain. Tubular wall thrombi and connective tissue framework are shown. From case No. 18 (1127).
4. Heavy, dense thrombi in the interlobular capillaries of the cortex. (Branches of the efferent vessels between the tubuli contorti.) From case No. 15 (910).
5. Loose thrombus in the intertubular capillaries of the cortex. (Branches of the efferent vessel between the tubuli contorti.) From case No. 20 (1157).
- 6, 7. Fibrin network in the afferent vessel of a glomerulus at the entrance into the latter. From case No. 20 (1157).
8. Tubular wall thrombi in the interglomerular capillaries. From case No. 18 (1127).
9. Artery and branch in cortex, completely obliterated by a heavy, dense thrombus. In the longitudinally cut artery some endothelial and muscle cells are shown. From case No. 18 (1127).
10. Heavy thrombus in an interlobular artery. Vessel wall well preserved. From case No. 18 (1127).
11. Loose, fibrous thrombus in an interlobular vessel of the cortex, showing a well-preserved normal vessel wall. From case No. 18 (1127).
12. Cyst formation in a glomerulus with compression of the thrombosed tuft. From case No. 20 (1157).

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<sup>1</sup>All the illustrations are photomicrographs prepared by the aid of a large Zeiss camera from paraffin-embedded sections, fixed in Zenker's fluid and stained with carmine and Weigert's gentian-violet, unless otherwise stated. The objectives used were DD and homogenous oil immersion, 2 millimeters; aperture 1.40, and projection ocular No. 4. Length of bellows of camera, generally 35 centimeters.

FIGURE 13. Loose thrombus in a terminal branch of an interlobular artery in the glomeruli-free subcapsular zone of the cortex. Vessel wall normal. From case No. 20 (1157).

14. Fibrin network in a vein in the medulla. From case No. 11 (1143).
15. Heavy, dense tortuous thrombus in a vein in the medulla. From case No. 18 (1127).
16. Heavy thrombi in the vasa recta of the medulla. From case No. 15 (910).
17. Bacterial embolism in a capillary of the medulla. From case No. 18 (1127).
18. Bacterial embolism and fibrin thrombus in an interglomerular vessel cut transversely. Eosin and methylene-blue stain. *a*, Bacterial embolism; *b*, Fibrin thrombus. From case No. 18 (1127).
19. Fibrin network and bacterial embolism in an afferent vessel just at the entrance into the glomerulus. Eosin and methylene-blue stain. *a*, Bacterial embolism; *b*, Fibrin network. From case No. 20 (1157).

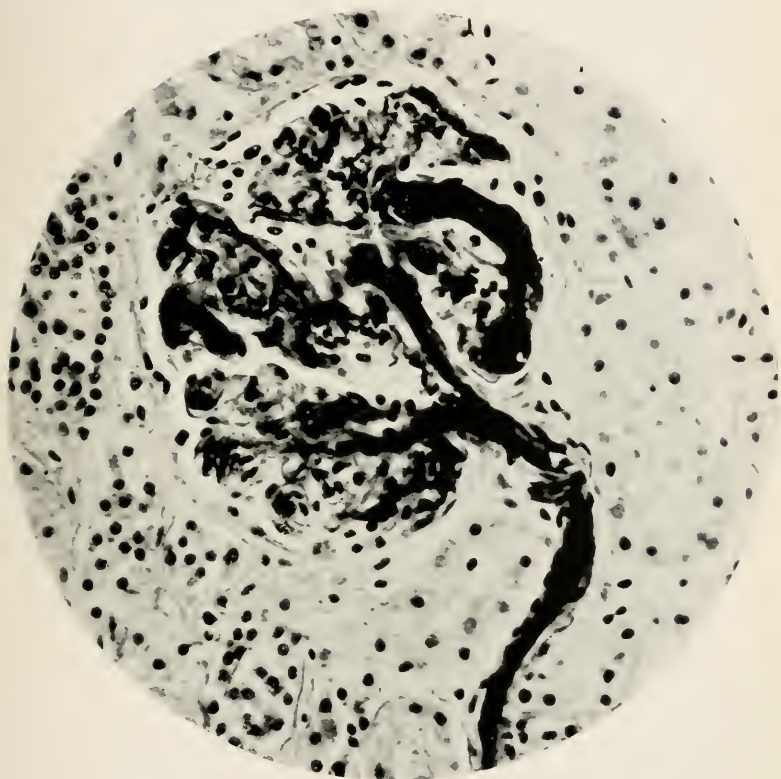


FIG. 1.



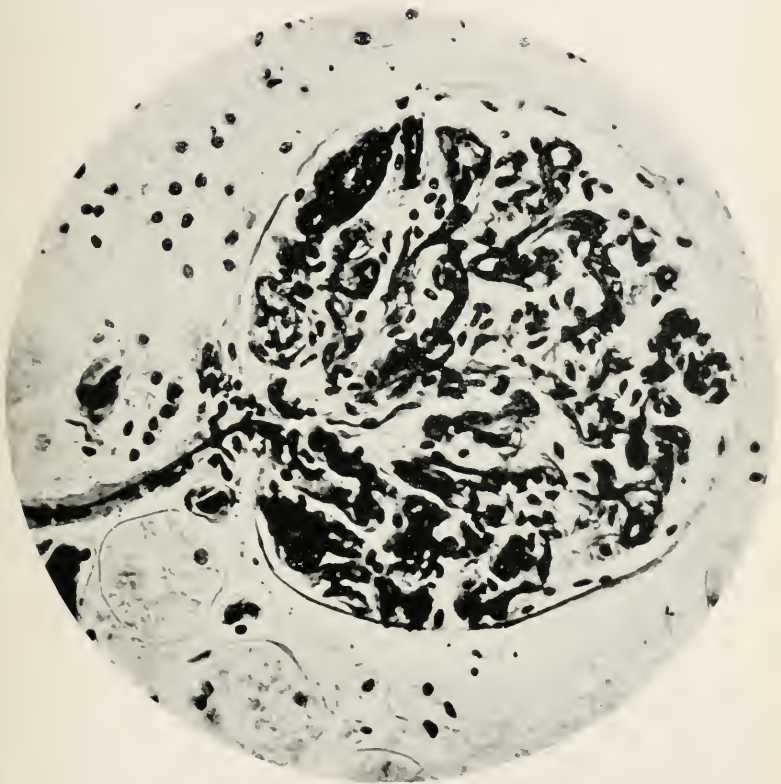


FIG. 2.





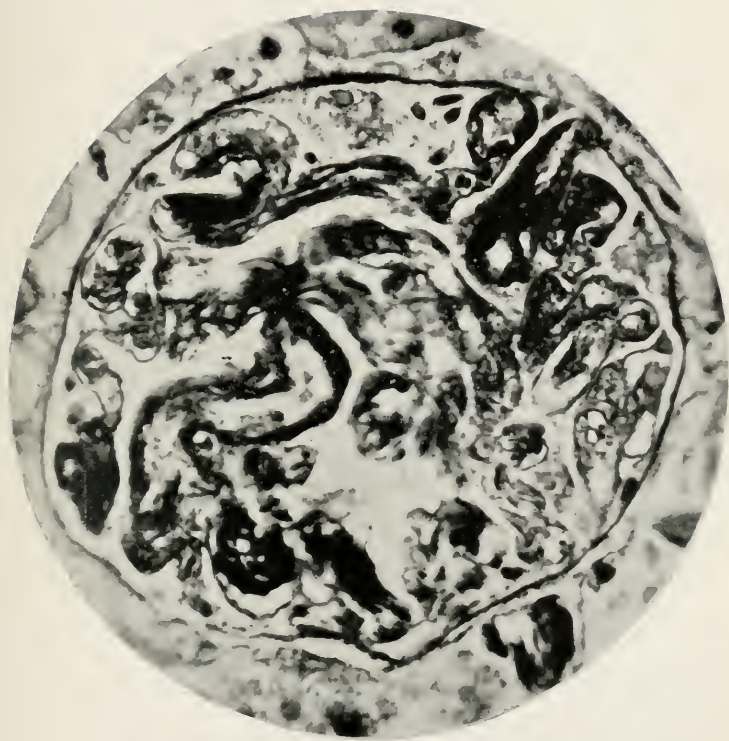


FIG. 3.



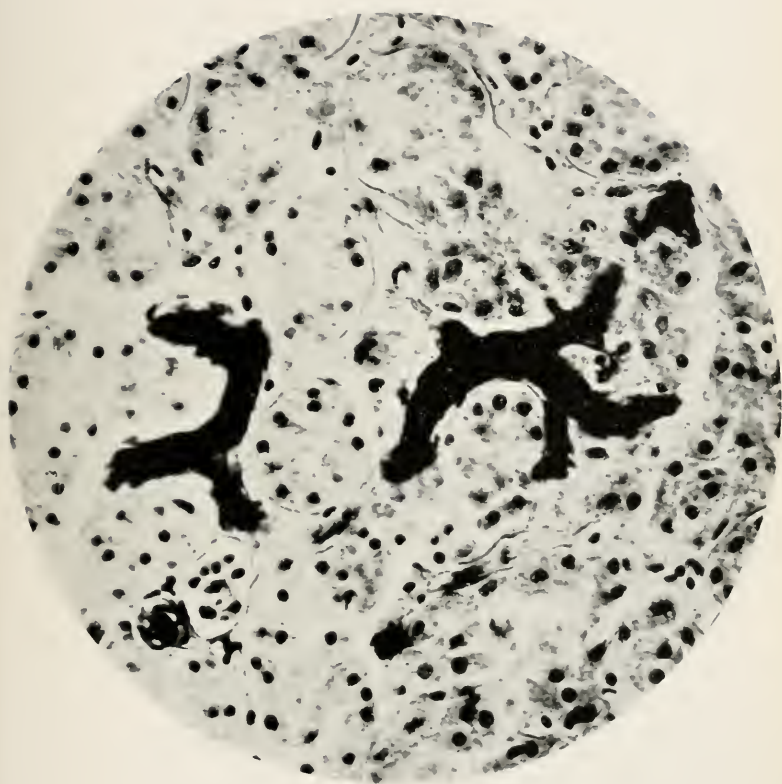


FIG. 4.



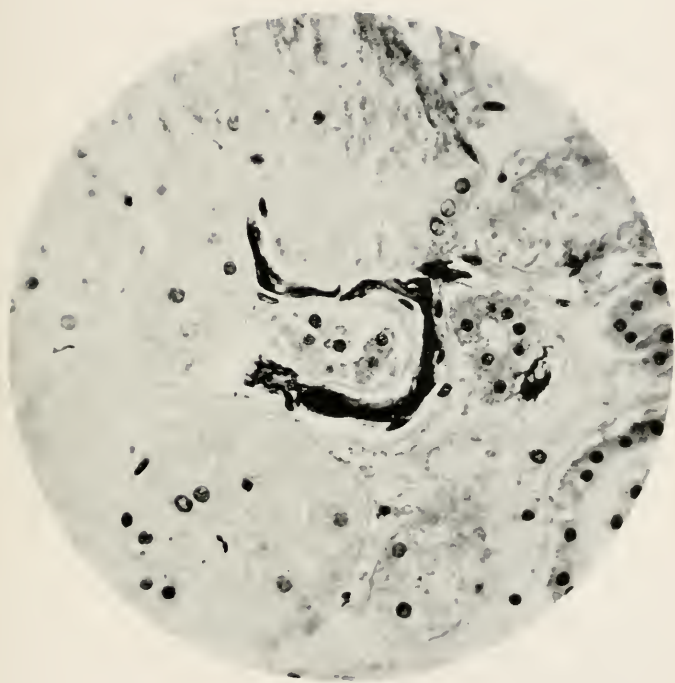


FIG. 5.





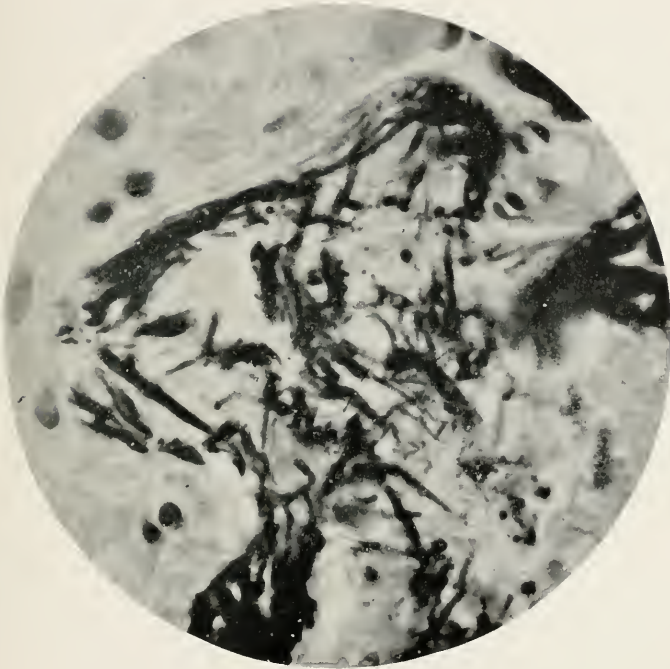


FIG. 6.



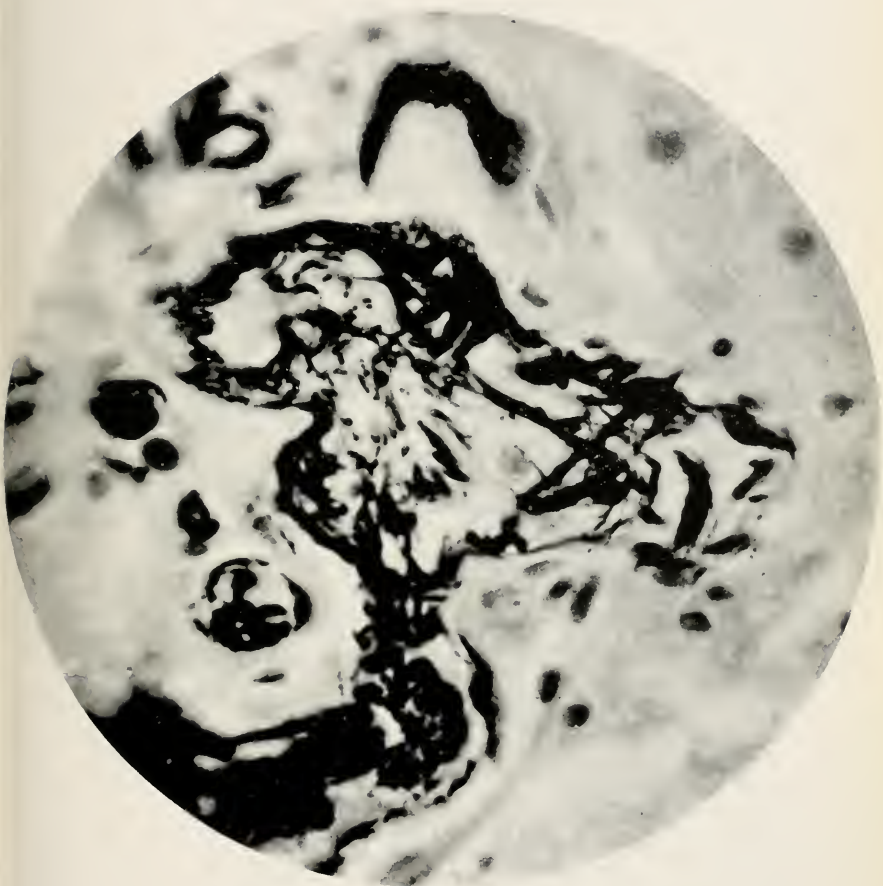


FIG. 7.



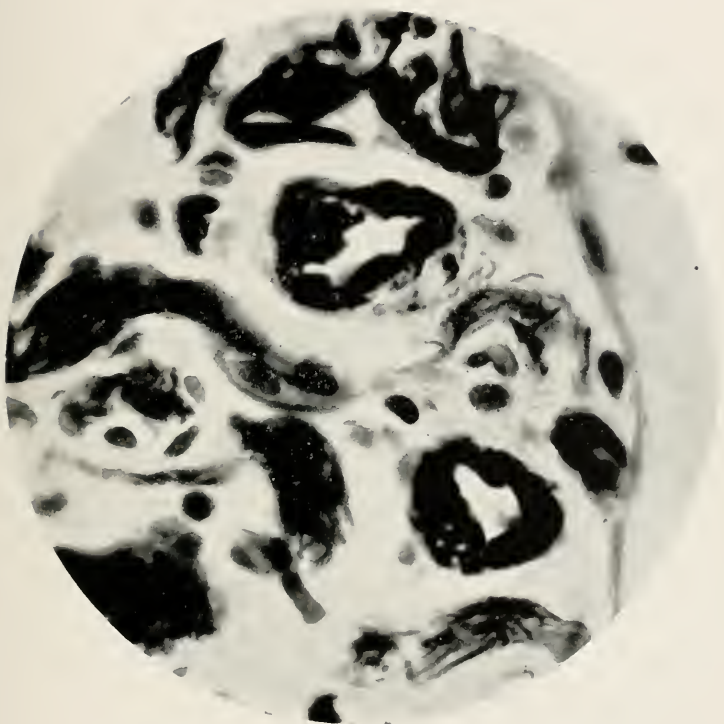


FIG. 8.





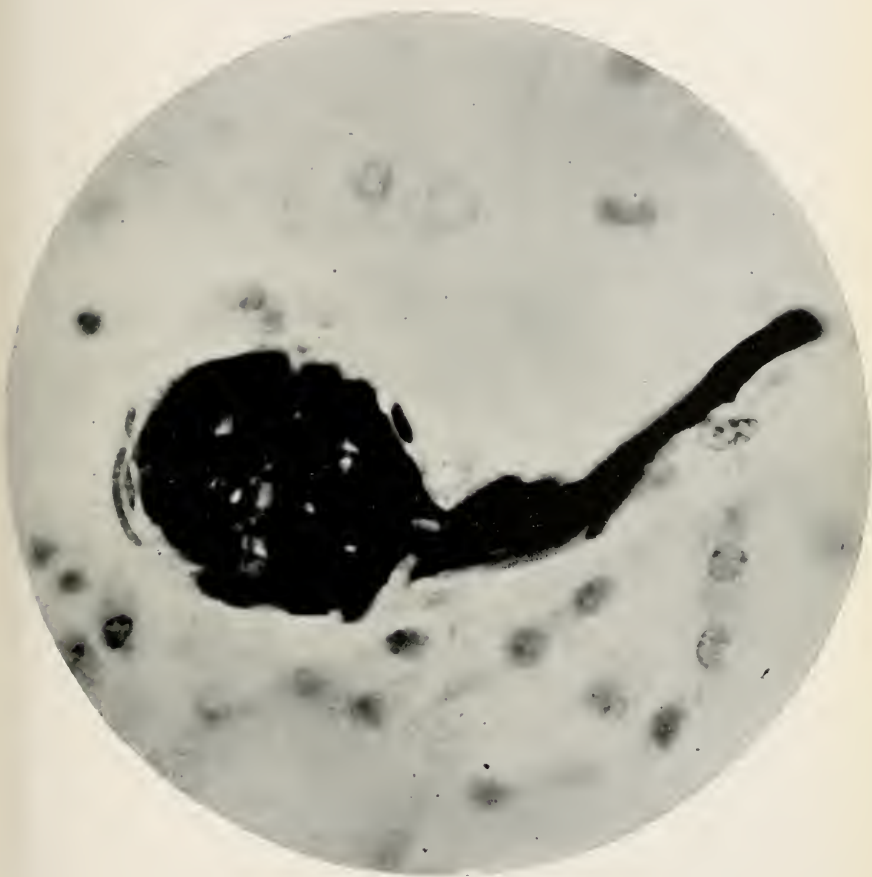


FIG. 9.



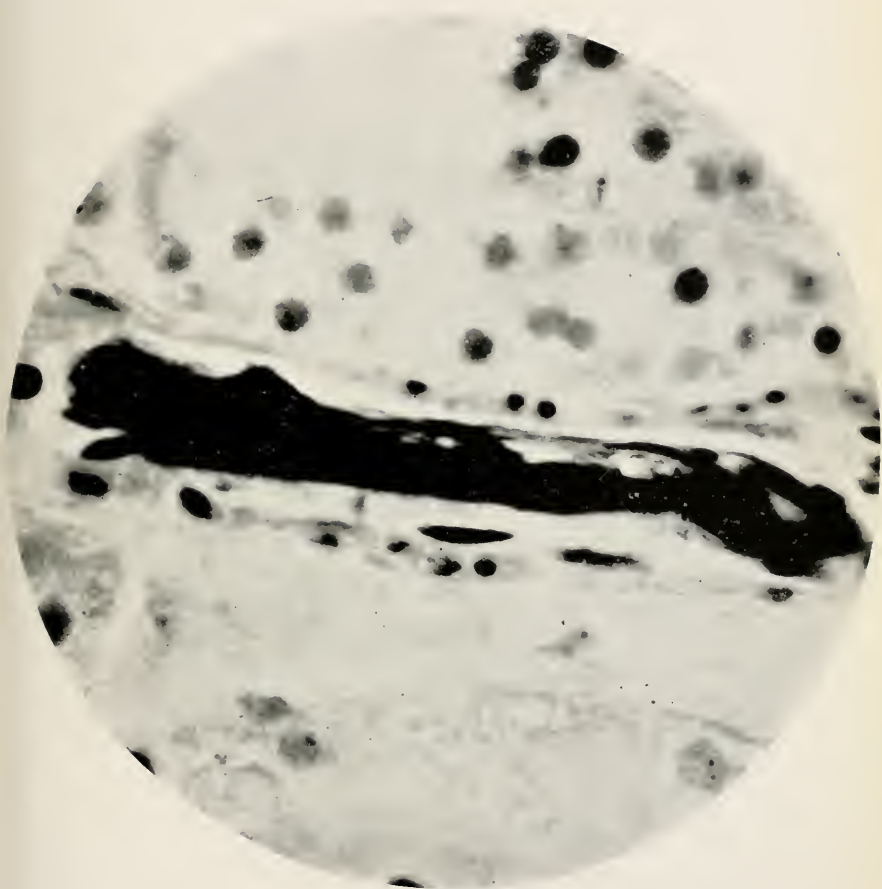


FIG. 10.



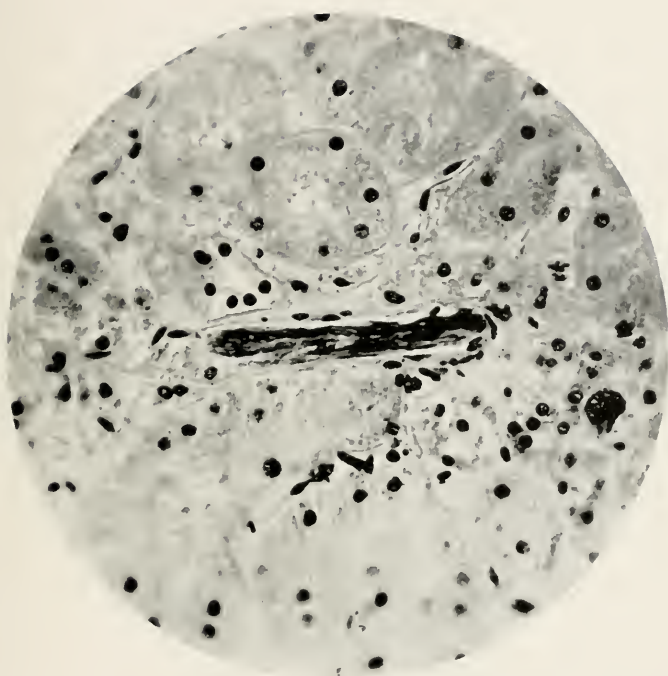


FIG. 11.





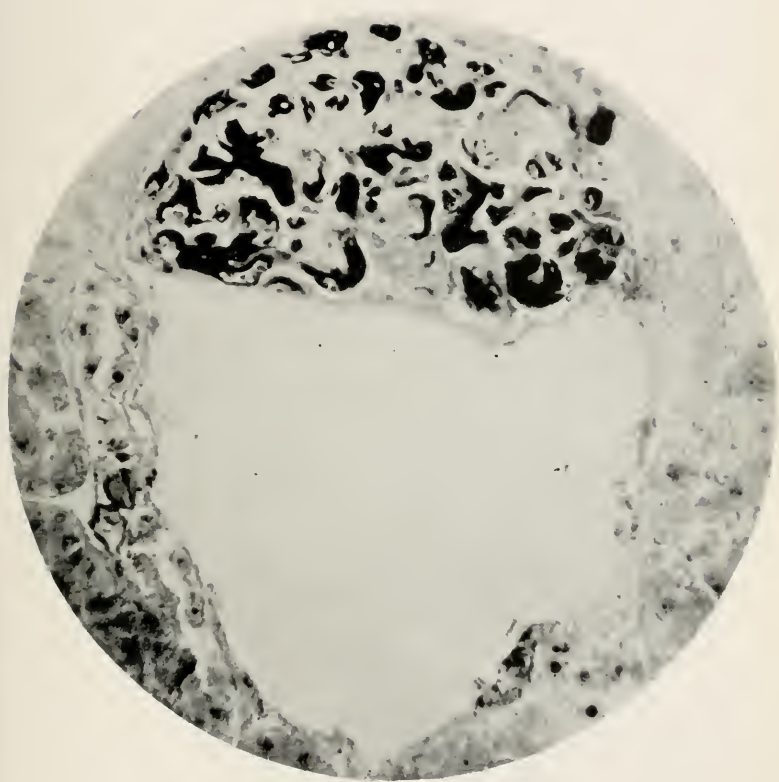


FIG. 12.





FIG. 13.



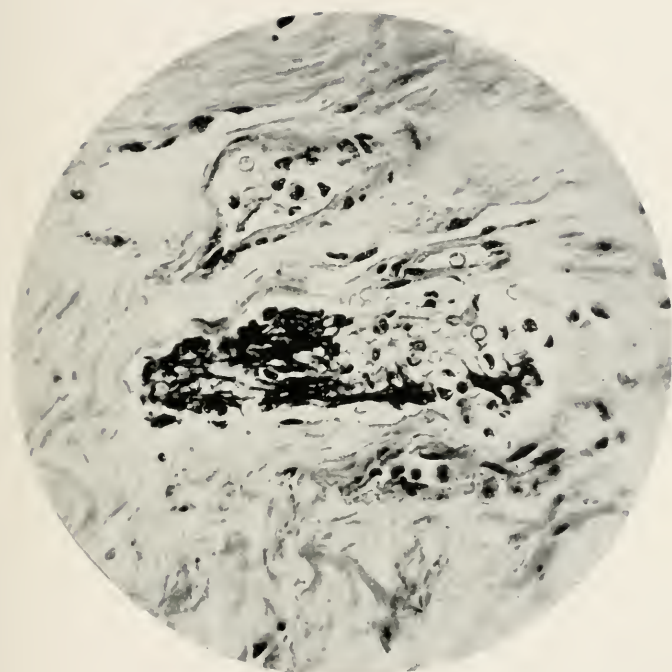


FIG. 14.





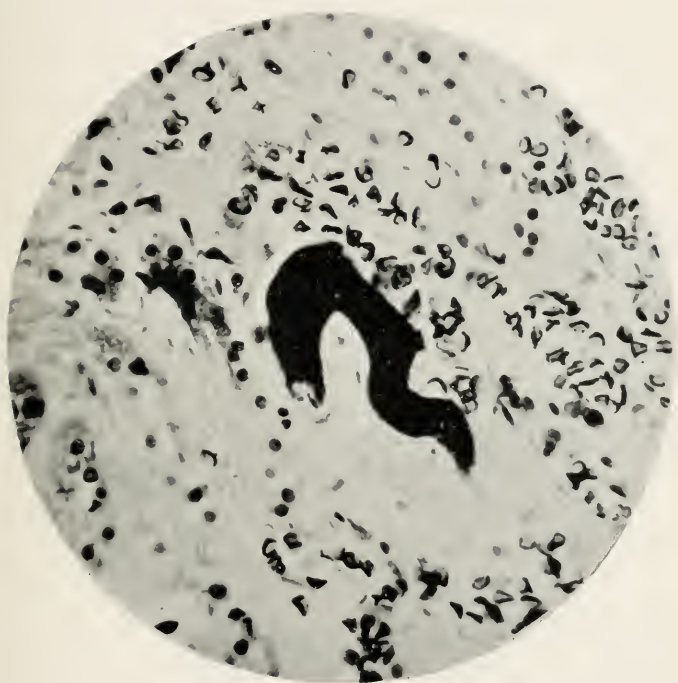


FIG. 15.





FIG. 16.



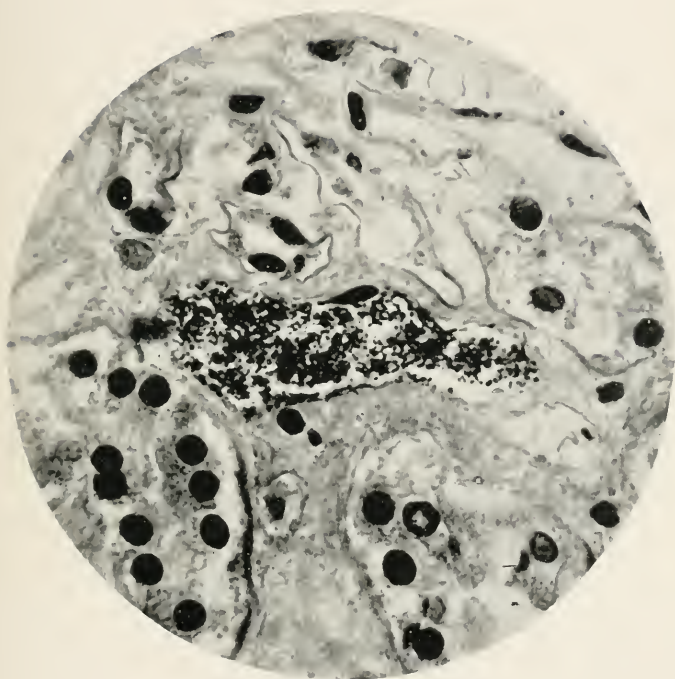


FIG. 17.





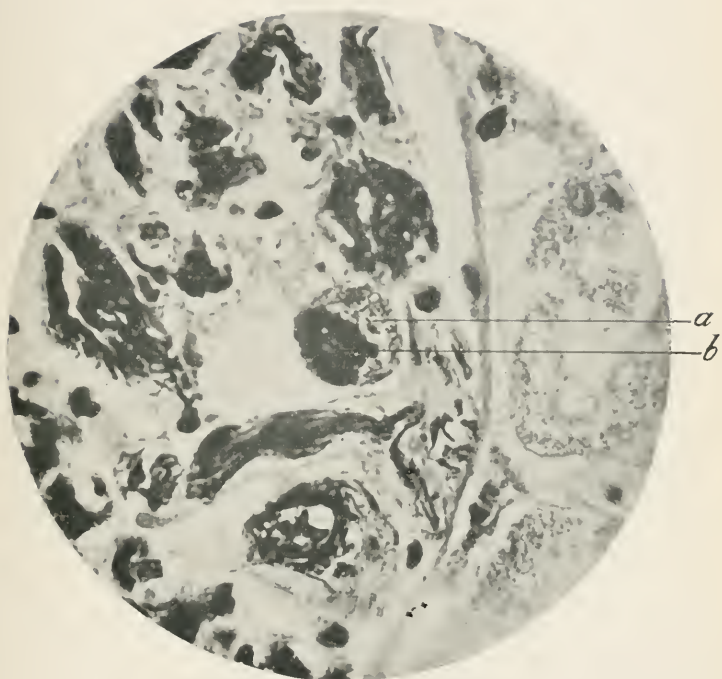


FIG. 18.



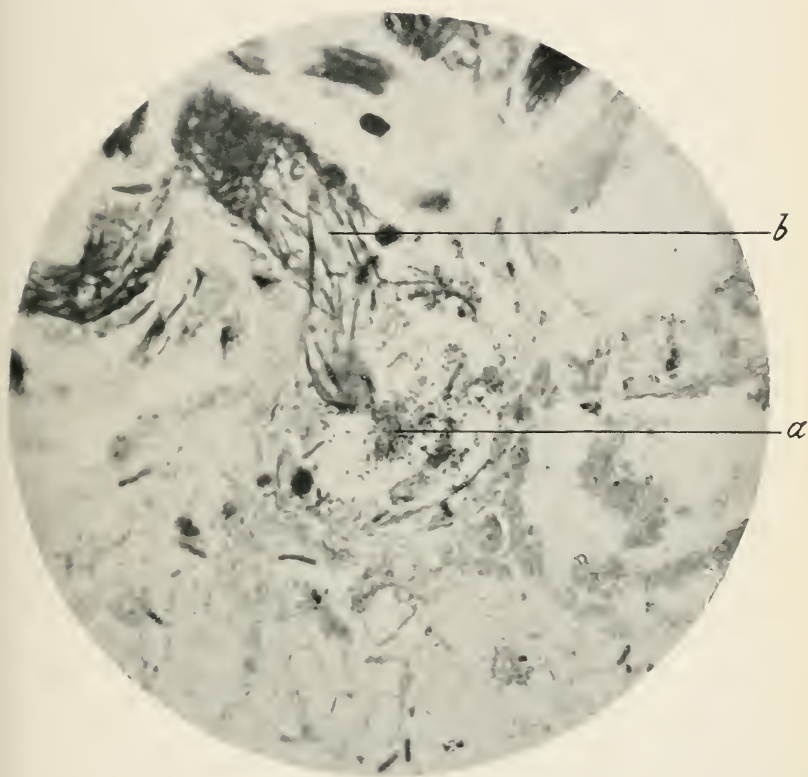


FIG. 19.



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No. 34.—OCTOBER, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

I. BIRDS FROM MINDORO AND SMALL  
ADJACENT ISLANDS

II. NOTES ON THREE RARE LUZON BIRDS

BY

RICHARD C. MCGREGOR

MANILA  
BUREAU OF PUBLIC PRINTING  
1905

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(Continued on third page of cover.)

No. 34.—OCTOBER, 1905

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

I. BIRDS FROM MINDORO AND SMALL  
ADJACENT ISLANDS

II. NOTES ON THREE RARE LUZON BIRDS

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RICHARD C. MCGREGOR

MANILA  
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1905



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF SUPERINTENDENT,

*Manila, August 12, 1905.*

SIR: I have the honor to transmit herewith a paper entitled "I. Birds from Mindoro and Small Adjacent Islands," and "II. Notes on Three Rare Luzon Birds," by Richard C. McGregor, collector of natural-history specimens, Bureau of Government Laboratories.

I am, very respectfully,

PAUL C. FREER,

*Superintendent of Government Laboratories.*

Hon. DEAN C. WORCESTER,

*Secretary of the Interior, Manila, P. I.*





## I. BIRDS FROM MINDORO AND SMALL ADJACENT ISLANDS.

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By RICHARD C. MCGREGOR.

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### MINDORO.

In the present paper there will be found recorded the birds seen or collected along the Bacó River in the northern part of Mindoro during an expedition to that island covering March, April, and May, 1905. Our first station was but a short distance from the coast, at a locality known as Chicago. This point was selected in order to take advantage of a house which the owner, Mr. E. C. Hamill, of the North American Trading Company, kindly placed at our disposal. Here we secured the two specimens of *Chatura*, which I refer to a new species, and a specimen of the beautiful little cuckoo *Chalcococcyx xanthorhynchus*. At Chicago collecting was not satisfactory, and therefore I very soon made preparations to move well up the river. Natives were dispatched in advance to build a house (Pl. I) in the virgin forest as near as possible to the base of Mount Halcón (Pl. II). This, our second station, I shall refer to as Balete, assuming it to have been at least in the vicinity of the camp of that name occupied by Bourns and Worcester in 1891. Balete is a much more satisfactory locality than Chicago, as the forest is extensive, fairly free from underbrush, and is traversed by numerous trails.

No startling discoveries were made in this locality, but good series of the species peculiar to Mindoro were obtained and several species were added to the known avifauna of this island; among the latter was an *Edolisoma* which appears to be undescribed.

We found it impossible to make a station on the mountain, as not enough of the wild hill people of Mindoro, known as the Mangyanes, could be found to carry even a third of our outfit.

To Dr. C. W. Richmond for copied lists of Mindoro birds, to Mr. E. C. Hamill for the use of his house at Chicago, and to my friend, Governor R. S. Offley, for assistance and many personal favors, I herewith express my sincere thanks and appreciation.

#### NOTES ON THE SPECIES OBSERVED.

##### **Megapodius cumingi** Dillw.

Two specimens of the "tabon" were collected at Balete. The species seems to be rare in Mindoro, as we were unable to secure a specimen on our previous trip, either at Calapan or Puerto Galera.

##### **Gallus gallus** (Linn.).

Very abundant in the vicinity of Balete. A chick in the down was taken May 25, but was dead on the next day. We have never been able to keep these wild chicks alive for more than one or two days.

##### **Turnix fasciata** (Temm.).

This species was collected by us at Calapan in December, 1902. A nest found at Chicago March 23, 1905, and believed to belong to this species, was situated on the ground in an old clearing, where it was well hidden by the surrounding grass. A bird was flushed from it, but could not be identified with certainty. The nest was composed of dry grass and was spherical in shape with an opening on one side. The three slightly incubated eggs measure 0.99 by 0.79, 0.99 by 0.79, and 0.97 by 0.78. It will be noticed that two of the eggs are of the same size, while the third is but a trifle smaller. Ground color white, closely speckled with dull greenish-brown and occasional small spots of various shades of lilac; the larger end rather thickly marked with blotches of blackish-brown.

##### **Osmotreron axillaris** (Bp.).

Several specimens from Balete.

##### **Osmotreron vernans** (Linn.).

Apparently less common than the preceding species; a male was collected at Chicago.

##### **Phapitreron leucotis** (Temm.). (Pl. III.)

Several nests of this dove were taken at Balete, and a photograph of one of these is reproduced. In the several specimens which we examined almost the sole material was twisted plant tendrils, which gave the nests the appearance of being made of spiral springs; they were invariably placed in small trees and rested on horizontal branches at 6 to 20 feet altitude. Eggs two, pure white.

Eggs and young were collected as follows:

April 8: One egg from oviduct of bird, 1.08 by 0.81.

April 27: Two eggs, incubation slight, 1.12 by 0.80 and 1.11 by 0.81.

May 2: Two eggs, incubation slight, 1.05 by 0.77 and 1.06 by 0.80.

May 5: Two young birds.

May 6: Two eggs, incubation slight, 1.15 by 0.81 and 1.10 by 0.78.

### ***Leucotreron occipitalis* Bp.**

Several specimens of this dove in full plumage were obtained in the heavy forest near Balete.

### ***Muscadivora*<sup>1</sup> *ænea* (Linn.).**

This fruit pigeon was not uncommon at various points along the river. Great numbers spent each night in two large balete trees near our camp, coming shortly before sundown and filling their crops with balete fruits before settling to rest for the night. Grant<sup>2</sup> gives the name of the Mindoro variety as *Carpophaga chalybura* Bp., and this may be correct, but as I have not worked out the varieties of this species I prefer to refer them all to *ænea* for the present.

### ***Ptilocolpa carola* Bp.**

Numerous specimens which were examined do not differ from the ones taken in Luzon, but one male agrees with the Sibuyan males in having the gray patch on the fore-breast much darker than is usual with the Luzon skins. In specimens from Sibuyan we find what is perhaps a tendency toward the Negros bird described by Whitehead as *P. nigrorum*, in which the fore-breast is black. It would be interesting to compare birds from Negros, Sibuyan, and Luzon.

### ***Zonophaps poliocephala* (Hartl.).**

This species was found only in the highest trees and usually in the deep forest; it was never observed associated in numbers. Several skins from Mindoro do not differ from those of our series taken in Sibuyan.

<sup>1</sup> *Carpophaga* Selby (1835) is preoccupied by *Carpophaga* Billberg (1828) for a genus of cuckoos. The next available name is *Muscadivora* Schlegel. Teste Mearns, *Proc. Biol. Soc. Wash.*, XVIII, p. 84, 1905.

<sup>2</sup> *Ibis*, 1896, p. 477.

***Myristicivora bicolor* (Scop.).**

One specimen of the "camasu" from Chicago.

***Columba griseigularis* (Wald. and Lay.).**

Two specimens of the gray-throated pigeon were collected.

***Macropygia tenuirostris* Bp.**

The slender-billed dove was not common.

***Streptopelia dussumieri* (Temm.).**

One or two pairs of Dussumier's dove were observed in the river bottom at Balete.

***Chalcophaps indica* (Linn.).**

One specimen of the Indian bronze-winged dove was killed at Chicago.

***Phlogœnas platenæ* Hartert. (Pls. IV, V, VI.)**

This fine, blood-breasted dove was not obtained by us during our previous trip to Mindoro when we worked only on the coast at Puerto Galera and Calapan. One or two individuals were observed at Chicago, but it was not until we reached Balete that the species was found in abundance, although owing to its habit of feeding on the ground and flying at the slightest noise, it might easily be overlooked. The species is very distinct from its Luzon relative; the red breast-spot is very small, the wing coverts are marked with white in place of gray, and the upper parts are differently colored.

Two nests of this species were obtained at Balete. The first was taken April 28, and was situated on a horizontal limb of a small tree 5 feet from the ground. The two eggs were advanced in incubation. They measure 1.18 by 0.88 inches and 1.14 by 0.88 inches. The second was similarly placed in a shrub. The nest which was photographed (Pl. VI) measures 8 by 11 inches across the top and is very shallow, the outside depth being about 2 inches. On the bottom are a number of rather large leaves and sticks, topped by fine rootlets and spiral plant tendrils. The materials were poorly put together so that a large part of the bottom fell off when the nest was removed from its site. The two eggs were well incubated. They measure 1.14 by 0.86 inches and 1.18 by 0.85 inches. Their color is light cream.

***Hypotænidia striata* (Linn.).**

One specimen from Balete.

**Hypotænidia torquata** (Linn.). (Pl. VII.)

One specimen from Balete has the tip of the bill twisted to the left as shown in the plate.

**Rallina euryzonoides** (Lafr.).

One specimen of this small rail was killed at Balete.

**Limnobænus fuscus** (Linn.).

A female was taken at Balete May 3.

**Amauornis olivacea** (Meyen.).

A nest of this species, found at Balete, was well hidden in a clump of saw grass. It was very neatly made of dry grass and had a deep cup. The single egg was heavily incubated when taken on May 20. It measures 1.64 by 1.22. The ground color is pale creamy white. Small spots and fine dots of reddish brown are scattered over the whole shell, but more numerous on the larger end, where there are also two large blotches of lavender. A few small lavender dots are scattered over the entire surface.

**Amauornis phænicura** (Forster.).

One specimen from Balete.

**Ochthodromus geoffroyi** (Wagler.).

One specimen was killed on the sea beach at the mouth of the river.

**Ægialitis dubia** (Scop.).

This little plover was abundant along the river in the vicinity of Balete, where it nested on the extensive gravel flats exposed by low water. A nest found April 24 was a slight hollow, lined with a mosaic of small pebbles. The three eggs measure 1.20 by 0.86, 1.14 by 0.86, and 1.22 by 0.86. Their ground color is very pale gray, almost white, carrying a considerable number of small lilac-colored spots. Small spots and irregular-shaped markings of dark brown are scattered over the entire surface, but are more numerous on the larger end. If one looks into the drill hole of one of these eggs while it is being held toward a good light the shell appears to be bright sea green.

**Glottis nebularius** (Gunn.).

A male was killed at Balete May 3, 1905.

**Actitis hypoleucos** (Linn.).

*Tringoides hypoleucos* SHARPE. Hand-list, I, p. 161.

Observed in many places along the river.

**Gallinago megala** Swinh.

One specimen of Swinhoe's snipe was taken at Balete on April 27, 1905.

**Dissoura episcopus** (Bodd.).

During our first visit to Calapan in December, 1902, this adjutant was abundant in the rice fields back of town, and although I attempted to secure specimens, my No. 5 shot seemed to have no effect whatever. At Balete we killed two along the margins of the river, where they were found searching for food. This bird is the most deliberate in its movements of any I have ever seen. It takes flight with ease, either from the ground or from a perch on a high tree. So slow is the motion of the wings that it would seem almost impossible for the bird to maintain itself in the air. In this species, the under side of the fore arm is bare and decorated with a wide line of dark crimson.

After having examined two specimens of this species, I am certain that the bird we saw in Calayan was *Dissoura episcopus*, although at the time I was obliged to record it from that island with doubt.<sup>1</sup>

**Nycticorax manillensis** Vig.

Two female night herons in adult plumage do not agree with the description of *N. mallinensis* as given in the Catalogue of Birds. The most obvious discrepancy is in regard to the nuchal plumes and the line over eye. Sharpe<sup>2</sup> says: "Crown of head and crest feathers, including the long nuchal plumes, greenish black, extending down the hind neck on to the mantle; no white eyebrow." Tweeddale<sup>3</sup> says of a male taken in Leyte: "The lengthened occipital plumes are black throughout their length and not only at their tips, as described by Vigors and figured by Fraser."

In an adult female (Chicago, Mindoro, March 21, 1905) the occipital plumes are nearly 7 inches in length and are white, with the tips and shafts blackish brown with a line of brown along each side of the basal third of the shaft. Likewise there is a very evident "eyebrow," a narrow line of white mixed with cinnamon, which extends from the base of the bill, over the eye nearly to the hind border. The crown and crest feathers are blue black, not "greenish black." Another female from the same locality, collected

<sup>1</sup> *Bull. Philippine Mus.*, No. 4, p. 11.

<sup>2</sup> *Cat. Bds.*, XXVI, p. 162.

<sup>3</sup> *P. Z. S.*, 1878, p. 345.



by Dean C. Worcester, February 19, 1905, does not differ from the above except in having the occipital plumes one-half as long.

***Butorides javanica* (Horsf.). (Pl. VIII.)**

Three nests of this species were found near Balete. Two of these each contained two young, and the third held a single blue egg measuring 1.48 by 1.06. Each consisted of a very small mass of twigs and was placed on the roots of a fallen tree in midstream. The nests were examined during the latter part of April. A heron collected in Mindoro by Everett is listed as *Butorides javanica amurensis* (Schrenck).<sup>1</sup>

***Bubuleus coromandus* (Bodd.).**

A few individuals observed along the lower river.

***Ardetta cinnamomea* (Gmel.).**

One example of the chestnut bittern was seen near Balete.

***Anas luzonica* Fraser.**

The Luzon mallard was not uncommon on the lower river, and an occasional pair was seen as far up as Balete. During this trip no other species of duck was seen.

***Anhinga melanogaster* (Pennant).**

*Plotus melanogaster* SHARPE, Hand-list, I, p. 236.

Three specimens of the black-breasted darter were preserved.

***Haliastur intermedius* Gurney.**

Abundant.

***Pernis ptilonorhynchus* (Temm.).**

Dean C. Worcester killed a nesting female at Chicago, February 19, 1905, and a male was secured by our party at the same place in March.

***Microhierax erythrogenys* (Vig.).**

One specimen from the vicinity of Chicago.

***Polioaëtus ichthyaëtus* (Horsf.) ?**

Birds supposed to be of this species were seen along the river on several occasions.

***Ninox mindorensis* Grant.**

Two male specimens of the Mindoro hawk-owl from Balete are

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<sup>1</sup> Hartert, *Novit. Zool.*, II, p. 488.

similar to a male from Puerto Galera, the latter being recorded in another paper.<sup>1</sup>

**Cacatua hæmaturopygia** (P. L. S. Müller).

At least one pair of cockatoos had a nest in the hollow limb of an immense tree near Balete.

**Prioniturus mindorensis** Steere.

Very abundant in the forests about Balete.

**Tanygnathus luconensis** (Linn.).

Equally abundant with the last species.

**Loriculus mindorensis** Steere.

Not abundant, but a few individuals usually seen in suitable flower or fruit trees.

**Eurystomus orientalis** (Linn.).

The broad-billed roller was noted at both of our camps.

**Pelargopsis gouldi** Sharpe. (Pl. IX.)

On April 18 a nest of this kingfisher was discovered in a deserted termites' nest which was built approximately 30 feet from the ground, in a small dead stub. It was probably excavated by the birds, as there is no other way in which the hole could have been made. Two of the eggs are oval and nearly equal at each extremity; the third is blunt pointed at one end. In color they are glossy white and measure 1.49 by 1.09, 1.58 by 1.14, and 1.56 by 1.14. Incubation was far advanced.

A few sharp raps on the decaying tree caused the incubating bird to leave. A kingfisher, presumably one of the owners of the nest, lit in a tree standing nearby while we were taking the eggs, but when he discovered us left with a startled squawk.

Hume<sup>2</sup> records a nest of *Pelargopsis burmanica* which was made of grass roots placed in the fork of a bamboo, and also a nest of *Halcyon smyrnensis* is described as "a mass of moss, of a large oval in shape, wedged into a hollow between two stones, covered at the top with another, and supported underneath by a projecting root."

**Alcedo bengalensis** Briss.

*Alcedo ispida* SHARPE, Hand-list, II, p. 50 (pt.).

Abundant.

<sup>1</sup> Bull. Philippine Mus., No. 4, p. 17.

<sup>2</sup> Nests and Eggs of Indian Birds, 2d. ed., III, pp. 12 and 17.

**Ceyx cyanopectus** (Lafres.). (Pl. X.)

Grant,<sup>1</sup> in his report on Whitehead's collection from Isabela Province, Luzon, gave the history of *Ceyx cyanopectus* and *Ceyx philippinensis* at length and on the evidence of specimens collected by Whitehead he revived the latter name for the form which is without the blue pectoral band.

Whitehead<sup>2</sup> himself considered them male and female of one species. Bourns and Worcester,<sup>3</sup> who made a large collection of the small river kingfishers, did not agree with Grant's view.

I have before me fourteen specimens of *Ceyx cyanopectus* collected in Mindoro during the breeding season between the dates March 23 and May 18. In nearly all of these individuals the sexual organs were so greatly enlarged that a mistake in sexing was well-nigh impossible. Each of these fourteen specimens was sexed by one of my assistants, his mark verified by myself, and the sex again marked on the back of the tag—not in a book. Seven of these skins are marked males and have a blue band across the fore breast. Seven are marked females and lack the blue band across the breast. Seven others from Luzon, Masbate, Ticao, and Sibuyan confirm the conclusion that these two forms are male and female of one species.

**Halcyon coromandus** (Latham).

One specimen of the Coromandel kingfisher from Balete.

**Halcyon gularis** (Kuhl). (Pl. XI.)

The white-chinned kingfisher was seldom seen near our Balete camp because we were there during the nesting season, but by a careful search along the smaller streams we soon discovered birds of this species in abundance. A sand or clay bank, even if but a foot or two high, was usually burrowed, although the hole was not always occupied. Another favorite site was the earth held between the roots of a large, fallen tree. Many trees of this sort lay in midstream, and I imagine that the birds were glad to place their nests therein, as the water certainly afforded some protection from snakes, ants, and the other natural enemies of eggs and nestlings. One burrow was in the earth between two large roots of a standing tree and another in the end of a dead limb of a fallen one. The usual burrow had an entrance from 2.75 to 3 inches in diameter

<sup>1</sup> *Ibis*, Jan., 1895, pp. 112-115.

<sup>2</sup> *Ibis*, Oct., 1895, p. 102.

<sup>3</sup> *Ibis*, 1895, p. 404.

and was 12 to 20 inches long. The nest chamber, as is usual with the kingfishers, was enlarged and more or less flask shaped. No nesting material was used, unless a few pieces of dead insects and the bones of lizards can be regarded as such. However, these remains were the exception rather than the rule. The eggs are pure, glossy white in color and of the shape typical for kingfishers. It is usual to find three eggs, although occasionally four are seen. Three sets yield the following measurements:

Set *a*, April 15; burrow in earth held between roots of large fallen tree; incubation advanced; 1.28 by 1.09, 1.31 by 1.12, 1.31 by 1.08, and 1.27 by 1.08.

Set *m*, April 22, burrow in sandy bank; fresh; 1.27 by 1.06, 1.23 by 1.09, and 1.27 by 1.10.

Set *r*, April 25, burrow in clay bank; incubation slight; 1.23 by 1.08, 1.23 by 1.08, and 1.24 by 1.10.

### **Halcyon chloris** (Bodd.).

The white-collared kingfisher was seen at Chicago, but was not noted at the Balete camp.

### **Penelopides mindorensis** Steere.

The Mindoro hornbill was common along the lower river and several individuals fed on the fruit of a tree standing within a few feet of the Chicago house. Numerous birds were seen at Balete, but nothing in regard to the nesting habits was observed.

### **Merops americanus** P. L. S. Müller.

*Merops americanus* P. L. S. MÜLLER, Syst. Nat. Suppl., p. 95 (1776), teste Sharpe.

*Merops bicolor* Bodd., Tabl. Pl. Enl., p. 15 (1783), *ex* Sharpe, Cat. Bds., XVII, p. 60; Hand-list, II, p. 73.

Dr. Richmond has called my attention to the necessary change in the name of the Philippine bee-bird which is indicated above. Specimens were obtained at Chicago.

### **Lyncornis macrotis** (Vigors).

Seven specimens of *Lyncornis* were collected at Balete, all of them killed within 100 yards of our camp. The birds flew during the night and morning, passing from the forest on one side of the river to that on the other.

### **Caprimulgus griseatus** Wald.

Not uncommon along the river at Balete, where three specimens were obtained. Two of these are males in the gray plumage, with scarcely a trace of fulvous beyond that on the wings; the under

tail coverts are pure white. My description<sup>1</sup> of the female of this species needs modification. I stated that the fulvous spot on the inner web of the first primary does not reach the web; this was true of the specimen then in hand, but is not so in other skins.

**Caprimulgus manillensis** Wald.

Four specimens of the Manila goat-sucker from Balete do not differ from others taken in Luzon and Masbate.

**Macropteryx major** Hartert.

*Macropteryx major* HARTERT, Novit. Zool., II, p. 473 (1895), teste Sharpe, Hand-list, II, p. 89.

*Macropteryx comata* HARTERT, Cat. Bds. XVI, p. 517 (pt.).

Three specimens from Balete.

**Collocalia whiteheadi** Grant.

**Collocalia fuciphaga** (Thunb.).

Small swifts were exceedingly abundant along the river in the vicinity of our upper camp. The large feeding flocks comprised mainly *C. fuciphaga* and *C. whiteheadi* with only occasional individuals of *C. marginata* and *C. linchi*. The first two species mentioned are very similar and the presence or absence of tarsal plumes seems to be the most reliable criterion for their identification and should be noted while the birds are in the flesh, as the plumes are so small as to be very easily worn off by the string of the label.

**Collocalia marginata** Salvad.

One specimen of this small species was taken by us at Puerto Galera, Mindoro, in December, 1902; another was killed near Balete, May 11, 1905. The species seems to be rare in Mindoro and the few individuals seen were associated with *C. fuciphaga* and *whiteheadi*.

**Collocalia linchi** Horsf. and Moore.

A small flock of this species was discovered feeding over the river at the base of the mountains on May 5, and two specimens were killed. I believe this is the first time Linch's swift has been taken in Mindoro.

**Chætura dubia** new species. (Pl. XII.)

*Type*.—Adult male, No. 4717, Government Laboratories Collection; Mindoro, P. I., March 18, 1905; McGregor et aliae.

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<sup>1</sup> *Bull. Philippine Mus.*, No. 1, p. 6.

*Description*.—General color blackish brown; back and rump noticeably lighter, being light seal brown, each feather with a subterminal, more or less concealed area, or band, of bluish violet; head and body shot with bluish violet gloss, strongest on chin, throat, breast, and sides of head and neck; a large white patch on each side between nostril and antorse feathers in front of eye; crissum white, each feather blackish brown at its base, the longest feathers with edges also blackish brown except near tip;<sup>1</sup> extending diagonally upward and forward on each flank a wide white stripe connected with the white crissum behind as in *Chatura gigantea*; exposed edges of wing feathers black, inner webs of primaries largely light brown; inner webs of alula and primary and secondary coverts shot with greenish blue gloss, this gloss also on outer web of primaries where hidden by primary coverts; tertiaries greenish blue; lining of wing brown, each feather bordered with dirty white which has its greatest extent on the innermost feather; axillaries dark brown, shot with bluish violet gloss; exposed portion of tail blackish, the concealed basal portion glossed with green and blue. Bill black; iris brown; legs and feet reddish flesh; nails light brown. Length in flesh, 9 inches; wing (flat on rule), 8.67; tail (spines much worn), 2.52; bill from nostril, 0.29; tarsus, 0.71.

*Cotype*.—Adult female, No. 4718, Government Laboratories Collection; Mindoro, P. I., March 18, 1905; McGregor et aliae. Length in flesh, 9.2 inches; wing, 8.57; tail (spines worn), 2.52; bill from nostril, 0.30; tarsus, 0.72.

The few words, without measurements, in Catalogue of Birds, XVI, p. 476, scarcely apply to the Mindoro species for Hartert says of *celebensis*: "In size similar to *C. gigantea*," whereas *C. dubia* is decidedly larger than *gigantea*; Clarke's<sup>2</sup> measurements of the Negros specimen certainly agree much better with our bird, but neither of these writers makes any mention of white wing lining in *C. celebensis*, a character very noticeable in *C. dubia*.

This species was seen almost daily flying high over the clearing at Chicago and I also observed large swifts near Balete. The two specimens obtained by us were killed at the former locality.

### ***Surniculus velutinus* Sharpe.**

Several specimens of this little black cuckoo were killed at Balete.

<sup>1</sup> In the female specimen before me the two longest undertail coverts have the shaft blackish brown to the tip.

<sup>2</sup> *Ibis*, 1894, p. 533.



**Hierococcyx spaveroides** (Vig.).

A male taken at Balete on May 5, 1905.

**Cacomantis merulinus** (Scop.).

Balete.

**Chalcococcyx xanthorhynchus** (Horsf.).

A male of this pretty little cuckoo was killed March 20, 1905, near Chicago.

**Endynamis mindanensis** (Linn.).

The Philippine koel is abundant in Mindoro.

**Centropus mindorensis** (Steere).

*Centrococyx mindorensis* STEERE, List Bds. and Mams. Steere Exp., p. 12.

The Mindoro cuckoo was abundant in the localities visited by us, but was not often seen far from a thick tangle of brush or a bed of saw grass in which it could hide at the first sign of danger. It was merely by chance that I discovered a nest of this species, situated in the interior of a bed of saw grass and made fast to several stems. The nest, placed about 5 feet from the ground, was entirely composed of wide grass with a slight lining of bamboo leaves. It was very bulky, measuring 2 feet in height by 15 inches in the shortest diameter, and was not unlike a ricebird's nest greatly enlarged, having the top covered, and a small hole in one side. On April 8 there were two eggs in the nest, which were taken on April 12 as no more had been deposited. In color they are dull white, covered by a thin chalky layer which is of a pale, creamy white; their measurements are 1.08 by 0.86 and 0.96 by 0.83.

In the short description given by Steere the characters of this species are well described, but his statement "Wings slightly shaded with rufous, most apparent on edges of primaries" needs some modification. The "rufous" is not a constant character, and when present is confined to the edges of the alula and primary coverts, rarely present on the secondary coverts, and never on the primaries. This is not dependent upon sex, but it may be due to the age of the bird. These statements are based upon the examination of eleven adult specimens.

A young bird, No. 5109, Balete, May 18, 1905, has the upper parts similar to those of the adult, but duller; alula, primary coverts, and some secondary coverts, barred and mottled with light

cinnamon; lower parts dull blackish, a few feathers on the breast with whitish shaft lines.

**Centropus steerii** Bourns and Worcester.

Steere's cuckoo was quite as abundant as the last species. It was usually seen in the tops of vine-covered shrubs.

**Centropus javanicus** (Dumont).

Not uncommon in grass patches along the lower river.

**Xantholæma hæmatocephalum** (P. L. S. Müller).

The "took-took-took" of this barbet was often heard in the vicinity of both camps, and specimens were obtained.

**Iyngipicus validirostris** Blyth.

A few specimens of this little woodpecker were collected.

**Thriponax mindorensis** Steere.

A young female, culmen 1.70 inches, differs from the adult in having the abdomen and rump band pure white without any buff wash.

**Pitta erythrogaster** Temm.

Abundant.

**Hirundo javanica** Sparrm.

Several nests were seen attached to dead and fallen trees in the river.

**Cyornis philippinensis** Sharpe.

Rare.

**Hypothymis occipitalis** (Vig.). (Pl. XIII.)

Early in April a nest of the black-naped flycatcher was discovered saddled in the fork of a young tree standing in a piece of forest near the river. As the nest was but three feet from the ground it was an excellent subject for the camera. At one time the female was quite fearless of my approach and would still be on the nest when I left. I never saw the male incubating, nor did I observe him helping his mate in any way, unless his presence in a near-by thicket was of assistance to her. The nest measured 2.5 inches in outside diameter and 3.2 in outside depth; the base was much thickened so that the inside depth was but 1.2 inch. It was a dainty thing when new, resembling somewhat the nest built by an American gnatcatcher (*Polioptila*). The bulk of the material was green moss, soft bits of dry bamboo leaves, and fine blackish fibers, the latter being employed on the inside. The outside was

decorated with a white material resembling cobweb, but this was in reality the cotton-like substance which grows in large masses and streamers upon the back of a jumping insect, one of the *Fulgoridae*. The three eggs were white, marked with dots of reddish brown, the dots more numerous at, and forming rings about, the larger ends of two of them, and about the smaller end of the third.

**Zeocephus rufus** (G. R. Gray).

A few specimens of the rufous flycatcher were taken at Balete.

**Artamides mindorensis** Steere. (Pl. XIV.)

A nest containing a single fresh egg was taken near Balete, April 26, 1905; these, together with a female *Artamides*, were collected by my assistant, who assures me that he saw the bird leave the nest. The nest is composed of mosses (*Pogonatum* and others), small leaves, lichens, and fine rootlets; the outside is covered with cobwebs which serve to hold the materials together and to fasten the nest to the fork in which it is built. The nest is 4.5 inches across the top and its outside depth is but two. The ground color of the egg is light gray, with a slight greenish tinge; a heavy and continuous wreath of spots and blotches encircles the shell near the plane of its short diameter; a few small spots are scattered about over the entire surface; the deep shell markings vary from pale to dark lavender; the surface spots and blotches are reddish brown; measurements, 1.21 by 0.83.

**Edoliisoma elusum** new species.

*Type*.—Adult male, No. 5102, Government Laboratories Collection; Balete, Rio Bacó, Mindoro, P. I., May 17, 1905; McGregor et alia.

*Description*.—General color bluish slate; chin, throat, forebreast, forehead, and side of head including lores and a wide line over eye, jet black; alula, primary coverts, and primaries black; inner primaries and inner feathers of alula narrowly edged with blue gray; secondaries and tertiaries black, with wide edges of blue gray, which covers all or nearly all of the outer web; secondary coverts gray; inner web of quills partly dark blue gray, this begins as a small basal area on the short first primary, becomes greater on each succeeding quill, and reaches nearly to the tips of inner quills; a narrow edging of white on inner web of first four quills (in the type this is not so pronounced as in the two other skins at hand); tail black; from below, outer pair of rectrices tipped with blue gray

(0.75 inch in length); on second pair, gray tip much less and only a trace on some of the other rectrices; central pair blue gray with a subterminal black area. Bill, legs, and nails black; irides, dark brown. Length in the flesh, 9.3 inches: bill from nostril, 0.62; culmen from base, 0.88; wing, 5.00; tail, 4.18; tarsus, 0.92.

*Cotype*.—Adult female, No. 5103, Government Laboratories Collection; Balete, Rio Bacó, Mindoro, May 17, 1905; McGregor et alia.

*Description*.—General color leaden gray (nearly the same color as *Artamides mindorensis* Steere), thus much lighter than the male; chin, throat, and head areas described as black in male, are gray in the female, uniform with rest of general color; lores, however, slightly blackish; wing and tail as in the male. Length in the flesh, 9.3 inches; bill from nostril, 0.61; culmen from base, 0.86; wing, 4.96; tail, 4.18; tarsus, 0.92.

*Distribution*.—Mindoro and Luzon, Philippines.

A male and female from Lamao, Bataan Province, Luzon, do not differ from the Mindoro specimens, of which we collected two of each sex.

This species differs from *E. mindanense* in having rump and upper tail coverts uniform in shade with the back, and from *E. panayense* in having no wing bar: it appears to be closely related to *E. everetti* of Sulu, Tawi-Tawi, and Bongao. Possibly this is the species referred to by Sharpe when he says:<sup>1</sup> "Lord Tweeddale also told me, shortly before his death, that he had yet another new species of *Edoliisoma* from Luzon."

### ***Pericrocotus cinereus* Lafres.**

In March the ashy minivet was fairly common at Chicago.

### ***Lalage melanoleuca* (Blyth).**

Abundant at Chicago, where a number of specimens were taken; it was not seen at our upper camp.

### ***Iole mindorensis* Steere.**

The nest and eggs of the Mindoro bulbul have been described by Grant and Whitehead, but notes on two nests collected near Balete may be of interest. April 2, a set of three heavily incubated eggs was taken with the nest from a small tree. The ground color of these eggs is white, with faint lavender undershell markings: the entire surface is thickly and uniformly marked with

<sup>1</sup> *Cat. Bds.*, IV, p. 471.

elongated and twisted spots of reddish brown. The measurements are 1.03 by 0.72, 1.00 by 0.71, and 0.99 by 0.75.

The nest is composed of several leaves held in place by threads of a black hairlike fungus; cobweb and green moss are also present in small quantities; the lining consists of a quantity of long slender fibers; the cavity is 1.5 inches deep and 3 inches in diameter; the outside depth is 3.5 inches.

An incomplete set of two fresh eggs was taken April 9. These are colored very differently from the set of three; the ground color is light reddish brown, produced by very fine spots of that color: both the lavender under shell markings and the rich reddish brown spots are few and blotchy, the latter usually with a blackish brown center from which the lighter color seems to have been smeared out over the shell. The measurements are 1.06 by 0.75 and 0.98 by 0.72.

### ***Pycnonotus goiavier* (Scop.).**

Several nests of this bulbul were observed: they were all situated in small bunches of "ta-lá-hib," or saw-grass, growing in the dry bed of the river.

### ***Geocichla cinerea* Bourns and Worcester. (Pl. XV.)**

*Geocichla cinerea* BOURNS AND WORCESTER, Occ. Papers Minnesota Acad., I, No. 1, p. 23, 1894.

Three skins collected in the heavy forest at Balete are in all probability of this species. In the original description no mention is made of the white spot on the inner web of the two outer pairs of tail feathers. I also find in our specimens a much greater length of tarsus than is assigned to the type (0.98 inch). In one male specimen the under tail coverts are strongly washed with buff. Bill black, base of lower mandible whitish, legs and nails white; irides very dark brown.

#### *Measurements of Geocichla cinerea.*

Number.	Sex.	Date.	Length.	Wing.	Tail.	Exposed culmen.	Tarsus.
5113 -----	♂	May 18	7.7	4.50	2.68	0.71	1.25
5111 -----	♂	do	7.7	4.37	2.71	0.76	1.18
4960 -----	♀	Apr. 26	7.9	4.40	2.54	0.72	1.20

### ***Petrophila manilla* (Bodd.).**

This thrush has a peculiar habit of flitting about just at dusk: this sometimes leads to its being killed by mistake.

**Locustella ochotensis** (Midden.).

A specimen of Middendorf's warbler was killed May 17 within ten feet of our house at Baleté.

**Acrocephalus orientalis** (Temm. and Schl.).

One specimen killed April 27.

**Cisticola exilis** (Vig. and Horsf.).

A few seen in grass patches along the river.

**Megalurus ruficeps** Tweed.

A specimen of the smaller *Megalurus* from Baleté.

**Acanthopneuste borealis** (Blas.).

Rare.

**Artamus leucorynchus** (Linn.). (Pls. XVI, XVII, XVIII.)

*Artamus leucogaster* SHARPE, Hand-list, IV, p. 260.

This species was abundant near Baleté, and during April was busily engaged in nesting or in feeding young. Several nests, each containing three young, were found during that month, indicating that if the collector wishes to find eggs the search should begin in March. Two nests which were examined, each contained four eggs; these are described below. The nest was always placed on the end of a stub or on the butt of a fallen tree in the river bed. The old birds are very pugnacious if their nest contains young, but if the eggs are not hatched, they are less energetic in their efforts to drive away the intruder.

April 22, 4 fresh eggs, measurements: 0.97 by 0.70, 0.96 by 0.70, 0.94 by 0.70, and 0.90 by 0.70; nest of small rootlets and one or two leaves compactly made and deeply cupped; placed on the butt of a partly burned and drifted tree in the river bed.

April 30, four heavily incubated eggs; measurements: 0.91 by 0.70, 0.91 by 0.70, 0.89 by 0.79, and 0.90 by 0.70; nest on the top of a stub five feet in height, in the river bed; it was composed of fine blackish-brown rootlets.

The two nests just described were not surrounded by water, but many of the others were placed on stubs or fallen trees in midstream as is the case with the one about to be described, of which an illustration is given (Pl. XVI).

April 15, three small young; nest 20 inches above water, on slanting stub; nest composed of weathered rootlets and a few straws, giving it a dark gray color, exactly like that of the stub; inside diameter, 3 by 4 inches; inside depth, 1.75 inches.



The eggs of this species are most easily and accurately described by saying that both in color and shape they are like those of the shrikes. They have a peculiarly faded or washed-out appearance which at once recalls to mind the eggs of *Lanius*. Authors<sup>1</sup> have called attention to this similarity, which is one of the reasons for placing the shrikes and swallow-shrikes near each other in the system. The ground color is dull white; the light lavender under shell markings are large and usually confluent around or over the larger end of the egg; other markings of light reddish brown are scattered about the same situation; both lavender and brown occur in small spots over the entire surface. The third egg in the set of April 30 has its wreath of color near the smaller end. One in each of the two sets differs from the others in having a light brownish ground color.

**Otomela lucionensis** (Linn.).

Rare.

**Hyloterpe albiventris** Grant.

One specimen of the white-bellied thick-head was taken near Balete.

**Dicæum retrocinctum** Gould.

**Dicæum xanthopygium** Tweed.

This and the last-named species were first found feeding in a flowering vine at Chicago, but very few specimens were obtained. A number of those we attempted to shoot were not killed and about half of those killed could not be found. At Balete we again encountered the two species; sometimes they were feeding in high flowering trees and again near the ground on the fruit of various fig trees. A fair series of each species was obtained. We have never seen either in cocoanut trees.

**Dicæum pigmæum** (Kittlitz).

A few specimens taken, but the species was not common.

**Prionochilus inexpectatus** Hartert.

Several specimens killed in fig trees.

**Æthopyga flavipectus** Grant.

One male and two females are all we were able to secure of this handsome little sunbird. The male agrees with several from Mari-veles, Luzon, in having the breast darker yellow than Lubang specimens (*Æ. rubrinota*).

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<sup>1</sup> Whitehead, *Ibis*, 1899, p. 240; Baker, *Ibis*, 1901, p. 420.

**Cinnyris sperata** (Linn.).

The red sunbird was obtained at Chicago, but was by no means abundant.

**Cinnyris jugularis** (Linn.).

A male black-throated sunbird made daily visits to an ornamental flowering shrub within 2 feet of the porch at Chicago. The species was not noted at our upper camp.

**Anthreptes griseigularis** Tweed?.

So far as I know, no species of *Anthreptes* has been recorded from Mindoro. The present collection contains two adult females and one male; the latter, unfortunately, is immature, with but a few metallic feathers on head, mustachial line, and upper tail coverts and with no feathers of the adult plumage on the throat, so that no absolute determination can be made. The two females agree very well in size and coloration with those of *A. griseigularis* from Luzon. The Mindoro bird can not be *A. chlorigaster*, which is much larger and has a longer bill.

**Motacilla melanope** Pall.

Four males, May 4 to 10, are in full breeding dress, the entire throat being black with narrow gray edges to the feathers. This is the first time we have found this bird in full plumage.

**Chlorura brunneiventris** Grant.

On April 29 a pair of this species were killed in the river bottom within 100 yards of our Balete camp. No more were seen.

**Munia jadori** Martens.

Jagor's chestnut weaver-bird was seen in small companies in the high grass of the river bottom, but was by no means common. Probably the species was breeding, but I saw no nests.

**Oriolus chinensis** Linn.

Abundant.

**Dicrurus balicassius** (Linn.).

Not uncommon in the forests about Balete.

**Sarcops calvus** (Linn.).

Common.

**Lamprocorax panayensis** (Scop.).

*Calornis panayensis* SHARPE, Cat. Bds., XIII, p. 147.

Common.

*Corvus pusillus* Tweed.

*Corone philippina* Bp.

Both species of crow are very abundant in Mindoro.

#### BIRDS FROM SMALL ISLANDS ADJACENT TO MINDORO.

The species recorded in the following lists were noted by Dean C. Worcester and the writer during a few hours on Maestre de Campo, Semerara, and Sibay. All three of the islands are near Mindoro and are within the 100-fathom line, which extends outward from the eastern and southern coast of the larger island so as to include these smaller ones.

A second list of birds from Semerara is also introduced, giving the observations made by Dean C. Worcester on a subsequent visit to that locality.

#### MAESTRE DE CAMPO.

Maestre de Campo lies directly to the east of Mindoro; its surface is elevated and broken; some of the summits, which we had not time to visit, are crowned with small patches of forest. None of the species observed are of importance, with the possible exception of a *Centropus*, of which no specimen was taken.

#### LIST OF BIRDS NOTED ON MAESTRE DE CAMPO NOVEMBER 8, 1904.

<i>Streptopelia dussumeri</i> (Temm.).	<i>Acanthopneuste borealis</i> (Blas.).
<i>Haliastur intermedius</i> Gurney.	<i>Otomela lucionensis</i> (Linn.).
<i>Tanygnathus lucionensis</i> (Linn.).	<i>Dicaeum</i> (Kittlitz).
<i>Eurystomus orientalis</i> (Linn.).	<i>Cinnyris jugularis</i> (Linn.).
<i>Haleyon gularis</i> (Kuhl).	<i>Motacilla melanope</i> Pallas.
<i>Haleyon chloris</i> (Bodd.).	<i>Anthus rufulus</i> Vieill.
<i>Endynamis</i> sp.	<i>Anthus gustavi</i> Swinh.
<i>Centropus</i> sp.	<i>Oriolus chinensis</i> Linn.
<i>Hirundo gutturalis</i> Scop.	<i>Sarcops calvus</i> (Linn.).
<i>Hypothymis occipitalis</i> Vig.	<i>Corone philippina</i> Bp.

#### SEMERARA.

Semerara lies to the southward of Mindoro and has no high elevations; however, the summits of the hills bear small patches of trees. A large part of this island is covered with grass. A species of fruit thrush was observed here, but none of the birds were killed.

Worcester visited the island again on July 24, 1905, and collected specimens of the *Iole* which proves to be the Mindoro species;

he also secured specimens of two other species of interest. One of these is a cuckoo which is identical with *Centropus steerii* of Mindoro, the other is a distinct variety of *Chibia*, which I take pleasure in naming after its discoverer.

The presence of *Centropus mindorensis* and *Iole mindorensis* is very decided evidence in favor of uniting Semerara with Mindoro. The discovery of a *Chibia* in this island suggests that Semerara may have been one of the stepping-stones by which the genus reached Tablas from the Cuyos or from the Calamianes.

LIST OF BIRDS NOTED ON SEMERARA NOVEMBER 12, 1904.

Gallinago sp.	Iole sp. (See following list.)
Haliaëtus leucogaster (Gmel.).	Cisticola exilis (Vig. and Horsf.).
Haleyon chloris (Bodd.).	Anthus rufulus (Vieill.).
Endynamis mindanensis (Linn.).	Oriolus chinensis Linn.

A SECOND LIST OF BIRDS FROM SEMERARA, NOTED BY DEAN C.  
WORCESTER, JULY 24, 1905.

**Chibia worcesteri** new species.

*Type*.—Adult male, No. 10508, Government Laboratories Collection; Semerara Island, Mindoro Province, Philippines; July 24, 1905; Dean C. Worcester.

*Specific characters*.—Closely related to *Chibia cuyensis* McGregor, but wing longer and outer tail feather much more recurved; similar to *Chibia palawanensis* Tweeddale, but tail longer and its outer feather more recurved, bill longer and deeper.

*Description of type*.—Entire plumage black, with dark bluish gloss on head and on tips of breast and neck feathers; wings and tail glossed with dark green; back, dull black without any gloss. "Eyes dark brown; bill, legs, and feet black; length, 11.5 inches." Wing, 5.90 inches; tail, 5.40; middle rectrices, 4.74; bill from nostril, 0.82; culmen, 1.20; depth of bill at angle of gonyes, 0.42.

I have placed this species in the genus *Chibia* because of its general coloration and its much recurved outer tail feather. Possibly it belongs in *Dicrurus*, but with the material at hand I can not come to this conclusion unless *Chibia* be united to *Dicrurus*.<sup>1</sup>

<sup>1</sup> Dubois, *Syn. Av.*, p. 529, unites both *Chibia* and *Buchanga* with *Dicrurus*, a proceeding which gives satisfactory results when applied to the Philippine species of those genera.

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|--|--|
| Osmotreron axillaris (Bp.).            | Lalage melanoleuca (Blyth).?   |
| Leucotreron leclancheri (Bp.).         | [A bird, probably of this species,<br>was seen.—D. C. W.]                    |
| One female specimen.                   |  |
| Carpophaga aenea (Linn.).              | Iole mindorensis Steere.   |
| Streptopelia dussumieri (Temm.).       | Two specimens in molt. These do<br>not differ from typical Mindoro<br>skins. |
| Demiegretta sacra (Gmel.).             |  |
| Butorides javanica (Horsf.).           |  |
| Merops americanus P. L. S. Müller.     | Copsychus mindanensis (Gmel.).?  |
| Endynamis mindanensis (Linn.).         | Cisticola exilis (Vig. and Horsf.).  |
| Centropus mindorensis (Steere).        | Artamus leucorynchus (Linn.).  |
| Two specimens of <i>Centropus</i> from | Dicaeum pygmaeum Kittlitz.   |
| Semerara do not differ from the        | Cinnyris jugularis (Linn.).  |
| Mindoro bird, <i>C. mindorensis</i> .  | Anthus rufulus Vieill.   |
| Centropus javanicus (Dumont).          | Munia jagori Martens.  |
| [One specimen killed.—D. C. W.]        | Oriolus chinensis Linn.  |
| Pitta atricapilla Less.                | Sarcops calvus (Linn.).  |
| [Abundant.—D. C. W.]                   | Lamprocorax panayensis (Scop.).  |
| Hirundo gutturalis Scop.               | Corone philippina Bp.  |
| Cyornis philippinensis Sharpe.         |  |

## SIBAY.

Sibay lies to the southward of Semerara, is low and nearly level, and has no trees except a fringe of small growth just above the beach. No birds of interest were seen on Sibay.

## LIST OF BIRDS NOTED ON SIBAY NOVEMBER 12, 1904.

- |  |                                     |
|--|-------------------------------------|
| Myristicivora bicolor (Scop.).         | Petrophila manila (Bodd.).          |
| Streptopelia dussumieri (Temm.).       | Cisticola exilis (Vig. and Horsf.). |
| Charadrius dominicus (P. L. S. Müll.). | Artamus leucorynchus (Linn.).       |
| Actitis hypoleucos (Linn.).            | Otomela lucionensis (Linn.).        |
| Circus melanoleucus (Forster).         | Cinnyris jugularis (Linn.).         |
| Butastur indicus (Gmel.).              | Motacilla melanope Pallas.          |
| Haleyon chloris (Bod.).                | Munia jagori Martens.               |
| Hirundo gutturalis Scop.               | Oriolus chinensis Linn.             |
| Lalage niger (Forster).                | Sarcops calvus (Linn.).             |
|  | Corone philippina Bp.               |





## II. NOTES ON THREE RARE LUZON BIRDS.

---

By RICHARD C. MCGREGOR.

---

### **Antigone sharpei** Blanf.

*Antigone sharpei* MCGREGOR, Bull. Philippine Mus., No. 4, p. 11 (Aparri and Candaba Swamp, Luzon).

Although this species has been recorded from Luzon, the record was based upon a mounted specimen and a bird in confinement. Therefore it is not superfluous to note that Mr. Worcester observed five individuals of the species in the Cagayan Valley, northern Luzon, in January, 1905.

### **Botaurus stellaris** (Linn.).

*Botaurus stellaris* SHARPE, Cat. Bds., XXVI, p. 253: Hand-list I, p. 204 (Temperate Palaearctic Region, N. W. India, Burma).

A specimen of the bittern has been added to the Laboratories collection through the kindness of Major Babbitt, who killed the bird at Laguna, on the Laguna de Bay, Luzon, March 12, 1905. The specimen was received in the flesh during my absence from Manila and the sex was not determined. I believe this species has not previously been recorded from the Philippines.

### **Zosterornis nigrocapitatus** (Steere).

*Mizornis nigrocapitatus* STEERE, List Bds. and Mams. Steere Exp., p. 17 (Samar, Leyte).

*Zosterornis nigrocapitatus* GRANT, Ibis, 1897, pp. 232 and 234; Sharpe, Hand-list, IV, p. 51.

A single male specimen of a *Zosterornis* from Bataan Province, Luzon, is provisionally referred to the above species, but there is little doubt that it will be found to represent a distinct one when compared with typical specimens. The specimen was collected December 3, 1904, in the forest on the Mariveles Mountains. This makes the fourth species of the genus known from Luzon, Grant having described three (*Z. striatus*, *Z. whiteheadi*, and *Z. dennistouni*) from the collections obtained by Whitehead in the northern part of the Island.



## LIST OF ILLUSTRATIONS.

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### PLATE I. Camp Balete.

- II. Mount Halcon from Camp Balete.
- III. Nest of *Phapitreron leucotis*.
- IV, V. *Phlogœnas luzonica* and *P. platenæ*.
- VI. Nest of *Phlogœnas platenæ*.
- VII. Abnormal bill of *Hypotœnidia torquata*.
- VIII. Nesting site of *Butorides javanica*.
- IX. Nest of *Pelargopsis gouldi*.
- X. *Ceyx cyanopectus*.
- XI. Nesting site of *Halcyon gularis*.
- XII. *Chætura gigantea* and *C. dubia*.
- XIII. Nest of *Hypothymis occipitalis*.
- XIV. Nest of *Artamides mindorensis*.
- XV. *Geocichla cinerea*.
- XVI. Nest and young of *Artamus leucorhynchus*.
- XVII. Nesting site of *Artamus leucorhynchus*.
- XVIII. Nest and young of *Artamus leucorhynchus*.



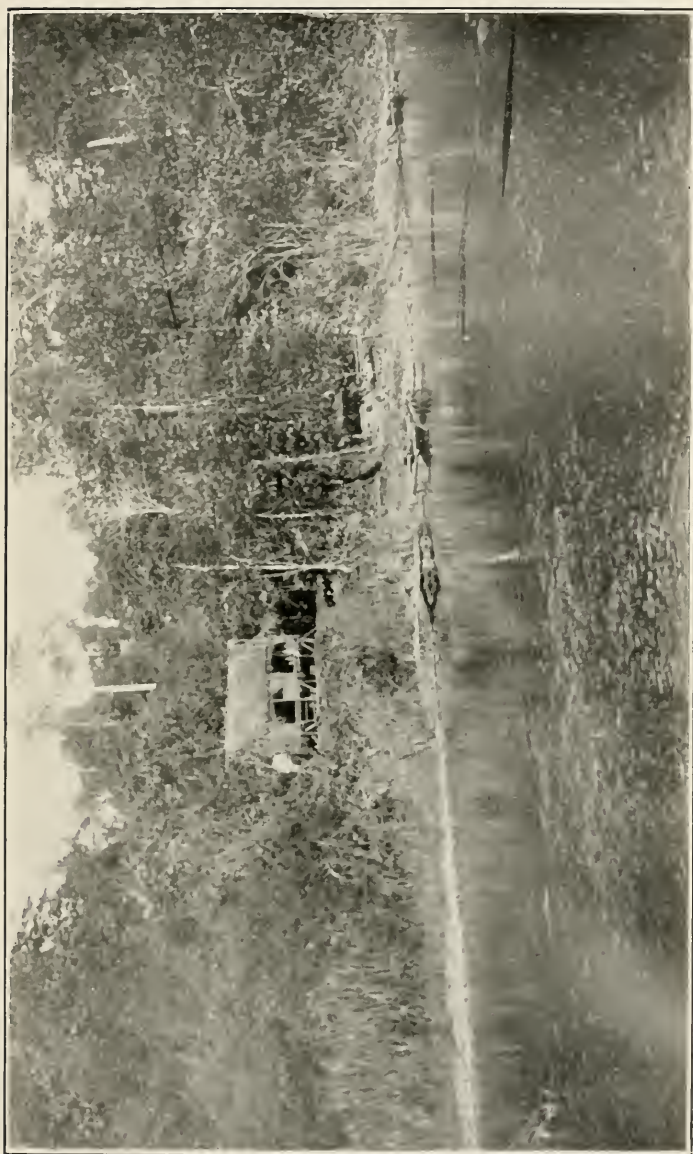


PLATE I. CAMP BALETE.







PLATE II. MOUNT HALCON FROM CAMP BALETE. (FROM PHOTOGRAPH TAKEN JUST AFTER SUNSET.)





PLATE III. TYPICAL NEST OF PHAPITRERON LEUCOTIS.

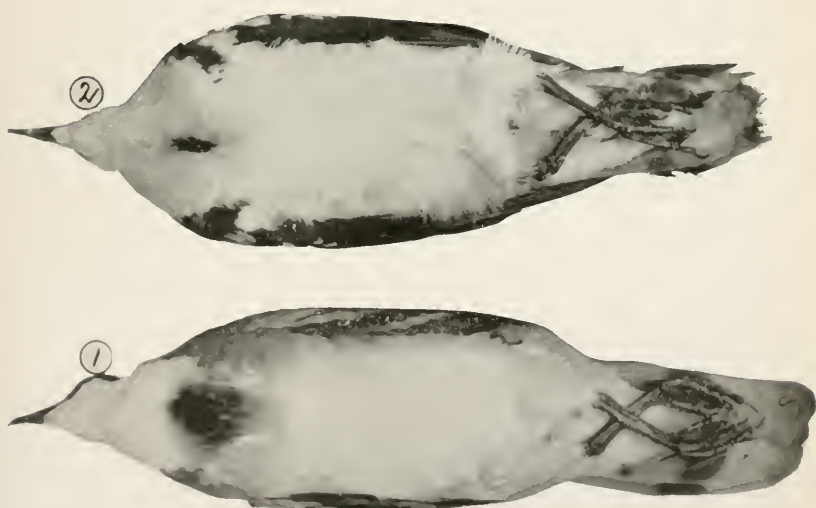


PLATE IV. (1) PHLOGŒNAS LUZONICA; (2) PHLOGŒNAS PLATENÆ.



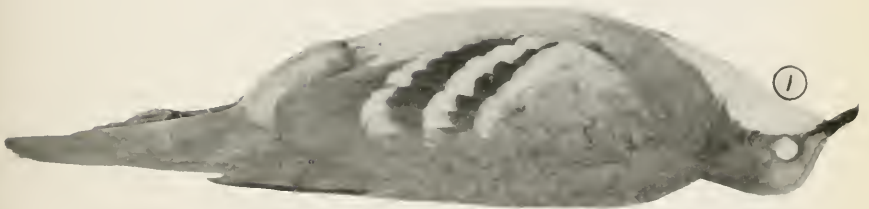
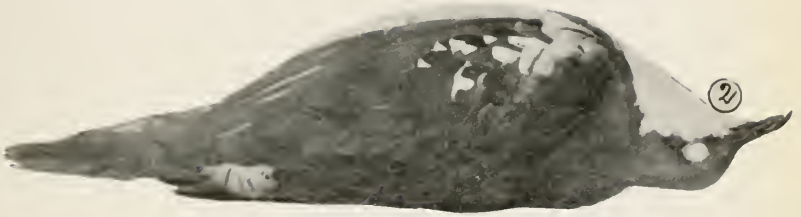


PLATE V. (1) PHLOGŒNAS LUZONICA; (2) PHLOGŒNAS PLATENÆ.







PLATE VI. NEST OF PHLOGENAS PLATENÆ.



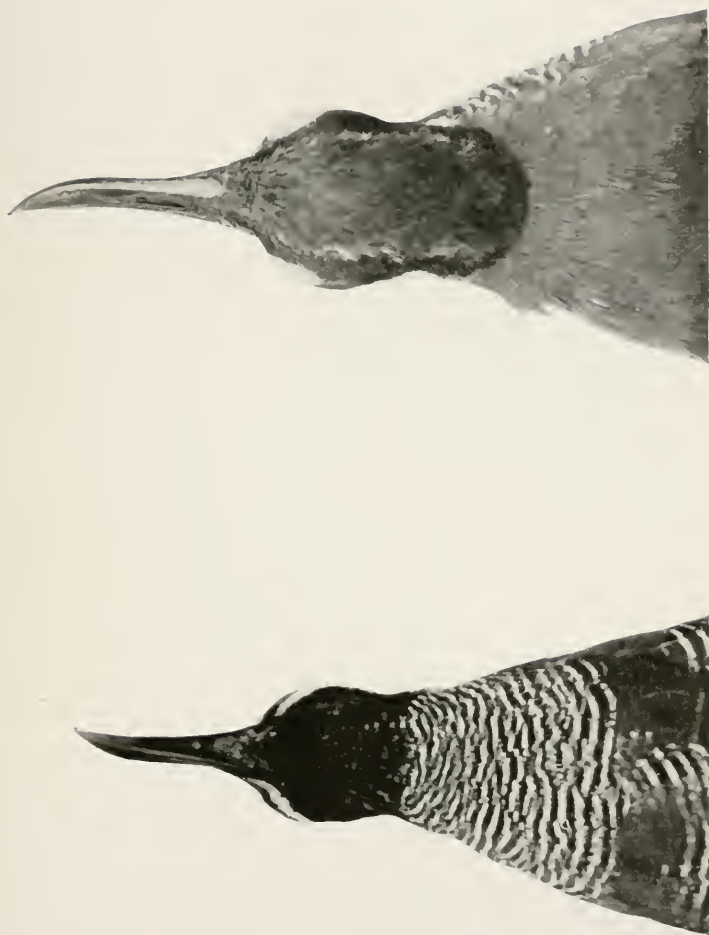


PLATE VII. ABNORMAL BILL OF *HYPOTAENIDIA TORQUATA*.





PLATE VIII. TYPICAL NESTING SITE OF BUTORIDES JAVANICA WITH BIRD ON THE NEST.







PLATE IX. NESTING SITE OF PELARGOPSIS GOULDI.



PLATE X. CEYX CYANOPECTUS, MALE AND FEMALE.





PLATE XI. NESTING SITE OF HALCYON GULARIS BETWEEN ROOTS OF A TREE, ENTRANCE JUST BELOW THE CROSS (X).





PLATE XII. (1) CHÆTURA GIGANTEA; (2) CHÆTURA DUBIA, NEW SPECIES; (3) CHÆTURA DUBIA, SIDE VIEW OF HEAD (ABOUT HALF ACTUAL SIZE).







PLATE XIII. NEST AND FEMALE OF *HYPOTHYMIS OCCIPITALIS*.





PLATE XIV. NEST OF *ARTAMIDES MIDORENSIS*. (1) TOP VIEW; (2) SIDE VIEW.



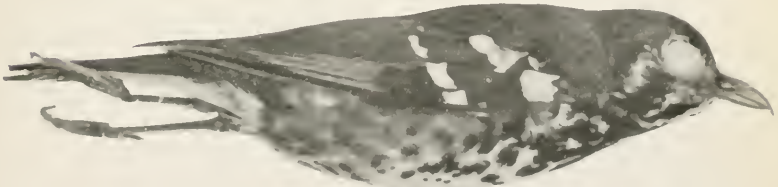
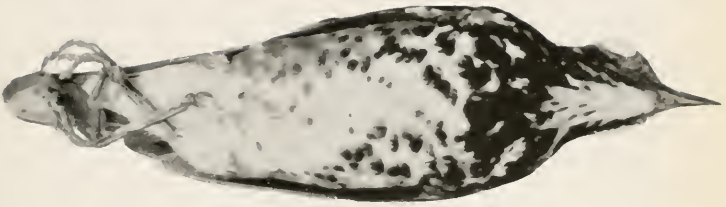


PLATE XV. *GEOCICHLA CINEREA*.







PLATE XVI. NEST OF ARTAMUS LEUCORYNCHUS ON END OF A STUB.





PLATE XVII. NESTING SITE OF *ARTAMUS LEUCORYNCHUS*. THE NEST WAS PLACED AMONG ROOTS JUST BELOW THE CROSS (X).  
TYPICAL GROWTH OF SAW GRASS (*TALAHIB*) IN BACKGROUND.





PLATE XVIII. NEST WITH YOUNG OF *ARTAMUS LEUCORYNCHUS* FROM THE SITE SHOWN ON PLATE XVII.



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(Continued on third page of cover.)

No. 35.—December, 1905.

DEPARTMENT OF THE INTERIOR  
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1905



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES.  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,  
*Manila, P. I., August 30, 1905.*

SIR: I have the honor to transmit herewith, for publication in a bulletin of the Bureau of Government Laboratories, the following: "I. New or Noteworthy Philippine Plants, IV;" and "II. Notes on Cuning's Philippine Plants in the Herbarium of the Bureau of Government Laboratories," by Elmer D. Merrill, botanist; "III. Notes on Philippine Gramineæ," by E. Hackel; "IV. Scitimineæ Philippinenses," by H. N. Ridley; "V. Philippine Acanthaceæ," by C. B. Clarke.

I am, very respectfully,

PAUL C. FREER,  
*Superintendent of Laboratories.*

Hon. DEAN C. WORCESTER,  
*Secretary of the Interior, Manila, P. I.*





## I. NEW OR NOTEWORTHY PHILIPPINE PLANTS, IV.

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By ELMER D. MERRILL, *Botanist.*

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### INTRODUCTION.

The present publication includes five papers, two by myself, the first a continuation of the series "New or Noteworthy Philippine Plants," the first three numbers having already been issued as previous publications of this Bureau, Nos. 7, 17, and 29; the second paper consists of notes on some of the more interesting plants of Cuming's Philippine collection, recently received from the British Museum; the remaining three have been submitted by the following botanists: Dr. E. Hackel, Graz, Austria, "Notes on Philippine Gramineæ"; H. N. Ridley, director of the Botanic Garden, Singapore, "Scitimineæ Philippinenses"; and C. B. Clarke, Kew, England, "Philippine Acanthaceæ." To these gentlemen I wish to extend my thanks for their kindness in examining the material sent to them and for preparing the accompanying papers.

---

### CYPERACEÆ.

**Carex rhynchachaenium** C. B. Clarke, sp. nova.

Hemiscaposa, imnovationum foliis culmum superantibus, 3 ad 4 mm. latis. Spicis pluribus, remotis, terminali masculi, 8 mm. longa, 1 mm. lata; utriculis 5 ad 6 mm. longis, striis longitudinalibus 15, pilosis; nucce ellipsoidea trigona, rostro erasse cylindrico; stylo vix ullo, ramis 3, oblongis brevissimis. *C. ligata* Boott., affinis.

Luzon, Province of Bataan, Mount Mariveles; altitude 1,100 m. (6983 Elmer) November, 1904.

### COMMELINACEÆ

**Forrestia philippinensis** sp. nov.

A nearly glabrous, suberect plant about 1 m. high, with caudate-acuminate leaves which are narrowed below to the elongated petiole, axillary, dense,

capitate inflorescence, the flowers purple, the capsule shorter than the sepals. Stems simple, about 1 cm. thick, glabrous, prostrate below and rooting at the nodes. Leaves including the petioles 30 to 36 cm. long, 7 to 10 cm. wide, membranous, glabrous except the somewhat villous margin above, the young leaves slightly pubescent beneath, the apex slender caudate acuminate, narrowed below into the 6 cm. long glabrous or puberulous winged petiole; sheaths lax, 4 to 5 cm. long, glabrous or nearly so, except the ciliate villous margin. Inflorescence 3 to 4 cm. in diameter, many flowered; bracts broadly ovate, acute 6 mm. long. Sepals subequal, 12 mm. long, 5 to 6 mm. wide when spread, firm, purple, keeled, cucullate, the keel at the apex forming a small crest, slightly strigose pubescent or nearly glabrous. Petals membranous, equaling the sepals. Stamens 6, all fertile, the filaments glabrous; anthers 1.8 mm. long. Capsule ellipsoid, membranous, 9 mm. long, 6 mm. thick, somewhat trigonous, very slightly pubescent with short scattered hairs or nearly glabrous. Seeds 3.5 to 4 mm. long, 2.5 to 3 mm. thick, rugose.

Type specimen: Baco River, Mindoro (4051 Merrill). March 15, 1905; also, from the same locality (323 McGregor), May 9, 1905. A rare plant in very humid forests, found once only by the author and once by Mr. McGregor. No. 654 Whitford, Atimonan. Tayabas Province, Luzon, is the same, growing along streams in forests.

The first species of the genus to be reported from the Philippines, apparently related to *Forrestia marginata* Hassk., and *F. hispida* Less., differing from the former in its larger, nearly glabrous leaves, much larger flowers, and the capsule shorter than the sepals, and from the latter in its caudate acuminate leaves and other characters. *Forrestia mollis* Hassk., differs especially from the species here proposed in its smaller leaves and flowers, the leaves being villous beneath.

## JUGLANDACEÆ.

### *Englehardtia subsimplicifolia* sp. nov.

A small tree 8 or 9 m. high, with simple, or at most 1-jugate leaves, the leaflets entire, glandular on both surfaces. Branches gray or brown, glabrous, the young parts densely lepidote-glandular. Leaves alternate, the rhachis lepidote glandular, 1.5 cm. long; leaflet solitary or a single terminal pair, subcoriaceous, oblong-ovate, acute, subacuminate or obtuse, the base narrowed, inequilateral, the upper surface dark, the lower surface pale, not at all pubescent, the glands numerous above, very numerous beneath; nerves 14 to 18 pairs, prominent beneath, the reticulations obscure; petiolules 1 to 2 mm. long. Male inflorescence axillary, simple or slightly branched, subpendulous, 1 to 1.5 cm. long, the rhachis and bracts glandular-lepidote; anthers ovoid, about 1 mm. long. Female flowers not known, the racemes in fruit, including the peduncle, 8 to 12 cm. long, erect, the rhachis glandular-lepidote, hirsute with scattered hairs, the bract 3-lobed, sparingly glandular-lepidote, the middle lobe 1.5 cm. long, 4 mm. wide, oblong-spatulate, acute or obtuse, the lateral lobes less than 1 cm. long.

Type specimens from Mount Mariveles, Province of Bataan, Luzon (3942 (male flowers) and 3951 (fruit) Merrill), March, 1905.

A small or medium sized tree growing in the forests and on exposed ridges from 700 to 1000 m. above the sea, readily distinguished from all described species of the genus by its simple or 1-jugate leaves.

## MAGNOLIACEÆ.

### TALAUMA.

- |  |                           |
|--|---------------------------|
| 1. Flowers 9 to 10 cm. long; pistils pubescent.....  | (1) <i>T. grandiflora</i> |
| 1. Flowers 8 cm. long or less; pistils glabrous or nearly so.                                      |                           |
| 2. Flowers 5 cm. long, broad, not contracted below, the leaves broad, usually acute.....           | (2) <i>T. angatensis</i>  |
| 2. Flowers 6 to 8 cm. long, elongated, contracted below, the leaves usually narrow, acuminate..... | (3) <i>T. villariana</i>  |
| 1. Flowers unknown.  |                           |
| 2. Fruit 15 to 18 cm. long; leaves 25 to 45 cm. long, the petioles 4 to 5 cm.....                  | (4) <i>T. oblongata</i>   |
| 2. Fruit 10 cm. long; leaves 17 to 35 cm. long, the petioles 3 cm.....                             | (5) <i>T. luzonensis</i>  |

(1) *Talauma grandiflora* Merrill, Govt. Lab. Publ. 29:13. 1905.  
Guimaras Island, (314 Gammill) February, 1904.

(2) *Talauma angatensis* (Blanco) Vidal. Cat. Pl. Prov. Manila, 17, November, 1880; Synopsis, Atlas, t. 3. 1883; Rev. Pl. Vase. Filip. 38. 1886; F-Vill. Nov. App. 3, December, 1880, excl. syn. Hook. f. et Th. *Magnolia angatensis* Blanco, Fl. Filip. ed. 1, 859. 1837; ed. 2, 328. 1845; ed. 3, 2:243.

This species, at least as interpreted by Vidal, is represented by a specimen from Bosoboso, Province of Rizal, Luzon (2880 Ahern's collector), March, 1905, the specimens referred to this species by Vidal (Nos. 912, 1099 Vidal) being from the same province and the latter from the same locality. No. 2880 is identical with the plant figured by Vidal, and, like Vidal's figure, differs from *Magnolia angatensis* as described by Blanco, in having but 6 petals instead of 9. Until other material is collected agreeing more closely with Blanco's description, it is believed that this form should be considered to represent his species. The form here referred to *Talauma angatensis* is doubtless the same as the one credited to the Philippines by F-Villar as *Talauma gigantifolia* Miq.

(3) *Talauma villariana* Rolfe, Journ. Linn. Soc. Bot. 21:307. 1884; Vidal, Rev. Pl. Vase. Filip. 38. 1886; *Talauma mutabilis* F-Vill. Nov. App. 3. 1880; Naves, in Blanco Fl. Filip. ed. 3, pl. 178; Vidal, Cat. Pl. Prov. Manila, 15. 1880, non Blume.

A small tree with lanceolate to broadly oblanceolate acuminate leaves 18 to 30 cm. long, 3 to 9 cm. wide, glabrous and shining, except for the usually pubescent midrib beneath. Flowers white, elongated, contracted below, 6 to 8 cm. long, very fragrant. Sepals 3. Petals 6, in two series. Pistils glabrous. Fruit 4 to 6 cm. long, the carpels few, glabrous, maculate.

Specimens examined: Luzon, Province of Bataan, Lanna River (668, 1746

Borden), April, August, 1904, the former in flower, the latter in fruit, from the same tree; (2506 Meyer) January, 1905 (flower); Dinalupihan (2512 Merrill), January, 1903 (flower): Antipolo (50 Merrill), Decades Philippine Forest Flora, a specimen with immature flowers, 5 cm. long, considerably smaller than those of the other specimens cited above.

This species is exceedingly variable in its vegetative characters, leaves from the same tree being from 3 to 9 cm. in width, without proportional variation in length. It was based in the plate cited above, and Nos. 942 and 1099 Vidal. The specimens under discussion agree well with the plate, except that the flowers are somewhat larger than they are represented to be in the figure, and are doubtless identical with the ones cited by Rolfe.

(4) ***Talauma oblongata*, sp. nov.**

A tree with subcoriaceous, oblong-lanceolate, acute leaves, 25 to 45 cm. long and oblong, many carpelled fruit 15 to 18 cm. long. Branches thickened, annular, nearly glabrous. Leaves glabrous and shining above, when young, dull and sparingly pubescent beneath, becoming glabrous and shining with age, 25 to 45 cm. long, 6 to 11 cm. wide, the apex acute, the base acute or slightly decurrent-acuminate; nerves about 20 on each side of the midrib, the reticulations prominent on both surfaces; petioles stout, 4 to 5 cm. long, glabrous, thickened at the base, somewhat flattened above. Flowers unknown. Peduncle terminal, stout, appressed pubescent, annular, 4 to 5 cm. long. Fruit about 7 cm. thick, glabrous, the axis about 2 cm. thick, deeply pitted. Carpels numerous, the exposed portions glabrous, shining, somewhat roughened-maculate, grayish brown, 3 cm. long, somewhat acuminate at the apex. Seed dark brown, irregularly compressed, about 1 cm. in diameter.

Type specimen: Baler, Province of Principe, Luzon (1003 Merrill), August, 1902.

(5) ***Talauma luzonensis* Warb. in Perk. Frag. Fl. Philip. 171. 1905.**

The type of this species is No. 11767 Warburg, Malaueg, Province of Cagayan, Luzon. *T. grandiflora* Merrill may not be distinct.

F.-Villar<sup>1</sup> credits to the Philippines five species of *Talauma*, *T. mutabilis* Blume, *T. angatensis* (Blanco) Vidal, *T. pumila* Blume, *T. rumphii* Blume, and *T. gigantifolia* Miq. Of these five species two were certainly correctly identified, *T. angatensis* Vidal, considered above, and *T. pumila* Blume = *Magnolia pumila* Andr., the latter a species introduced from southern China, and occasionally cultivated for ornamental purposes. *Talauma mutabilis* F.-Vill., non Miquel, is *Talauma villariana* Rolfe. The remaining two species must for the present, at least, be excluded, and we can only surmise what species F.-Villar had in mind, as his botanical material no longer exists. It is probable that the species credited to the Philippines as *Talauma rumphii* is *Magnolia pumila* Andr., and the one enumerated as *Talauma gigantifolia* Miq., is either *Talauma angatensis* Vidal or *T. oblongata* Merrill.

<sup>1</sup> Nov. App. 3. 1880.

## ANONACEÆ.

**Alphonsea philippinensis** sp. nov.

A small or medium sized tree with lanceolate, glabrous leaves, axillary short peduncled, fasciculate inflorescence, globose flower buds, the small flowers with numerous stamens and a solitary pubescent 10 to 12 ovuled ovary. Branches nearly black, striate, glabrous, when young slightly ferruginous pubescent. Leaves 8 to 14 cm. long, 2 to 3 cm. wide, gradually narrowed upward to the obscurely acuminate apex, the base rather abruptly acute, subcoriaceous, shining, the midrib beneath with few hairs, becoming entirely glabrous; nerves very obscure, scarcely more prominent than the reticulations, 12 to 15 on each side of the midrib; petioles deeply channeled above, slightly pubescent, about 8 mm. long. Inflorescence densely fulvous pubescent throughout, of axillary, short peduncled, 3 to 5 flowered fascicles, the pedicels about 1 cm. long. Calyx pubescent, the lobes acute. Petals 6, in two series, pubescent, all valvate, the outer ones ovate, acute, 5 mm. long, the inner ones obovate, somewhat smaller than the outer. Stamens about 30, 2 mm. long, the filaments glabrous, 1 mm. long; anther cells large, contiguous, the connective apiculate, scarcely exceeding the anther cells and not at all concealing them. Ovary solitary, oblong-ovoid, pubescent, the ovules 10 or 12, in two rows, parietal; stigma subglobose, sessile.

Type specimen: Island of Masbate (3075 Merrill), August, 1903. A species apparently related to *Alphonsea lutea* Hook. f. et. Th., from Malacca. No species of this genus has previously been reported from the Philippines.

**Goniothalamus obtusifolius** sp. nov.

A medium-sized tree with subcoriaceous, glabrous, oblong-obovate, obtuse leaves and large, axillary, solitary flowers. Branches grayish brown, glabrous, striate. Leaves 15 to 18 cm. long, 6 to 8 cm. wide, shining, the apex broad, rounded-truncate, sometimes retuse, narrowed below to the cuneate base; primary nerves not prominent, about 13 pairs, scarcely more pronounced than the secondary nerves; petioles stout, rugose, glabrous. Flowers yellow, fragrant, about 5 cm. long, the pedicel 1 cm. long or less. Sepals suborbicular-ovate, acute or rounded, glabrous or nearly so, about 1 cm. long. Outer petals broadly ovate, acute, 5 cm. long, 3.5 cm. wide, membranous, glabrous, the base broad, rounded-truncate; inner petals oblong ovate, acute, 9 mm. long, arched, but not vaulted, connivent, more or less pubescent outside, densely hirsute-pubescent on the margins inside, the claw broad, short. Stamens many, 1.8 mm. long, the anther cells concealed by the overlapping truncate connectives. Ovaries glabrous, 2 mm. long, 1-ovuled; styles simple, elongated, 2.5 mm. long.

Type specimen: Bongabon, Mindoro (2183 Merrill), May, 1903. A medium-sized tree in the lower hill forests, reaching a diameter of about 45 cm. with rather smooth bark and white wood, known locally as *Amuyon*, but quite different from the species described by Blanco (*Uraria amuyon* = *Unona cantiflora* Blanco = *Goniothalamus* sp.?) to which he applies this name.



**Goniothalamus trunciflorus** sp. nov.

A tree with oblong, short acuminate, glabrous leaves, and large flowers, solitary (or fascicled?) on the trunk, the outer petals ovate-lanceolate, 6.5 to 9 cm. long. Branches dark brown, the ultimate branchlets light colored, glabrous. Leaves subcoriaceous, shining on both surfaces, the apex short acuminate, the base acute, the margins recurved, 18 to 25 cm. long, 7 to 8 cm. wide; nerves distant, distinct beneath, 8 to 10 on each side of the midrib, very laxly anastomosing, the reticulations lax; petioles 1 to 1.5 cm. long, glabrous. Flowers red, the peduncles 3 cm. long, glabrous. Sepals subreniform to broadly ovate, acute, 1 cm. wide, slightly pubescent. Outer petals membranous, 9 cm. long or less, 2 to 3 cm. wide, tapering above to the long slender acuminate apex, both surfaces sparingly pubescent with short hairs; inner petals coriaceous, broadly ovate, acuminate, 2 cm. long and 1.5 cm. wide or smaller, arched, the margins cohering, the claw very short, broad, densely cinereous pubescent outside and also on the upper portion within. Stamens many, 2.5 mm. long, the anther cells obscured by the overlapping, rounded-truncate connectives. Ovaries many, pubescent, 2.5 mm. long, 1-ovuled; styles elongated 2-cleft at the apex. Fruit unknown.

Type specimen: Tinuan River, Province of Tayabas (Infanta), Luzon (774 Whitford), September 6, 1904. A tree growing in the hill forests at an altitude of about 120 m. above the sea, at once distinguished by its cauline inflorescence, the large flowers being borne near the base of the trunk. The only other described Philippine species that approaches this is *Uvaria amuyon* Blanco = *Unona cauliflora* Blanco. The latter species was referred by F. Villar to *Melodorum fulgens* Hook. f. et Th., to which Blanco's description does not all apply. Blanco's species is apparently represented by No. 775 Whitford, from the same locality as the above, but as the specimens are in fruit it is quite impossible to definitely determine just what *Unona cauliflora* Blanco may be. However, Blanco's description does not at all apply to the species here proposed.

**Mitrephora reflexa**, sp. nov.

A medium-sized tree with elliptical-ovate, nearly glabrous leaves 17 cm. long or less, and rather large leaf-opposed hermaphrodite flowers, the outer petals reflexed in anthesis, the inner very different from the outer, connivent, vaulted. Branches dark brown, glabrous, the ultimate branchlets slender, light gray, more or less ferruginous pubescent, the terminal buds densely so. Leaves 8 to 17 cm. long, 5 to 8 cm. wide, the apex acuminate, the base acute to somewhat rounded, glabrous and shining above, slightly ferruginous pubescent on the nerves and midrib beneath; nerves prominent beneath, about 12 pairs; petioles thickened, rugose, slightly pubescent, 1 cm. long. Flowers yellow, about 5 cm. in diameter when spread, on a short leaf-opposed axis, only one flower developing at a time, the peduncle stout, densely ferruginous-pubescent, about 6 mm. long. Sepals orbicular-ovate, about 6 mm. long, densely ferruginous pubescent. Outer petals broadly ovate, 2.5 cm. long, 1 cm. wide, subcoriaceous, acute, glabrous within, densely cinereous-ferruginous pubescent outside. Inner petals 1.5 cm.

long, vaulted, glabrous except the densely hirsute inner surface of the lamina, the limb 7 mm. long, 5 mm. wide above, gradually narrowed below, the lamina subrhomboidal, about 1 cm. wide. Stamens many, 1.5 mm. long, the anther cells concealed by the overlapping, truncate connectives. Ovaries many, as long as the stamens, more or less hirsute, 4-ovuled.

Type specimen: Bosoboso, Province of Rizal, Luzon (2882 Ahern's collector), March, 1905.

***Orophea maculata*, sp. nov.**

A small tree about 10 m. high, with broadly lanceolate, acuminate leaves and solitary, axillary flowers 1.5 to 2 cm. in diameter. Branches brownish gray, striate, the young parts densely pubescent. Leaves 14 to 18 cm. long, 3.5 to 5.5 cm. wide, membranous, with numerous minute translucent glands, the base acute, the apex slender acuminate, the acumen blunt, upper surface glabrous except the somewhat pubescent midrib the under surface minutely glandular punctate, glabrous except for the pubescent midrib and slightly pubescent nerves; nerves about 15 on each side of the midrib, rather prominent beneath; petioles pubescent, thickened, 5 to 8 mm. long. Flowers fragrant, creamy yellow, the pedicel 1 to 1.5 cm. long, densely pubescent. Sepals broadly ovate, obtuse or slightly acute, 2 mm. long, cinereous pubescent. Outer petals elliptical ovate, obtuse, 5.5 mm. long, 4.5 mm. wide, densely pubescent outside, the base narrowed to a broad short claw; inner petals vaulted, the margins cohering slightly above, 1.5 mm. long, pubescent outside, the claw slender, 6 mm. long, the blade rhomboidal, 1 cm. wide, the apex acute, the lateral angles obtuse, the inner surface of the vaulted petals with purple spots. Ovaries about 15, densely pubescent, 2 mm. long, each 4-ovuled, the disc pubescent. Staminate flowers not seen.

Type specimen: Lamao River, Province of Bataan, Luzon (2389 Borden), January, 1905; also No. 2418 Meyer same locality and date. Here should also be referred No. 745 Ahern Mariveles, Province of Bataan, Luzon, reported by the author<sup>1</sup> as *Mitrephora reticulata*.

A small tree reaching a diameter of from 12 to 18 cm. growing on forested slopes at an altitude of about 550 m. above the sea.

***Phaeanthus acuminatus*, sp. nov.**

A shrub 6 m. high or less, with hirsute-pilose branchlets, membranous leaves, and solitary flowers 1 to 1.5 cm. long, the outer petals about twice as large as the sepals. Branches dark colored, striate, nearly glabrous, the younger branchlets rather densely pilose-hirsute with spreading fulvous hairs. Leaves elliptical-lanceolate, sharply acuminate, 12 to 20 cm. long, 4 to 6 cm. wide, the base somewhat rounded, the upper surface shining, glabrous except for the pilose midrib, the lower surface with scattered hairs and hirsute-pilose on the midrib and nerves; primary nerves about 10 on each side of the midrib, prominent beneath, interarching, the reticulations lax; petioles hirsute-pilose, about 2 mm. long. Inflorescence mostly leaf

<sup>1</sup> Forestry Bureau, Bul. 1:20, 1903.



opposed, one, rarely two pedicels from the same tubercle or minute branchlet, the pedicels slender, 2.5 to 3 cm. long, pubescent. Flowers salmon pink, odorless or nearly so. Calyx lobes sparingly pubescent, 3 to 3.5 mm. long, ovate, strongly acuminate. Petals sparingly pubescent, the outer ones similar in shape to the sepals but twice as large, the inner ones oblong, acute, 10 to 14 mm. long, about 4 mm. wide. Stamens many, about 1.5 mm. long, glabrous, the broad truncate connectives concealing the anther cells. Ovaries about 1.5 mm long, pubescent, about 5, each with 2 ovules; stigmas ovoid, pubescent. Ripe carpels subglobose, bright red, sparingly pubescent, 2-seeded, 1 cm. or less in diameter.

Type specimen: Baco River, Mindoro (4050 Merrill), March 14, 1905. A small shrub common in the humid river forests, apparently most closely related to *Phaeanthus malabaricus* Bedd.

***Polyalthia flava*, sp. nov. § Monoon.**

A small tree, about 12 m. high, with nearly glabrous, coriaceous oblong, acuminate leaves, and solitary axillary flowers about 5 cm. in diameter. Branches striate, dark gray, the branchlets densely ferruginous pubescent. Leaves 7 to 12 cm. long, 3 to 4.5 cm. wide, glabrous and shining above, beneath with very few scattered hairs on the lamina, the midrib sparingly pubescent, the apex rather sharp acuminate, the base rounded or subacute, somewhat inequilateral; nerves numerous, the primary ones scarcely more prominent than the secondary and reticulations; petioles ferruginous pubescent, 5 mm. long. Flowers solitary, bright yellow, odorless, the peduncles about 2 cm. long, ferruginous pubescent, with 2 or 3 small bracts near the base. Calyx lobes broadly ovate, ferruginous pubescent, acute, 4 mm. long. Petals, 6, in two series, subequal, elliptical ovate to elliptical obovate, obtuse, 2.5 cm. long, 1.5 to 1.8 cm. wide, glabrous except for the pubescent base and few scattered hairs on the outside. Stamens many, 1.8 mm. long or less, the connectives truncate. Ovaries many, pubescent, 1.3 mm. long, with a solitary basal ovule.

Type specimen: Bosoboso, Province of Rizal, Luzon (2135 Ahern's collector). December, 1904; also Lamao River, Province of Bataan, Luzon (3052 Borden), October, 1904. A small tree in the hill forests at 200 m. above the sea.

***Sageraea glabra*, sp. nov.**

A small tree about 15 m. high, with subcoriaceous, glabrous, elliptical oblong, acuminate leaves, and small hermaphrodite flowers in axillary fascicles. Branches black and grayish, glabrous, striate. Leaves 11 to 15 cm. long, 4 to 5 cm. wide, short acuminate, the base acute, shining on both surfaces, the margins slightly revolute; nerves obscure, about 8 on each side of the midrib, loosely anastomosing; petioles stout, rugose, channeled above, 5 to 6 mm. long. Fascicles axillary, rarely extra-axillary, about 3-flowered, the pedicels 1 cm. long or less, each with 3 or 4 small distichous bracts at the base. Flowers white, nearly odorless, about 1 cm. in diameter. Calyx lobes orbicular-ovate, subacute, 2 mm. long, the margins somewhat ciliate, otherwise glabrous. Petals glabrous, except the

slightly ciliate margins, the outer three broadly ovate, obtuse, 6 to 7 mm. long, rather strongly imbricate in bud, the inner three slightly imbricate, similar to the outer ones but somewhat smaller. Stamens 2.5 mm. long, glabrous, the anther cells not entirely obscured by the truncate connectives. Ovaries 3, oblong, glabrous, 2 mm. long, the ovules about 8, parietal in two rows.

Type specimen: Laguinanoc, Province of Tayabas, Luzon (4021 Merrill), March 12, 1905. A small tree rather common in the open hill forests, the first species of the genus to be found in the Philippines.

**Unona clusiflora**, sp. nov. § *Dasymaschalon*.

A shrub or small tree, with oblong-elliptical, acute or short acuminate glabrous, glaucous leaves, and axillary 3-petaled flowers 3 to 6 cm. long. Branches dark reddish brown, glabrous. Leaves 11 to 15 cm. long, 3.5 to 5 cm. wide, submembranous, pale when dry, the base acute; nerves about 12 on each side of the midrib, not prominent; petioles glabrous, channeled above, nearly 1 cm. long. Flowers solitary, yellowish green. Sepals subreniform, rounded, 2 mm. long, 4 mm. wide, sparingly cinereous pubescent. Petals 3, ovate-lanceolate, 5 to 6 cm. long, about 2 cm. wide, concave at the base, but not at all narrowed below, tapering to the blunt apex, rather densely cinereous pubescent outside, glabrous inside, their margins cohering throughout. Stamens many, glabrous, 3 to 4 mm. long, the connectives subglobose, concealing the linear anther cells. Ovaries indefinite, densely fulvous-hirsute, linear-oblong, 1.5 mm. long, 2 to 3 ovuled; styles glabrous, rather slender, about 1 mm. long.

Type specimen: Lamao River, Province of Bataan, Luzon (2521 Merrill), June, 1903. A small tree growing in the open forests at an altitude of about 100 m. above the sea. Related to *Unona dasymaschala* Blume, but entirely glabrous, except the flowers, also differing from that species in its smaller flowers, longer styles, fewer ovules, and other characters.

## MONEMIACEÆ.

**Kibara depauperata**, sp. nov.

A subscandent shrub 2 to 3 m. high, with glabrous, elliptical ovate, acute, broadly obscurely acuminate or subobtuse leaves, 5 to 8 cm. long, cymose, axillary, pubescent inflorescence 2 to 3 cm. long, and oblong ellipsoid, glabrous, fruits 1.8 cm. long. Branches light gray, glabrous, the branchlets yellowish green, glabrous, or the very young branchlets pubescent. Leaves subcoriaceous, opposite, 5 to 8 cm. long, 2 to 4.5 cm. wide, the base acute, the margins entire; nerves 5 to 6 on each side of the midrib, irregular, anastomosing, the reticulations lax; petioles about 5 mm. long, glabrous, or pubescent when young. Cymes usually solitary, with few branches, few flowered, the peduncles, branches, pedicels, and receptacles uniformly but not densely cinereous strigose pubescent, the peduncles and branches 1 cm. long, the pedicels 6 to 10 mm. long. Receptacles coriaceous, ovoid or obovoid, 4 mm. long, becoming nearly glabrous. Tepals 6, small, less than 1 mm. long, acute, or somewhat obtuse. Carpels 14, pubescent, 1 to 1.5 mm. long. Fruits 1.8 cm. long, 1 cm. thick, glabrous, 6 to 8 sessile

on the much thickened, irregular, glabrous, yellow receptacle. Male flowers not known.

Type specimen: Baguio, Province of Benguet, Luzon (5959 Elmer), March, 1904. Not common in thickets on limestone outcroppings. A species manifestly related to *Kibara coriacea* (Blume) Tul., but differing in its small, fewer nerved leaves and other characters. No. 6151 Elmer, with fruits only, collected at Sablan, Province of Benguet, April, 1904, is an apparently closely related species, if not identical.

***Matthaea chartacea*, sp. nov.**

A shrub 3 to 4 m. high, with oblong ovate to lanceolate ovate, acuminate, glabrous, chartaceous leaves 15 to 25 cm. long, and axillary 3-flowered cymes about 1.5 cm. long, the receptacle fleshy, turbinate, truncate, nearly glabrous, gradually narrowed below into the pedicel, the receptacle and pedicel 1 cm. long. Branches light gray, glabrous, the terminal bud pubescent. Leaves opposite, 15 to 25 cm. long, 5 to 10 cm. wide, the base acute, the apex rather slender acuminate, the margins with distant, small teeth, or subentire, dark above, pale brown and shining beneath when dry; nerves about 14 on each side of the midrib, obscure above, somewhat prominent beneath, irregular, anastomosing and forming a marginal nerve, the reticulations lax; petioles 1.5 to 2 cm. long, glabrous. Inflorescence solitary or two or three peduncles from the same axil, the peduncles 5 to 7 mm. long, strigose pubescent, the bracts and bracteoles about 1 mm. long, pubescent, each peduncle with three flowers at the apex, the pedicels strigose pubescent, gradually merging into the nearly glabrous receptacle. Receptacles yellow, fleshy, 5 to 6 mm. long, turbinate, the apex truncate, somewhat depressed, about 5 mm. in diameter, glabrous or with very few scattered hairs. Tepals 4, small, obscure, obtuse. Stamens 4, free, the filaments very short, broad; anthers broadly ovoid, 1 mm. long, the cells subparallel, not confluent at the apex, the connective not at all produced. Female flowers and fruits not known.

Type specimen: Baco River, Mindoro (167 McGregor), April, 1905. A species growing in humid forests, apparently closely related to *Matthaea coriacea* Perk., ex description, differing from that species in its chartaceous, somewhat toothed leaves, longer peduncles and differently shaped receptacles. *Matthaea sancta* Blume, has been reported from the Philippines by Ceron<sup>1</sup> (3574 Vidal), Luzon, but no species of the entire family is credited to the Philippines in the recent monograph by Perkins and Gilg.<sup>2</sup>

## LAURACEÆ.

***Endiandra coriacea*, sp. nov.**

A large tree with coriaceous, glabrous, shining, alternate leaves 10 to 18 cm. long, axillary panicles shorter than the leaves and glabrous elliptical or elliptical-oblong fruits 2 to 2.5 cm. long. Branches brown, lenticellate, glabrous, the branchlets sparingly fulvous pubescent, becoming glabrous or nearly so. Leaves ovate, ovate-lanceolate or oblong-ovate, usually pale

<sup>1</sup> Cat. Pl. Herb., 141. 1891.

<sup>2</sup> Engler's Pflanzenreich 4. 1901.

brown when dry, 10 to 18 cm. long, 5 to 7.5 cm. wide, the base usually acute, somewhat decurrent, the apex blunt acuminate, both surfaces glabrous, shining, foveolate; nerves 5 to 7 on each side of the midrib, subprominent, irregular, curved upward, the primary reticulations lax, the ultimate reticulations relatively prominent, dense; petioles rugose, glabrous or nearly so, 1.5 to 2 cm. long, flattened or channeled above. Panicles 5 to 7 cm. long, more or less fulvous pubescent, the ultimate branches rather densely so, the longest branches not exceeding 2.5 cm. Flowers creamy white, fragrant, about 7 mm. in diameter, the tube short, campanulate, fulvous pubescent inside and out. Perianth segments 6, in two series, coriaceous, sparingly fulvous pubescent outside, glabrous inside except at the base which is very densely fulvous pubescent, oblong or elliptical-oblong obtuse, the outer three 3 to 3.5 mm. long, 2.5 mm. wide, the inner three 2.5 to 3 mm. long, 1.5 to 2 mm. wide. Stamens 3, very thick, densely fulvous pubescent throughout, oblong-ovate, acute, erect, the margins approximate but free. Ovary free, globose, glabrous, the style very short. Fruit nearly black when dry, 2 to 2.5 cm. long, 1 to 1.5 cm. thick.

Specimens examined, all from Lamao River, Province of Bataan, Luzon: (3066 Borden) May, 1905 (flower); (126, 190 Barnes) January, 1904 (fruit); (3780 Merrill) January, 1904 (fruit). Apparently also No. 2200 Merrill, Subic, Province of Zambales, Luzon, May, 1903, is referable here, a specimen with immature flowers. A tree reaching a height of 25 m. growing in the lower hill forests at an altitude of about 100 m. This genus has not previously been reported from the Philippines.

## CAPPARIDACEÆ.

### *Capparis oblongata*, sp. nov.

A scandent shrub reaching a height of 20 m. and a diameter of 4 cm., with oblong, membranous, glabrous, shortly abruptly acuminate leaves 10 cm. long or less, and large white flowers in axillary racemes towards the ends of the branches, the whole inflorescence forming a terminal panicle, the leaves falling above. Branches glabrous, the thorns recurved, usually pubescent. Leaves bright green, 7 to 10 cm. long, 2.5 to 3.5 cm. wide, the base abruptly rounded-subcordate; nerves 9 or 10 on each side of the midrib, anastomosing, not prominent; petioles 1 cm. long or less, rusty pubescent. Panicles 20 to 25 cm. long, the lower racemes about 5 cm. long, glabrous or sparingly pubescent, spreading, 4 to 8 flowered, the flowers long pedicelled, the pedicels slender, glabrous, 2.5 to 3 cm. long. Flowers white, fragrant, including the stamens about 3 cm. long. Sepals four, 2-seriate, obovate, about 1 cm. long, membranous, the margins ciliate. Petals 4, about equaling the sepals, their margins strongly ciliate. Stamens indefinite, the filaments slender; anthers 2 mm. long. Gynophore 2.5 to 3 cm. long, slender, glabrous. Ovary elliptical-ovoid, glabrous, 1-celled, the ovules arranged on four parietal placentæ.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (2632 Meyer), February, 1905. A scandent shrub in the hill forests at an altitude of about 500 m., not common.

## PITTOSPORACEÆ.

## PITTOSPORUM.

1. Leaves lanceolate or oblong lanceolate; fruit 8 mm. long or less..... (1) *P. pentandrum*  
 1. Leaves oblanceolate to obovate; fruit 1 to 3 cm. long.  
     2. Inflorescence terminal..... (2) *P. odoratum*  
     2. Inflorescence from the branches below the leaves;  
        fruit very resinous.  
        3. Fruit oblong..... (3) *P. resiniferum*  
        3. Fruit orbicular..... (4) *P. resiniferum orbiculatum*

- (1) **Pittosporum pentandrum** (Blanco) Merrill, Govt. Lab. Publ. 27:19. 1905. *Aquilaria pentandra* Blanco, Fl. Filip. ed. 1. 373. 1837; *Limonia laureola* Blanco, l. c., ed. 2, 251. 1845; ed. 3, 2:101; Naves, l. c., ed. 3, pl. 128. *Pittosporum brachysepalum* Turcz. Bull. Soc. Nat. Mosc. 27:366. 1854; Rolfe, Journ. Bot. 23:210. 1885; Vidal, Phan. Cuming. Philip. 95. 1885; Rev. Pl. Vasc. Filip. 50. 1886; Ceron, Cat. Pl. Herb. 18. 1892. *Pittosporum fernandezii* Vidal, Cat. Pl. Prov. Manila, 17. 1880; Sinopsis, Atlas, t. 8. f. A. 1883; Rev. Pl. Vasc. Filip. 50. 1886; F-Vill. Nov. App. 13. 1880; Ceron, Cat. Pl. Herb. 18. 1892. *Pittosporum floribundum* F-Vill. Nov. App. 13. 1880, non W. et A.

Specimens examined: Philippines (1050, 1427 Cuming), 1836-40. Luzon, Province of Bataan, Lamao River (3177 Merrill), October, 1903; (1937, Borden), (2228 Meyer), December, 1904; Dinalupihan (1483 Merrill), January, 1903. Province of Zambales, Botolan (2951 Merrill), May, 1903. Province of Rizal, Bosoboso (1159 Ahern's collector), June, 1904; (2804 Merrill), July, 1903; Antipolo (1308 Merrill), February, 1903. Province of Benguet (6052 Elmer), March 1904. Culion Island (500 Merrill), December, 1902. Guimaras Island (219, 291 Gammill), January, 1904.

This species is very common and widely distributed in the Philippines, being characteristic of those localities which by the Tagalogs are called "Parang"—that is, land which was once forested but from which the valuable timber trees have been removed, so that it is now covered with thickets of shrubs and small trees. The species is universally known to the Tagalogs as *Mamals*, and to the Visayans to a greater or less extent as *Boloncoyon*. Vidal states that his *Pittosporum fernandezii* is very closely related to *P. brachysepalum*, and after a careful examination of the figures, descriptions, cotype of *P. brachysepalum*, and specimens cited above, it has been concluded that the two species are identical, and also identical with Blanco's *Aquilaria pentandra*, which being the earliest name, is here retained, there being absolutely no doubt as to the identity of Blanco's species. A species apparently closely related to *Pittosporum floribundum* W. et A. and undoubtedly the form credited to the Philippines by F-Villar as the latter.

- (2) **Pittosporum odoratum**, sp. nov. *Pittosporum glabratum* Vidal, Sinopsis, Atlas, t. 8. f. B. 1883; F-Vill. Nov. App. 13. 1880, non Lindl.

A small tree about 7 m. high, with oblanceolate to narrowly obovate



glabrous, acuminate leaves, and terminal, few flowered peduncled corymbs, the flowers white, about 12 mm. long. Branches light gray, glabrous, the young branchlets ferruginous pubescent, soon becoming glabrous. Leaves opposite, sometimes subverticillate at the upper nodes, subcoriaceous, 6 to 10 cm. long, 2 to 4 cm. wide, the very young ones slightly pubescent, especially on the midrib, soon becoming glabrous, tapering to the cuneate base, the apex rather abruptly short acuminate, the margins entire or slightly undulate, the upper surface shining, the lower surface paler, dull or slightly shining; nerves about 8 on each side of the midrib, obscure above, anastomosing, the reticulations beneath distinct, fine; petioles about 1 cm. long, at first ferruginous pubescent, soon becoming glabrous. Inflorescence terminal, the peduncle ferruginous pubescent, becoming glabrous, about 5 cm. long, the lower branches 1.5 cm. long, 3-flowered. Flowers white, fragrant, the pedicels slender, somewhat pubescent, 5 mm. long, the bracteoles about 2 mm. long, linear. Calyx 4.5 mm. long, slightly pubescent or nearly glabrous, the lobes acute or acuminate, ovate lanceolate. Petals 12 mm. long, 2.5 mm. wide, abruptly acute, glabrous, 3-nerved, somewhat united below forming a tube, spreading above. Anthers nearly 3 mm. long, dark brown. Ovary lanceolate-oblong, about 6 mm. long, many ovuled, densely pubescent, the style glabrous, about 4 mm. long. Fruit 2-valved, yellow, oblong, somewhat compressed, 3 cm. long, 15 to 18 mm. wide when mature, glabrous, rugose when dry, the base rounded or subcordate, the apex obtuse, short apiculate. Seeds many, oblong or rounded, flattened, red, 5 to 6 mm. in diameter.

Type specimens from Mount Mariveles, Province of Bataan, Luzon: (2616, 2795 Meyer), February, 1905 (flower); (6902 Elmer), November, 1904 (fruit). The following specimens are also referred here: Province of Benguet, Luzon (5832, 6372 Elmer), May, 1904; Province of Principe, Baler (1113 Merrill), October, 1902.

This is apparently a distinct species, and although no specimens of the plant identified by Vidal as *Pittosporum glabratum* are extant, and his drawing represents only the fruit, still the latter agrees well with that of the present species, and accordingly *Pittosporum glabratum* Vidal, non Lindl., is referred here. Vidal's drawing represents a 2-valved fruit, while according to the description, the fruit of *Pittosporum glabratum* is 3-valved. F.-Villar's record of *Pittosporum glabratum* from the Philippines was based on a specimen in the herbarium of Vidal, from Iloilo, Panay, evidently the same specimen from which Vidal's drawing was made. In his "Revision" Vidal cites no specimen of *Pittosporum* from Panay, and it is accordingly probable that the specimen from which the drawing was made was destroyed before the publication of the latter work.

This species reaches a diameter of about 10 cm. growing on Mount Mariveles on exposed ridges in the mossy forest at an altitude of about 900 m., and in Benguet in shaded ravines at an altitude of about 1,500 m.

(3) *Pittosporum resiniferum* Hemsl. Kew. Bull. 1894:344. 1894.

This species was based on No. 1136 Vidal, Province of Benguet, Luzon, and is also represented by Nos. 2009, 2010 Loher, according to a manuscript

list of identifications of the latter's Philippine plants made at Kew. It was originally described from fruiting specimens only, and as the flowers were previously unknown, they are accordingly described here. Flowers white, odorless, in fascicles of from 6 to 10 flowers each, axillary or extra-axillary on the branches below the leaves, the pedicels pubescent, 3 to 6 mm. long. Calyx cup shaped, glabrous, 5 mm. deep, the lobes broadly ovate, obtuse, about 2 mm. long. Petals linear, obtuse, about 14 mm. long, 2.5 mm. wide, fleshy, glabrous, their tips more or less spreading. Filaments 8 mm. long, the anthers 3 mm. long. Ovary oblong, 6 mm. long, densely hirsute pubescent, the style glabrous, 4 mm. long.

Specimens examined, all from Luzon: Province of Bataan, Mount Mariveles (3729 Merrill), January, 1904 (fruit); (6903 Elmer), November, 1904 (fruit); (2380 Borden); (2403 Meyer), January, 1904 (fruit); (2794 Meyer), March, 1905 (flower). Province of Benguet, Mount Santo Tomas, (5812 Elmer), March, 1904 (fruit).

This species is remarkable for the amount of resin in its leaves, twigs, and fruits; fresh fruits burn readily when a lighted match is applied to them.

It reaches a height of about 10 m., and is apparently entirely confined to the mossy forests of the higher mountains, being common on exposed ridges on Mount Mariveles above 800 m.

(4) *Pittosporum resiniferum*, var. *orbiculatum* var. nov.

A form apparently identical with the species except that the fruit instead of being oblong, is orbicular or nearly so, 2 to 2.8 cm. in diameter, compressed.

Mount Arayat, Province of Pampanga, Luzon (3919 Merrill), October, 1904. Not common, and apparently growing only near the summit of the mountain in the slightly developed mossy forest, at an altitude of 878 m. above the sea.

*Pittosporum ferrugineum* Ait.; F.Vill. Nov. App. 13. 1880. *Busaria inermis* Blanco, Fl. Filip. ed. 2, 124. 1845; ed. 3. 1:122?

No Philippine specimens of *Pittosporum ferrugineum* Ait. have been seen, although its range is given by King<sup>1</sup> as from Burmah to the Malayan Archipelago, Philippines, and Queensland. F.-Villar refers *Busaria inermis* Blanco here without question, stating that he saw specimens from near Iloilo, Panay. Blanco's specimens were from Calauan, Province of Laguna, Luzon. The fruit of *Bursaria inermis* is described as being 4-seeded, which at once precludes the possibility of this species being referable to *Pittosporum resiniferum* or *P. odoratum*, although this character does not conflict with the description of *P. ferrugineum*. The description of *Bursaria inermis*, although very short, applies well to *Pittosporum pentandrum*, and the species which was seen and described by Azaola, and not by Blanco, might well be identical with *Limonia laureola* Blanco, of the same work = *Pittosporum pentandrum*. Unless fairly typical specimens of *Pittosporum ferrugineum* Ait., are found in the Philippines, it will probably be best to refer *Bursaria inermis* to *Pittosporum pentandrum* (Blanco) Merrill.

<sup>1</sup> Journ. As. Soc. Beng., 58: 129. 1890.



## ROSACEÆ.

*Eriobotrya ambigua*, sp. nov.

A tree 8 to 10 m. high with oblong, glabrous, acute or short acuminate leaves 10 cm. long or less, the inflorescence a corymbose panicle, the petals imbricate in bud, the ovary 4 to 5 celled. Branches dark brown, glabrous, the branchlets densely ferruginous pubescent, becoming nearly glabrous. Leaves 6 to 10 cm. long, 2 to 3.5 cm. wide, shining on both surfaces, submembranous, glabrous except the midrib beneath which is somewhat pubescent in the lower part, the base acute the margins cartilaginous, slightly undulate-crenate above; nerves about 15 pairs, freely anastomosing, scarcely more prominent than the primary reticulations; petioles 1.5 cm. long, densely ferruginous pubescent, channeled above, the pubescence deciduous, the petioles becoming glabrous or nearly so. Panicles terminal, 4 to 7 cm. long, the entire inflorescence including the bracts and calyces densely ferruginous pubescent, becoming more or less glabrous in age, the lower branches 4 cm. long, ascending, corymbosely branched above the middle; bracts linear to linear lanceolate, 5 to 7 mm. long, pubescent, the bracteoles similar but smaller. Flowers white, fragrant, about 1 cm. in diameter. Calyx decidedly ferruginous pubescent, funnel shaped, about 3 mm. long, the teeth triangular, acute, erect. Petals glabrous, imbricate, broadly ovate, obtuse, about 4 mm. long. Stamens many. Ovary pubescent, 5-celled, or by abortion 4-celled, each cell with two basal ovules. Styles 5 or 4, about 4 mm. long, united for one-half their length.

Type specimen; Mount Mariveles, Province of Bataan, Luzon (2796 Meyer), March, 1905; also Nos. 1155, 1168, and 1307 Whitford same locality, March and June, 1905. A tree reaching a diameter of about 40 cm. growing on the forestal slopes and ridges at an altitude of about 1,000 m. above the sea. The second species of the genus to be found in the Philippines.

## CONNARACEÆ.

*Agelaea wallichii* Hook. f. Fl. Brit. Ind. 2:47. 1876; King, Journ. As. Soc. Beng. 66<sup>2</sup>:19. 1897.

This species is represented by the following specimens, all from Luzon: Province of Bataan, Lamao River (29 Whitford), April, 1904 (flower); (3025 Meyer), May, 1905 (flower); (6004 Leiberg), July, 1904 (fruit); Lucena, Province of Tayabas (2895 Merrill), June, 1903 (fruit). Specimens were sent to Dr. H. N. Ridley, Director of the Botanical Garden, Singapore, who kindly compared them with authentic material of *Agelaea wallichii*, Dr. Ridley verifying my identification. No species of the genus has previously been reported from the Philippines. Penang to Malacca, Singapore, and Sumatra.

## LEGUMINOSÆÆ.

*Apalatoa blancoi* (Rolle) *Crudia blancoi* Rolfe, Journ. Linn. Soc. Bot. 21:309. 1884; Vidal, Rev. Pl. Vasc. Filip. 118. 1886. *Crudia spicata* Blanco, Fl. Filip. ed. 2. 261. 1845; ed. 3. 2:121. t. 244; F. Vill. Nov. App. 71. 1880; Vidal, Synopsis, Atlas. t. 13. f. B. 1883, non Willd.

A medium-sized or large tree with nearly glabrous leaves and axillary racemes of white flowers, 10 to 15 cm. long. Branches grayish brown, glabrous. Leaves alternate, 15 to 20 cm. long, the rachis glabrous; leaflets lanceolate-ovate, acuminate, alternate, 5 to 9 cm. long, 2 to 3.5 cm. wide, the base inequilateral, on one side rounded, on the other acute, the apex blunt acuminate, glabrous above, sparingly pubescent beneath; nerves 8 or 10 on each side of the midrib, spreading, anastomosing, the reticulations lax; petiolules glabrous, 2 to 3 mm. long. Racemes rather densely flowered, the rachis and pedicels more or less pubescent, the latter 5 to 6 mm. long. Sepals 4, reflexed, ovate, acute, 4 mm. long, 2.5 to 3 mm. wide. Stamens 10, the filaments 7 mm. long. Ovary densely hirsute-pilose, 2-ovuled; style glabrous, 2 mm. long. Pod oblong, compressed, 3 to 4 cm. long, 1.5 to 2 cm. wide, densely ferruginous pubescent. Seed usually solitary, compressed, 4 mm. in diameter, dark, shining.

This species is represented by Nos. 2661 and 2968 Ahern's collector, Bosoboso, Province of Rizal, Luzon, February, 1905, and the above description is here given to supplement that of Blanco, which is the only description of the species previously published, and which is imperfect in many details.

**Desmodium quinquepetalum** (Blanco) *Cytisus quinquepetalus* Blanco, Fl. Filip. ed. 1, 598. 1837. *Cajanus quinquepetalus* Blanco, l. c., ed. 2, 417. 1845; ed. 3, 2:397. *Desmodium cephalotes* F.-Vill. Nov. App. 61. 1880; Merr. Govt. Lab. Publ. 27:38. 1905, non Wall. § *Dendrolobium*.

A shrub 2 to 4 m. high with trifoliate leaves, the leaflets broadly lanceolate, acuminate, strongly veined beneath, axillary and terminal racemose panicles, the flowers disposed in small umbels at the apices of the short branches, and fulvous pubescent 6 to 7 jointed pods 3 to 4 cm. long. Branches slender, brown or light gray, glabrous, lenticellate, the branchlets somewhat pubescent. Leaves alternate, the rachis pubescent, becoming glabrous, the petiole 1 to 1.5 cm. long, swollen at the base; stipels lanceolate-subulate, about 2 mm. long; leaflets submembranous, 3 to 7 cm. long, 1 to 3 cm. wide, acuminate, narrowed somewhat below to the acute or rounded base, glabrous and shining above, paler beneath and pubescent with appressed or spreading soft white hairs, but not densely so; nerves rather obscure above, very prominent beneath, ascending, about 9 on each side of the midrib; petiolules pubescent, about 2 mm. long. Inflorescence of narrow, pubescent, racemose axillary and terminal panicles 5 to 7 cm. long, the branchlets very short, each terminated by from 3 to 8 flowers umbellately disposed. Flowers white, about 1.8 cm. long, the pedicels densely pubescent, 5 or 6 mm. long, the calyx subtended by two opposite, deciduous, ciliate, ovate, bracteoles about 2 mm. long. Calyx appressed fulvous pubescent, 4-lobed, the tube about 4.5 mm. long, scarcely narrowed below, the lobes reflexed, broadly lanceolate, subequal, short acuminate, 5 mm. long. Corolla white, the standard elliptical, the apex rounded, retuse, 1.7 cm. long, about 1 cm. wide, narrowed below to the slender claw; wings about as long as the standard, 5 mm. wide, the claws long, slender; keel about 14 mm. long, incurved above, nearly 1 cm. wide (when spread). Anthers

oblong, 1 mm. long. Ovary narrowly oblong, pubescent; style pubescent below. Pod 3 to 4 cm. long, 5 mm. wide, the joints 6 to 7, about 5 mm. long.

Specimens examined all from the Province of Rizal, Luzon: San Mateo (1841 Ahern's collector), September, 1904 (flower); Bosoboso (2154 Ahern's collector), December, 1904 (fruit); also a specimen collected by Rufino Marave, presumably from near Manila, December, 1895 (fruit). Sterile specimens were observed by the author along streams near Maragondon, Cavite Province, Luzon, July, 1905.

These specimens agree perfectly with Blanco's description of *Cytisus quinquepectatus*, and accordingly his specific name is retained for the species. His material was from Mandaloyon, Province of Rizal, Luzon, flowering in May, from which it seems probable that the species flowers twice each year. *Desmodium cephalotes* Wall., to which F. Villar referred Blanco's species, and which identification was previously accepted by the author, is a British Indian species, which does not extend to the Philippines. Specimens of this interesting species were sent to Dr. D. Prain, Director of the Royal Botanic Garden, Calcutta, who states that it is a very distinct undescribed species of *Desmodium*, represented at Kew by Nos. 245, 246, 247, and 1063 Vidal, and Nos. 2368, 2389, and 2370 Loher, but although admitted at Kew as a distinct species, it had never received a name. T. *Paispis*.

***Ormosia paniculata*, sp. nov.**

A small tree with odd-pinnate leaves about 30 cm. long, the inflorescence an ample, terminal, densely ferruginous-pubescent panicle nearly as long as the leaves. Branches thickened, densely ferruginous pubescent. Leaves alternate, the leaflets 7, the rhachis, petiolules, and under surface of the leaflets ferruginous pubescent. Leaflets elliptical oblong, 9 to 13 cm. long, 3.5 to 5 cm. wide, the base acute, the apex prominently acuminate, the acumen apiculate, the upper surface with few scattered hairs, the midrib densely ferruginous pubescent; nerves about 11 pairs, ascending; petiolules densely ferruginous-pubescent, the leaf rhachis about 20 cm. long, extending beyond the terminal pair of leaflets. Panicles many flowered, the branches ascending, the longer primary ones 15 cm. in length. Flowers fragrant, creamy white, about 2 cm. long, the pedicels about 7 mm. long. Calyx campanulate, 1.5 cm. long, densely ferruginous-pubescent outside, the lobes also pubescent inside, ovate, acute, slightly longer than the tube, the two upper teeth somewhat larger than the three lower ones. Corolla exceeding the calyx, about 1.6 cm. long, the standard suborbicular, about 15 mm. across. Stamens 10, apparently all fertile, glabrous, unequal in length, the longer ones 1.5 cm. long; anthers 1.4 mm. long. Ovary pubescent, 2-ovuled, its pedicel 2 to 3 mm. long.

Type specimen: Lamao River, Province of Bataan, Luzon (2028 Borden), October, 1904.

A tree reaching a height of about 20 m. and a diameter of 30 cm. growing on forested slopes at an altitude of about 60 m. about the sea. The second species of the genus to be discovered in the Philippines, the other, *Ormosia calarensis* Blanco, being also endemic.

***Pterolobium membranulaceum*** (Blanco) *Mimosa membranulacca* Blanco, Fl. Filip. ed. 1, 739. 1837; *Reichardia pentapetala* Blanco, l. c., ed. 2, 233. 1845; ed. 3, 2:71. *Pterolobium indicum* F.-Vill. Nov. App. 70. 1880; Vidal, Sinopsis, Atlas, t. 42, f. G. 1883; Rev. Pl. Vasc. Filip. 114. 1886; Merrill, Govt. Lab. Publ. 27:41. 1905, non A. Rich.

A scandent shrub with evenly bipinnate leaves 7 to 18 cm. long, with 6 to 10 jugate pinnae, 6 to 8 jugate leaflets, and 20 to 60 flowered racemes arranged in terminal and axillary, lax panicles, the winged fruits 5 cm. long. Branches dark reddish brown or grayish, glabrous, or more or less pubescent when young. Leaves alternate, the common rhachis densely ferruginous pubescent, becoming nearly glabrous, with a pair of retrorse spines at the attachment of each pair of pinnae; pinnae 4 to 5 cm. long, opposite, curved, spreading or reflexed, the rhachis pubescent; leaflets 6 to 8 pairs, sessile, about 1 cm. long, 5 to 6 mm. wide, oblong, or the terminal pair obovate-cuneate, glabrous and shining on both surfaces, the base strongly inequilateral, the apex rounded or obtuse, often slightly retuse, the margins irregularly obscurely crenate. Panicles rather strongly ferruginous pubescent, slender, 15 to 20 cm. long, the branches few, 6 to 14 cm. long, the flowers scattered, the pedicels slightly pubescent, slender, 3 to 4 mm. long; bracteoles narrowly lanceolate, long acuminate, deciduous, 2.5 to 3 mm. long. Flowers about 4 mm. long. Calyx glabrous, the lobes oblong, acute, 3 to 4 mm. long. Petals similar to the calyx lobes and about as long. Stamens 10; filaments densely woolly at the base. Ovary glabrous. Pod glabrous, 5 cm. long including the wing, the seed-bearing portion ovate-rhomboidal, 1.5 cm. long, 1 cm. wide, the membranous wing 4 cm. long, 1.3 cm. wide.

Specimens examined, all from Rizal Province, Luzon: San Mateo (1837 Ahern's collector), September, 1904 (flower); Bosoboso (1884 Ahern's collector), November, 1904 (fruit).

A species apparently related to *Pterolobium indicum* A. Rich., with which it has previously been identified, but quite distinct from it in its inflorescence, fewer leaflets and shorter pods. The specimens on which Blanco based his species were from Tagudin and Agoo, Province of Ilocos Sur, Luzon, and although he apparently erroneously describes it as having but five stamens, yet manifestly his description applies to the species as here redescribed. The reduction of *Mimosa membranulacca* Blanco to *Pterolobium indicum* A. Rich., was previously accepted by the author on the assumption that Vidal's identification of his Luzon material as *Pterolobium indicum* was correct. Dr. D. Prain, to whom specimens were sent, pronounced it a distinct species and accordingly Blanco's name is here adopted.

***Vigna pilosa*** (Roxb.) Baker in Hook. f. Fl. Brit. Ind. 2:207. 1876; Prain in King, Journ. As. Soc. Beng. 66<sup>2</sup>:53. 1897. *Dolichos pilosus* Roxb.; *Phaseolus difformis* Wall.

Caloocan, Province of Rizal, Luzon (3674 Merrill), November, 1903. A species not previously recorded from the Philippines, growing in bamboo thickets, the specimen identified by Prain. British India to Indo-China and the Andaman Islands.

## RUTACEÆ.

***Evodia semecarpifolia*, sp. nov.**

A shrub 3 to 5 m. high with trifoliate glabrous leaves and axillary, short, narrow, inflorescence 3 to 5 cm. long, the flowers 4-merous. Branches light gray, striate, glabrous, the younger parts more or less fulvous pubescent. Leaves opposite, the petioles 3 to 8 cm. long, somewhat pubescent, becoming glabrous; leaflets usually pale when dry, subcoriaceous, glabrous throughout except the slightly pubescent midrib beneath, obovate to obovate oblong, obtuse or obscurely broadly acuminate, narrowed below to the cuneate base, 11 to 18 cm. long, 5 to 8 cm. wide; primary nerves prominent beneath, spreading-ascending, anastomosing, 9 to 11 on each side, the reticulations lax; petiolules of the lateral leaflets 3 to 4 mm. long, that of the terminal leaflet about 1 cm. long. Panicles axillary, the branches few, densely flowered, 1 cm. long or less, spreading, the axis and branches densely pubescent. Flowers about 2.5 mm. long. Calyx cinereous pubescent, the lobes ovate, acute, about 1 mm. long. Petals 4, elliptical ovate, 2 mm. long, 1.2 mm. wide, acute, glabrous. Stamens 4, glabrous, included; filaments 1 mm. long; anthers 0.4 mm. long. Ovary densely pubescent, 4-celled. Stigma 4-lobed. Cocci slightly pubescent, ovoid, slightly compressed, about 3 mm. in diameter.

Type specimen: Baguio, Province of Benguet, Luzon (5868 Elmer), March, 1904; also from the same locality, a specimen collected by Mrs. Pond, same date and No. 1168 Merrill January, 1903, with imperfect fruit.

A shrub in thickets in ravines and on bluffs near the river, the leaflets similar in appearance to the leaves of some Philippine species of *Semecarpus*.

***Evodia dubia*, sp. nov.**

A shrub 2 to 3 m. high with opposite trifoliate leaves, the leaflets subcoriaceous, 5 cm. long or less, and axillary, peduncled, few flowered cymes. Branches light gray, glabrous, striate, the ultimate branchlets densely cinereous-fulvous pubescent. Petioles 1 cm. long or less, pubescent, leaflets shining, glabrous above, sparingly pubescent beneath, at least on the midrib, becoming glabrous, lanceolate to elliptical lanceolate, the base acute, the apex broadly blunt acuminate, apiculate, rarely retuse, 3 to 5 cm. long, 1 to 1.5 cm. wide; primary nerves about 10 on each side of the midrib, obscure, scarcely more prominent than the reticulations; petiolules 1 to 2 mm. long, pubescent, becoming nearly glabrous. Cymes axillary, very few flowered, peduncled, cinereous pubescent, about 3 cm. long, the peduncle slender, 1 cm. long or longer. Flowers yellowish white, 2 mm. long. Calyx slightly pubescent, the lobes acute, about 1 mm. long. Petals 4, glabrous, ovate, acute, 2 mm. long. Stamens 4, glabrous, 1.5 mm. long, included. Disc large, fleshy, glabrous. Cocci 4 from each flower, coriaceous, reticulate, glabrous, compressed, 4 to 5 mm. long, 3 mm. wide, each with a single seed.

Baguio, Province of Benguet, Luzon (939 Barnes), May, 1904 (flower); (5992 Elmer), same locality, March, 1904 (fruit).

A species referred to *Erodia* with some doubt, as no trace of the ovary could be found in the flowers examined.



**Melicope luzonensis** Engler, in Engl. und Prantl, Nat. Pflanzenfam. 3<sup>4</sup>: 122. 1897, nomen; Perk. Frag. Fl. Philip. 161. 1905.

The following synonymy should be added: *Fagura octandra* Blanco. Fl. Filip. ed. 1, 67. 1837; ed. 2, 48. 1845; ed. 3, 1:90; Merrill, Govt. Lab. Publ. 27:27. 1905, non Linn. *Melicope ternata* Vid. Cat. Pl. Prov. Manila 21. 1880; Sinopsis. Atlas, t. 24. f. A. 1883; F.-Vill. Nov. App. 34. 1880, non Forst.

A specimen of Cuming's No. 1819 exists in our herbarium, and the species is also represented by the following material: Luzon, Province of Benguet (6282 Elmer), May, 1904; Province of Rizal, Bosoboso (2787 Merrill). July, 1903. Mindoro, Pola (2397 Merrill), May, 1903. Island of Ticao (1069 Clark), May, 1904. Blanco's description applies very closely to the above species, and specimens from the same province from which he received his material bear the same Tagalog name, *Matang arao*.

**Melicope obtusa**, sp. nov.

An entirely glabrous shrub or small tree with opposite trifoliate leaves, the small leaflets obtuse, retuse, the inflorescence axillary. Branches grayish brown, glabrous. Petioles 1 to 2 cm. long; leaflets subcoriaceous, obovate-elliptical to oblong elliptical, 3 to 6 cm. long, 1 to 2.5 cm. wide, usually three, or by abortion two, rarely only one, gradually narrowed to the acute base, the apex rounded or obtuse, usually more or less retuse; nerves 7 to 8 on each side of the midrib, not prominent, anastomosing, the reticulations lax; petiolules 3 to 4 mm. long, that of the terminal leaflet scarcely exceeding those of the lateral leaflets. Panicles racemose, 1 to 3 cm. long, the branches spreading, less than 1 cm. long, many flowered, the flowers yellowish white, 3.5 mm. long, their pedicels about 2 mm. long, fasciculate. Calyx glabrous, the lobes short, rounded. Petals 4, membranous, glabrous, oblong ovate, 3 mm. long, 1.5 mm. wide, acute or obtuse. Stamens 8, all fertile, unequal, four with filaments 3 mm. long, the alternating ones about 2 mm. long. Ovary subglobose, glabrous.

Type specimen: Bagnio, Province of Benguet, Luzon (6370 Elmer), May, 1904.

**Paramigyna longipedunculata**, sp. nov.

A scandent shrub, unarmed or with few short axillary spines, with pubescent branches and axillary solitary or fascicled flowers about 2 cm. long, the peduncles densely pubescent, 2.5 to 3 cm. long. Branchlets dark green when dry, densely pubescent, the solitary spines, when present, stout, pubescent, about 5 mm. long. Leaves 7 to 10 cm. long, 5 to 7 cm. wide, 1-foliate, the joint obsolete or nearly so, elliptical-ovate, the apex abruptly acute or broadly short acuminate, the base rounded, the margins slightly crenate towards the apex, the upper surface glabrous, shining, the lower surface pubescent throughout, the midrib densely so; petioles 8 to 10 mm. long, densely pubescent. Flowers 1 to 3, fasciculate, white. Calyx cupular, densely pubescent, about 7 mm. in diameter, 5-lobed, the lobes erect, broadly ovate, 2.5 mm. long. Petals 5, linear-oblong, obtuse, 2 cm. long, 5 mm. wide, thick, pubescent on the outside. Stamens 10, the filaments pubescent, about 12 mm. long, the anthers 5 mm. long. Ovary 5-celled; style about 1.5 cm. long, densely pubescent.

Type specimen: Bosoboso, Province of Rizal, Luzon (2146 Ahern's collector), December, 1904. A species apparently closely related to *Paranigyna monophylla* Wight, differing in its longer peduncles and other characters. This is undoubtedly the species credited to the Philippines by F.-Villar<sup>1</sup> and Vidal<sup>2</sup> as *P. monophylla*.

## SIMARUBACEÆ.

***Ailanthus philippinensis***, sp. nov. *Ailanthus pongelion* Blanco, Fl. Filip. ed. 1, 380. 1837; ed. 2, 286. 1845; ed. 3, 2:134, non Gmel.; *A. malabarica* F.-Vill. Nov. App. 349. 1883, non DC.; *A. moluccana* Merr. Forestry Bureau Bull. 1:27. 1903, non DC. § *Euailanthus*.

A large tree, reaching a height of about 40 m. with nearly glabrous, 12 to 16 jugate leaves, the leaflets falcate, oblong-lanceolate, the base strongly inequilateral, the apex acuminate, with a single prominent gland at the apex on the lower surface, the fertile panicles, in anthesis, shorter than the leaves, the samara 5 cm. long. Branches thickened, brown, the leaf scars large and prominent. Leaves alternate, odd pinnate, 50 to 70 cm. long, the rachis minutely pubescent or nearly glabrous, often somewhat pruinose; leaflets entire, opposite, or subopposite below, 9 to 15 cm. long, 2.5 to 4 cm. wide, usually slender acuminate, the tip of the acumen somewhat dilated by the prominent gland on the lower surface, base strongly inequilateral, the upper half rounded or cordate, the lower half acute, glabrous on both surfaces, or very sparingly pubescent on the midrib below, shining above, dull beneath; nerves 14 to 16 on each side of the midrib; petiolules slender, about 1 cm. long. Fertile panicles slender, in anthesis 25 cm. long or less, the rachis and branches more or less ferruginous pubescent, the latter spreading, 3 cm. long or less, the panicles much elongated in fruit, 40 cm. long or more. Fertile flowers yellow, odorless, 4 to 5 mm. long, their pedicels 3 to 4 mm. long. Calyx small, slightly pubescent, the teeth acute. Petals glabrous, lanceolate, acute, 4.5 mm. long, about 1.5 mm. wide, somewhat concave. Stamens included, 10; filaments 3 mm. long; anthers about 0.5 mm. long. Ovary glabrous, the carpels 3, free, flattened, oblong, obtuse, 2.5 mm. long; styles united, 1.5 mm. long; stigma 3-lobed. Samara flat, oblong, glabrous, 5 cm. long, 2.5 cm. wide, the wings thin, obtuse, the seed in the middle, circular.

Specimens examined, all from Luzon: Province of Bataan (2719 Borden), February, 1905 (flower); Province of Tayabas, Pitogo (2137 Merrill), April, 1903 (fruit); Province of Camarines Sur, Pasacao (93 Ahern), March, 1902 (fruit).

On securing flowering specimens of this plant and examining the same it was at once evident that the specimens were referable to neither *Ailanthus malabarica* as determined by F.-Villar, nor to *A. moluccana* as previously determined by the author. *Ailanthus philippinensis* is apparently most closely related to *A. glandulosa* Desf., the only species mentioned by Engler in his section *Euailanthus*.

<sup>1</sup> Nov. App., 37, 1880.

<sup>2</sup> Rev. Pl. Vasc. Filip., 77, 1886.



*Brucea luzonensis* Vidal, Sinopsis. Atlas, 19 t. 21. f. B. 1883.

The original description of this species, which is not listed in Index Kewensis, nor in the first or second supplement to that work, is as follows: "Arbol. Hojas con 4 pares de hojuelas festoneado-aserradas, obliquas, pecioladas, finamente vellosas en el envés, 0.1 m. de longitud. Flores con cáliz y corola apenas empizarradas en la base; pétalos lineales, verdes, reflexos en el ápice; anteras rojas. Inflorescencia en racimos axilares, cortos. Afine á la *B. glabrata* Deene., de la cual difiere en número y tamaño de las hojuelas así como en la inflorescencia. Hallada con flores en Enero." Vidal's specimens were from Mariveles, Province of Bataan, Luzon, but he does not mention the material in his Revision.

The validity of this species is very doubtful, it being apparently only a form of *Brucea sumatrana* Roxb. It is apparently represented by No. 987 Cuming, in Herb. Govt. Laboratory, and the following specimens, all from Luzon: Province of Bataan (181, 480, Whitford), May, July, 1904; (2608, 2799, 2800 Meyer), February, 1904, and March, 1905; (1766, 2750 Borden), August, 1904, and March, 1905; (6165 Leiberger), July, 1904; (6786 Elmer), November, 1904. Province of Rizal, Bosoboso (1151 Ahern's collector), June, 1904. This species is common at Mount Mariveles, growing in the forests at from 30 to 1,000 m. above the sea, the material cited above being exceedingly variable, especially in vegetative characters. No. 987 Cuming is cited by Turczaninow<sup>1</sup> as being very close to *Brucea sumatrana*, and half way between that species and *B. glabrata* Deene. Apparently typical *B. sumatrana* Roxb. is represented by No. 512 Ahern, Suigao, Mindanao, and No. 30 DeVore and Hoover, Island of Basilan, but *Brucea luzonensis* Vidal seems to gradually pass into the former species. If the Luzon form is to be retained as distinct, Vidal's specific name should be adopted, but I am of the opinion that abundant material will only more closely connect the species with *Brucea sumatrana* Roxb.

## BURSERACEÆ.

*Canarium perkinsæ*, sp. nov. *Canarium ovatum* Perk. Frag. Fl. Philip. 94. 1904, non Engl.

A tree about 15 m. high, with 6 to 7 jugate, glabrous or nearly glabrous leaves, membranous, oblong, inequilateral, caudate acuminate leaflets, glabrous, long peduncled racemes 8 to 18 cm. long, and 3-merous, cylindrical flowers 10 to 11 mm. long. Branches grayish brown, striate, scarcely thickened, glabrous, the tips slightly pubescent with scattered ferruginous hairs. Leaves alternate, 20 to 28 cm. long, the rhachis at first slightly pubescent, becoming glabrous, 15 to 20 cm. long, the internodes about 2 cm. long; leaflets opposite, glabrous, shining on both surfaces, oblong, abruptly caudate acuminate, the acumen slender, blunt, often 1.5 cm. long, the margins entire, the base strongly inequilateral, the lamina on one side of the midrib acute, on the other side much broader usually rounded, 7 to 9 cm. long, 2 to 3 cm. wide; nerves 9 to 12 on each side of the midrib,

<sup>1</sup> Bull. Soc. Nat. Mosc. 31: 445.

not very prominent; petiolules slender, glabrous, or slightly pubescent, about 5 mm. long. Racemes axillary, their peduncles often 10 cm. long, the flowers borne in fascicles of from 2 to 5, the pedicels about 3 mm. long, the bracteoles very small. Calyx glabrous, about 4 mm. long, 3-lobed, the lobes broadly ovate, obtuse, about 2 mm. long. Petals 3, imbricate, oblong, acute, glabrous, 10 to 11 mm. long, 4 mm. wide. Stamen 6, glabrous, the filaments 6 mm. long, slender, united below into a short 1 mm. long tube, which is outside of and entirely free from the disc; anthers oblong lanceolate, 2.5 mm long. Disc fleshy, 3.5 mm. long, channeled, truncate, irregularly toothed, pubescent outside, hirsute within and on the margin. Ovary rudimentary, pilose hirsute.

Specimens examined, all from Mindoro: Pola (2472 Merrill), June, 1903; Baco River (121 McGregor), May, 1905.

No. 2472 Merrill was identified by Dr. Perkins as *Canarium ovatum* Engler, but our specimen agrees with neither the description of the species nor with Cuming's No. 904, on which the species was based, a specimen of which is in the herbarium of this Bureau. *Canarium perkinsae* is not at all closely related to *C. ovatum*, differing in its racemose, elongated, not paniculate inflorescence, very different flowers, much smaller and very differently shaped leaflets, shorter petiolules, and many other characters.

**Canarium villosum** (Blume) F. Vill. Nov. App. 40. 1880; Vidal, Synopsis, Atlas, 19. t. 28. f. A. 1883. *Pimela villosa* Blume, Mus. Bot. Lugd. Bat. 1:223. 1850. *Canariopsis villosa* Miq. Fl. Ind. Bat. 1<sup>2</sup>:652. 1859; Vidal, Cat. Pl. Prov. Manila. 22. 1880. *Canarium commune* Blanco, Fl. Filip. ed. 1, 791. 1837, non Linn. *Canarium pimela* Blanco. 1. c., ed. 2, 545. 1845; ed. 3, 3: 201; Naves 1. c., ed. 3, pl. 353. 1880, non Koen. *Canarium cumingii* Engler in DC. Monog. Phan. 4:132. 1883; Vidal, Phan. Cuming. Philip. 101. 1885; Rev. Pl. Vasc. Filip. 79. 1886.

Luzon: Province of Zambales, Botolan (2936 Merrill). May, 1903. Z., Dulit; Subic (1767 Merrill). April, 1903. T., Pagsainguin; (858 Maule), May, 1904, T., Palasanguin. Province of Bataan, Lamao River, Mount Mariveles (125 Barnes), January, 1904, T., Pagsainguin; (2789 Meyer), February, 1905; (74, 376 Whitford), April, June, 1904. T., Pagsainguin; (2556 Merrill). June, 1903, T., Pagsainguin; 697, 1284, 1311, 1312, 1314, 1319, 1554, 1558, 1564, 1676 Borden). July, August, 1904, all T., Pagsainguin; Mariveles (788 Ahern), February, 1901. T., Pagsainguin. Province of Pangasinan, Balungao (2864 Merrill), July, 1903. H., Anteng. Rizal Province, Bosoboso (1145 Ahern's collector), June, 1904, T., Puchauguin; Antipolo (1731 Merrill), March, 1903. T., Jatsahengin. Negros, Tanhay (Jose Muñoz). 1904, V., Lonay. Masbate (3083 Merrill), August, 1903.

With view to the possible identification of *Canarium commune* Blanco, much material has been collected with reference to the native names cited by Blanco under this species, and the physical characters of the tree as described by him. Blanco's description, although imperfect, applies closely to the material cited above, the native names are the same or similar to those cited by him, and are almost invariably applied to this tree, which is very common in the lower hill forests of central Luzon, and which yields

all or nearly all the dark-colored, fragrant pitch mentioned by Blanco, used by the natives for torches and for caulking boats.

The specific name *villosa* was adopted by Blume because the two names previously used by Blanco were untenable, he having erroneously identified the species, first with *Canarium commune* Linn., and later with *Canarium pimela* Koen., neither of these species extending to the Philippines. Miquel transferred Blume's specific name to *Canariopsis*, and F.-Villar first transferred the name to *Canarium*, and accordingly should be cited as the authority. Regarding the identity of *Canarium cumingii* Engl., with *Canarium villosum* (Blume) F.-Vill., there can be little doubt, and Engler in his monograph of the *Burseraceae*, judging from a single number of Cuming's collection, with no data as to the native names or physical properties of the tree, suggested that perhaps *Pimela villosa* Blume was referable to *Canarium cumingii*.

In working over the *Canarium* material in the Herbarium of this Bureau, it seems evident that it will be necessary to reduce several other species to *Canarium villosum*, a matter which can be determined by some future monographer. The species are mentioned below.

*Canarium luxurians* Eng. forma *monstrosa* Engl. in DC. Monog. Phan. 4:146.

This species and form was based on a single number of Cuming's Philippine collection, and is represented by the following specimens in the herbarium of this Bureau:

Philippines: No. 796 Cuming (cotype), Luzon, Province of Rizal. Bosoboso (2821 Merrill), July, 1903, T., *Pachainguin*; same locality (1861 Ahern's collector), September, 1904, T., *Palasahinguin*; Tanay (2348 Merrill), May, 1903, T., *Pachainguin*. Province of Tayabas, without locality, native collector, November, 1904, T., *Pagsanguin*. Guimaras Island (282 Gammill), January, 1904, V., *Salong*.

Engler has placed *Canarium luxurians monstrosa* in the section *Triandra*, while *C. cumingii* = *C. villosum*, is in the section *Eucanarium*. Perkins<sup>1</sup> under *Canarium carapifolium*, has suggested that the section *Triandra* must be abandoned, as she found flowers of *Canarium carapifolium* with 3, 4, and 6 stamens. It is here suggested that *Canarium luxurians monstrosa* is only a form of *Canarium villosum*, as the vegetative characters and native names are the same, and that the peculiar, dense, many branched inflorescence of the former may be due to the work of insects or to some parasitic fungus. I have found the same abnormal type of inflorescence on *Diospyros* (448 Ahern's collector; 1654 Merrill) Province of Rizal, Luzon. Normal flowers of *Canarium luxurians* forma *monstrosa* have not been found.

*Canarium juglandfolium* Perk. Frag. Fl. Philip. 93. 1904. The type of this species is No. 1974 Merrill, Subic, Province of Zambales, Luzon, T., *Pagsainguin*.

*Canarium thyrsoides* Perk. l. c. 97. No. 2119 Merrill, Pitogo, Province of Tayabas, Luzon, April, 1903, T., *Anangi*. Pola, Mindoro (2256 Merrill), May, 1903, T., *Pasahinhin*.

<sup>1</sup> Frag. Fl. Philip.. 92.

*Canarium stachyanthum* Perk. 1. c., 97. No. 1748 Merrill, Subic. Province of Zambales, Luzon, April, 1903, T., *Pagsainguin*. Abonabon, Mindoro (2177 Merrill), May, 1903, T., *Pagsainguin*.

The above three species are apparently merely forms of *Canarium villosum* (Blume) F-Vill., as I have failed to find characters in the specimens or in the descriptions by which they can be satisfactorially distinguished from that species.

*Canarium villosum* (Blume) F-Vill., as here interpreted, includes *Canarium commune* and *C. pimela* Blanco, *C. cumingii* Engl., and apparently also *C. luxurians monstrosa* Engl., *C. juglandifolium* Perk., *C. thyrsoidum* Perk., and *C. stachyanthum* Perk., should be referred to that species. Regarding the constancy of leading the Tagalog name of the species, *Palsahihin*, as cited by Blanco, and variations of it, such as *Pagsainguin*, *Pachainguin*, *Palsahinguin*, etc., I find them applied only to *Canarium villosum* (Blume) F-Vill., and to the species mentioned above which I believe to be only synonyms of that species. This native name does not appear in any of its forms on any of the other specimens of *Canarium* representing other species than those discussed above (about 70 sheets), at present in the herbarium of this Bureau.

#### ***Santiria nitida*, sp. nov.**

A tree 15 to 30 m. high, with entirely glabrous coriaceous, shining usually 3-jugate leaves, short cinereous-puberulous paniculate inflorescence, the flowers ovoid, 3 to 4 mm. long, the stamens free from the glabrous disc, not united in a tube. Branches light brown or grayish, glabrous. Leaves 20 to 30 cm. long, 3, rarely 4-jugate, the rachis glabrous, 10 to 17 cm. long; leaflets opposite, long petioled, elliptical ovate to elliptical lanceolate, coriaceous, glabrous and shining on both surfaces, 8 to 12 cm. long, 2.5 to 4.5 cm. wide, the apex rather strongly acuminate, the acumen blunt, the base more or less inequilateral, acute, the margins entire; nerves 9 to 12 on each side of the midrib, spreading, curved upwards, prominent, anastomosing, the reticulations distinct beneath; petiolules glabrous, 1 to 1.8 cm. long, that of the terminal leaflet often 3 cm. long. Panicles 5 to 7 cm. long, terminal, densely cinereous puberulous throughout, the primary branches 2 cm. long or less, the tertiary ones very short. Flowers white, very fragrant, their pedicels about 2 mm. long. Calyx densely cinereous puberulent, cup shaped, truncate or very obscurely 3-toothed, 1.5 mm. long. Petals cinereous puberulous outside, 3, free, broadly orbicular-ovate, 3 to 3.5 mm. long, 3 to 4 mm. wide, acute. Stamens 6, inserted outside the disc, free from the disc and from each other, the glabrous filaments 1.5 mm. long, the anther 0.8 mm. long. Disc glabrous, fleshy, about 10-lobed. Ovary pubescent, 3-celled, not exceeding the fleshy disc. Drupe (immature) ovoid or ellipsoid, 2 to 2.5 cm. long, 1.5 cm. thick, slightly compressed on one side but not triangular, rugose when dry, glaucous, glabrous, 1-celled.

Luzon: Province of Bataan, Lamao River, Mount Mariveles (2786 Meyer), February, 1905 (flower); (808 Borden) May, 1904 (fruit); also the following sterile numbers: (517, 519 Barnes), (638, 2912 Borden). Tayabas Province (Infanta), (768 Whitford) September, 1904 (fruit).

A tree growing in the hill forests, reaching a diameter of 45 cm., extending from an altitude of 100 m. to about 700 m. above the sea, the bark exuding a very small amount of resin when cut. T., *Alupag maesin*.

Two species of this genus, *Sautiria maingayi*, and *S. laevigata* are credited to the Philippines by F.-Villar.<sup>1</sup> The former is *Canarium gracile*, according to Vidal<sup>2</sup> where he cites the Tayabas specimen, which Villar quotes as having seen in Vidal's herbarium. The latter is undeterminable, but F.-Villar's identification is undoubtedly erroneous.

## MELIACEE.

*Aglaia apoana*, sp. nov. § *Hearnia*.

A tree about 8 m. high, with unequally pinnate, 3-jugate leaves, the leaflets with a subprominent marginal nerve, and lax panicles about as long as the leaves, densely ferruginous-stellate pubescent. Branches densely stellate-ferruginous pubescent. Leaves alternate, about 30 cm. long, the petiole and rhachis 12 cm. long, densely stellate-ferruginous pubescent; leaflets membranous, elliptical-oblong to broadly oblong-lanceolate, opposite, short acuminate, the nerves prominent beneath, anastomosing and forming a marginal nerve about as prominent as the lateral nerves, the reticulations lax, the midrib on both surfaces stellate-ferruginous pubescent, the lateral nerves and lamina with few scattered stellate hairs, becoming glabrous or nearly so; terminal leaflet 17 cm. long, 5 cm. wide, the base acute, nerves about 23 on each side of the midrib; lateral leaflets rounded or subcordate at the base, 3 to 3.5 cm. wide, the lower ones 5 to 6 cm. long, with about 12 pairs of nerves, the upper ones 13 cm. long, with about 18 pairs of nerves; petiolules stout, densely ferruginous-stellate pubescent, 3 to 4 mm. long. Panicles lax, about 30 cm. long, densely ferruginous-stellate pubescent, the branches spreading, the lower ones 15 cm. long, the branchlets densely flowered, 3 cm. long or less. Flowers small, the pedicels about 1 mm. long. Calyx 5-cleft, densely stellate pubescent, the teeth acute. Petals 5, free, glabrous, elliptical, obtuse, 1.3 mm. long. Staminal tube glabrous, the margin slightly crenate. Stamens 5, borne on the margin of the tube, the anthers 0.3 mm. long. Ovary stellate-pubescent.

Type specimen collected by E. B. Copeland, without number, Mount Apo, District of Davao, Mindanao, October, 1904. A species apparently related to the Bornean *A. villosa*, ex. description, but differing from that species in its 3-jugate leaves, smaller, membranous, more numerous nerved leaflets, and other characters.

*Aglaia glomerata*, sp. nov.

A tree about 15 m. high, with 3-jugate, more or less stellate-pubescent leaves and axillary panicles one-half to two-thirds as long as the leaves, the minute flowers glomerate on the panicle branchlets. Branches light gray, striate, glabrous, the younger parts densely rufous-stellate-pubescent.

<sup>1</sup> Nov. App. 40. 1880.

<sup>2</sup> Rev. Pl. Vasc. Filip. 80. 1886.



Leaves 15 to 20 cm. long, the rachis with the petiole 8 cm. long, densely stellate-rufous-pubescent like the younger branches and inflorescence; leaflets oblong to broadly oblanceolate, 7 to 12 cm. long, 2.5 to 4 cm. wide, sharp acuminate, the base acute or subobtuse, often inequilateral, the upper surface glabrous except for few stellate hairs on the midrib and nerves, the lower surface pale, uniformly, but not densely ferruginous-stellate-pubescent, the midrib more densely so; nerves 12 to 14 on each side of the midrib; petiolules densely rufous-stellate-pubescent, about 2 mm. long, that of the terminal leaflet about 5 mm. long. Panicles 10 cm. long, the lower branches 4 cm. long, the upper ones gradually shorter, the branchlets densely glomerate flowered throughout. Flowers short pedicelled yellowish brown, fragrant. Calyx stellate-pubescent, 5-cleft, the teeth acute. Petals glabrous, obovate to oblong-obovate, obtuse, 1 mm. long. Staminal tube somewhat shorter than the petals, obscurely 5-toothed, the stamens 5, inserted near the apex of the tube, included, the anthers about 0.2 mm. long.

Type specimen: Island of Masbate (2524 Clark), October, 1904. A species said by the collector to be common in the dense hill forests at an altitude of about 100 m. above the sea, apparently related to *Aglaia palembanica* Miq., which has been reported from the Philippines by Perkins,<sup>1</sup> but differing from that species in its 3-jugate leaves, larger leaflets, smaller panicles, and longer petals.

***Aglaia laevigata*, sp. nov.**

A small or medium sized, tree, nearly glabrous throughout, the leaves and inflorescence turning black when dry, with 5 to 6 jugate leaves, and long peduncled panicles nearly equaling the leaves, the flowers rather long pedicellate, spicately disposed. Branches brown or black, lenticellate, when young sparingly lepidote, becoming glabrous. Leaves 20 to 28 cm. long, the rachis with the petiole 12 to 18 cm. long, black, glabrous; leaflets lanceolate to ovate lanceolate, dark when dry, entirely glabrous, subopposite, the apex acuminate, the acumen blunt, the base strongly inequilateral, rounded on the upper half, acute on the lower, 5 to 9 cm. long, 2 to 3.5 cm. wide; nerves about 15 pairs, obscure; petiolules 2 to 3 mm. long. Panicles glabrous, 15 to 20 cm. long, the peduncle 5 to 7 cm. long, the branches ascending, the lower ones 5 to 7 cm. long. Flowers numerous, alternate, their pedicels 2 to 4 mm. long. Calyx shortly 5-toothed, the margins slightly ciliate. Petals glabrous, oblong, obtuse, 2.5 mm. long. Staminal tube about 1.6 mm. long, truncate, the anthers inserted below, included, large, ovate, 1 mm. long. Ovary slightly pubescent.

Type specimen: Bosoboso, Province of Rizal, Luzon (2818 Merrill), July, 1903.

***Aglaia pauciflora*, sp. nov. § *Hearnia*.**

A tree about 10 m. high, with alternate, 5-jugate leaves, the branches, petioles, petiolules, and midribs of the leaflets more or less densely ferruginous stellate pubescent, the inflorescence of stout, few branched, axillary

<sup>1</sup> Frag. Fl. Philip., 34. 1904.

panicles, 10 to 15 cm. long. Leaves about 45 cm. long, the rhachis 30 cm. long; leaflets thinly coriaceous, pale when dry, elliptical ovate to obovate, the base rounded or somewhat cordate or nearly acute, the apex obtuse to broadly obscurely blunt acuminate, 11 to 17 cm. long, 5 to 8 cm. wide; nerves about 15 pairs, spreading-ascending, the midrib and lower portions of the nerves more or less stellate ferruginous pubescent, the lamina frequently with scattered stellate hairs, becoming glabrous; petiolules stout, about 1 cm. long. Panicles densely ferruginous stellate pubescent, the few branches spreading or ascending, 1.5 to 3 cm. long. Flowers few, 2 mm. in diameter, nearly sessile. Calyx 5-lobed, ferruginous stellate pubescent. Petals orbicular, glabrous, about 1 mm. long. Staminal tube very short, 0.5 mm. long, slightly erenate, the 5 stamens borne on the margin of the tube. Fruit globose, orange yellow, rusty pubescent, about 3 cm. in diameter, 1-celled, 1-seeded, the pericarp crustaceous when dry.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (6699 Elmer), November, 1904.

**Dysoxylum pauciflorum**, sp. nov.

A small or medium sized tree with alternate evenly pinnate 4 to 5 jugate leaves 20 to 30 cm. long, axillary lax, few flowered panicles 10 to 15 cm. long, appearing with the leaves, gamosepalous calyx and pubescent corolla. Branches light brown, densely pubescent. Leaves alternate, the petiole and rhachis slender, densely pubescent, 15 to 20 cm. long, the petiole proper 2.5 to 3.5 cm. long; leaflets opposite, membranous, oblong, the upper ones gradually larger, 9 to 24 cm. long, 2 to 5 cm. wide, the apex abruptly acuminate, the base acute, often slightly inequilateral, the midrib above and beneath densely softly pubescent, the lower surface more or less pubescent with soft hairs; nerves about 12 pairs, spreading, freely anastomosing; petiolules densely pubescent, 1 to 2 mm. long. Panicles simple, slender, the rhachis and branches densely pubescent, the latter scattered, few, almost filiform, spreading, 2 to 4 cm. long, each with but from 1 to 5 flowers, the pedicels about 5 mm. long. Calyx cup-shaped, about 3 mm. long, pubescent, coarsely 4-toothed. Corolla 15 mm. long, more or less united with the staminal tube below, the outside nearly glabrous below, densely pubescent above. Staminal tube cylindrical, glabrous outside, hirsute on the lower part within, irregularly toothed. Stamens 8, 1.5 mm. long. Disk cylindrical glabrous, 2.5 to 3 mm. long. Style equaling the staminal tube, glabrous above, densely hirsute below. Fruit subglobose, apiculate red when mature, slightly pubescent, about 2 cm. in diameter.

Type specimen: Mountban, Province of Rizal, Luzon (2430 Ahern's collector), January, 1904 (flower); also Bosoboso (3109 Ahern's collector), May, 1905 (fruit).

**Dysoxylum rubrum**, sp. nov. § *Eudysoxylum*.

A small or medium sized tree with alternate, glabrous, 3 to 4 jugate leaves, the panicles short, few flowered, in the leaf axils on the younger branchlets. Branches light brown, lenticellate, ferruginous pubescent or puberulent. Leaves 18 to 25 cm. long, unequally pinnate, the leaflets opposite, the rhachis with petiole, 10 to 15 cm. long, glabrous or nearly



so, the petiole proper about 5 cm. long, prominently channeled above. Leaflets membranous, glabrous, usually reddish when dry, oblong-ovate to elliptical-ovate, 10 to 20 cm. long, 3 to 7 cm. wide, the apex usually abruptly short caudate-acuminate, the acumen blunt, the base acute, equal or slightly inequilateral; nerves about 8 on each side of the midrib, curved upwards, obscurely anastomosing, the reticulations lax, very faint; petiolules 3 to 5 mm. long. Panicles axillary, on the leaf-bearing branchlets, 8 cm. long or less, few flowered, slightly ferruginous furfuraceous-pubescent, the branches few, spreading, the lower ones about 2 cm. long. Flowers greenish white. Calyx with 5 obscure teeth, sparingly pubescent. Petals, 5 or sometimes 6, very slightly pubescent towards the apex with few scattered hairs, 10 to 11 mm. long, about 2.5 mm. wide. Staminal tube 8 to 9 mm. long, glabrous, free from the petals, the apex irregularly obscurely toothed. Stamens 10, sometimes 11, inserted near the apex of the tube, included; anthers 1 mm. long. Disk about 1.5 mm. long, only slightly exceeding the ovary. Ovary densely pubescent, 4-celled; style pubescent below; stigma discoid. Fruit subglobose, dehiscent, glabrous, red when mature, about 2.5 cm. in diameter; seeds usually 4, oblong, slightly compressed, nearly 2 cm. long.

Type specimen: Lamao River, Province of Bataan, Luzon (1293 Whitford), May 18, 1905 (flower), and also from the same locality (2013 Borden), October, 1904 (fruit). No. 871 Whitford, Gumaea, Province of Tayabas, Luzon, September, 1904, is also referred here, and No. 3108 Ahern's collector, Bosoboso, Province of Rizal, Luzon, May, 1905. A tree growing in the hill forests at altitudes of from 10 to 180 m. above the sea, reaching a height of about 20 m.

## MALPHIGIACEÆ.

### *Hiptage luzonica*, sp. nov.

A scandent shrub with ovate to lanceolate, acuminate, somewhat pubescent leaves 6 cm. long or less, pubescent racemes, and small fruits. Branches dark brown, lenticellate, glabrous, the young branchlets densely appressed fulvous-pubescent. Leaves subcoriaceous, 4 to 6 cm. long, 1 to 2.3 cm. wide, the base acute, the apex sharp or blunt acuminate, glabrous and shining above, beneath sparingly pubescent with scattered, appressed, shining, pale, or fulvous hairs; nerves not prominent, 5 to 6 pairs; petioles 3 to 4 mm. long, densely fulvous pubescent. Racemes densely appressed pubescent, 3 to 5 cm. long, the pedicels slender, about 1 cm. long. Flowers 1.5 cm. in diameter or less. Calyx 3 mm. long, densely cinereous-pubescent, with a single large gland, lobes obtuse. Petals densely sericeous pubescent outside, clawed. Fruit small, somewhat ferruginous pubescent, the wings glabrous or nearly so, the middle one about 1.5 cm. long, 5 mm. wide, the lateral ones less than 1 cm. long.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (1148 Whitford), March 24, 1905. A scandent shrub clambering over low trees on exposed ridges at an altitude of 910 m. above the sea.

## POLYGALACEÆ.

*Xanthophyllum glandulosum*, sp. nov.

A medium-sized tree with glabrous shining yellowish leaves, many flowered panicles equaling or somewhat exceeding the leaves, the ovary glabrous, 10 to 11 ovuled, the style pubescent. Branches yellowish brown, glabrous, shining, the branchlets pubescent. Leaves subcoriaceous, oblong ovate to elliptical ovate, 9 to 13 cm. long, 4 to 6.5 cm. wide, acuminate, the base acute, glabrous and shining on both surfaces, the lower surface slightly paler than the upper and with two or three large glands near the insertion of the petiole; primary nerves 5 to 6 on each side of the midrib, somewhat prominent beneath, curved-ascending, irregular, the reticulations lax; petioles 3 to 4 mm. long, slightly pubescent. Panicles many flowered, axillary and terminal, 8 to 13 cm. long, densely cinereous pubescent. Flowers 7 to 8 mm. long, their pedicels 4 mm. long or less, the bracteoles 1 to 3 mm. long. Sepals unequal, ovate to elliptical, 3 to 4 mm. long, obtuse, densely puberulous. Petals glabrous, except the somewhat pubescent keel. Filaments somewhat thickened and pubescent below. Ovary glabrous, its stalk nearly 1 mm. long; style densely pubescent. Disk a thickened glabrous ring.

Type specimen: Bosoboso, Province of Rizal, Luzon (3107 Ahern's collector), May, 1905; also from the same province, Tanay (2335 Merrill), May, 1903; Bosoboso (2826 Merrill), July, 1903.

## DICHAPETALACEÆ.

*Dichapetalum monospermum*, sp. nov.

A shrub or slender tree 5 to 8 m. high, with broadly lanceolate to broadly oblanceolate, acuminate, membranous, glabrous leaves, axillary, almost sessile, fasciculate cymes shorter than the petioles and slightly falcate, rugose, 1-seeded drupes. Branches light gray, glabrous, striate, the branchlets more or less cinereous pubescent. Leaves alternate, 10 to 20 cm. long, 3.5 to 7 cm. wide, narrowed below to the acute, equilateral base, the apex rather abruptly acuminate; nerves 6 to 7 on each side of the midrib, somewhat prominent, curved ascending, the reticulations rather lax; petioles glabrous or nearly so, rugose, 5 to 10 mm. long. Cymes almost sessile, several in each axil, shorter than the petiole, the peduncle, pedicels, and calyces uniformly densely cinereous pubescent, the pedicels 2 to 3 mm. long, the flower buds subglobose. Flowers yellowish or greenish white, about 4 mm. long. Calyx lobes oblong ovate, acute, about 3 mm. long, glabrous inside, slightly united below. Petals narrowly oblong, glabrous, 4 mm. long, 1 mm. wide, free, slightly notched at the apex, the lobes subacute, 0.3 mm. long, the keel inside obscure. Stamens free, glabrous, slightly shorter than the petals, the anthers 0.6 mm. long. Disk scales opposite the petals, thick, glabrous, about 1 mm. long. Ovary free, densely cinereous pubescent, 1-celled, the cell 2-ovuled. Drupe yellow when mature, oblong, slightly falcate, rugose, more or less cinereous pubescent, about 1.7 cm.

long, 1 cm. thick, 1-celled, 1-seeded, the seed similar in shape to the drupe but much smaller, about 1 cm. long.

Specimens examined, all from Mindoro: Baco River (230 McGregor), April, 1905 (flowers and fruits); (1801 Merrill), April, 1903 (immature flowers), specimens growing in very humid river forest; Puerto Galera (3323 Merrill), October, 1903 (fruit), growing in the lower hill forests.

**Dichapetalum tricapsulare** (Blanco) *Riana tricapsularis* Blanco, Fl. Filip. ed. 1. 850. 1837; ed. 2. 126. 1845; ed. 3. 1:225. Merrill, Govt. Lab. Publ. 27:32. 1905. *Chaillietia helferiana* F.-Vill. Nov. App. 45. 1880, non Kurz.

A small shrub 1 to 5 m. high, with lanceolate or oblong lanceolate, acuminate, somewhat inequilateral pubescent leaves, and axillary inflorescence, the entire inflorescence including the calyces densely villous pubescent. Branches densely villous pubescent, the older ones becoming glabrous and reddish brown. Leaves 8 to 12 cm. long, 1 to 3 cm. wide, blunt acuminate, the base acute, the margins entire, the midrib above villous pubescent, the lamina and margins with scattered hairs, also more or less villous pubescent beneath; nerves about 8 pairs, ascending; petioles densely villous pubescent, about 2 mm. long. Cymes very short, few flowered. Flowers (immature) with petals shorter than the sepals, cleft at the apex, glabrous, elliptical ovate, slightly exceeding 1 mm. in length. Anthers 1 mm. long. Fruit salmon pink, orbicular-ovoid somewhat triangular, densely cinereous pubescent, 3-valved, 3-celled, dehiscent, the cells 1-seeded, the seeds about 12 mm. long.

Specimens examined, all from Mount Mariveles, Province of Batuan, Luzon, where the species is rather common on wooded slopes above 800 m.: (3191 Merrill), October, 1903 (fruit); (145 Barnes), January, 1904 (fruit); (6642 Elmer), November, 1904 (fruit); (2842 Meyer), March 1905 (immature flowers). The above specimens agree very closely with Blanco's description, and certainly represent his *Riana tricapsularis*, which is apparently a very distinct species of *Dichapetalum*.

## EUPHORBIACEÆ.

### **Endospermum peltatum**, sp. nov.

A large tree, 25 to 30 m. high, with thickened branchlets, the leaf scars large and prominent, and suborbicular to broadly ovate, acute, or obtuse, strongly peltate to deeply cordate leaves, 13 to 20 cm. long. Branchlets brownish gray, 1 to 1.5 cm. in diameter, densely pubescent, the numerous leaf scars about 1 cm. in diameter. Leaves crowded at the apices of the branchlets, 10 to 18 cm. wide, entire or somewhat repand above, the base truncate to deeply cordate, the petiole often inserted 3 or 4 cm. from the margin, palmately 7 to 9 nerved, the nerves rather prominent on both surfaces, dark colored and pubescent above, becoming nearly glabrous, beneath pale, densely pubescent, with two large glands at the insertion of the petiole, and with few smaller glands at the ramifications of the nerves

near the margins; petioles 10 to 15 cm. long, densely pubescent. Inflorescence axillary, densely pubescent. Male flowers whitish, numerous, paniculate, the panicles 10 to 20 cm. long, the longer branches about 5 cm. long. Calyx 2 mm. long, obovoid, truncate, or very obscurely 5-toothed, densely grayish pubescent, the pedicel 1 mm. long or less. Stamens about 10, the staminal column somewhat exserted. Female flowers in narrow few flowered panicles 8 to 14 cm. long, the branches few flowered, 1 to 2 cm. long. Calyx similar to that of the male flower, but somewhat larger. Ovary 4-celled, each cell with one ovule; styles connate, forming a 4-lobed disk. Fruit ovoid, entire, glabrous or nearly so, 1 cm. long, crowned by the persistent stigmas, the calyx also persistent, the epicarp somewhat fleshy, inclosing two indehiscent cocci about 7 mm. long.

Specimens examined, all from Luzon: Province of Bataan, Mount Mari-veles (716, 1669, 1672 Borden), May and August, 1904; Province of Rizal, Bosoboso (2700 Merrill), June, 1903 (female flowers); Province of Tayabas, Pagbilao (2603 Merrill), April, 1903. T., *Indang*, *Callueoy*.

No species of this genus has previously been reported from the Philippines, the species here proposed being apparently related to *Endospermum chinense* Benth., from Hongkong, *E. borneense* Muell. Arg., from Borneo and *E. formicarium* Becc., from New Guinea, but is apparently sufficiently distinct from all these species. A tree growing in the lower hill forests, with exceedingly variable leaves, strongly peltate and deeply cordate leaves being frequently found on the same branchlet.

**Macaranga hispida** (Blume.) Muell. Arg. in DC. Prodr. 15<sup>2</sup>:990. 1862.

*Mappa hispida* Blume.

This species, previously known only from the Moluccas, is apparently well represented by No. 202 McGregor, Baco River, Mindoro, April, 1905 (male flowers), and No. 316 Ahern, Surigao, Mindanao, 1901 (fruit).

## ACERACEÆ.

**Acer philippinum**, sp. nov. § *Integrifolia*.

A tree 8 to 12 m. high with simple, entire, acuminate, glabrous leaves which are glaucous beneath, and short axillary, glabrous racemes, the stamens long exserted. Branches glabrous, dark reddish brown, nearly black when dry. Leaves elliptical ovate, subcoriaceous, dark above when dry, very glaucous beneath, 7 to 11 cm. long, 3 to 5.5 cm. wide, the apex slender acuminate, the acumen blunt, the base cuneate, 3-nerved; lateral nerves 5 to 6 on each side of the midrib, irregular, ascending, prominent, the reticulations dense; petioles slender, glabrous, 2 to 5 cm. long. Racemes axillary, glabrous, 1 to 2 cm. long, contemporary with the leaves, with 4 to 6 imbricated, subdistichous bracts at the base. Male flowers greenish white, 3 to 4 mm. long including the stamens. Sepals 5, linear or oblong linear, 1.5 to 2 mm. long. Petals similar to and equaling the sepals. Stamens 8, the filaments slender, glabrous, 3 to 4 mm. long; anthers 0.7 mm. long. Ovary 2-lobed, densely pilose; style bipartite, the lobes divaricate, recurved. Fruit unknown.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (3872 Merrill), August, 1904. A small tree rather common on exposed forested ridges at an altitude of about 1,000 m. Related to *Acer nivicum* Blume and *A. oblongum* Wall., differing from both species in the cuneate base of the leaves, from *Acer nivicum* also in its exserted stamens, and from *A. oblongum* in its racemose inflorescence.

No species of this family has previously been reported from the Philippines, although *Acer nivicum* Blume is generally distributed in the Malayan region, and two species of the genus are known from Hongkong.

## RHAMNACEÆ.

### *Zizyphus inermis*, sp. nov.

A medium-sized tree with spineless branches, broadly lanceolate, oblong lanceolate to lanceolate, membranous, glabrous, equilateral, evenly 3-nerved leaves, and axillary short peduncled cymes but slightly longer than the petioles. Branches slender, glabrous, dark brown, lenticellate, the branchlets fulvous pubescent. Leaves 8 to 13 cm. long, 2.5 to 5 cm. wide, the base acute, regular, the apex acuminate, entirely glabrous except for the slightly pubescent nerves on the lower surface, strongly 3-nerved from the base, the nerves continuing to the apex, unbranched, and with a pair of faint submarginal nerves formed by the anastomosing of the transverse nerves, and not more prominent than the latter, the lateral nerves numerous, spreading, freely anastomosing, those outside the longitudinal nerves not more prominent than those between the midrib and the longitudinal nerves; petioles slightly pubescent, about 1 cm. long. Cymes densely fulvous pubescent, 5 to 15 flowered, 1 to 1.5 cm. long, the peduncle and pedicels about 2 mm. long. Flowers yellowish, 5 mm. across. Sepals spreading, ovate, acute, 2.5 mm. long, more or less fulvous pubescent outside. Petals oblong, 1.8 mm. long, less than 1 mm. wide, cucullate. Stamens 5, the filaments 1.5 mm. long. Disc glabrous, rugose. Ovary surrounded and inclosed by the disc but free, glabrous, 3-celled; styles short. Fruit unknown.

Type specimen: Bosoboso, Province of Rizal, Luzon (3075 Ahern's collector), May, 1905. A species characterized by its equilateral glabrous, membranous leaves and spineless branches.

## VITACEÆ.

### *Leea magnifolia*, sp. nov. § *Paucifoliolosac*.

A subscandent shrub or suberect suffrutescent plant, with very large, simple, serrate leaves 40 to 80 cm. long, and axillary congested inflorescence not exceeding 7 cm. in length. Stems 1 to 2 cm. or more in diameter, brown, strongly sulcate when dry, more or less hirsute. Leaves alternate, membranous, glabrous or nearly so, glandular beneath, oblong-obovate, 40 to 80 cm. long, 20 to 40 cm. wide, the margins twice serrate, the larger somewhat repand teeth at the ends of the lateral nerves, the whole margin irregularly moderately serrate, apex short abruptly acuminate, gradually



narrowed below to the abruptly rounded-obtuse base, the basal portion 4 to 7 cm. wide below; nerves prominent, 16 to 18 on each side of the midrib, spreading-ascending, straight, often forked above, not anastomosing, the reticulations rather lax, somewhat prominent on the lower surface; petioles about 8 cm. long, 1 cm. thick, stout, striate, more or less ferruginous hirsute, deeply sulcate and wing margined on the upper side, the wings coriaceous, about 6 mm. wide. Cymes axillary, congested, the inflorescence 5 to 7 cm. long, the primary branches 2 to 3 cm. long, the flowers crowded in dense subglobose heads about 2 to 3 cm. in diameter. Flowers greenish white, their pedicels 3 to 4 mm. long. Calyx green, glabrous, membranous, punctate, about 4 mm. long, the four teeth about 1 mm. long, broadly triangular, acute. Corolla 7 mm. long, glabrous, 4-lobed, the lobes white, their tips somewhat lavender, reflexed, oblong ovate, acute, glabrous, 4 to 4.5 mm. long, 2.5 mm. wide. Staminal tube 4-lobed, the four anthers connate with and included in the tube. Ovary subglobose, 4-celled, glabrous, the style about 2 mm. long. Fruit subglobose, somewhat flattened, 3-celled, each cell 1-seeded, more or less sulcate between the cells when dry, glabrous, about 1.2 cm. wide.

Baco River, Mindoro (187 McGregor), April, 1905 (flower), suberect, suffrutescent, about 2 m. high, in very humid forests; (644 Whitford). Atimonan, Tayabas Province, Luzon, August, 1904 (fruit). A large vine along the beds of dry streams in forests, the stem more or less prostrate, rooting at the nodes when in contact with the ground, the branches erect.

## ELAEOCARPACEÆ.

### *Elaeocarpus macranthus*, sp. nov.

A large tree with oblong, acuminate, entire or somewhat crenate leaves, crowded with the inflorescence at the apices of the usually thickened branches, the racemes about equaling the leaves, the flowers 1.5 cm. long, 5-merous, the stamens indefinite, one cell of the anther short awned, the ovary 4 to 5 celled, cells many ovuled. Branches light gray, glabrous, the younger parts densely pubescent. Leaves 12 to 15 cm. long, 4 to 4.5 cm. wide, subcoriaceous, glabrous and shining above, sparingly pubescent beneath, the base somewhat rounded or abruptly acute; nerves about 10 on each side of the midrib; petioles 4 to 5 cm. long, the rachis, pedicels, and calyces densely uniformly brownish pubescent. Flowers yellowish, their pedicels 1 to 1.5 cm. long. Sepals broadly lanceolate, 14 mm. long, 5 mm. wide, tapering to the acute apex, glabrous within. Petals slightly exceeding the sepals, densely appressed silky pubescent outside, 3-lobed at the apex, the lobes laciniate fringed. Stamens indefinite, the filaments 2 mm. long or less, the anthers 4 to 5 mm. long, minutely pubescent, one cell with a short apical awn 1 mm. long or less. Ovary pubescent; style glabrous, at least above, 3 to 4 mm. long. Drupe globose to ellipsoid-globose, pubescent, becoming nearly glabrous, 2 to 2.5 cm. in diameter, the stone vertically 10-grooved, 5-celled, usually but one cell with seed.

Specimens examined, all from the Province of Rizal, Luzon: (2688 and

2897 (type) Ahern's collector), February and March, 1905, the former with immature, the latter with mature flowers; (1883 and 2298 Merrill), April and May, 1903 (fruit).

## TILIACEÆ.

**Brownlowia lanceolata**, Benth. Journ. Linn. Soc. Bot. 5: Suppl. 2:27. 1861; Hook. f. Fl. Brit. Ind. 1:381. 1874; King. Journ. As. Soc. Beng. 60:97. 1891.

This tidal forest tree, previously known from Burma, Bengal and Malacca, has recently been collected in the Philippines, thus considerably extending the known range of the species. (No. 894 Whitford), Gumaca, Province of Tayabas, Luzon, September, 1904, a small tree growing in the "Nipa formation." The specimen is with immature fruit, but agrees perfectly with the description of the species and with specimens in the Herbarium of this Bureau collected by D. Prain at Malanchi, Sundribums near Calcutta, August 5, 1902.

## MALVACEÆ.

**Hibiscus bicalyculatus**, sp. nov. § *Ketmia*.

A shrub or small tree with stellate pubescent, 3-lobed leaves, and large yellow flowers, the bracteoles connate for one-half their length, forming an inflated calyx-like involucre, the calyx inflated but not ventricose, about 5 cm. long. Branches densely cinereous pubescent, pale. Leaves 9 to 12 cm. long, nearly as wide, the base strongly cordate, the sinus usually narrow, 1.5 to 2.5 cm. deep, the basal lobes broad, rounded, the leaf above 3-lobed, the lobes broad, acuminate, upper surface scabrous, more or less stellate pubescent, especially on the nerves, the lower surface pale, very densely stellate pubescent throughout; basal nerves 7, distinct, the reticulations lax; petiole cinereous pubescent, 4 to 6 cm. long. Flower yellow, about 8 cm. long, axillary, solitary, the pedicel stellate pubescent, often 20 cm. long. Bracteoles 5, ovate, acute, about 1 cm. wide, connate and inflated below, free from the calyx, ultimately split down one side, subcoriaceous, yellowish brown, densely pubescent, 2.5 cm. long. Calyx 4.5 to 5 cm. long, about 2 cm. in diameter, inflated, yellowish gray when dry, very densely stellate pubescent outside, and with numerous long hispid hairs, glabrous inside, the lobes ovate-oblong, acute or acuminate, 1.5 to 2 cm. long, about 1 cm. wide. Petals about 8 cm. long, 3 cm. wide above, the apex rounded, much narrowed below and densely bearded on the inside at the insertion of the staminal tube. Staminal tube glabrous, about 9 cm. long, antheriferous for the upper 3 cm.; filaments 1 cm. long; anthers about 3 mm. long. Ovary oblong ovoid, 1 cm. long, glabrous, 5-celled, each cell many ovuled.

Montalban, Province of Rizal, Luzon (2450 Ahern's collector), January, 1905. A shrub or small tree growing in thickets and along borders of the forests, the connate bracteoles forming an involucre similar to and about one-half as long as the calyx.



## STERCULIACEÆ.

***Sterculia brevipetiolata*, sp. nov.**

A shrub or small tree 5 to 10 m. high, with membranous, short petioled, glabrous, narrowly to broadly lanceolate or oblanceolate leaves, slender, few flowered, drooping panicles 10 to 20 cm. long, the tips of the calyx lobes slightly coherent. Branches slender, brownish gray, glabrous, the tips usually densely ferruginous stellate pubescent. Leaves 10 to 22 cm. long, 2 to 5 cm. wide somewhat crowded at the apices of the branchlets, tapering below to the narrow, abruptly obtuse or slightly cordate base, the apex slender acuminate; nerves, 10 to 12 pairs; petioles 4 to 7 cm. long, thickened, densely ferruginous stellate pubescent, the stipules persistent, 1 cm. long or less, subulate. Panicles slender, axillary, more or less ferruginous stellate pubescent, the branches filiform, 1 to 4 flowered, the pedicels 1 to 2 cm. long. Flowers dull yellow, 7 to 10 mm. long, sparingly stellate pubescent outside, the tube urceolate, about as long as the lobes, the lobes 5, lanceolate, subulate, villous within. Male flowers: staminal column slender, shorter than the calyx tube, slightly curved, bearing at its apex about 8 broad, sessile anthers. Hermaphrodite flowers: ovary villous, the anthers at the base, sessile or nearly so; style short, stout, pubescent. Follicles coriaceous, 2 to 4, sessile, oblong, slightly curved, the apex slightly acuminate, densely rusty pubescent outside, glabrous within, 5 to 7 cm. long, 2 cm. wide or less, the seeds 3 or 4, about 1.3 cm. long.

Specimens examined Luzon, Province of Bataan, Lamao River (1907 Borden), September, 1904; (200 Barnes), January, 1904 (fruit); (6829 Elmer), November 1904. Pasacao, Province of Camarines Sur (60 Ahern), February, 1902. Growing in hill forests at from 300 to 500 m. above the sea.

***Sterculia montana*, sp. nov.**

A tree about 10 m. high, with elliptical to obovate-elliptical, cordate, very abruptly short acuminate leaves, glabrous above, densely pale, velvety stellate pubescent beneath, and short, erect, few flowered panicles. Branches striate, dark grayish brown pubescent, the tips densely rusty pubescent. Leaves 9 to 13 cm. long, 6 to 8 cm. wide, subcoriaceous, shining above; nerves about 8 on each side of the midrib, prominent beneath, sparingly stellate pubescent, brown, in strong contrast to the pale surface of the lamina; petioles about 3 cm. long, sparingly ferruginous stellate-pubescent. Panicles 4 to 6 cm. long, slender, strict, narrow, erect, axillary, the axis, short branches, and pedicels more or less stellate pubescent, the branches 1 cm. long, few flowered, erect or ascending, mostly in the upper part of the panicle. Flowers about 1 cm. long, densely ferruginous pubescent, the tube urceolate, nearly as long as the lobes, the lobes 5, hirsute within, not coherent at their tips. Male flowers: staminal column very short, bearing numerous sessile anthers in a sessile mass. Hermaphrodite flowers: gynophore short; ovaries 5, pubescent; stigmas recurved; stamens numerous, sessile, surrounding the base of the ovaries. Follicle unknown.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (6761 Elmer), November, 1904. A small or medium sized tree, apparently not common, on the exposed ridges at an altitude of about 1,200 m.

## DILLENIACEÆ.

### SAURAUIA.

1. Flowers in axillary, solitary, peduncled panicles about equalling or exceeding the leaves.
  2. Bracts large, foliaceous, broadly ovate, 2 to 3 cm. long.
    3. Inflorescence ample; styles 5; sepals lepidote..... (1) *S. latibracteata*
    3. Inflorescence few flowered; styles 3; sepals densely strigose-hirsute..... (2) *S. involocrata*
  2. Bracts small, linear or lanceolate ..... (3) *S. elegans*
1. Flowers in few-flowered, axillary, often fascicled cymes very much shorter than the leaves.
  2. Leaves densely brown pubescent beneath..... (4) *S. cinnamomea*
  2. Leaves not at all pubescent.
    3. Cells of the ovary and styles 3 ..... (5) *S. whitfordi*
    3. Cells of the ovary and styles 5 ..... (6) *S. subglabra*

- (1) *S. latibracteata* Choisy in Zoll. Syst. Verz. Ind. Archip. 148. 1854-55; Miq. Fl. Ind. Bat. 1<sup>2</sup>:479. 1859; Vidal, Sinopsis, Atlas, t. 13. f. B. 1883; Phan. Cuming. Philip. 96. 1885; Rev. Pl. Vasc. Filip. 56. 1886; Ceron, Cat. Pl. Herb. 23. 1892. *Saurauia cumingiana* DeVries, Pl. Ind. Bat. Or. 38. 1856-57.

Specimens examined: Philippines, without locality (1302 Cuming), 1836-1840, Luzon; Province of Laguna (455 Cuming), 1836-1840; Province of Albay (944 Cuming), 1836-1840; Province of Tayabas, Mount Banahao (887 Klemme), June, 1904; Atimonan (697 Whitford), August, 1904; Province of Rizal, Tanay (2295 Merrill), May, 1903.

- (2) *S. involocrata* Merrill, sp. nov.

A shrub about 5 m. high, with ovate-lanceolate, acuminate, strigose leaves, few flowered, axillary cymose, strongly bracteate inflorescence, the flowers with densely long-strigose-hirsute calyces, and glabrous 3-celled ovary. Branches brown, more or less strigose. Leaves membranous, 9 to 18 cm. long, 3 to 7 cm. wide, both surfaces beset with scattered, brown, strigose hairs, those beneath, especially on the nerves, longer than those above, the margins irregularly spinulose-serrate, the base acute, rounded or subcordate, the apex short acuminate; nerves about 12 on each side of the midrib, prominent beneath; petioles 1 to 1.5 cm. long, strigose. Inflorescence 4 to 8 cm. long, strigose, the peduncle 2 to 4 cm. long, the flowers subumbellate, few, 3 to 8, crowded, the branches, branchlets, and pedicels subtended by ovate to ovate-lanceolate bracts and bracteoles 1 to 2.5 cm. long, giving the appearance of an involucre subtending the flowers. Flowers white, odorless, about 1 cm. long. Sepals 8 mm. long, the three outer ones oblong-ovate, acute, densely strigose, the stiff bristle-like hairs 2.5 to 3.5 mm. long, the inner two oblanceolate, glabrous except for a few bristles on the median portion below. Petals 5, membranous, glabrous, obovate, irregularly, strongly sinuate-emarginate, undulate, 10

mm. long, 6 mm. wide, slightly united at the base. Stamens 20, the filaments 2 mm. long, the anthers 1.5 mm. long. Ovary ovoid, glabrous, 3-celled, 3 mm. long; styles 3, free, 4 mm. long.

Type specimen: Todaya, District of Davao, Mindanao (1273 Copeland), April, 1904.

A species growing in forests at an altitude of about 900 m. above the sea, resembling *Saurauia bracteosa* DC., in general appearance, but quite distinct from that species.

- (3) *S. elegans* (Choisy) F.-Vill. Nov. App. 19. 1880; *Scapha elegans* Choisy Mem. Ternst. 119. t. 1. 1855; *Saurauia rugosa* Turcz. Bull. Soc. Nat. Mosc. 31<sup>1</sup>:245. 1858; F.-Vill. l. c., Vidal Phan. Cuming. Philip. 96. 1885, Rev. Pl. Vasc. Filip. 57. 1886; Ceron, Cat. Pl. Herb. 23. 1892. *Saurauia exasperata* De Vriese Pl. Ind. Bat. Or. 56. 1856; Miq. Fl. Ind. Bat. 1<sup>2</sup>:483. 1859; Vidal l. cc., 96, 56; Ceron, l. c., 23; F.-Vill. l. c.

Specimens examined: Philippines (922 Cuming), 1836-1840 (cotype of *Saurauia rugosa* Turcz., and *Scapha elegans* Choisy); Province of Benguet, Baguio (5796 Elmer), March, 1904; (925 Barnes), May, 1904; (65 Topping), February, 1903; also a single specimen collected by Lardizabal, 1901.

*Saurauia rugosa* Turcz., and *S. elegans* Choisy, were both based on the same number of Cuming's Philippine collection, cited above, the latter name being the earlier is retained. Some doubt exists as to the exact identity of *Saurauia exasperata* DeVriese, the description given by Miquel apparently applying to the present species, but No. 455 Cuming, cited by Miquel in the description of the species, as represented in our herbarium, being identical with specimens of *Saurauia latibracteata* Choisy.

- (4) *S. cinnamomea* Merrill, sp. nov.

A shrub about 5 m. high, with oblong-ovate, sharply acuminate leaves, dark colored and nearly glabrous above, beneath densely pale brown pubescent, the inflorescence axillary, solitary or two or three peduncles from the same axil, each peduncle bearing about three flowers. Branches densely dark brown pubescent, more or less scaly, the older ones glabrous. Leaves 12 to 20 cm. long, 5 to 8 cm. wide, the margins finely spinulose-serrate, the base obtuse, often somewhat rounded, slightly inequilateral, the upper surface with few, scattered, scale like hairs, becoming glabrous or nearly so; nerves about 15 pairs; petioles densely brown pubescent, 1.5 to 2 cm. long. Whole inflorescence, including the sepals, densely dark brown scaly-pubescent, the peduncle 1 cm. long or less, bearing at the apex about three flowers, the pedicels 8 mm. long or less, the bracts very small. Flowers white. Sepals about 4 mm. long, ovate, obtuse. Petals ovate or obovate, about 5 mm. long, irregularly retuse. Stamens many. Ovary glabrous, 4-celled; styles 4, about 3 mm. long.

Type specimen: Tinauan River, Province of Tayabas (Infanta), Luzon (779 Whitford), September, 1904. A shrub growing in the forests at an elevation of about 80 m. above the sea. T., *Calap*.

- (5) *S. whitfordi* Merrill, sp. nov.

A shrub 3 to 4 m. high, with oblong-obovate to oblanceolate, nearly

glabrous leaves, the flowers in axillary solitary cymes 3 to 4 cm. long, the cells of the ovary and styles 3, rarely 4. Branches dark brown, nearly glabrous except for few scattered scales. Leaves 15 to 20 cm. long, 7 to 8 cm. wide, very short acuminate, narrowed below to the acute or slightly obtuse, somewhat inequilateral base, the margins spinulose-serrate, glabrous on both surfaces except for few scattered scales on the nerves beneath, the upper surface dark, the lower yellowish brown when dry, somewhat shiny; nerves about 12 pairs, prominent beneath; petioles 2 to 3 cm. long, more or less scaly. Cymes dichotomous, the peduncles, branches, pedicels, bracts, and calyx lobes scurfy-scaly, the peduncles 1.5 to 2 cm. long; bracts broadly ovate, nearly 1 cm. long, their margins spinulose-serrate. Flowers white. Calyx lobes ovate, obtuse, 5 to 6 mm. long, about 3.5 mm. wide. Petals obovate, about 8 mm. long. Stamens 20. Ovary glabrous, 3, rarely 4 celled. Fruit subglobose, 5 to 6 mm. in diameter, the seeds many, irregular, cuneate, nearly 1 mm. long.

Type specimen: Mount Banahao, Province of Tayabas, Luzon (1006 Whitford), October, 1904. A small shrub growing in the forests on the mountain slopes at an altitude of about 900 m. above the sea. A species related to the succeeding, but differing in its much larger bracts, smaller flowers, and 3, rarely 4 celled ovary.

(6) *S. subglabra* Merrill, sp. nov.

A shrub or small tree, 5 to 8 m. high, with oblong-ovate to oblong obovate, almost entirely glabrous leaves, the flowers nearly 2 cm. in diameter, in few flowered, axillary cymes 3 to 7 cm. long, the ovary-cells and styles 5. Branches brown, lenticellate, with few stiff scale like hairs and somewhat ferruginous lepidote, or nearly glabrous. Leaves 13 to 23 cm. long, 5 to 10 cm. wide, glabrous on both surfaces except for very few scattered appressed scales on the nerves beneath, the margins slightly undulate to obscurely serrate, the teeth with small hard scale like tips, the apex short acuminate or almost acute, the base somewhat obtuse or acute; nerves about 17 pairs, prominent beneath; petioles 2 to 3.5 cm. long, more or less brown lepidote and with few hard appressed scales. Inflorescence axillary, from 1 to 4 peduncles, from the same axil, each peduncle 1 to 4 flowered, the peduncles and pedicels slender, ferruginous-pubescent; bracts linear-oblong, 4 mm. long, 1 mm. wide, pubescent. Flowers white, odorless. Calyx 1.5 cm. in diameter, pubescent outside, 5-lobed, the lobes ovate, 5 to 6 mm. long, 4 to 5 mm. wide, obtuse. Petals obovate, retuse, about 1 cm. long, 8 mm. wide. Stamens many. Ovary glabrous, 5-celled; styles 5.

Type specimen: Lamao River, Mount Mariveles, Province of Bataan, Luzon (2767 Meyer), February, 1905; also from the same locality (268 Whitford), May, 1904. Apparently also belongs here, No. 6115 Elmer, Sablan, Province of Benguet, Luzon, April, 1904. A small tree growing on steep wooded slopes in cañons at an altitude of from 800 to 900 m. above the sea.

Doubtful and excluded species include the following: *Saurauia lanceolata* DC., a Javanese species credited to the Philippines by F. Villar,<sup>1</sup> who

<sup>1</sup> Nov. App., 19. 1880.

states that he saw specimens in Vidal's herbarium from Angat, Province of Bulacan, Luzon. Vidal in his "Revision" mentions no specimens of *Saurauia* from this locality. F.-Villar's identification was undoubtedly erroneous and the species should be excluded. *Saurauia ferox* Korth., a Malayan species extending from Sumatra to Borneo is questionably extended to the Philippines by Stapf<sup>1</sup> No. 1712 Cuming, Samar, being referred to the above species. Complete material is necessary to determine definitely its occurrence in the Philippines. *Saurauia reinwardtiana* Blume, credited to the Philippines by the author,<sup>2</sup> should be excluded for the present at least, as the specimen referred to this species does not agree with sufficient closeness to the description. However, the material is too imperfect definitely to determine what the species may be.

## THEACEÆ.

*Thea montana* (Blanco) Merrill, Govt. Lab. Publ. 27:21. 1905; *Salceda montana* Blanco, Fl. Filip. ed. 2, 374. 1845; ed. 3, 2:327. 1878. *Camellia lanceolata* F.-Vill. Nov. App. 19. 1880, non Seem. *Pyrenaria camelliaeflora* Vidal, Sinopsis, Atlas, t. 13. f. D. 1883, non Kurz. *Pyrenaria* sp. Vidal, Rev. Pl. Vasc. Filip. 57. 1886.

A shrub or small tree 2 to 6 m. high, with oblong-ovate to broadly lanceolate, acuminate, serrate leaves which are densely glandular punctate beneath, and axillary, sessile white flowers about 1.5 cm. in diameter, the stamens borne on the margin and interior of a well defined staminal tube, few free. Branches light gray or brown, glabrous, the ultimate branches sometimes with few scattered hairs. Leaves 6 to 10 cm. long, 2 to 4 cm. wide, alternate, subcoriaceous, minutely wrinkled-reticulate when dry, glabrous except for few scattered hairs beneath, the base acute, the apex short acuminate, the margins serrate except near the base; nerves 9 or 10 on each side of the midrib, spreading, anastomosing, not prominent, the reticulations very lax; petioles glabrous or sparingly pilose, 5 to 10 mm. long. Flowers fragrant. Sepals imbricate, the outer two small, bract like, the inner three coriaceous, broadly ovate, 6 to 7 mm. long, their margins minutely ciliate. Petals free, glabrous, oblong-ovate, obtuse, 1 cm. long. Staminal tube cylindrical, glabrous, 6 mm. long, the margin irregularly dentate. Stamens numerous, mostly sessile or nearly so on and near the margin of the tube, few with well developed filaments scattered on the interior of the tube, and few, 3 to 5 (or more ?), entirely free from the tube, inserted at the base of the ovary. Ovary narrowly ovoid, densely hirsute, 3-celled, the ovules few in each cell, arranged in two axillary rows; styles thick, united throughout, 2 mm. long; stigmas 3. Fruit subglobose or somewhat compressed vertically, 3 to 4 cm. in diameter, woody. Seeds mostly 2 in each cell, irregularly angularly compressed, 1 to 1.5 cm. in diameter.

This species is apparently common on the mountains of Luzon, and is

<sup>1</sup> Trans. Linn. Soc. Bot. 4:134. 1894.

<sup>2</sup> Forest. Bureau Bull. 1:39. 1903.



represented by the following specimens: Province of Bataan, Mount Mariveles (304, 441 Whitford), May and July, 1904; (6787, 6977 Elmer), November, 1904; (1905, 2378 Borden) and (2402 Meyer), January, 1905. Province of Tayabas, Mount Banahao (1007 Whitford), October, 1904. Province of Benguet, Mount Santo Tomas (5808 Elmer), March, 1904.

It was with some hesitation that Blanco's *Salceda montana* was identified with the species here described, as in one detail his description does not agree with the plant here considered. Blanco described his species as having 13 free stamens, while in the specimens enumerated above I have not found more than 5 free stamens, and usually but three. As in all other characters our specimens agree so well with Blanco's description, it is considered that the specimens here cited represent his species, which is apparently very distinct from others in the genus. If in the future, however, specimens are secured from the vicinity of Angat, Province of Bulacan, Luzon, the type locality of *Salceda montana* Blanco, that agree more closely with Blanco's description than do our specimens from Mount Banahao and Mount Mariveles, then the species here described will have to receive a new name. The species here considered is certainly represented by the figure in Vidal's Synopsis, cited above, to which in his Revision, Vidal refers No. 61 of his collection, from Mount Banahao. According to a manuscript list of identifications of Loher's Philippine Plants, made at Kew, No. 80 Loher is identical with No. 61 Vidal.

## VIOLACEÆ.

### *Rinorea copelandi*, sp. nov. § *Prothesia*.

A small tree 6 to 7 m. high, with oblong-obovate, membranous leaves which are narrowed to the acute base, and axillary, hirsute-pubescent, short, fascicled, cymose inflorescence, the anther cells and connectives appendaged. Branches light gray, almost white, somewhat pubescent, becoming glabrous, the younger portions densely ferruginous-pubescent with spreading hairs. Leaves 18 to 22 cm. long, 9 to 12 cm. wide, dark, glabrous and somewhat shining above, pale, shining and somewhat pubescent, especially on the midrib beneath, the apex short acuminate, the base acute, the margins obscurely glandular dentate or crenate-dentate; nerves about 18 on each side of the midrib, prominent beneath, spreading-ascending, the reticulations subparallel; petioles 1.5 to 2 cm. long, pubescent. Inflorescence of short, few-flowered cymes, 2 cm. long or less, or merely fascicled, the axis, branches, bracts, and calyx lobes uniformly, but not densely hirsute-pubescent. Flowers about 6 mm. long, pedicellate. Calyx lobes oblong-ovate, 2 mm. wide, obtuse. Petals elliptical-oblong, thin, glabrous, obtuse, 5 mm. long, 2 to 2.5 mm. wide. Stamens 5, inserted on an annular disk, the anthers including the appendages, broadly ovate, 1.6 mm. long; filaments short, broad; appendage of the connective suborbicular, 1 mm. in diameter, of the anther cells subulate, 0.5 mm. long. Ovary oblong, 2 mm. long, somewhat pubescent; style 2 mm. long glabrous. Fruit unknown.

Type specimen: Catalonan, District of Davao, Mindanao (943 Copeland), April, 1904.

## FLACOURTIACEÆ.

*Casearia solida*, sp. nov.

A shrub or small tree 2 to 6 m. high, with glabrous, oblong-ovate to elliptic-oblong, entire, acuminate leaves, which are acute and equilateral at the base, five parted calyx, the fertile stamens 8. Branches light gray, glabrous. Leaves subcoriaceous, shining and reticulate on both surfaces, paler beneath, 10 to 18 cm. long, 4 to 9 cm. wide, obscurely punctate, the apex short acuminate, the acumen blunt or sharp; nerves 7 or 8 pairs, spreading-ascending, anastomosing; petioles glabrous, 5 to 10 mm. long. Inflorescence in small axillary or extra-axillary fascicles, few flowered, the bracts ovate, imbricate, pubescent. Flowers nearly white, fragrant, the pedicels very short. Sepals 5, elliptical-ovate, obtuse, concave, rather densely pubescent outside. Fertile stamens 8, the glabrous filaments 1.5 mm. long; anthers 0.5 mm. long, the alternating staminodes narrowly oblong, 0.5 mm. wide, equaling the stamens, the apex densely bearded. Ovary 1.5 mm. long, ovoid, the stigma capitate, subsessile. Fruit glabrous, ovoid, to oblong-ovoid, bright red when mature, somewhat triangular, 2.5 cm. long or less, dehiscent by 3 valves. Seeds about 6 mm. long, irregularly subcompressed angular ovoid, arillate.

Specimens examined: Luzon, Province of Bataan, Mount Mariveles (2810 Meyer), March, 1905 (type): (3722, 2499 Merrill), January, June, 1904; (192, 526 Whitford), May, July, 1904: (626, 670, 1230 Borden), April, June, 1904; Province of Benguet, Twin Peaks (6460 Elmer), June 1904.

A species growing on steep forested slopes, common on Mount Mariveles from an altitude of 75 m. to at least 700 m. above the sea. Apparently related to *Casearia esculenta* Roxb., and doubtless the form referred to this species by F.-Villar.<sup>1</sup>

Although F.-Villar credits 10 species of this genus to the Philippines, but 3 or 4 are definitely known from the Archipelago at the present time. Of the species definitely known, *Casearia fuliginosa* Blanco and *C. cinerea* Turcz. are well established, while of *C. luzonensis* Warb., no description has apparently been published, this name being mentioned by Warburg.<sup>2</sup> The species is not mentioned in the text, nor is it listed in the first or second supplement to Index Kewensis. Most of the species listed by F.-Villar probably do not extend to the Philippines.

## RHIZOPHORACEÆ.

*Gynotroches parvifolia*, sp. nov.

A small tree 8 to 10 m. high, with subcoriaceous, glabrous, shining leaves 5 to 7 cm. long, and perfect flowers. Branches dark brown, striate, entirely glabrous. Leaves elliptical to obovate, short blunt acuminate, tapering to the base, entire, 2.5 to 3.5 cm. wide; main nerves 6 pairs, anastomosing; petioles 5 to 8 mm. long. Flowers green, in axillary,

<sup>1</sup> Nov. App. 93. 1880.

<sup>2</sup> Engler und Prantl, Nat. Pflanzenfam. III. 6A:51. 1893, sub. *Fig. 19*.



6 to 10 flowered fascicles, the glabrous pedicels jointed in the middle, 3 mm. long. Calyx glabrous, 4-lobed, the lobes ovate, acute, 1.5 cm. long, with a minute tuft of hairs at the apex. Petals 4, obovate, glabrous, fimbriate, about 2 mm. long. Stamens 8, the filaments about 1 mm. long, the anthers 0.3 mm. long. Ovary subglobose, glabrous; style less than 1 mm. long; stigma obscurely lobed.

Type specimen Mount Mariveles, Province of Bataan, Luzon (1173 Whitford) March, 1905. A tree growing on exposed ridges in the mossy forest at an altitude of about 1,200 m., related to *Gynotroches axillaris* Blume, but differing from that species in its much smaller, few nerved leaves and perfect flowers.

***Pellacalyx pustulata*, sp. nov.**

A small or medium sized tree with oblong nearly glabrous, acuminate leaves which are pustular-glandular beneath, and axillary, solitary, or fascicled, 5-merous flowers. Branches glabrous, light gray, the younger parts sparingly puberulous. Leaves 9 to 14 cm. long, 4 to 6 cm. wide, subcoriaceous, dark and shining above when dry, paler beneath and glabrous, or the midrib sparingly puberulous, the apex abruptly short blunt acuminate, the base acute, the margins entire or distantly, obscurely glandular toothed; nerves 9 to 10 on each side of the midrib, curved-ascending, prominent beneath; petioles stellate puberulous, 1 cm. long; stipules lanceolate, acuminate, 1 cm. long densely puberulous. Flowers white, fragrant, 1 to 5 in each axil, the pedicels slender, glabrous, 1 cm. long, minutely bracteate at the base, jointed at the base of the calyx. Calyx ebracteolate, glabrous outside, subcampanulate, 8 mm. long, pilose at the base inside, 5-lobed, the lobes reflexed in anthesis, broadly ovate, acute, 4 mm. long, densely puberulous inside. Petals 5, narrowly obovate, the base narrowed, entire, the apex subacute, fringed, glabrous inside, densely puberulous outside. Stamens 10, inflexed. Ovary inferior, 9-celled; ovules many in each cell, axillary, fascicled. Style 4 mm. long; stigma discoid, 2 mm. in diameter, 9 to 10 lobed.

Type specimen Lamao River, Province of Bataan, Luzon (3019 Meyer), May 12, 1905, (3040 Borden), same locality. A tree 12 m. high near the river, at an altitude of 300 m. above the sea, not common. Also collected by F. R. Alberto, near Los Baños, Province of Laguna, Luzon, May, 1905.

This genus has previously not been reported from the Philippines, the present species being the fourth proposed of the genus, *Pellacalyx axillaris* Korth., and *P. saccardianus* Schort., being found in the Malayan Peninsula, and *P. cristatus* Hemsl., in Borneo.

## MYRTACEÆ.

***Eugenia bordenii*, sp. nov. § *Jambosa*.**

A tree reaching a height of 25 m. with elliptical-oblong, to oblanceolate, oblong or obovate, few nerved leaves, 13 cm. long or less, and terminal, rarely also axillary, dense, sessile or short peduncled panicles, the flowers including the stamens about 2 cm. long. Branches uniformly light gray, glabrous,

terete. Leaves 8 to 13 cm. long, 3 to 6 cm. wide, the base cuneate, the apex usually short, broad, blunt-acuminate, coriaceous, glabrous, shining, light brown above, pale and with few small scattered dark glands beneath; nerves obscure, 10 to 12 on each side of the midrib, irregular, anastomosing and forming a faint marginal nerve, the secondary nerves nearly as prominent as the primary; petioles stout, about 3 mm. long. Panicles 4 to 6 cm. long, densely flowered, the branches stout, spreading, the lower ones 3 cm. long or less. Flowers white, sessile or nearly so, the buds obovoid. Calyx funnel shaped, 1 cm. long, 5 to 6 mm. thick above, the lobes reniform, glandular punctate, 5 to 6 mm. long, spreading. Petals 4, free, broadly ovate, 8 to 9 mm. long, glandular-punctate. Stamens many, 1 cm. long, the anthers 0.7 mm. long. Style 1.5 cm. long. Fruit globose, 1.5 cm. in diameter, crowned by the calyx lobes.

Specimens examined, all from Luzon: Province of Bataan, Lamao River (633, 644, 690, 691, 1206, 1208, 1630, 1736 Borden), April to August, 1904; (328 (type), 492, 497, 540 Barnes, same locality; (362 Whitford), same locality; Province of Rizal (393, 2434 Ahern's collector).

A large tree with light gray bark, growing in the lower hill forests very common at Lamao River.

**Eugenia lobas** Blanco, Fl. Filip. ed. 1, 857. 1837. *Eugenia cauliflora* Blanco, ed. 2, 291. 1845 (err. typ. *canliflora*); ed. 3, 2:177; F.-Vill. Nov. App. 86. 1880, not *Jambosa cauliflora* DC. § *Jambosa*.

A tree reaching a height of 20 m., with elliptical-oblong to lanceolate-oblong few nerved leaves 10 cm. long or less, the flowers in 3 to 5 flowered cymes, arranged in small or very large fascicles on the trunk and larger branches. Branches light gray to grayish red, glabrous, leaves 7 to 10 cm. long, 2 to 5 cm. wide, pellucid-punctate, the apex acuminate, the base acute, glabrous and shining on both surfaces; nerves 6 to 8 on each side of the midrib, distant, rather prominent beneath, anastomosing and forming a rather prominent marginal nerve, the reticulations lax, not prominent; petioles glabrous, about 4 mm. long. Cymes 2 to 5 cm. long, glabrous, borne on nodules throughout the length of the trunk, the pedicels 6 mm. long or less. Flowers white or pink, the buds obovoid. Calyx funnel shaped, about 8 mm. long, the lobes spreading, reniform. Petals 4, free, not cohering, orbicular, about 5 mm. in diameter, strongly glandular punctate. Stamens many; filaments about 6 mm. long; anthers 0.4 mm. long. Fruit ovoid, about 4 cm. long, when mature, very fleshy, acid, crimson.

Specimens examined, Luzon: Province of Tayabas, Atimonan (3995 Merrill), March, 1905 (flower); Guinayangan (837 Hagger), May, 1904 (sterile). Province of Camarines, Pasacay (187 Ahern), January, 1902 (sterile). Province of Pampanga, Mount Arayat (112 Bolster), May, 1905 (fruit). Mindanao, District of Davao (504 Copeland), March, 1904 (flowers).

A very distinct species, there being no doubt as to the identity of Blanco's species with the form here described. It is well characterized by its cauline inflorescence, and rather large, crimson, very fleshy, acid fruits. Blanco states that he saw specimens cultivated in Manila, and that the natives called the tree *Lobas*. I have been unable to find it in the city and

have not encountered a native who knows a fruit by the above name. The tree is very common on Mount Arayat, and is common and widely distributed in Tayabas Province, while Mr. Bolster informs me that it is also common in the mountains of Cagayan Province, northern Luzon. Known to the Pampangans as *Bagabúg*, and to the Tagalogs as *Midbit*, and, according to Blanco, *Lobas*.

***Eugenia congesta*, sp. nov. § *Syzygium*.**

A small tree with obovate coriaceous, glabrous, obtuse or shortly abruptly blunt acuminate, densely veined leaves, and short terminal panicles, the flowers small, sessile in clusters at the apices of the branches, the corolla calyptrately deciduous. Branches reddish brown, glabrous, the branchlets much compressed. Leaves 4 to 6 cm. long, 2.5 to 4 cm. wide, the upper surface shining, the lower paler, pellucid-punctate, the margins rather strongly revolute, base acute; nerves very numerous, parallel, the midrib prominent beneath; petioles 6 to 8 mm. long. Panicles short, 2 to 3 cm. long, densely flowered, the rhachis and branches much compressed, glabrous, reddish brown. Flowers white, sessile, 6 to 8 mm. long including the stamens, the buds obovoid. Calyx funnel shaped, the mouth with 4 short, irregular teeth. Stamens numerous, 4 to 5 mm. long; anthers minute, 0.3 mm. long. Ovary 2-celled, each cell many ovuled. Fruit ovoid, glabrous, dark purple when mature, about 2 cm. long.

Type specimens: Mount Mariveles, Province of Bataan, Luzon (448. 150 Whitford), May and July, 1904. A small tree apparently related to *Eugenia discussata* Duthie, growing in the mossy forest on exposed ridges at an altitude of about 1,200 m.

***Eugenia whitfordii*, sp. nov. § *Jambosa*.**

A tree reaching a height of 20 m., with small, elliptical-lanceolate, acuminate, few-nerved leaves, and 4-merous white flowers in few flowered cymes which are loosely fasciculate on the lower portion of the trunk. Branches light gray, glabrous, the branchlets slender, reddish. Leaves 5 to 8 cm. long, 1.5 to 3 cm. wide, mostly elliptical-lanceolate, but varying from lanceolate to oblanceolate, the base acute, the apex acuminate, glabrous, subcoriaceous, dark above, pale beneath when dry; nerves 5 to 6 on each side of the midrib, rather prominent beneath, anastomosing in a marginal nerve, the reticulations obscure; petioles reddish brown, 5 to 8 mm. long. Cymes 3 to 7 cm. long, 2 to 6 from each tubercle, 2 to 4 flowered, the rhachis 3 to 5 cm. long, the pedicels 5 to 10 mm. long. Flower buds obovoid. Calyx funnel shaped, about 1 cm. long, the lobes broader than long. Petals 4, deciduous, distinct, orbicular, 7 mm. in diameter. Filaments numerous, about 15 mm. long; anthers 1.5 mm. long.

Type specimen: Lamao River, Mount Mariveles, Province of Bataan, Luzon (468 Whitford), July, 1904; (1182 Borden), same locality and date.

A tree reaching a diameter of 40 cm., with pale bark, growing on forested slopes at an altitude of about 600 m. above the sea, well characterized by its cauline inflorescence.

***Eugenia longissima*, sp. nov. § *Jambosa*.**

A lax shrub about 3 m. high, with very long, narrow lanceolate leaves, cordate at the base, and mostly solitary, pendulous, white flowers, 4 to 5 cm. in diameter, including the stamens, terminal and from the branches below the leaves. Branches 4-angled and narrowly wing-margined, slender, the older ones light gray, the young parts reddish brown. Leaves nearly sessile, 25 to 35 cm. long, 3 to 5 cm. wide, the base abruptly rounded, deeply cordate, the sinus narrow, gradually tapering above to the slender, scarcely acuminate apex, glabrous, shining, pale brown beneath; primary nerves 20 to 26 on each side of the midrib, distant, anastomosing and forming a marginal nerve, the secondary nerves nearly as prominent as the primary, the reticulations lax. Flowers terminal, 1 or 2 from the tips of the branchlets, or solitary on the branches below the leaves, pendulous, white, the pedicel slender, jointed, 4 cm. long. Calyx disk like, 2.5 cm. in diameter, the lobes reniform, spreading. Petals 4, broadly ovate, obtuse, about 1.5 cm. long. Stamens very many.

Type specimen: Sablan, Province of Benguet, Luzon (6218 Elmer), April, 1904. A lax shrub, not common, overhanging the banks of damp shaded ravines along streams, well characterized by its large, pendulous flowers, 4-angled branches and very long, narrow leaves strongly cordate at the base.

***Eugenia glaucicalyx*, sp. nov. § *Syzygium*.**

A tree reaching a height of 30 m., with ovate-lanceolate to lanceolate, acuminate leaves, usually rounded at the base, pale beneath, the inflorescence axillary and terminal racemose panicles, the calyx oblong-obovate, strongly wrinkled, densely covered with a silvery gray, minutely crystalline bloom. Branches reddish brown, glabrous, terete, slender. Leaves 9 to 17 cm. long, 2 to 4.5 cm. wide, the base rather abruptly rounded, sometimes slightly cordate, rarely subacute, tapering above to the usually long, slender acuminate apex, shining above, pale and with few, minute, scattered, dark colored glands beneath, but not pellucid-punctate, glabrous; primary nerves about 20 on each side of the midrib, irregular, rather obscure, scarcely more prominent than the secondary nerves and reticulations; petioles rugose, about 3 mm. long. Inflorescence 7 to 14 cm. long, the rhachis and branches pale, glabrous, or slightly whitish crystalline like the calyx, the branches spreading or ascending, few flowered, 2.5 cm. long or less. Flowers, including the stamens, about 2 cm. long, white, sessile. Calyx 8 to 9 cm. long, 3 to 4 mm. thick above, narrowed below to the short pseudostalk, strongly longitudinally rugose wrinkled when dry, densely covered with a crystalline silvery bloom, the lobes short. Petals 4, orbicular to broadly ovate, very strongly imbricate, 3 to 4 mm. long, with few pellucid glands, falling as a whole. Stamens many, about 1 cm. long, the anthers 0.7 mm. long. Style equaling the anthers.

Specimens examined, all from Mount Mariveles, Province of Bataan, Luzon: (2748 Borden), March, 1905 (flower); (817, 826, 1250 Borden), June, 1904 (all sterile); (3949 Merrill), March, 1905 (flower.)

A large tree in the hill forests at an altitude of from 600 to 700 m. above the sea, distinguished by its peculiar rugose calyces which are covered with a silvery, minutely crystalline bloom.

***Tristania decorticata*, sp. nov. § *Eutristania*.**

A tree 15 to 20 m. high with alternate, glabrous, acuminate, petioled leaves, and axillary cymes shorter than the leaves, the pentadelphous stamens in groups of threes, opposite to and about as long as the petals, the bark shredding freely, giving the trunk a naked appearance. Branches grayish brown, the branchlets reddish brown, glabrous. Leaves 6 to 10 cm. long, 2 to 3 cm. wide, tapering at both base and apex, the latter slightly acuminate, the acumen blunt, both surfaces shining, the lower pale, sparingly and minutely glandular punctate, the margins reflexed; nerves numerous, obscure; petioles about 1 cm. long. Cymes glabrous or minutely puberulous, 4 to 6 cm. long, the pedicels 2 to 3 mm. long. Flowers white, about 4 mm. in diameter. Calyx obscurely 5-toothed, pubescent inside. Petals 5, orbicular, glabrous, not clawed. Stamens 15, in five groups of three each, the filaments slightly united below, the middle one of each group slightly longer than the lateral ones. Ovary densely pubescent, subglobose, more than  $\frac{1}{2}$  superior, 3-celled, each cell with many ovules.

Type specimen: Tinauan River, Province of Tayabas (Infanta), Luzon (787 Whitford), September, 1904. A tree growing in the hill forests along the river at altitude of from 100 to 200 m. above the sea, said by the collector to be common in the locality where the specimens were taken. No species of the genus, which is largely developed in Australia, has previously been found in the Philippines.

## MELASTOMATACEÆ.

***Astronia meyeri*, sp. nov.**

A tree about 8 m. high with elliptical-oblong, sub-5-nerved leaves, which are densely fulvous furfuraceous beneath, short densely flowered panicles, and 5-merous flowers. Branches terete, dark brown, glabrous, scarcely thickened. Leaves 10 to 20 cm. long, 6 to 8 cm. wide, narrowed regularly to the acute base and apex, or the apex very slightly acuminate, green and glabrous above, beneath pale brown and densely covered with thin papery scales; nerves 5, the inner three prominent, the marginal ones not more prominent than the transverse nerves; petioles 3 to 5 cm. long, glabrous. Panicle bright red, densely fulvous furfuraceous, 6 cm. long, the branches stout, spreading or ascending, densely flowered, the lower ones 4 cm. long. Flowers red, odorless, subglobose, 3 to 4 mm. in diameter, the calyx teeth five, triangular, acute, regular, 1.5 mm. long. Petals 2 mm. long.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (2840 Meyer), March, 1904. A very distinct species, reaching a height of 8 m. and a diameter of 15 cm., growing in forested ravines at an altitude of about 1,200 m. above the sea.

***Medinilla involucrata*, sp. nov.**

A scandent shrub, more or less stellate-plumose pubescent, with opposite 7-nerved leaves, short axillary few flowered racemose inflorescence 2 to 4 cm. long, the 5-merous flowers subtended by two large persistent bracts. Branches light gray, glabrous, the branchlets very densely ferruginous stellate-plumose pubescent. Leaves elliptical oblong to broadly lanceolate,



membranous, 7 to 10 cm. long, 3 to 5 cm. wide, the apex sharp acuminate, tapering below to the narrow obtuse base, glabrous above, nearly glabrous beneath except the rather densely stellate-plumose pubescent nerves and midrib; petiole very short or the leaves sessile. Racemes 2 to 5 flowered, the rhachis and pedicels densely ferruginous stellate-plumose pubescent, the bracts with scattered stellate hairs; pedicels 2 to 3 mm. long, each subtended by a broadly ovate bract 5 to 6 mm. long, each flower subtended by two persistent, membranous, red, broadly ovate, acute bracts about 13 mm. long, and 10 mm. wide. Calyx urceolate, 4 mm. long, densely hirsute with spreading white hairs, the margin strongly 5-lobed, the teeth membranous, acute broadly ovate, about 2 mm. long. Petals 5, oblong or narrowly obovate oblong, regular, the apex rounded, 9 mm. long, 5 mm. wide. Stamens 10, subequal; filaments 5 mm. long; anthers 4 mm. long.

Type specimen: Baco River, Mindoro (328 McGregor), May 15, 1905, growing in very humid forests; also a specimen collected by Copeland at San Ramon, District of Zamboanga, Mindanao, January, 1905, growing near streams at an altitude of from 200 to 500 m. above the sea. A species apparently related to *Medinilla setigera* Miq., and *M. bracteata* Blume, but very distinct from those species.

***Medinilla copelandi*, sp. nov.**

A shrub about 3 m. high, with opposite, glabrous, petioled, 7-nerved leaves and lateral, cymose inflorescence. Branches slender, light gray, glabrous, terete or the ultimate branches somewhat angular. Leaves oblong-ovate, narrowed to the acute base, the apex short slender acuminate, 15 to 20 cm. long, 7 to 8.5 cm. wide. Inflorescence from the branches below the leaves, 5 to 7 cm. long, glabrous or very slightly furfuraceous, the peduncle 3 to 5 cm. long, the bracts about 3 mm. long, the bracteoles minute. Calyx cylindrical-campanulate, glabrous, truncate, 6 mm. long. Petals 4, 9 mm. long, very strongly subrhomboidal oblique. Stamens 8; filaments 4 mm. long; anthers 6 mm. long.

Type specimen collected by E. B. Copeland, without number, in the mountains near San Ramon, District of Zamboanga, Mindanao, April 7, 1905. A small shrub growing in forests along mountain streams at an altitude of about 800 m. above the sea.

***Memecylon affine* sp. nov. § *Eumemecylon*.**

A slender lax shrub 1 to 3 m. high, with hermaphrodite flowers, axillary and terminal cymose inflorescence, 3-nerved sessile leaves, the slender lateral nerves arched between the transverse nerves, the branches terete glabrous, brownish gray. Leaves triangular-ovate, ovate oblong, to triangular lanceolate, broadest near the rounded or cordate base, gradually narrowed above to the rather slender acute or slightly acuminate apex, 6 to 11 cm. long, 2.5 to 4.5 cm. wide, coriaceous, glabrous, pale beneath when dry, the nerves obscure above, and not prominent beneath, the transverse nerves straight, about 12 on each side of the midrib, about as prominent as the lateral nerves. Cymes 5 to 7 cm. long, minutely furfuraceous puberulent, the peduncle 2 to 3.5 cm. long, the branches verticillate, divaricate, the flowers at the apices of the branchlets in



capitulate umbels, pedicels 1 to 2 mm. long. Calyx about 2 mm. long, obscurely 5-toothed. Petals broadly orbicular-ovate. Fruit globose, 6 to 7 mm. in diameter.

Specimens examined, all from Mount Mariveles, Province of Bataan, Luzon: (3190 Merrill), October, 1903; (1336 Borden), July, 1904; (6059 Leiberg) July, 1904. An apparently narrow-leaved form is represented by No. 3184 Merrill.

A small, weak shrub growing on exposed forested ridges in the mossy forest at an altitude of about 1,000 m. Apparently most closely related to *Memecylon preslii* Triana, however differing in its much smaller, differently shaped leaves and shorter inflorescence.

**Pogonantha reflexa** Blume, Flora, 14: 521. 1831; Cogn. in DC. Monog. Phan. 7: 610. 1891.

This species is apparently well represented by a specimen from Baco River, Mindoro, (313 McGregor) May, 1905. The above specimen differs from the species as described, in its slightly larger leaves, which are rather prominently acuminate, and somewhat longer panicles, but is apparently referable to this species, which extends from Malacca to Sumatra, Java, and Borneo. *Pogonantha reflexa* has been reduced by various authors to *P. pulverulenta* Blume, but our specimen agrees more closely with the description of the former species, which is here retained. A typical Malayan genus, of which no species have previously been reported from the Philippines.

## ARALIACEÆ.

**Schefflera angustifolia** sp. nov.

A scandent shrub with digitate leaves, the leaflets elongated, narrowly lanceolate, the flowers pedicellate in small umbels, the umbels racemously arranged on the elongated branches of the terminal panicle. Branches glabrous. Leaves alternate, glabrous; petiole 11 to 14 cm. long; stipules adnate to the petiole, prominent, about 1 cm. long; leaflets 6 to 9, membranous, narrowly lanceolate, 12 to 20 cm. long, 1.5 to 3 cm. wide, entire, the base acute, the apex sharp acuminate, margins revolute; primary nerves 13 to 15 on each side of the midrib, not more prominent than the secondary nerves and rather lax reticulations; petiolules 3 to 4 cm. long. Panicle terminal, the rachis short, stout, 5 to 6 cm. long, densely white or rufous stellate pubescent, the branches 20 to 35 cm. long, more or less stellate pubescent at least below, becoming nearly glabrous, each subtended by a large ovate, acute, or acuminate, densely mealy pubescent bract 1 to 1.5 cm. long. Flowers disposed in 10 to 15 flowered umbels, the umbels racemously arranged on the long branches, the peduncles to the individual umbels slender, more or less stellate pubescent, 1 cm. long or less: male flowers white, 5-merous, the pedicels 4 to 5 mm. long, the calyx teeth very short. Petals oblong ovate, acute, 1.5 mm. long. Stamens 5; filaments 4 mm. long. Female flowers not seen.

Specimens examined, all from Rizal Province, Luzon: San Mateo (1117 Ahern's collector), May, 1904; Bosoboso (3111 Ahern's collector), May,

1905, (1889 Merrill), April, 1903; (1735 Merrill), Antipolo, is probably also referable here. T., *Sainit*.

A characteristic species recognized by its narrow elongated leaves, terminal panicle and very long panicle branches.

## CORNACEÆ.

***Alangium meyeri* sp. nov.** § *Marlea*.

A tree 20 m. or more in height, with oblong, acuminate, feather veined leaves, axillary, few flowered cymes, and fragrant flowers 12 to 14 mm. long, the ovary glabrous, 1-celled, 1-ovuled. Branches brownish gray, glabrous, the ultimate branchlets more or less puberulous. Leaves coriaceous, pale when dry, 10 to 18 cm. long, 4 to 7 cm. wide, the base rounded or obtuse; nerves about 10 on each side of the midrib, rather prominent beneath; petioles 6 to 8 mm. long, stout, puberulous. Cymes about 2 cm. long, 5 to 8 flowered, the axis, branches, calyx and corolla, finely, densely, cinereous pubescent. Flowers cream colored, very fragrant, the pedicels 3 to 4 mm. long. Calyx green, furrowed, 3 mm. long, almost truncate. Petals 7, coriaceous, about 14 mm. long, 2 mm. wide. Stamens 6 to 7; filaments thick, curved, 4 mm. long, slightly hairy on the inner side above; anthers 6 to 7 mm. long. Ovary glabrous, 1-celled, 1-ovuled. Style clavate, about 10 mm. long, sparingly appressed pubescent above.

Type specimen: Lamao River, Province of Bataan, Luzon (2284 Meyer), December, 1904, also No. 2334 Borden, same locality and date.

A tree reaching a height of 15 m. and a diameter of from 15 to 25 cm. not common in the hill forests at altitudes of from 15 to 100 m. above the sea.

## ERICACEÆ.

***Vaccinium banksii* sp. nov.**

An undershrub, 1 m. high or less, with lanceolate to elliptical lanceolate, acute or obtuse, short petioled leaves, 4 cm. long or less, and axillary, few flowered racemes about 3 cm. long. Branches striate, glabrous, black and light gray. Leaves coriaceous, 3 to 4 cm. long, 8 to 15 mm. wide, pale beneath, glandular, tapering to the cuneate base, the margins revolute, slightly undulate; nerves not prominent, ascending, 3 or 4 on each side of the midrib; petioles stout, 2 mm. long or less. Racemes very sparingly pubescent, becoming glabrous or nearly so, the pedicels 3 to 5 mm. long. Calyx sparingly pubescent, 5-toothed, the teeth acute, 1 mm. long. Corolla urceolate, glabrous, 7 mm. long, gradually smaller upwards, shortly 5-lobed, the lobes reflexed, about 1.5 mm. long, obtuse. Stamens 10; filaments about 1.5 mm. long; anthers oblong, 1 mm. long. Ovary glabrous, 5-celled; style stout, nearly 6 mm. long. Fruit unknown.

Type specimen collected by C. S. Banks, Canlaon Volcano, Negros, March, 1902, growing in rather open forests at an approximate altitude 1,300 m. A species related to *Vaccinium cumingianum* Vidal, but quite distinct. Mr. Banks's small collection is to our knowledge the only one ever made on Canlaon Volcano, he having ascended to the summit in March, 1902.

## SAPOTACEÆ.

*Palaequium whitfordii* sp. nov.

A tree reaching a height of 25 m. with glabrous, obovate, obtuse, 7 to 9 nerved leaves, and very few, axillary, solitary flowers. Branches grayish brown, striate, glabrous, the ultimate branchlets appressed ferruginous pubescent. Leaves 6 to 10 cm. long, 4 to 6 cm. wide, coriaceous, pale when dry, tapering from above the middle to the cuneate base, the nerves spreading, 8 to 10 mm. apart; petioles slightly ferruginous pubescent, becoming glabrous, 1 to 2 cm. long. Flowers solitary in the upper axils, very few, usually but one on a branchlet, the pedicels and calyx appressed ferruginous pubescent, the former 5 mm. long. Calyx lobes broadly triangular ovate to suborbicular, acute or obtuse, 3 mm. long, the inner lobes much thinner than the outer. Corolla 5 mm. long, the lobes 2 mm. long, blunt. Stamens 4 mm. long. Ovary pubescent.

Type specimen: Lamao River, Province of Bataan, Luzon (1015 Whitford), December, 1904; also from the same locality (496 Barnes), November, 1903.

A species most closely related to *Palaequium batuancense* Merr., but distinguished from that species by its broadly obovate, fewer nerved leaves and few flowers. A careful examination of the tree from which Whitford secured his specimens in December yielded but three branchlets, each with a solitary flower, and on a second examination in January, 1905, no flowers were found. An inspection of the tree from which Barnes secured his specimens, in December, 1903, and again in December, 1904, yielded no flowers, those on the specimen collected in November, 1903, being immature. This tree grows in the hill forests at an altitude of about 100 m., reaching a height of 25 m. and a diameter of from 40 to 60 cm.

*Sideroxylon ahernianum* sp. nov.

A small or medium sized tree, with glabrous, coriaceous, 9 to 11 nerved, narrowly oblong-ovate to elliptical-lanceolate leaves, and small, axillary, fasciculate flowers. Branches light gray, glabrous, striate, the ultimate branchlets more or less ferruginous pubescent. Leaves 9 to 12 cm. long, 3 to 5 cm. wide, the apex blunt, or nearly acute, below tapering to the somewhat decurrent base, the upper surface smooth and shining, pale beneath, the young leaves minutely silvery pubescent beneath, becoming entirely glabrous; nerves subprominent on both surfaces, anastomosing near the margin, the reticulations evident on both surfaces; petioles at first appressed pubescent, becoming glabrous, 2 to 2.5 cm. long. Flowers 4 mm. in diameter, in axillary 5 to 25 flowered fascicles, the pedicels and calyx densely silvery and ferruginous pubescent, the former 4 to 7 mm. long. Calyx lobes 5, broadly ovate, 3 mm. long. Corolla lobes 5, ovate, obtuse, 3 mm. long. Anthers 1.8 mm. long, the filaments short; staminodes entire, lanceolate, 1 to 1.5 mm. long. Ovary pubescent.

Type specimen: Bosoboso, Province of Rizal, Luzon (2165 Ahern's collection), December, 1904. A species apparently related to *Sideroxylon attenuatum* A. DC., but the leaves not ferruginous pubescent.

**Sideroxylon angustifolium** (*Palaquium angustifolium* Merrill, Govt. Lab. Publ. 17:43. 1904.)

Additional material of this species, in flower, has been collected from the same locality from which the type of *Palaquium angustifolium* was secured, from an examination of which a reëxamination of No. 3744 Merrill the species must go to *Sideroxylon*. Calyx 5-partite, not 6, as in the original description, the lobes ovate, acute, 5 mm. long, densely ferruginous pubescent. Corolla glabrous, 3 mm. long (immature) 5-lobed, the lobes oblong-obovate, truncate. Stamens 5, the filaments short, the anthers ovoid, nearly 1.5 mm. long; staminodes 2 to 2.5 mm. long, about 0.4 mm. wide, linear-oblong, truncate, obtuse or somewhat retuse, not lobed or lacerate. Ovary ferruginous pubescent, 5-celled; style glabrous, stout, channeled, 3 mm. long.

Mount Mariveles, Province of Bataan, Luzon (3744 Merrill), January, 1904 (fruit), type of *Palaquium angustifolium*; (1166 Whitford), same locality, March, 1905 (flower). This species was originally described from fruiting specimens, and the calyx erroneously characterized as 6 lobed instead of 5 lobed as it really is.

**Sideroxylon macranthum** sp. nov.

A large tree, reaching a height of 30 m., with oblong-obovate, long petioled, obtuse to somewhat acuminate leaves, which are more or less rusty tomentose when young, becoming glabrous, and numerous flowers about 5 mm. long, fasciculate in the axils of the leaves, the staminodes entire. Branches rather stout, brownish gray, striate, more or less ferruginous pubescent, becoming glabrous, the leaf scars rather prominent. Leaves subcoriaceous, 11 to 18 cm. long, 4 to 8 cm. wide, shining, the base acute, often somewhat decurrent; nerves 10 to 11 pairs, prominent, the secondary ones and reticulations rather obscure; petioles 2 to 4.5 cm. long, at first rusty tomentose, becoming glabrous. Flowers creamy white, in fascicles of from 3 to 5, crowded in the axils near the apices of the branchlets, the buds subglobose, obtuse, the pedicels 3 to 5 mm. long and with the sepals uniformly densely rusty pubescent. Sepals 5, imbricate, orbicular-ovate, obtuse, 5 mm. long. Corolla glabrous, cylindrical, equaling the sepals, 5-lobed, the lobes 2 mm. long, ovate, obtuse-truncate. Stamens 5, included, the anthers nearly 1 mm. long, obtuse; staminodes lanceolate, blunt, entire, about 1 mm. long. Ovary densely villous, 5-celled; style stout, about 1 mm. long. Fruit globose, about 3.5 cm. in diameter, deciduously ferruginous pubescent, 2 to 3 seeded.

Type specimens: (2741 (flower) and 1809 (fruit) Borden), Lamao River, Province of Bataan, Luzon, March, 1905, and September, 1904; (51 Barnes, same locality), October, 1903; also apparently No. 2608 Merrill, Pagbilao, Province of Tayabas, Luzon. This species was identified by the author, when received, as *Sideroxylon duclitan* Blanco, but is certainly not that species, and is apparently undescribed. The species previously described by the author as *Sideroxylon ramiflorum* is certainly a synonym of *Sideroxylon duclitan* Blanco.

## EBENACEÆ.

**Diospyros nitida** sp. nov.

A small tree 5 to 10 m. high, with alternate, lanceolate, acuminate leaves, very black and shining when dry, and axillary fascicled or short, dense, cymose inflorescence. Branches grayish, striate, more or less pubescent, the branchlets slender, black, usually rather densely pubescent. Leaves 5 to 8 cm. long, 1.5 to 3 cm. wide, submembranous, glabrous, very shiny above, rather dull and slightly pubescent beneath, especially on the midrib, the apex rather slender acuminate, the acumen blunt, the base acute; nerves obscure; petioles 4 to 5 mm. long, pubescent. Fascicles 4 to 8 flowered. Flowers 4-merous, white. Calyx 2 mm. long, slightly pubescent, 4-lobed, the lobes broadly ovate, 1 mm. long, the margins ciliate. Corolla 4 mm. long, urceolate, the lobes ovate, acute, 2 mm. long. Stamens 16, unequal, all on the receptacle or at the base of the corolla, glabrous or minutely puberulous, the anthers dehiscing by longitudinal slits. Ovary glabrous. Fruit somewhat fleshy, globose, black, shiny and more or less wrinkled when dry, 10 to 12 mm. in diameter, 4-celled, each cell with one seed. Seeds 6 mm. long, brown, reticulate, the albumen not ruminated, the fruiting calyx about 1 cm. in diameter, the lobes spreading, elliptical-ovate, rounded.

Specimens examined: Luzon, Province of Rizal, Antipolo (1737 Merrill), March 1903 (fruit); Province of Zambales, Botolan (2976 Merrill), June, 1903 (fruit); Province of Bataan, Mount Mariveles (6713 Elmer), November, 1904 (flower). Guimaras Island (230 Gammill), January, 1904 (fruit).

A small tree in open thickets. T., *Canalum*, *Catclana*; V., *Manogaron*.

## OLEACEÆ.

**Fraxinus philippinensis** sp. nov. § *Ornus*.

A small tree with 3 to 4 jugate leaves, the leaflets entire, 5 cm. long or less, and hermaphrodite flowers, the samara 3 cm. long, retuse. Branches gray, glabrous, the ultimate branchlets somewhat pubescent. Leaves 10 to 15 cm. long, the rachis slightly pubescent, becoming glabrous; leaflets 7 to 9, glabrous, subcoriaceous, lanceolate to ovate lanceolate, 2 to 5 cm. long, 0.8 to 1.5 cm. wide, somewhat inequilateral, the base acute, tapering above to the acuminate apex; nerves obscure, 9 to 10 on each side of the midrib; petiolules 3 to 9 mm. long. Panicles terminal and axillary, numerous, many flowered, pubescent, 8 to 10 cm. long. Flowers white, 3.5 mm. long, the pedicels 2 to 3 mm. long, slender, the bracts lanceolate, 2 mm. long. Calyx cup shaped, 1 mm. long, obscurely toothed. Petals 4, free, narrowly oblong, obtuse, 3 mm. long, 1 mm. wide. Stamens 2, the anthers nearly 3 mm. long. Ovary small, glabrous. Style slender, short. Samara 3 cm. long, glandular below but not pubescent, the seed bearing portion 6 to 8 mm. long, terete, margined above by the decurrent wing, the wing 4 to 5 mm. wide, narrowed below and slightly above, the apex retuse.

Province of Rizal, Luzon, Tanay (2274 Merrill), May, 1903 (flower);



Bosoboso (3082 Ahern's collector), May, 1905 (flower); (3200 Ahern's collector), July, 1905 (fruit).

No species of this genus has previously been found in the Philippines, the present one being evidently closely related to the Hongkong *Fraxinus retusa* Champ.

***Mayepea pallida* sp. nov.**

A tree 8 to 10 m. high with very thick, coriaceous, glabrous, pale, short stout petioled leaves, the nerves obscure, and axillary, usually many flowered panicles, 2 to 7 cm. long, the flowers yellowish green, small. Branches silvery gray, glabrous. Leaves lanceolate to elliptical lanceolate, tapering below to the acute base, the apex acute or short acuminate, shining; nerves obscure, about 7 on each side of the midrib, sometimes nearly obsolete; petioles very thick, glabrous, light gray, about 5 mm. long. Panicles many flowered, solitary, glabrous, each subtended by several imbricated, pale, ovate lanceolate, acuminate bracts, the branches short, 1 cm. long or less. Flowers yellowish green, the pedicels 2 mm. long or less. Calyx 1 mm. long, the lobes short, triangular acute, slightly ciliate. Corolla glabrous, 2 mm. long, the lobes slightly united below, elliptical, obtuse, concave. Anthers broad, less than 1 mm. long. Ovary ovoid, glabrous, slightly exceeding 1 mm. in length. Fruit oblong obovoid, nearly 1 cm. long, apiculate, dark colored and reticulate when dry.

Type specimens: Bosoboso, Province of Rizal (2874 Ahern's collector), March, 1905 (flower); also No. 2670 Merrill, same locality, June, 1903 (fruit), and No. 1835 Merrill April, 1903; Province of Bataan, Mount Mariveles (1142 Whitford), March, 1905; (2792 Meyer), same date; Province of Camarines, Pasacao (44 Ahern), 1902; Mindoro, Pola (2255 Merrill), May, 1903; Guimaras Island (267, 280, 309 Gammill), January-February, 1904.

A species well characterized by its very thick, coriaceous, pale short petioled leaves and small flowers. The leaves of young specimens are frequently sinuous spinescent toothed, simulating those of *Taxotrophis ilicifolia* Vidal, and some species of *Ilcx*.

***Mayepea racemosa* sp. nov.**

A shrub or small tree 5 to 7 m. high with glabrous subcoriaceous, pale, rather short petioled leaves, the yellowish white flowers in axillary racemes. Branches silvery gray, glabrous. Leaves elliptical ovate, rather prominently acuminate, the acumen blunt, the base acute or acuminate, glabrous and shining on both surfaces, 8 to 13 cm. long, 5 to 7 cm. wide; nerves 7 to 8 on each side of the midrib, not prominent, anastomosing, the reticulations very lax; petioles thick, light gray, glabrous, about 5 mm. long. Racemes glabrous, solitary or two or three in each axil, black when dry, the rhachis slender, 2 or 3 cm. long. Flowers opposite, yellowish white, somewhat fragrant, each subtended by a broad subtruncate bracteole about as long as the pedicel, the pedicels 1 to 1.5 mm. long. Calyx 1.5 mm. long, glabrous, the lobes orbicular ovate, obtuse, occasionally retuse. Petals 4, free, 5 to 5.5 mm. long, 1.3 mm. wide, oblong obtuse, glabrous, the margins recurved. Anthers 1.5 mm. long. Ovary ovoid, glabrous 1 mm. long.



Type specimen: Lamao River, Province of Bataan, Luzon (3042 Borden), May, 1905. Apparently also No. 3079 Ahern's collector, Bosoboso, Province of Rizal, Luzon, May, 1905.

A species differing from all other Philippine ones of the genus in its short petioles.

## APOCYNACEÆ.

### *Alstonia parvifolia* sp. nov.

A shrub or small tree 3 to 6 m. high, with whorled, lanceolate, acuminate, distantly nerved leaves, the ultimate branches of the inflorescence and calyces densely mealy pubescent the corollas glabrous or nearly so. Branches dark gray, glabrous, the ultimate branchlets reddish brown. Leaves 6 to 13 cm. long, 1 to 3.5 cm. wide, subcoriaceous, tapering above to the usually slender, blunt acumen and below to the narrow, somewhat decurrent base, the margins revolute; nerves about 18 pairs, subprominent; petioles 1 to 2 cm. long. Cymes subumbellate in the upper axils, 7 cm. long or less, the peduncles glabrous, the ultimate branchlets, bracteoles, and calyces densely mealy pubescent. Flowers white, fragrant. Calyx campanulate, 4 mm. long the lobes short, obtuse. Corolla 8 mm. long, glabrous outside, the tube about 4 mm. long, slightly contracted at the mouth and sparingly villous inside. Stamens about 1 mm. long. Ovary ovoid, glabrous, 2-celled, many ovuled; style 2 mm. long. Follicles in pairs glabrous, 20 cm. long, about 3 mm. in diameter. Seeds oblong, 6 mm. long, pubescent with brownish hairs, the apices and margins above long pilose.

Type specimen: Mount Mariveles, Province of Bataan, Luzon (2209 Meyer), November, 1904 (flower). From the same locality: (6876 Elmer), November, 1904 (flower); (1164 Whitford), March, 1905 (fruit).

A species apparently closely related to *Alstonia macrophylla* Wall., differing from the latter in its much smaller, firmer, glabrous leaves, more congested inflorescence and very densely mealy-pubescent calyces and younger parts of the inflorescence. A small tree growing on exposed ridges in the mossy forest at an altitude of about 1,100 m. above the sea.

### *Ellertonia mcgregori* sp. nov.

A scandent, nearly glabrous shrub with opposite, ovate, acuminate, membranous, opposite leaves and many flowered cymose axillary panicles, the flowers, including the corolla lobes, about 1.5 cm. long. Branches twining, glabrous, brown. Leaves 8 to 20 cm. long, 5 to 10 cm. wide, the base broad, rounded or cordate, glabrous, except for few scattered hairs on the nerves and margins of the younger leaves; nerves prominent, 9 to 12 on each side of the midrib, spreading, strongly anastomosing the primary reticulations subparallel, the nerves and reticulations darker colored and in strong contrast to the surface of the leaves; petioles 1 to 2.5 cm. long, somewhat strigose pubescent, becoming glabrous. Inflorescence axillary, 15 to 18 cm. long, somewhat strigose ferruginous pubescent, especially the branchlets, many flowered. Flowers fragrant, the pedicels 3 to 4 mm. long, the bracteoles broadly triangular ovate, about 1 mm. long. Calyx eglandular, the lobes elliptical ovate, obtuse, about 1 mm. long, the margins somewhat ciliate. Corolla salver shaped, white, the lower part of the tube

pale yellow, the tube cylindrical, slender, swollen below, constricted above, glabrous outside, hirsute within, limb lobed, the lobes spreading, 6 mm. long, 3 mm. wide at about the middle, then abruptly narrowed on one side, the terminal portion about 1.5 mm. wide, subobtus. Stamens included in about the lower third of the tube, the anthers in the swollen portion, free from the style; filaments about 0.5 mm. long, pubescent; anthers 1.5 mm. long, oblong lanceolate, apiculate, the lobes rounded at the base. Ovary of two distinct glabrous oblong carpels united by the style, the ovary and style 3.5 mm. long, the style slender, not reaching beyond the anthers, slightly swollen above, the stigma slightly 2-lobed; ovules many in each cell, 2 or more seriate. Follicle unknown.

Type specimen: Baco River, Mindoro (285 R. C. McGregor), April 23, 1905. A scandent shrub growing in very humid forests, reaching a height of about 20 m. A species perhaps most closely related to *Ellertonia rhecdii* Wight, a species of British India, but very distinct from the latter. A genus not previously reported from the Philippines, of which one species is known from British India, and three from Madagascar.

## BORRAGINACEÆ.

### CORDIA.

1. Calyx prominently 10-striate, hirsute-pubescent.
  2. Leaves obtuse or subcordate at the base ----- (1) *C. cumingiana*
  2. Leaves acute at the base ----- (2) *C. propinqua*
1. Calyx glabrous or pubescent, not striate.
  2. Flowers small 5 to 7 mm. long, the corolla tube shorter than the calyx.
    3. Plant glabrous or nearly so ----- (3) *C. blancoi*
    3. Plant softly pubescent ----- (4) *C. blancoi mollis*
  2. Flowers large 3 to 4 cm. long the corolla tube exceeding the calyx ----- (5) *C. subcordata*

- (1) *Cordia cumingiana* Vidal. Phan. Cum. Philip. 128, 187. 1885; Rev. Pl. Vase. Filip. 192. 1886; Ceron, Cat. Pl. Herb. 120. 1892.

A distinct endemic species represented by No. 1181 Merrill, Mindoro; (1321 Merrill), Province of Rizal, Luzon, and No. 5663 Elmer, Province of Union, Luzon.

- (2) *Cordia propinqua*, sp. nov.

A small tree with ovate-lanceolate, acuminate, irregularly serrate sparingly scabrous-pubescent leaves, and rather lax terminal and axillary corymbs, the sessile flowers glomerate at the ends of the branchlets, 5 mm. long, the tubular calyx densely hirsute, prominently 10-striate, 5-dentate. Branches brown, sparingly appressed hirsute. Leaves membranous, 9 to 16 cm. long, 4 to 7 cm. wide, widest at about the middle, narrowed below to the acute base, and above to the rather slender acuminate apex, the margins irregularly serrate above, entire below, both surfaces with few short scattered appressed hairs; nerves about 6 on each side of the midrib, sharply ascending; petioles 1.5 to 2.5 cm. long, sparingly appressed hirsute. Corymbs about 10 cm. long, dichotomously branched, appressed hirsute.

Flowers white. Calyx tubular, prominently 10-striate, densely short hirsute-pubescent, 5-toothed. Corolla tube nearly as long as the calyx, the 5 lobes about 1.5 mm. long spreading or reflexed. Stamens 5, included, about 3 mm. long; filaments glabrous; anthers 0.5 mm. long. Ovary ovoid, 1.5 mm. long, glabrous, 2-celled, each cell 2-ovuled. Style 3 mm. long, obscurely twice cleft at the apex, scarcely partite. Drupe 7 to 8 mm. in diameter, the putamen very hard, strongly rugose, the calyx in fruit cleft on one side, rotate 6 mm. in diameter.

Type specimen collected by E. B. Copeland, without number, Davao, District of Davao, Mindanao, March, 1904.

A species apparently closely related to *Cordia cumingiana* Vidal, differing from the latter in its narrower, differently shaped leaves, which are acute at the base, and obscurely cleft style.

- (3) *Cordia blancoi* Vidal, Rev. Pl. Vasc. Filip. 192. 1886; Ceron, Cat. Pl. Herb. 120. 1892; Merrill, Forestry Bureau Bull. 1: 50. 1903; *Cordia sebestena* Blanco, Fl. Filip. ed. 1, 121. 1837; ed. 2, 87; ed. 3, 1:158; Naves, ed. 3, pl. 43, excl. syn., non Linn.; *Cordia dichotoma* Blanco, l. c., ed. 1, 123; ed. 2, 88, ed. 3, 1: 159, non Forst. *Cordia myxa* F.-Vill. Nov. App. 137. 1880; Vidal, Cat. Pl. Prov. Manila, 37. 1880; Sinopsis, Atlas, t. 70. f. D. 1883; Ceron, Cat. Pl. Herb. 121. 1892, non Linn.; *Cordia leschenaultiana* Vidal, Phan. Cuming. Philip. 128. 1885; Rev. Pl. Vasc. Filip. 193. 1886, non A. DC.

An endemic species apparently very closely related to *Cordia myxa* Linn., common throughout the Philippines, represented by the following specimens: Luzon, Province of Rizal (1872, 2625 Merrill), Province of Bataan (768, 1267, 1273 Borden), Province of Zambales (2912 Merrill), Province of Tayabas (22 Ritchie), Province of Camarines Sur (33, 84, 783, 791 Ahern). Guimaras Island (321 Gammill). Burias Island (983 Clark). Masbate (1008 Clark). Mindanao, District of Surigao (355 Ahern); District of Davao (342 Copeland).

*Cordia leschenaultiana* A. DC., has been credited to the Philippines by Vidal<sup>1</sup> based on No. 1612 of Cuming's Philippine collection, this number being also cited by A DeCandolle<sup>2</sup> in a footnote under the above as possibly representing the species. A specimen of Cuming's plant exists in our herbarium, and it is certainly only a young form of *Cordia blancoi* Vidal. The leaves of *Cordia blancoi* are exceedingly variable, being frequently acute, truncate or cordate at the base on the same specimen. In Cuming's specimen mentioned above, the leaves are all acute at the base, while no open flowers are with it, only young flower buds being present.

- (4) *Cordia blancoi* Vidal, var. *mollis* Merrill, var. nov.

Similar to the species, differing in its more densely flowered cymes, slightly smaller flowers, the young branches, petioles, leaves, inflorescence and calyces rather densely softly fulvous pubescent.

Type specimen: Antipolo, Province of Rizal, Luzon (455 Ahern's collector), April, 1904.

<sup>1</sup> Phan. Cuming. Philip. 128. 1885; Rev. Pl. Vasc. Filip. 193. 1886.

<sup>2</sup> Prodr., 9: 482. 1845.

- (5) *Cordia subcordata* Lam. Illustr. 2: 421. 1793; DC. Prodr. 9: 477 1845; Miq. Fl. Ind. Bat. 2: 915. 1856; Clarke in Hook. f. Fl. Brit. Ind. 4: 140. 1883; F-Vill. Nov. App. 137. 1883; Vidal, Sinopsis, Atlas, 34. t. 70. f. E. 1883; Phan. Cum. Philip. 128. 1885; Rev. Pl. Vasc. Filip. 192. 1886; Ceron, Cat. Pl. Herb. 120. 1892; *Cordia banalo* Blanco, Fl. Filip. ed. 1, 124. 1837; *Cordia ignota* Blanco, l. c., ed. 2, 88. 1845, ed. 3, 1: 160.

A species apparently common along the sea shore, at least in the southern Philippines, extending from Bengal to Australia, Polynesia, and the Sandwich Islands. Burias Island (1733 Clark). Luzon, Province of Camarines Sur (84 Ahern). Mindanao, District of Davao (230 DeVore and Hoover) (620 Copeland).

### EXCLUDED SPECIES.

*Cordia paniculata* Roth. This species is credited to the Philippines by F-Villar.<sup>1</sup> It is a synonym of *Cordia myxa* Linn., a species not known from the Philippines, and the material cited by F-Villar was undoubtedly a form of *Cordia blancoi* Vidal. An accurate identification of the plant F-Villar had in mind when he credited this species to the Philippines is quite impossible at the present time, as his herbarium has been destroyed. The species should be excluded, or could be quite safely referred to *Cordia blancoi* Vidal. F-Villar's specimens were from Negros, the native name *Agut-ut* being cited. This name appears on specimens of *Cordia subcordata* Lam., in our herbarium.

### VERBENACEÆ.

- Clerodendron blancoi* Naves, Fl. Filip. ed. 3, pl. 223. 1877; Vidal, Cat. Pl. Prov. Manila, 39. 1880; Rev. Pl. Vasc. Filip. 211. 1886; Ceron, Cat. Pl. Herb. 133. 1892. *Clerodendron fortunatum* Blanco, Fl. Filip. ed. 1, 508. 1837; ed. 2, 354. 1845; ed. 3, 2: 281, non Linn.: *Clerodendron infortunatum* F-Vill. Nov. App. 161. 1882, non Linn. *Clerodendron minahassae* Merrill, Forestry Bureau, Bull. 1: 52. 1903, non Teysm et Binn.

A shrub or small tree 2 to 7 m. high, glabrous or nearly so, with oblong ovate, acuminate leaves, terminal few flowered panicles, the calyces inflated, tubular, 2 to 2.5 cm. long, the corolla tube slender, 5 cm. long, slightly puberulent. Branches gray or brown, lenticillate, glabrous or nearly so. Leaves opposite, 9 to 20 cm. long, 5 to 11 cm. wide, the base rounded or obtuse, the apex short acuminate, the margins entire, glabrous or nearly so; nerves about 12 on each side of the midrib; petioles glabrous, 3 to 7 cm. long. Panicles few flowered, simple, glabrous or slightly pubescent, the branches few, 2 to 2.5 cm. long, each bearing three flowers. Flowers fragrant, white or cream colored. Calyx slightly pubescent, green, often tinged with purple, about 6 mm. in diameter, somewhat dilated in the middle, 5 cleft, the teeth oblong ovate, about 8 mm. long. Corolla tube slender, exserted, the limb spreading, 5-cleft, the lobes oblong 1.5 to 2 cm.

<sup>1</sup> Nov. App., 138. 1880.

long. Stamens equaling the lobes. Calyx in fruit cleft half way to the base, enlarged, green outside, red within, the fruit globose, about 1 cm. in diameter, deep blue.

Specimens examined: Luzon, Lamac River, Province of Bataan (1609, 1915 Borden) (3089, 3866 Merrill) (6012, 6115 Leiberger) (418 Whitford); Province of Rizal, Antipolo (13 Guerrero); Bosoboso (2707, 2838 Merrill) (1153 Ahern's collector); Province of Zambales (2938 Merrill). Mindanao, District of Zamboanga, Tetuan (586 Ahern).

Although the name *Clerodendron blancoi* Naves, is published in the places cited above, without a description and without references to other species as synonyms, yet the plate so named by Naves, enables us at once to identify the species, and the reference by F.-Villar, of this plate, with *Clerodendron fortunatum* Blanco, to *Clerodendron infortunatum*, shows the species of Blanco, which Naves intended his plate to represent. This name was published before *Clerodendron blancoanum* F.-Vill., and although without a description, we are of the opinion that the citation of the name as a synonym, by F.-Villar, should be considered a valid publication, and the name retained rather than to adopt a new name for this common species. *Clerodendron blancoanum* F.-Vill., although well described by that author, is a synonym of *Clerodendron quadriloculare* Merrill (*C. navesianum* Vidal.)

**Clerodendron quadriloculare** (Blanco) *Ligustrum quadriloculare* Blanco, Fl. Filip. ed. 1, 10. 1837; ed. 2, 7. 1845; ed. 3, 1: 14. 1877: *Clerodendron longiflorum* Schauer, DC. Prodr. 11: 670. 1847, p.p., as to the Philippine specimens; F.-Vill., Nov. App. 161. 1882: *Clerodendron navesianum* Vidal, Cat. Pl. Prov. Manila. 39. 1880; Synopsis, Atlas, t. 75, f. D. 1883; Rev. Pl. Vasc. Filip. 210. 1886; Ceron, Cat. Pl. Herb. 133. 1892: *Clerodendron blancoanum* F.-Vill. Nov. App. 161. 1882: *Clerodendron longiflorum* Deene., var. *speciosa* Naves, Fl. Filip. ed. 3, pl. 224, without description.

This species is apparently closely related to *Clerodendron longiflorum* Deene., but as pointed out by Vidal,<sup>1</sup> is distinguished from that species by the form of the calyx, the setaceous glandular segments shorter than the tube, the tube of the corolla glandular tomentose, the stamens shorter than the lobes of the corolla, and the petioles glandular pubescent. Schauer<sup>2</sup> refers to *Clerodendron longiflorum* Deene., not only the type, which was collected in the Island of Timor, but also specimens collected in Manila by Gaudichaud and Perrottet. Although the author has had no opportunity to examine these specimens, it is with considerable confidence that they are referred to *Clerodendron quadriloculare*, rather than to *C. longiflorum*. As noted by Vidal<sup>3</sup> both Gaudichaud and Perrottet botanized only accidentally in the Philippines, and for a short time only, and it is exceedingly probable that their specimens of *Clerodendron*, referred by Schauer to *C. longiflorum*, were collected from cultivated specimens in the city of Manila. *Clerodendron quadriloculare* is commonly grown in Manila, and is not found growing

<sup>1</sup> Cat. Pl. Prov. Manila. 39. 1880.

<sup>2</sup> DC. Prodr., 11: 670.

<sup>3</sup> Rev. Pl. Vasc. Filip., 12.



spontaneously in the vicinity of the city, moreover, no specimens have been seen which agree well with Decaisne's original description of the species. After a careful examination of the original description of *Clerodendron longiflorum*, Schauer's later characterization of the species, and the material in the herbarium cited below, the conclusion has been reached that *Clerodendron longiflorum* Decne., does not extend to the Philippines, and that Schauer erred in referring the Philippine specimens collected by Gaudichaud and Perrottet, to this species. A future monographer can definitely settle this point, but for the present we are of the opinion that *Clerodendron longiflorum* Decne., should be excluded from the Philippines, and that the Philippine specimens previously referred to that species, should be referred to the species here considered.

Although Blanco's diagnosis of *Ligustrum quadriloculare* is imperfect, and in some characters apparently erroneous, it is quite certain that the species here considered is the one he attempted to describe, and accordingly his name is here accepted, as being the earliest available one for the species.

*Clerodendron quadriloculare* is abundant and widely distributed in the hill forests of the Philippines, extending to an altitude (Benguet) of at least 1400 M. above the sea. As noted above, it is commonly cultivated in Manila, the shrub with its numerous, very long white flowers and its leaves, green above, always more or less purplish, frequently uniformly dark purple beneath, making it very strikingly ornamental. It is represented by the following specimens:

Manila (Merrill), January, 1904; (Garcia), 1901, from specimens cultivated in gardens: Luzon, Province of Rizal (1355, 2338 Merrill) (1881, Ahern's collector); Province of Bataan, Mount Mariveles (3746 Merrill) (339 Barnes) (6762, 6767 Elmer); Province of Zambales, Subig (Hallier), January, 1904; Province of Benguet, Sablan (6220 Elmer); Baguio (5964 Elmer). Island of Ticao (1057 Clark).

***Clerodendron simile* sp. nov. § *Siphonanthus*.**

A shrub with glabrous, membranous, lanceolate to ovate-lanceolate acuminate leaves, and slender elongated flowers about 3 cm. long, in crowded, terminal, many-flowered panicles. Branches light gray, glabrous. Leaves 13 to 20 cm. long, 3 to 8 cm. wide, the base acute, the apex short acuminate, 3-nerved from the base, the margins entire; nerves about 7 on each side of the midrib, rather prominent beneath; petioles 2 to 8 cm. long. Panicles minutely puberulous, the branchlets 3-flowered, the bracts and bracteoles subulate, 1 to 3 mm. long. Calyx minutely sparingly puberulent, funnel shaped, 5 mm. long, 5-toothed, the teeth acute, 1.5 mm. long. Corolla 3 cm. long, the tube very slender, puberulous below, the lobes spreading, oblong, acute or obtuse, 6 mm. long, 2 mm. wide. Stamens about equaling the corolla lobes, the anthers 2 mm. long. Ovary globose, glabrous.

Specimens examined: Baco, Mindoro (1192 (type), 1234 Merrill), January, 1903; also a specimen collected on Semirara Island (R. C. McGregor), November, 1904.

A species with the general appearance of *Clerodendron quadriloculare*, differing from the latter in its much shorter flowers.



***Prema membranacea* sp. nov.**

A subscandent shrub with rather large, very thin, more or less pubescent, broadly elliptical-ovate to suborbicular-obovate entire leaves, and small 4-merous flowers, the calyx equally 4-toothed, the corolla equally 4-lobed, the lobes reflexed. Branches light gray, glabrous, the young branchlets dark brown, rather strongly pubescent with weak crisped hairs. Leaves 11 to 20 cm. long, 9 to 14 cm. wide, shortly abruptly acuminate, the base broad, truncate-rounded, the margins obscurely undulate, the upper surface with few scattered weak spreading hairs, especially on the nerves and midrib, the pubescence of the lower surface similar but stronger; nerves very prominent on both surfaces, ascending, 6 to 7 on each side of the midrib, the primary reticulations subparallel, rather lax; petioles 5 to 7 cm. long, rather densely pubescent with somewhat crisped hairs. Inflorescence a terminal corymbose panicle 12 to 14 cm. long, and nearly as broad, the peduncle, branches and bracts uniformly, rather densely, crisped, somewhat ferruginous pubescent, the bracts subulate, about 5 mm. long. Flowers yellowish white, sessile or nearly so. Calyx oblong, slightly strigose pubescent, 2 mm. long, equally 4-toothed, the teeth small, rounded or subacute. Corolla evenly 4-lobed, the tube 3 mm. long, glabrous outside, the throat densely villous, lobes reflexed, oblong, rounded, about 1.5 mm. long, slightly more than 1 mm. wide. Stamens 4, didynamous; filaments glabrous, slender, two slightly exceeding 4 mm. in length, two slightly shorter; anthers 0.4 mm. long. Ovary ovoid, glabrous; style glabrous, about 4 mm. long, the style arms 1 mm. long. Type specimen: Bosoboso, Province of Rizal, Luzon (1165 Ahern's collector), June, 1904; also from the same locality No. 3102, June, 1905.

**GESNERACEÆ.**

***Boea swinhoii*** Hance. Ann. Sc. Nat. V. 5: 231. 1866; Carke in DC. Monog. Phan. 5: 142. 1883; Forbes & Hemsley, Journ. Linn. Soc. Bot. 26: 234. 1890.

This species previously known only from Formosa and Borneo is represented by specimens from Mount Arayat, Province of Pampanga, Luzon (3928, 4209 Merrill), October, 1904, September, 1905, the specimen in fruit, agreeing well with one of *Boca swinhoii* (897a Henry), from Formosa (in Herb. Govt. Lab.).

**CAPRIFOLIACEÆ.**

***Virburnum sinuatum* sp. nov.** (*Euciburnum*, § *Opulus*.)

A shrub about 7 m. high or less, with oblong-ovate, coarsely sinuate-dentate, long-acuminate, nearly glabrous leaves, the petioles and inflorescence densely stellate pubescent, the fruit compressed, 1-celled, 1-seeded, the endocarp pitted but not ribbed, the albumen uniform. Branches slender, brown, glabrous, the branchlets more or less ferruginous pubescent. Leaves membranous, 6 to 8 cm. long, 2 to 5 cm. wide, the base rounded, broad, the apex long slender acuminate, the margins coarsely sinuate-dentate, the teeth subacuminate, entirely glabrous above, except the more or less pilose

midrib, paler beneath and glabrous except the somewhat pubescent midrib and veins, the axils of the veins densely pilose-bearded; nerves very oblique, 5 to 6 pairs, prominent beneath, not anastomosing, the reticulations fine, distinct; petioles about 1 cm. long, becoming glabrous. Cymes terminal, short peduncled, densely stellate pubescent, 3 to 4 cm. long, the primary branches about 1 cm. long. Flowers white, fragrant. Calyx stellate pubescent, its tube oblong-ovoid, 1 mm. long, the teeth spreading, short, triangular-acute. Corolla rotate, regular, 5 lobed, 5 mm. in diameter, the tube 1 mm. long, the lobes ovate, obtuse, nearly 2 mm. long. Filaments nearly 2 mm. long, the anthers 0.7 mm. long. Ovary 1-celled; style short, much thickened. Drupe deep purple, nearly black when ripe, ovoid, compressed, 7 mm. long, the pit rugose, 1-celled, 1-seeded, the seed much compressed, not concave or incurved, the albumen uniform.

Specimens examined, all from Mount Mariveles, Province of Bataan, Luzon: (3946 Merrill), March, 1905 (flower); (3875 Merrill), August, 1904 (fruit); (6904 Elmer), November, 1904 (fruit); (2618 Meyer), February, 1905 (flower); (120 Whitford), May, 1904 (fruit).

A shrub growing on exposed ridges in the mossy forest above an altitude of 1,000 m. The third species of the genus to be discovered in the Philippines.

## GOODENIACEÆ.

### BALINGAYUM Blanco.

*Balingayum*.—Calyx adherent, 5-lobed. Petals 5, the apices with two lateral appendages. Style 1. Stigmas 3, 2-lobed. Capsule crowned by the calyx, 6-seeded.

*Balingayum decumbens*.—Stem herbaceous, terete, procumbent. Leaves alternate, sessile, oblong, narrow, glabrous, with small remote teeth, and somewhat lobed at the base. Flowers solitary. Peduncles elongated. Calyx adnate, 5-parted, the lobes lanceolate. Corolla of 5 linear petals, each terminated by two lateral appendages which close, forming a hood. Stamens 5, inserted on the receptacle, shorter than the corolla. Anthers compressed, terminated by a beak. Style 1, short, thick. Stigmas 3 (the middle one shortest), very wide, each with two ciliate lobes. Capsule oval, 1-celled, with 6 compressed seeds.—A small glabrous plant reclining on the earth, rare. I saw it in Malinta (north of Manila), and it is not well known; it is found in very damp places. T., *Baglingaya*: This plant appears to form a new genus, although it approaches *Jussiaea* and *Oenothera*. I have given it the name by which it is known to the natives.

The above is a translation of the description of the genus and species as given by Blanco, *Flora de Filipinas*, edition 1, page 187: 1837.

This genus has previously been known only from Blanco's description, although several attempts have been made to identify it. Mr. A. Loher some years ago identified it with *Calogyne*, and recently indicated this identification to the author. From a careful comparison of the descriptions of *Calogyne* and *Balingayum* and a study of specimens of *Calogyne*, from near the locality from which Blanco secured his material on which the

description of *Balingayum* was based, it is evident that Mr. Loher was correct in his identification of the genus. Planchon<sup>1</sup> has suggested that *Balingayum* might be referred to *Erythropalum*, of the *Oleaceæ*, this reference being accepted with doubt by Benthani and Hooker<sup>2</sup> and Engler.<sup>3</sup> F.-Villar<sup>4</sup> considers *Balingayum* to be a distinct genus of the *Onagraceæ*. It is evident that F.-Villar had specimens of the plant in question, as he adds some data to the description given by Blanco, but although he rediscovered Blanco's *Balingayum decumbens*, he failed to identify it with *Calogyne*. Below are given parallel descriptions of *Balingayum decumbens* Blanco and *Calogyne pilosa* R. Br., to which species Blanco's plant is evidently referable:

**Balingayum decumbens** Blanco.

A small prostrate herb, the stems terete, glabrous.

Leaves alternate, sessile, oblong, narrow, glabrous, with small remote teeth and somewhat lobed at the base.

Calyx adnate, 5-lobed, the lobes lanceolate.

Corolla of 5 linear petals, each terminated by 2 lateral appendages which close, forming a hood.

Stamens 5, inserted on the receptacle; anthers terminated by a beak.

Style 1, short, thick; stigmas 3, the middle one shortest.

Capsule oval, 1-celled, 6-seeded; seeds compressed.

**Calogyne pilosa** R. Br.

An erect or branching and diffuse annual,  $\frac{1}{2}$  to 1 ft. long, more or less hispid.

Leaves sessile or the lower ones petiolate, the upper stem-clasping, lanceolate or almost linear, marked with few distant teeth, and the floral ones usually with 1 or 2 lobes on each side at the base.

Calyx adnate, 5-lobed, the lobes lanceolate, leafy, hirsute.

Corolla 5-lobed, the upper lobes unequally winged, with an inflexed, concave auricle; the lower lobes equally winged.

Stamens 5; anthers mucronate-acuminate.

Style divided to near the base into 2 branches, and a third shorter intervening one.

Capsule nearly globular; seeds compressed (number not given in description available, but presumably 6, as the ovary is described as 6 ovuled).

A comparison of the above descriptions will, it is believed, settle without doubt the status of *Balingayum* so far as the genus is concerned. Regarding the species, judging from Philippine material only and descriptions

<sup>1</sup> Ann. Sc. Nat. IV., 2:260.

<sup>2</sup> Gen. Pl., 1:384. 1862.

<sup>3</sup> Engler und Prantl Nat. Pflanzenfam. III., 1:236. 1894.

<sup>4</sup> Nov. App., 93. 1880.

of the various species of *Calogyne*, it seems probable that our plant is identical with *Calogyne pilosa* R. Br., an Australian species, although it may be more closely related to *Calogyne chinensis* Benth., a species of southern China, and the only one previously known from outside of Australia. Bentham<sup>1</sup> expresses doubt as to the validity of *Calogyne chinensis* as a distinct species and suggests that it may prove to be only a variety of *Calogyne pilosa* R. Br., although it is retained as a distinct species by Forbes and Hemsley.<sup>2</sup> If our identification of Blanco's species is correct, the synonymy should be as follows:

**Calogyne pilosa** R. Br. Prodr. 1:579. 1810; Benth. Fl. Austr. 4:81. 1869.  
*Goodenia dubia* Spreng. Syst. 1: 721. 1825. *Balingayum decumbens*  
 Blanco, Fl. Filip. ed. 1, 187. 1837; ed. 2, 132. 1845; ed. 3, 1:237;  
 F.-Vill. Nov. App. 93. 1880; Merrill, Govt. Lab. Publ. 27:48. 1905.

Specimens examined, Caloocan, Province of Rizal, Luzon (3669 Merrill), November, 1903; also specimens collected by Hallier, same locality and date. Manila. Balicbalic (173 Rufino Marave), January, 1895.

A procumbent, more or less pubescent plant, not common in damp places in open grass lands, banks of rice paddies, etc.

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<sup>1</sup> Fl. Austr., 4:80. 1869.

<sup>2</sup> Journ. Linn. Soc. Bot., 26:1. 1889.

## II. NOTES ON CUMING'S PHILIPPINE PLANTS IN THE HERBARIUM OF THE BUREAU OF GOVERNMENT LABORATORIES.

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By ELMER D. MERRILL, *Botanist*.

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Through the kindness of Dr. J. Britten, director of the botanical department of the British Museum, this office has been enabled to secure by exchange a very interesting series of duplicates of Cuming's Philippine plants, consisting of 880 numbers, received in April, 1905. Cuming collected in the Philippines during the years 1836-1840, and we are especially fortunate to be able to secure at this late date so many duplicates from his valuable collection.

Previously some material of Cuming's collection was sent to Manila, but these specimens were destroyed by fire in September, 1897.<sup>1</sup> Vidal<sup>2</sup> states that nearly all the specimens of Cuming's plants which he received from the British Museum were *Rubiaceæ*, *Gramineæ*, and *Ficus*. Later<sup>3</sup> he states that in all he obtained about 210 specimens of this valuable collection.

In the material recently received certain families of plants are well represented, in some cases containing nearly a complete representation of all the species collected by Cuming, while other families, of which Cuming secured much material, are represented by only a few specimens. The following larger families are well represented: *Anacardiaceæ*, 8 numbers; *Apocynaceæ*, 18 numbers; *Asclepiadaceæ*, 14 numbers; *Anonaceæ*, 35 numbers; *Amarantaceæ*, 10 numbers; *Acanthaceæ*, 18 numbers; *Borraginaceæ*, 10 numbers; *Capparidaceæ*, 8 numbers; *Compositæ*, 12 numbers; *Combretaceæ*, 8 numbers; *Convolvulaceæ*, 9 numbers; *Euphorbiaceæ*, 38 numbers; *Filices*, 195 numbers; *Gramineæ*, 53 numbers; *Labiataæ*, 17 numbers;

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<sup>1</sup>Merrill, Bureau of Agriculture Bull., 3:20. 1903.

<sup>2</sup>Phan. Cuming Philip., XIV. 1885.

<sup>3</sup>Rev. Pl. Vasc. Filip., 30. 1886.

*Lauraceæ*, 8 numbers; *Loranthaceæ*, 28 numbers; *Myristicaceæ*, 8 numbers; *Myrtaceæ*, 22 numbers; *Meliaceæ*, 12 numbers; *Piperaceæ*, 12 numbers; *Rutaceæ*, 12 numbers; *Sapindaceæ*, 21 numbers; *Sterculiaceæ*, 14 numbers; *Scrophulariaceæ*, 13 numbers; *Tiliaceæ*, 18 numbers; *Urticaceæ*, 21 numbers; *Verbenaceæ*, 34 numbers.

Although Cuming collected his material more than sixty years ago, and the duplicates were for most part widely distributed to botanical institutions in Europe and America at an early date, still many of his specimens have never been identified, especially in such families as the *Myrtaceæ* and *Anonaceæ*. In the material recently received are duplicate types of such recently described species as *Cynometra simplicifolia* Harms; *Allophylus quinatus* Radlk.; *Grewia philippinensis* Perk.; *Melicope philippinensis* Engl.; and *Vaccinium caudatum* Warb., these species, with the exception of the first, having been described within the past year wholly or in part from specimens of Cuming's collection. In the material received from the British Museum are the co-types of no less than 350 species, while a very large proportion of the remaining numbers have been cited by authors as representing various species. The following notes have been prepared from specimens in the herbarium of this Bureau:

### MAGNOLIACEÆ.

#### *Michelia parviflora* sp. nov.

A medium-sized tree with membranous, glabrous, oblong-lanceolate or oblanceolate acuminate leaves and fragrant white flowers 2 cm. in diameter. Branches brownish gray, the branchlets sparingly appressed ferruginous pubescent. Leaves 8 to 12 cm. long, 2.5 to 4 cm. wide, glabrous or nearly so, the midrib beneath with few short ferruginous hairs, both surfaces shining, the lower pale when dry, the apex prominently acuminate, the acumen blunt, the base cuneate; primary nerves 11 to 13 on each side of the midrib, about equally prominent on both surfaces and but slightly more prominent than the secondary nerves and reticulations; petioles about 1 cm. long, with few ferruginous hairs. Peduncles solitary, axillary, stout, about 3 mm. long, and with the deciduous bracts densely appressed ferruginous pubescent. Sepals oblong, obtuse, 10 mm. long, 3.5 mm. wide. Petals 7 or 8, in two series, similar to the sepals but somewhat smaller. Stamens about 20, 3 to 4 mm. long. Stalk of the gynophore 2.5 mm. long, ferruginous pubescent. Pistils about 8. Ovaries pubescent, each 2-ovuled, the ovules superposed.

Type specimen: Province of Tayabas, Luzon (783 Cuming), 1836-1840. Bosoboso, also Province of Rizal, Luzon (2155 Ahern's collector), December, 1904.



## ANONACEÆ.

***Polyalthia cumingiana* sp. nov. § *Monoon*.**

A shrub or tree with lanceolate, acuminate, nearly glabrous leaves 20 cm. long or less, and solitary, axillary flowers, the petals of the mature flowers 5 cm. long. Branches slender, brownish black, striate, lenticellate, very slightly ferruginous pubescent when young, becoming glabrous. Leaves 10 to 20 cm. long, 3 to 6 cm. wide, submembranous, shining and glabrous above, duller beneath, but not pale, and very slightly pubescent on the midnerve and lateral nerves, tapering above to the acuminate apex, the base rather abruptly acute; nerves 5 to 8 on each side of the midrib, curving-ascending, distant, rather prominent beneath, the reticulations lax, rather obscure; petioles 2 to 3 mm. long, slightly pubescent. Pedicels 1 to 1.5 cm. long, axillary, solitary, densely ferruginous pubescent. Calyx densely ferruginous pubescent outside, the sepals ovate, obtuse, about 3 mm. long. Petals all similar, subequal, when mature oblong lanceolate, obtuse, 4.5 to 5 cm. long, 1 to 1.5 cm. wide, more or less densely ferruginous-puberulous throughout, especially near the base outside. Stamens many, 1 to 1.5 mm. long, the connectives oblique, overlapping. Ovaries many, 1.5 mm. long, or less, densely pubescent, 1-ovuled; style ovoid. Fruit unknown.

Type specimen: Province of Tayabas, Luzon (827 Cuming), 1836-1840.

***Goniothalamus elmeri* Merr. Govt. Lab. Publ., 29:13. 1905.**

(793, 1684, Cuming.) These two numbers have previously been referred to *Goniothalamus giganteus* Hook. f. et Th., but do not at all agree with the description of that species or with the figure given by King.<sup>1</sup> They do, however, agree with the above species, recently described by the author.

***Orophea glabra* Merr. l. c., 14.**

(1277 Cuming.) This specimen is apparently referable to this species, although the material of this number in our herbarium is without flowers, rendering absolute identification impossible.

***Mitrephora lanotan* (Blanco) *Uvaria lanotan* Blanco, Fl. Filip. ed. 1, 464. 1837. *Unona latifolia* Blanco, l. c., ed. 2, 324. 1845; ed. 3, 2: 235, non DC. *Goniothalamus giganteus* F.-Vill. Nov. App. 6. 1880, at least with reference to synonymy of Blanco, non Hook. f. et Th. *Mitrephora ferruginea* Merrill, Govt. Lab. Publ. 17: 16. 1904, in part (610 Borden).**

A tree 6 to 10 m. high with oblong-ovate to ovate-lanceolate acuminate, nearly glabrous leaves, and subglobose or ovoid densely ferruginous pubescent fruits 1.5 to 2 cm. long. Branches dark brown, striate, more or less pubescent, the younger branchlets densely ferruginous pubescent. Leaves 9 to 16 cm. long, 3 to 5 cm. wide, entire, short acuminate, the base acute, upper surface glabrous and shining except for the ferruginous pubescent midrib, the under surface shining, more or less ferruginous pubescent on the midrib and nerves and often with few scattered hairs on the lamina, or nearly glabrous; nerves 9 to 10 on each side of the midrib, prominent beneath, curved-ascending; petioles thickened, densely ferruginous pubescent,

<sup>1</sup>Ann. Bot. Gard. Calcutta, 4: pl. 130. 1894.

3 to 5 mm. long. Flowers hermaphrodite, odorless, on short extra-axillary peduncles, solitary, or at least only one flower developing at a time, greenish brown or yellowish, 3 to 4 cm. in diameter, the pedicel densely ferruginous pubescent, 5 mm. long, and with three small, ovate, pubescent bracts at about the middle. Sepals very broadly triangular ovate, acute, 3 mm. long, 3.5 mm. wide, densely ferruginous pubescent on the outside. Petals creamy white, greenish at the base, the three outer ones spreading, narrowly ovate or somewhat obovate, 2 cm. long, 8 mm. wide above, the apex abruptly but bluntly acuminate, densely ferruginous pubescent on the outside, glabrous on the inside except for few scattered hairs near the base, the 3 inner petals about 1.5 cm. long, vaulted, connivent above, and with long slender claws, more or less ferruginous pubescent on the outside. Stamens numerous, yellow, slightly exceeding 1 mm. in length, the anther cells concealed by the overlapping connectives. Ovaries few, pubescent, 1 mm. long, 8-ovuled. Carpels ovoid to subglobose, densely ferruginous pubescent, 1.5 to 2 cm. long.

Nos. 773 and 1588 Cuming, and apparently also Nos. 1079 and 1135 Cuming, of which fragments with immature flowers exist in Herb. Govt. Laboratory. Also the following specimens, all from the Lamao River region, Province of Bataan, Luzon, where the species is common in the hill forests. (610, 763, 2364, and 2924 Borden) (2230 and 3016 Meyer) (1033 and 1250 Whitford) (1447 Ahern's collector) (6087 Leiberg). Flowering March to May.

While there will always be some doubt as to the exact identity of Blanco's *Uvaria lanotan*, still his description applies with sufficient closeness to the present species, and his name has been adopted rather than to describe the latter under an entirely new one. The native name, *Lanotan*, is very loosely applied to many arborescent species of *Anonaceae*, and accordingly does not aid in the identification of Blanco's species. Blanco's description applies very closely to the above species, the time of flowering agrees, and the tree is common in the regions from which Blanco received most of his material. This species was included by the author in *Mitrephora ferruginea* as noted above, but is sufficiently distinct from that species, being distinguished by its usually smaller much less pubescent, fewer nerved leaves the pubescence not at all stellate, and much smaller fruits.

## CAPPARIDACEÆ.

**Stixis philippinensis** (Turcz.) (*Roydsia philippinensis* Turcz. Bull. Soc. Nat. Mosc. 27<sup>2</sup>:229. 1854; Vidal, Sinopsis, Atlas, t. 6. f. B. 1883; Phan. Cuming. Philip. 94. 1885; Rev. Pl. Vasc. Filip. 48. 1886; Ceron, Cat. Pl. Herb. 16. 1892. *R. floribunda* Planch. ex Mast. in Hook. f. Fl. Brit. Ind. 1:409. 1874. *Stixis floribunda* Pierre, Bull. Soc. Linn. Paris, 1:655. 1887.)

*Roydsia philippinensis* Turcz., and *R. floribunda* Planch., were both based on the same number of Cuming's Philippine collection (No. 541), and the former name being the earlier should be retained. Turczaninow's diagnosis is very complete, while that of Planchon is very incomplete, the species being mentioned by Masters in a note only.

(541 Cuming, cotype). Luzon, Province of Bataan, Lamao River (2263 Meyer) (2326 Borden), December, 1904. A scandent shrub in tall trees in the hill forests at an altitude of about 100 m. reaching a diameter of 6 to 8 cm. Flowers yellow, fragrant.

## BURSERACEÆ.

**Garuga abilo** (Blanco) *Guaiacum abilo* Blanco, Fl. Filip. ed. 1, 364. 1837. *Icica abilo* Blanco, l. c., ed. 2, 256. 1845; ed. 3, 2:113. *Garuga mollis* Turcz. Bull. Soc. Nat. Mosc. 31<sup>1</sup>: 475. 1858; Engler in DC. Monog. Phan. 4:6. 1883; Rolfe, Journ. Bot. 23:211. 1885; Vidal, Phan. Cuming. Philip. 101. 1885; Perk. Frag. Fl. Philip. 100. 1904. *Garuga floribunda* F.-Vill. Nov. App. 40. 1880, non Deene.

(Cuming 960, 1235): also the following specimens: Luzon, Province of Rizal, Bosoboso (2815 Merrill), July, 1903; (2964 Ahern's collector), April, 1905; Tanay (2322 Merrill), May, 1903; Province of Tayabas, Guinayangau (2018 Merrill), April, 1903. Mindoro, Pinamalayan (2167 Merrill), May, 1903. The native names appearing on the above are the following: *Abilo*, *Bagulibas*, and *Mala-acla*.

F.-Villar reduces this species as described by Blanco in the first edition of the Flora de Filipinas, to *Garuga pinnata* Roxb., and as described in the second edition, to *G. floribunda* Deene., the latter identification being previously accepted by the author.<sup>1</sup> From a careful examination of the material cited above and Blanco's descriptions, it is evident that in the two editions they apply to the same species, and that this is identical with *Garuga mollis* Turcz., and not the same as *G. floribunda* Deene. Blanco's name being the earlier, should be retained.

## MELIACEÆ.

**Aglaia turczaninowii** C. DC. Monog. Phan. 1:456. 1878. *Nemodra?* sp. Turcz. Bull. Soc. Nat. Mosc. 31:412. 1858. *Amoora lepidota* Merrill, Govt. Lab. Publ. 17:23. 1904.

(772 Cuming, cotype.) A common and widely distributed endemic species to which *Amoora lepidota* Merrill must be referred. Anthers in many specimens 10, in others varying from 6 to 10.

## ANACARDIACEÆ.

**Koordersiodendron pinnatum** (Blanco) Merrill, Forest. Bureau Bull. 1:33. 1903. *Helicteres pinnata* Blanco, Fl. Filip. ed. 1, 384. 1837. *Cyrtocarpa quinquestyla* Blanco, l. c., ed. 2, 269. 1845, ed. 3, 2: 135. *Odina speciosa* Blume, Mus. Bot. Lugd. Bat. 1:206. 1849-51; Engler in DC. Monog. Phan. 4:274. 1883; F.-Vill. Nov. App. 55. 1880; Miq. Fl. Ind. Bat. 1<sup>2</sup>:623. 1859; Vidal, Phan. Cuming. Philip. 106.

<sup>1</sup> Govt. Lab. Publ., 27: 30. 1905.

1885. *Odina multijuga* Vid. Sinopsis, Atlas, 22. t. 37. f. A. 1883. *Odina speciosa* var. *multijuga* Vid. Rev. Pl. Vasc. Filip. 101. 1886; Ceron, Cat. Pl. Herb. 57. 1892. *Odina wodier* F.-Vill. Nov. App. 55. 1880; Tavera, Pl. Med. Filip. 100. 1892, English ed. 86. 1901?, non Roxb. *Calcsium speciosum* O. Kuntze, Rev. Gen. Pl. 151. 1891. *Lannea speciosa* Engl. in Perk. Frag. Fl. Philip. 26. 1904. *Koordersiodendron celebicum* Engl. Mededeel. 's Lands Plant. 19:410. 1898; Boerlage in Icon. Bogor. 1:55. pl. 94-95. 1901; Perk. Frag. Fl. Philip. 25. 1904.

Philippines (1032 Cuming). Also the following specimens: Luzon, Province of Bataan, Lamao River, Mount Mariveles (353, 515, 557, 576, 602, 608 Barnes), March, 1904; (649, 1611, 1618, 1646, 1664, 1678 Borden), April to August, 1904; (358 Whitford), June, 1904; (2575 Meyer), February, 1905; Dinalupihan (1472 Merrill), January, 1903. Province of Tayabas, Malieboi (J. W. Ritchie), April, 1903; Pagbilao, (1919, 2853 Merrill), April, 1903. Province of Rizal, Antipolo (438 Ahern's collector), April, 1904; (1 Merrill), Decades Philippine Forest Flora, February, 1904. Province of Camarines Sur, Pasacao (121 Ahern). Mindoro, Pola (2467 Merrill), June, 1903. Island of Ticao (1025 Cark), June, 1904.

A well-known timber tree in the Philippines, ranking seventeenth in amount of timber received in the Manila market in the year 1903, being much used for purposes of general construction. Common and widely distributed in the hill forests throughout the Philippines, flowering February to April, and also known from Celebes and New Guinea. T., *Amuguis*, *Amoguis*, *Muguis*. V., *Calumanog*, *Sambuluan*, *Sambabalan*.

A very complete description and discussion of this species, with two plates, is given by Boerlage in *Icones Bogoriensis*, cited above, where the identity of *Odina speciosa* Blume and *Koordersiodendron celebicum* is shown.

Inasmuch as Blanco's description, sub *Helicteres pinnata*, is much the earlier, and there being no doubt whatever as to the identity of his species, his name should be retained. *Cyrtocarpa quinquestila* of Blanco's second edition is only a new name for *Helicteres pinnata* of the first edition. *Odina wodier* of F.-Villar and Tavera, cited above is probably referable here, although the description given by the latter was evidently taken, at least in part, from Hooker's Flora of British India. Perkins enumerates this species under two names, *Lannea speciosa* Engl. (No. 1999 Merrill, flower) and *Koordersiodendron celebicum* Engl. (No. 121 Ahern, fruit). These two numbers certainly represent the same species, and are *Koordersiodendron pinnatum*. The above is the only published record I have been able to find of the transfer of *Odina speciosa* to *Lannea*.

**Buchanania florida** Schauer, var. *cumingii* Engl., in DC. Monog. Phan. 4:190. 1883.

(1115 Cuming), cotype of the variety. I am unable to separate from this variety, the species proposed by Perkins<sup>1</sup> *Buchanania pseudoflorida* (2061 Merrill), Guinayangan, Province of Tayabas, Luzon, April, 1903.

<sup>1</sup> Frag. Fl. Philip., 24. 1904.

**Semecarpus philippinensis** Engler in DC. Monog. Phan. 4:481. 1883.

(1146 Cuming, cotype.) This is undoubtedly the form described by Blanco as *Semecarpus cuneiformis*, a much earlier name, and considered by the author<sup>1</sup> to be a form of *S. perrottetii* March. I am unable to distinguish from this species *Semecarpus clmeri* Perk. (l. c. 26). (1176 Merrill), Baco, Mindoro, January, 1902). An undeveloped specimen in bud only:

## GUTTIFERÆ.

**Garcinia binucao** (Blanco) Choisy Guttif. Ind. 34; Panch. et Triana Mem. Guttif. 205; Pierre, Fl. Forest. Cochinch., Enum. 28; Vesque in DC. Monog. Phan. 8:454. *Cambodia binucao* Blanco, Fl. Filip. ed. 1, 434. 1837; ed. 2, 302. 1845; ed. 3, 2:196. *Garcinia cambogia* F.-Vill. Nov. App. 16. 1880, non Desrouss. *Garcinia duodecandra* Pierre, Fl. Forest. Cochinch. t. 64. f. 7, 10, 11; Vesque, Epharm. 2: 11. 124, 125; DC. Monog. Phan. 8:442.

(Cuming, 1509.) This specimen is identical with Nos. 612, 713, 783 Borden, from the Province of Bataan, Luzon, which certainly represent Blanco's species, agreeing with his description, being common in the forests of central Luzon, the fruits being acid and edible, the tree being universally known to the Tagalogs as *Binucao* or *Bilucao*. *Garcinia binucao* has previously been a doubtful species, known only from Blanco's description and Pierre distinguished his *Garcinia duodecandra* from *G. binucao* only by the petioles, Blanco describing the petioles of *G. binucao* only by the relative term, "very short."

## SAPOTACEÆ.

**Sideroxylon duclitan** Blanco, Fl. Filip. ed. 1, 129. 1837; ed. 2, 92. 1845; ed. 3, 1:168; A. DC. in DC. Prodr. 8:185. 1844; F.-Vill. Nov. App. 124. 1882; Vidal, Phan. Cuming. Philip. 124. 1885; Rev. Pl. Vasc. Filip. 176. 1886. *Sideroxylon ramiflorum* Merrill, Govt. Lab. Publ. 17:43. 1904.

(770 Cuming); also represented by the following specimens: Luzon, Manila (3412 Merrill), October, 1903; Province of Rizal, Bosoboso (2793 Merrill), July, 1903; Province of Bataan, Lamao River (77 Barnes), November, 1903 (2308 Meyer), December, 1904; (2353 Borden), January, 1905. Mindanao, District of Zamboanga, San Ramon (Hallier), February, 1904.

The above specimens are all apparently identical with Cuming's specimen, and agree very closely with Blanco's description of the species, and accordingly *Sideroxylon ramiflorum* should be reduced as a synonym of *S. duclitan*. The species erroneously identified by the author as *Sideroxylon duclitan* Blanco, is apparently a new species (see page 56). Blanco states that this tree was well known to the natives by the name *Duclitan*, but our specimens bear the Tagalog names *Bancalande*, *Malapaho* and *Nato*. *Sideroxylon balitbitan* Blanco, described as differing from *S. duclitan* only in its wider leaves, is probably not specifically distinct from the above species.

<sup>1</sup> Govt. Lab. Publ., 27:36. 1905.



## OLEACEÆ.

*Jasminum aculeatum* (Blanco) *Mogorium aculeatum* Blanco, Fl. Filip. ed. 1, 9, 1837; ed. 2, 7, 1845; ed. 3, 1:13. *Jasminum marianum* F.-Vill. Nov. App. 128, 1883, excl. syn. Naves, non DC. *Jasminum* sp. Vidal, Phan. Cuming. Philip. 125, 1885.

A scandent shrub 4 to 6 m. high with membranous, glabrous, ovate leaves and terminal paniculate inflorescence. Branches slender, glabrous, light gray; branchlets opposite, brown, puberulous, subtended by the hardened, truncate, persistent bases of the petioles (described by Blanco as the branchlet representing the rhachis of a compound leaf with two hard stipule-like truncate spines at the base). Leaves entirely glabrous, thinly membranous, broadly ovate, acute or acuminate, the base broad, truncate, rounded or slightly cordate, rarely somewhat acute, 4 to 7 cm. long, 2 to 5 cm. wide; nerves about 8 on each side of the midrib; petioles 1 to 1.5 cm. long, jointed below, the base becoming hardened and persistent on the branches. Panicles terminal, spreading. Flowers, white, fragrant, 2 cm. long. Calyx oblong, glabrous, small, with 6 minute teeth. Corolla tube slender, glabrous, 14 mm. long, the limb spreading, 6 to 8 cleft, the lobes lanceolate, acute or acuminate, 10 mm. long, 2 to 2.5 mm. wide. Anthers 2, 3 mm. long. Fruit ovoid or subglobose, glabrous, shining, about 8 mm. long.

(1211 Cuming); also the following specimens: Luzon, Province of Rizal, Bosoboso (1868 Merrill), April, 1903; Province of Tarlac (C. L. Hall), 1903; Province of Zambales, Subic (2100 Merrill), April, 1903. Mindoro, Bulalacao (921 Merrill), April, 1903; Pola (2449 Merrill), May, 1903. A scandent shrub rather common in open thickets and apparently widely distributed in the Philippines.

## VERBENACEÆ.

*Clerodendron blancoi* Naves.

(1573, 1644.) These numbers of Cuming's collection have not previously been identified, but certainly represent Naves's species, for a discussion and full synonymy of which see page 62.

*Premna odorata* Blanco, Fl. Filip. ed. 1, 489, 1837; 1. c., ed. 2, 341, 1845; ed. 3, 2:268; Miq. Fl. Ind. Bat. 2:900, 1856; Schauer in DC. Prodr. 11:638, 1847. *Premna vestita* Schauer, 1. c., 631; Miq. 1. c., 892; Vidal, Phan. Cum. Philip. 134, 1885; Synopsis, Atlas, t. 74. f. E. 1883; Rev. Pl. Vasc. Filip. 209, 1886; F.-Vill. Nov. App. 159, 1883; Merrill Forest. Bureau Bull. 1:51, 1903. *Premna pubescens* F.-Vill. 1. c., non Blume.

(599 Cuming, cotype, *Premna vestita* Schauer.) Blanco's name is the proper one for this species as determined by the author<sup>1</sup> *Premna vestita* Schauer being certainly identical with *P. odorata*. The most common and

<sup>1</sup> Govt. Lab. Publ., 27:68, 1905.



widely distributed species of the genus in the Philippines, especially common about towns and dwellings and in thickets in cultivated regions generally, well known to the natives by the names *Alagao* and *Adgao* which are almost invariably applied to it.

***Vitex turczaninowii***, nom. nov. *Premna philippinensis* Turez. Bull. Soc. Nat. Mosc. 36:215. 1863; F.-Vill. Nov. App. 159. 1883, non *Vitex philippinensis* Merr. Forest. Bureau, Bull. 1:52. 1903.

This species which belongs in *Vitex*, rather than in *Premna*, was based on Nos. 1172 and 1294 of Cuming's Philippine collection, both these numbers being represented in the herbarium of this Bureau. *Premna philippinensis* Turez., is not mentioned by Vidal<sup>1</sup> but No. 1172 is referred by him to *Rourea multiflora* Planch., and No. 1294 to *Vitex* sp. indet. Turezaninow evidently described it from fragmentary material, as his diagnosis leads one to infer that the leaves are simple. As his diagnosis in other respects applies exactly to the above numbers of Cuming's collection in our herbarium, it seems evident that he had only specimens with detached leaflets. The following should be added to the description of the leaf characters. Leaves 5, rarely 4 or 3 foliolate; petioles glabrous, 8 to 10 cm. long; petiolules 1 to 2 cm. long. Flowers yellow.

In addition to the two numbers of Cuming's Philippine collection referred by Turezaninow to this species, it is apparently well represented also by No. 1173 Cuming, and the following specimens of more recent collection: Luzon, Province of Bataan, Lamao River (1335 Whitford) (3059 Borden), May, 1905; Province of Rizal, Bosoboso (2951 Ahern's collector), April, 1905; San Mateo (1127 Ahern's collector), May, 1904; Province of Tayabas, Pagbilao (2852 Merrill), April, 1903. Island of Tieao (1096 Clark), May, 1904.

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<sup>1</sup>(Phan. Cuming. Philip. 1885.)



### III. NOTES ON PHILIPPINE GRAMINEÆ.

By E. HACKEL.

Some time ago a small collection of critical Philippine grasses was sent to Dr. E. Hackel, Graz, Austria, for identification, who kindly examined the same and submitted copious notes with his identifications. These notes have been amplified and are here presented. The diagnoses of the new species, in Latin, are published as submitted by Dr. Hackel.—(E. D. M.)

**Pollinia argentea** Trin., var. **lagopus** Hack., nov. var.

Differt a typo vaginis in basi culmo sitis fulvo-tomentosis (in typo glabris).

Mount Arayat, Province of Pampanga, Luzon (3902 Merrill), October, 1904. In a small area of open dry grass land at the summit of the mountain, altitude 870 m. above the sea.

**Pollinia quadrinervis** Hack. in DC. Monog. Phan., 6:158. 1889.

This species, not previously reported from the Philippines, is represented by a specimen from Baguio, Province of Benguet, Luzon (5783 Elmer), March, 1904, it growing in small tufts in the pine forests. The specimens are not quite typical, in some respects approaching *Pollinia villosa* Spreng., without being quite intermediate. China to subtropical Himalaya.

**Isachne Beneckeii** Hack. in Oesterr. Bot. Zeitsch., 51:459. 1901.

This species is represented by No. 464 Whitford and No. 3201 Merrill, Mount Mariveles, Province of Bataan, Luzon, July, 1904, growing on recently burned places on exposed ridges at an altitude of about 1,200 m. above the sea. Java.

**Isachne monticolor** Blüse in Miq. Pl. Jungh. 379, 1855; Fl. Ind. Bat., 3:461, 1859. *Isachne debilis* Rendle, Journ. Linn. Soc. Bot., 36:322. 1904.

Mount Mariveles, Province of Bataan, Luzon (264 Whitford) (3245 Merrill); Baguio, Province of Benguet (5821 Elmer), March, 1904. A species originally described from Javan material, with the description of which the material cited above obviously agrees. *Isachne debilis* Rendle is apparently a synonym.

**Isachne pauciflora** Hack. nov. spec.

Perennis. Culmi natantes vel in solo valde uliginoso radicanes, humifusi, ramosi, ramis floriferis glaberrimis, apice longiuscule nudis. Vaginæ laxæ, internodiis breviores, hirsutæ, ad nodos barbatae, ore longe ciliatæ. Ligula brevissima, truncata, pilis stipata. Laminae ovato-lanceolatae, acutæ, 1-1.4 cm. longæ, circiter 4 mm. latæ, rigidulæ, virides, utrinque (præsertim supra) setulis adpersæ, margine vix incrassato, scabræ, tenuinervis. Panicula paupera, 1-1.5 cm. longa, stricta, contracta, rhachi ramisque lævibus rigidulis, his alternis, 3-4, brevibus, suberectis, inferioribus 2-3 spiculatis, superioribus 1-spiculatis. Spiculæ pedicellis quam ipsæ paullo longioribus vel eas subæquantibus, lævibus, apice haud incrassatis fultæ, subglobose, 2 mm. longæ, sordide virides. Glumæ sterilis spiculam æquantes, inter se æquales, late ovales vel obovato-ovales, obtusæ vel II obtuse apiculata, versus apicem parce setulosæ, ad 2 mm. longæ, 7-nerves. Glumæ fertiles inter se longitudine structuraque æquales, 1.8 mm. longæ, late ovales, obtusissimæ, albo viridulæ, punctato-scabræ et dense puberulæ, flore atraque fertili. Palea glumæ similis, sed planiuscula.

Baguio, Benguet, Luzon (6486 Elmer), June 1904, natans vel in solo valde uliginoso.

Videtur affinis *I. myosoti* Nees, quæ (ex descr.) differt foliis vaginisque e tuberculatis hirsutis, spiculis minimis (vix magnitudin sem. *Papaveris*) glumæ sterilibus oblongis patentissimis.

**Panicum caudiglume** Hack. Oesterr. Bot. Zeitsch., 51:428. 1901. (*Panicum* n. sp. ? affinis *Panico trachyrhachidi* Benth., Mez. in Perk. Frag. Fl. Philip., 144. 1904.)

This species is represented by No. 832 Merrill, San Antonio Bay, Paragua, February, 1903, specimens old and in poor condition, and No. 3307 Merrill, Lamao River, Province of Bataan, Luzon, October, 1904. The former number in sandy open soil on the seashore, the latter rather common in the borders of dry thickets. Java.

**Panicum humile** Nees in Steud. Syn. Gram., 84, 1855; Hook. f. Fl. Brit. Ind., 7:48, 1897.

A species not previously known from the Philippines, represented by No. 3623 Merrill, Concepcion, Province of Tarlac, Luzon, November, 1904. Distribution, Borneo to Ceylon, Punjab, Assam, Bangal, Sikkim, etc.

**Panicum didactylum** Kunth, Rev. Gram., 1:33. 1835. § *Digitaria*.

This species, reduced by many authors to *Panicum sanguinale* Linn., is represented by No. 5634 Elmer, Bauang, Province of Union, Luzon, February, 1904. Said by the collector to be common in waste places.

**Ichnanthus pallens** (Sw.) Munro, in Benth. Fl. Hongk. 414. 1861. (*Panicum pallens* Sw.; *Panicum nitens* Merr., Govt. Lab. Publ. 17:8. 1904.)

This widely distributed species has not previously been reported from the Philippines, *Panicum nitens* Merr., being identical with *Ichnanthus pallens* Munro, the genus *Ichnanthus* being distinguished from *Panicum* only by the appendaged base of the flowering glume. Mount Mariveles, Province of Bataan, Luzon (3221 and 2756 Merrill).

**Oplismenus compositus** Beauv., var. **lasiorhachis** Hack., nov. var.

Foliis subsericeo-villosis, culmo superne pubescente, rhachis communi et spicarum speciali villosa a reliquis formis hujus speciei diversa (*Oplismenus burmanni* Mez in Perk. Frag. Fl. Philip. 144. 1904, non Beauv.)

Separation Point, Paragua (826 Merrill), February 18, 1903. In open dry places along trails.

Hooker<sup>1</sup> enumerates and describes several forms of *Oplismenus compositus*, without names. The variety here described does not correspond with any of these forms, but comes nearest to No. 1. *Oplismenus burmanni* Beauv. is well represented by No. 3290 Merrill, Lamao River, Province of Bataan, Luzon, October, 1903. A species very different from No. 826 Merrill, the type of the present variety, which was referred by Mez to that species.

**Oplismenus minus** Merr. Govt. Lab. Publ. 17:9. 1904.

This species is not sufficiently distinct from *Oplismenus undulatifolius* Beauv. var. *imbecillis* (Kunth) Hack., and should be reduced to this variety.

Mount Mariveles, Province of Bataan, Luzon (3203 Merrill), October, 1903.

**Leptaspis cochleata** Thw. ? Enum. Pl. Zeyl. 357. 1864; Trimen, Handbook Fl. Ceylon 5:191. 1900; Hook. f. Fl. Brit. Ind. 7:95. 1897.

Davao, District of Davao, Mindanao (703 Copeland), March, 1904. This species is known only from the Island of Ceylon, and the material here doubtfully referred to *Leptaspis cochleata* is too imperfect for accurate identification. It is quite distinct from *Leptaspis urceolata* R. Br., and *L. banksii* R. Br. The specimen here referred to *L. cochleata* differs from that species in its much longer leaf stalks, but the hooked hairs of the oblique flowering glume point strongly to that species.

**Monerma repens** (Forst.) Beauv. Agrost. 117. 1812; *Lepturus repens* R. Br. Prodr. 207. 1810.

This widely distributed grass has not previously been reported from the Philippines, and is represented by No. 606 Merrill, Culion Island, December, 1902, and No. 3331 Merrill, Puerto Galera, Mindoro, October, 1903. Seashores from Ceylon through the Malayan region to Australia and Polynesia.

**Eragrostis distans** Hack. nov. spec.

Anna. Culmi erecti, gracillimi, ad 30 cm. alti, compressi, glaberrimi, 3-nodes, simplices. Vaginae arctae, internodiis breviores, compressae, praeter os parce barbatum (raro glabrum) glaberrimae; ligula brevissima, truncata, ciliolata; laminae angustae lineares, sensim tenuiterque acuminate, 12-20 cm. longae, circiter 1.5 mm. latae, planae vel complicatae, flaccidae, erectae, glabrae vel basi parce ciliatae, virides, tenuinerves. Panicula ovata, patens, laxissima, 20-25 cm. longa, rhachi stricta, gracili, teretiusecula, laevi, ramis paucis (5-8) solitariis, distantibus, tenuibus, strictis patentibus, teretiuseculis, laevibus vel superne scaberulis in circ. 1/2 inferiore nudis

<sup>1</sup> Fl. Brit. Ind., 7:67. 1897.

dein spiculas secus ramos distichas distantes (interstitiis quam spicula longioribus) in superiore rami parte solitarias, in inferiore 2-3-nas, pedicellis scabris, spicula 2-5-plo brevioribus fultas gerentibus. Spiculæ lineares, acutiusculæ, compressæ, dense 10-18-floræ, floribus sese ad  $\frac{2}{3}$  usque tegantibus, 6 to 9 mm. longæ, 2 mm. latae pallide viridulæ, rhachilla tenace. Glumæ steriles subaequales, lineari-lanceolatae, acutæ, fere 2 mm. longæ, 1-nervis, carina scabræ, fertiles superpositas subaequant. Glumæ fertiles ovato-lanceolatae obtusiusculæ vel acutiusculæ, 2-2.5 mm. longæ, pallidæ, utrinque nervo viridi valido notatæ, puncticulato-scabræ, carina superne aculeato-scabra. caducæ. Palea gluma  $\frac{1}{3}$  brevior, lineari-obovata, curvula, carinis spinuloso-ciliolata, persistens. Antheræ 3, perpusillæ (0.2 mm. longæ) ovali-oblongæ.

Kias, Benguet, Luzon (6608 Elmer), June, 1904. Affinis *E. elegantulæ* Steud., quæ differt radice perenni, palea caduca, antheris (ex Hook.) circ. 0.7 mm. longis, nervis glumarum fertilium tenuibus. *E. luzonensis* Steud., quam Hook. f., ad *E. elegantulam* ducet, differt a nostra. paniculæ contractæ, radiis fasciculatis, spiculis longe pedicellatis.



#### IV. SCITIMINEÆ PHILIPPINENSES.

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By HENRY N. RIDLEY.

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The present paper was prepared by H. N. Ridley, director of the Botanic Garden, Singapore, to whom the material was sent for identification. (E. D. M.)

**Globba Barthei** Gagnepain.

Bosoboso, Province of Rizal, Luzon (2844 Merrill), July, 1904.

**Globba ectobolus** K. Schum.

San Mateo, Province of Rizal, Luzon (1846 Ahern's collector).

**Globba campsophylla** K. Schum.

Lamao River, Mount Mariveles, Province of Bataan, Luzon (1461 Ahern's collector); Kias, Province of Benguet, Luzon (6465 Elmer) (flowers white); District of Zamboanga, Mindanao (Copeland). This plant is apparently what Schumann intended by his *Globba campsophylla*, but the leaves, though narrow, are lanceolate caudate and not linear. The calyx teeth are ovate, acute, and subequal. Corolla lobes oblong, rounded. Stamines narrower, and lip broad and short broadly bilobed and the flowers appear to have been white. Fruit globose, glabrous.

**Globba Merrilli** Ridley, n. sp.

Whole plant a little over 2 feet tall, glabrous. Leaves lanceolate, acuminate, base rounded, 6 inches long, 1 inch wide, thin, very shortly petioled. Panicle lax, 4 inches long, slender, branches remote, 1 inch long or less. Bracts lanceolate, acute,  $\frac{1}{2}$  inch long, pale, caducous. Calyx tube cylindric, tubiform, teeth short, distinct, equal. Corolla white, lobes oblong, obovate. Stamines smaller. Lip entire, linear oblong, rounded at tip, spoon shaped, limb short. Filament short and broad; anther elliptic; appendages one on each side extending the whole length of the anther, elongate triangular, longer than the anther.

Lamao River, Mount Mariveles, Province of Bataan, Luzon (581 Whitford) (1598 Borden) (3869 Merrill); District of Zamboanga, Mindanao (Copeland).

**Globba parviflora** Presl.

Bosoboso, Province of Rizal, Luzon (2782, 2783 Merrill).

**Leptosolena insignis** Ridley, n. sp.

Stem 3 to 7 feet tall. Leaves linear, acuminate, glabrous, narrowed to the base, 12 inches long, half inch wide, midrib stout; sheaths 6 inches long, with an erect pair of auricles one-fourth inch long, oblong, rounded at the tip. Bracts 3, terminal, papery, lanceolate, caudate, 6 inches long, half inch wide. Panicle  $3\frac{1}{2}$  inches long, many-flowered, the branches  $1\frac{1}{4}$  inch long, ribbed, 3-flowered. Flowers sessile, white. Calyx tubular,  $3\frac{1}{2}$  inches long, bilobed, lobes short, ovate, tube split on one side. Corolla tube slender, 5 to 6 inches long, the lobes linear oblong obtuse, 1 inch long one-fourth inch wide. Staminodes linear oblong, shorter and narrower. Lip fleshy, elongate, 1 inch long, rolled up when withered. Stamen short; anther oblong, the crest broader, large, rounded, entire. Style longer. Stigma cup-shaped, hairy.

On gravelly landslides, Twin Peaks, Province of Benguet, Luzon (6428 Elmer).

**Costus speciosus** L. var. **argyrophyllus**.

Davao, Mindanao (448 Copeland).

**Curcuma zeodaria** L.

Malapadnabato, Province of Rizal, Luzon (2713 Merrill); Guimaras Island (26 Gammill).

**Zingiber cassuminaar** Roxb.

Sablan, Province of Benguet, Luzon (6255 Elmer); flowers white.

**Amomum elegans** Ridley, n. sp.

Rhizome long, slender, covered with oblong sheathing, brown and papery bracts half an inch long. Stem slender, 18 inches tall. Leaves few, linear lanceolate, acuminate, 6 to 7 inches long, one-half to three-fourths an inch wide, glabrous above, beneath paler and silky hairy; petiole one-fourth inch long, pubescent-hairy; sheaths 2 inches long, hairy. Inflorescence half an inch long, obconic, almost sessile. Bracts oblong, obtuse, pubescent, with about 10 elevated nerves. Bracteole tubular, silky-hairy. Calyx tube tubular silky-hairy, one-half inch long, lobes 2 (2 being connate) lanceolate, acuminate, silky-hairy, as long as the tube. Corolla tube not longer than the calyx, pubescent, lobes linear oblong, obtuse glabrous, three-fourths an inch long. Staminodes subulate, one-fourth an inch long. Lip an inch long, base narrow, limb broad, obovate, rounded, an inch across, entire. Stamen three-fourths an inch long; filament slender; anther narrowly oblong, crest trifid, central lobe oblong, small, lateral lobes from the upper angle of the anther, longer, linear, obtuse, recurved. Style very slender; ovary silky-hairy.

Lamao River, Mount Mariveles, Province of Bataan, Luzon (300, 207 Whitford); flowers white.

**Amomum propinquum** Ridley, n. sp.

Foliage not seen. Capitulum obconic. Peduncle 3 inches long, stout. Pedicel pubescent, short. Lower bract ovate, pubescent, one-fifth inch long. Bracteole tubular, mouth not split, half an inch long, pubescent, trifid, two lobes connate nearly to the tips. Calyx tube one-half inch long, glabrous, lobes three, two-connate for most their length, mucronate, keeled at the tips

and setulose. Corolla tube trumpet-shaped, pubescent, lobes oblong, obtuse, rounded, one-half inch long. Stamínodes very short, subulate. Lip obovate, 1 inch long, wide, central bar elevate papillose. Anther oblong, setose on the edges. Connective trilobed, upper lobe rounded, lateral lobes large, recurved, broad, oblong, obtuse. Filament broadly linear, thin. Style very slender; stigma capitate.

Baguio, Province of Benguet, Luzon (6284 Elmer). "Flowers yellowish, sepals 3, petals 2, reddish spotted and yellow on the middle inside." Davao, Mindanao (843 Copeland).

Allied to *A. flavum* Ridl. I have little doubt that the Davao plant, also leafless, is the same as the Benguet plant. It has unripe fruit, showing signs of stout processes covering them.

***Amomum trilobum* Ridley, n. sp.**

Rhizome slender, long, creeping, covered with loose sheaths half an inch long. Stems 4 to 7 feet tall. Leaves narrow lanceolate, acuminate caudate, 9 inches long, an inch wide, glabrous, closely ribbed, narrowed at the base into a petiole one-fourth of an inch long; sheath narrow, edge and short bifid ligule silky pubescent. Inflorescence obconic, three-fourths of an inch long on a short (half inch) peduncle. Bracts ovate, obtuse, ribbed, glabrous. Calyx tubular, tube as long as the corolla tube, lobes linear oblong, obtuse, half an inch long, 3-nerved. Stamínodes linear, obtuse, fleshy, nearly as long as the filaments. Lip obovate, rounded, three-eighths of an inch long, three-fourths inch wide, white with a yellow central bar, tip undulate, 3-lobed, the side lobes rounded, midlobe bifid, narrow. Filament linear, fleshy, grooved; anther linear, glabrous, the crest with two lateral fleshy linear subacute curved arms from the side, and a thin, flat, oblong, quadrate, median lobe, obscurely bilobed in the center.

Mount Arayat, Province of Pampanga, Luzon (67 F. H. Bolster), May, 1905.

Closely allied to *A. elegans* Ridl., but differs in its quite glabrous leaves and bracts, larger fleshy stamínodes, and trilobed lip.

***Plagiostachys*, sp.?**

Province of Benguet, Luzon (947 Barnes). Plant 2.5 m. high, growing at an altitude of 1,600 m.

This is in fruit only. It appears to be a species of *Plagiostachys*, of which genus none are recorded from the Philippines.

***Hornstedtia (Nicolaia) paradoxa* Ridley, n. sp.**

Plant 10 feet high. Leaf narrow, lanceolate, acuminate at both ends, glabrous, 16 inches long, 1 inch wide, subcoriaceous. Ligule entire, truncate. Flowering stem leafy, 3 feet tall, rather slender. Capitulum globose, 2 inches across, purple-red. Bracts 1 inch long, oblong ovate, obtuse, margins hairy. Bracteole oblong, rounded, edges hairy. Inner bracteole oblong, thinner, glabrous. Calyx tubular, spathaceous, thin, glabrous, lobes 3, acuminate. Corolla tube half as long again as the lobes which are oblong, obtuse, one-fourth inch long. Lip fleshy (incomplete). Anther oblong, crestless.

Mount Santo Tomas, Province of Benguet, Luzon (6629 Elmer). Altitude, 5,500 feet.

This specimen is unfortunately incomplete, the flowers being in poor condition. It is an interesting plant and differs in several points from the normal *Hornstedtia*s but may belong to that genus.

***Hornstedtia philippinensis* Ridley, n. sp.**

Stems 2 m. tall. Leaves oblong lanceolate, caudate, glabrous, narrowed to the base. 10 inches long, 2 inches wide, paler beneath. Ligule bilobed, oblong, obtuse, one-fourth inch long. Inflorescence 2 inches long, bracts thin, lanceolate, ribbed, hairy at the tip, the largest about an inch long. Flowers scarlet, 3 inches long. Bracteole oblong lanceolate, strongly nerved, three-fourths inch long, margins ciliate. Calyx tubular,  $1\frac{1}{2}$  inches long, the trifid lobes acute, one-fourth inch long. Corolla tube 2 inches long, slender, lobes linear oblong, narrow, obtuse, one-fourth inch long. Lip 1 inch long, fleshy, linear oblong, obtuse, entire, narrow. Stamens crestless, one-fourth inch long, apex retuse. Fruit on a peduncle one-half inch long, stout, elliptic, obtuse, 1 inch long, covered with short simple and forked processes.

Island of Masbate (1704 Clark); Davao, Mindanao (416 Copeland).

This species is remarkable for the fruit which resembles more that of *Amomum*. Fruit edible, "Tugis."

***Kolowratia elegans* Presl.**

Lamao River, Mount Mariveles, Province of Bataan, Luzon (73 Whitford); 6 to 8 feet high. An unripe fruit over an inch long, glabrous, elliptic, narrowed upwards and terminated by the withered flower is with the specimen. This plant is referred to the genus *Alpinia* by Schumann, a suggestion I am unable to endorse.

***Alpinia Haenkei* Presl.**

Plant 2 m. tall. Leaves oblong, acuminate, 25 inches long, 5 inches wide, glabrous on both surfaces except on the edges and at the base which are pubescent silky, base narrowed; petiole 4 inches long, pubescent; ligule oblong, half an inch long, pubescent. Peduncle stout, 7 inches long, pubescent. Bract large, spathaceous, three-fourths of an inch long, scabrid pubescent. Calyx spathaceous urn-shaped, cleft on one side, irregularly toothed, as long as the corolla tube, half of an inch long. Corolla tube broad, lobes white silky, broad, oblong, obtuse, white, three-fourths of an inch long, one-fourth inch wide. Lip  $1\frac{1}{4}$  inches long, broad, apex narrowed (apparently bifid) yellow with purple spots.

Baco River, Mindoro (4047 Merrill), March, 1905. In very humid forest; fragrant.

I take this to be Presl's *Alpinia Haenkei*, which he first referred to *A. malaccensis*. There is indeed but little difference between the two species. The original *A. malaccensis* Roscoe is a native of India and does not occur wild in Malacca so far as is known, nor in the Malay archipelago.

***Alpinia philippinensis* Ridley, n. sp.**

Plant 12 feet tall, leaves lanceolate linear, 19 inches long,  $2\frac{1}{2}$  inches wide, acuminate caudate, hairy on both surfaces, hairs longer and scantier on edge and upper surface; petiole 1 inch long, hairy; ligule bifid, hairy. Raceme 2 feet long, rhachis fairly stout, densely rufous hairy with rather bristly white hairs. Pedicels one-half inch long, scattered to base of raceme.

Flowers "yellow." Bracts oblong, apex trifid, lobes rounded, minutely scabrid, one-fourth inch long. Calyx spathaceous, trifid, lobes rounded, one-fourth inch long, hairy, as long as the corolla tube. Corolla lobes oblong, three-fourths inch long, blunt, silky hairy. Lip an inch long, yellow, spotted and streaked with purple, tip prolonged, bilobed. Fruit globose, three-fourths inch long, pale, covered with long hairs.

Lamao River, Province of Bataan, Luzon (144 Barnes), January, 1904; (1203 Borden), June, 1904. Sablan, Province of Benguet, Luzon (6089 Elmer), April, 1904.

This species differs from what I take to be *Alpinia Haenkei* in its much smaller flowers, narrower leaves, smaller bract and 3-lobed calyx.

**Alpinia** sp.

Leaves broad, blade oblong, glabrous above, finely pubescent beneath, 18 inches long, 5 inches across, petiole 3 inches. Panicle stout, hairy, peduncle 3 inches long, infrutescence 8 inches. Fruit globose, three-fourths of an inch long, sparsely hairy, on pedicels half inch long. Seeds numerous, pale, angled.

Davao, Mindanao (417 Copeland). Growing in a damp thicket, 7 feet high, in fruit only, the material insufficient for definite identification.

**Alpinia (Hellenia) pubiflora** Presl.

Mount Santo Tomas, Province of Benguet, Luzon (6268 Elmer); Guimaras Island (34 Ritchie); Davao, Mindanao (319 Copeland).

This appears to be *A. pubiflora*, but I have found no trace of any anther crest.

**Alpinia brevilabris** Presl.

Lamao River, Mount Mariveles, Province of Bataan, Luzon (58 Whitford): 2 to 3 m. high, in river bottom; also No. 239 Whitford, same locality, at altitudes of from 1,800 to 2,700 feet. Island of Masbate (1703 Clark). Schumann does not mention in his description of this species that the leaves are armed with minute thorn-like processes near the tip.

**Alpinia (Hellenia) sp.**

Lamao River, Mount Mariveles, Province of Bataan, Luzon (1202 Borden); Atimonan, Province of Tayabas, Luzon (655 Whitford). Six feet high, along streams at an altitude of 250 feet. Fruit yellowish brown. These are in fruit only and may be *A. brevilabris* Presl.





## V. PHILIPPINE ACANTHACEÆ.

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By C. B. CLARKE.

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The following Latin diagnoses of new species of Acanthaceæ, are submitted for publication as prepared by Mr. C. B. Clarke, Kew, England, and transmitted by him to this office, the material cited, other than the numbers of Cuming's, Vidal's, and Loher's collections, having been submitted to Mr. Clarke from this office. Additional notes in English have been added by myself. The types are at Kew.—(E. D. M.)

**"*Eranthemum curtatum* C. B. Clarke, MS.**

"(Cuming No. 1658). Foliis usque ad 27 cm. longis, 8 cm. latis, basi longe attenuatis, apice breviter acutatis; panicula in pseudoapicam continuam, 18 cm. longam, contracta; corollae tubo 3 cm. longo, usque ad apicem lineari; cetero ut *E. racemosum* Hassk.

"*Eranthemum malabaricum* Vid. Rev. Pl. Vasc. Filip. 205. 1886, non Hook. f.; *E. crenulatum* Nees, MS., non Lindley; *E. Andersoni* Herb. Kew, partim." C. B. Clarke in lit.

An erect simple or slightly branched suffrutescent plant 0.7 to 1.5 m. high. Stem light gray, glabrous, striate, angular, the younger parts somewhat ferruginous furfuraceous. Leaves membranous, glabrous or nearly so; nerves 6 to 9 on each side of the midrib, rather prominent; petioles 1 to 3 cm. long, more or less ferruginous furfuraceous, becoming glabrous or nearly so. Calyx lobes linear-lanceolate, acuminate, 4 to 5 mm. long, slightly pubescent. Corolla white, becoming yellowish white with age, more or less hirsute pubescent, the lobes about 11 mm. long. Capsule glabrous, 2.5 cm. long.

Luzon, Province of Bataan, Mount Mariveles (3952 Merrill), March, 1905; Province of Benguet, Sablan (6122 Elmer), April, 1904. Mindoro, Baco River (1779 Merrill), April, 1903. Ticao Island (1046 Clark), May, 1904. Rather common in forests, but scattered, extending to an altitude of about 200 m. on Mount Mariveles.

**"*Hypoestes cinerea* C. B. Clarke, MS.**

"(Vidal Nos. 340, 482; Loher, Nos. 4277, 4278.) Puberula, foliis 1 dm. longis, ovati-lanceolatis; paniculis compositis, pro magna parte terminalibus; involucris 7 to 8 mm. longis, puberulis, lobis apice oblongis, vix acutis;

capsula in dimidia parte superiore pilosa. *H. purpurea* Vidal, Rev. Pl. Vasc. Filip. 201. 1886. non R. Br." C. B. Clarke in lit.

Herbaceous, 1 m. high or less, the branches divaricate. Stems glabrous or slightly pubescent, nearly black when dry. Leaves ovate to ovate-lanceolate, 6 cm. wide or less, membranous, nearly glabrous, or somewhat cinereous puberulent beneath, the base equilateral, acuminate, the apex slightly acuminate, or acute; nerves 7 to 8 on each side of the midrib; petioles 1 to 3 cm. long, usually somewhat pubescent. Panicles 4 to 7 cm. long, more or less cinereous puberulent, the spikes rather densely flowered, 4 cm. long or less. Corolla 1.5 to 2 cm. long, more or less pubescent, white, pale pink inside. Stamens 2; anthers yellow. Capsule less than 1 cm. long.

Luzon, Province of Pampanga, Arayat (1418, 1451 Merrill), March, 1903; Province of Rizal, Antipolo (1717 Merrill), March, 1903; Province of Bataan, Lamao River (2292 Meyer), December, 1904.

Nos. 1418, 1451, 1717 Merrill, were identified by Lindau<sup>1</sup> as *Hypoestes malaccanus* Wight.

**"*Hypoestes subcapitata*, C. B. Clarke, sp. nova.**

"Minute pubescente, foliis inaequalibus, alternis, majoris lamina 1 dm. longa, 4 cm. lata, utrinque brevius acuminate; petiolo 2 cm. longo; involucri in capus terminale sessile fere congestis, 12 mm. longis, perangustis, villosis; bracteis alte coalitis, lobis 2, lineari-lanceolatis, acutis, fere mucronatis; corolla 25 mm. longa; staminibus 2, antheris 1-locularibus." C. B. Clarke in lit.

Herbaceous, 80 cm. high or less, erect, the branches more or less ferruginous or cinereous pubescent or puberulent. Leaves ovate-lanceolate to elliptical-lanceolate, membranous, minutely ferruginous or cinereous pubescent on the midrib beneath, and slightly so on the lamina, 4 to 10 cm. long, 2 to 4 cm. wide; nerves 5 to 6 on each side of the midrib, curved-ascending; petioles pubescent. Inflorescence 2 to 3 cm. long, dense. Flowers odorless. Corolla pink.

Lamao River, Mount Mariveles, Province of Bataan, Luzon (2367, 2561 Borden), January, February, 1905; (721 Borden), May, 1904; (2288 Meyer), December, 1904; (173 Barnes), January, 1904.

Growing in open forests and in recent clearings at from 100 to 275 m. above the sea.

**"*Hypoestes Vidalii* C. B. Clarke, MS.**

"(Vidal, No. 3407.) Foliorum laminis 18 cm. longis, 5 cm. latis, utrinque anguste triangularibus, fere glabratis; paniculis terminalibus, 5 to 12 cm. longis, densis, hirsutis, involucri 13 mm. longis, lobis 2, tubo longioribus, apice fere rotundatis; capsula pilosa.

"This species is closely allied to *H. cinerea* and to another undescribed Philippine species." C. B. Clarke in lit.

Erect herbaceous, the stem glabrous, the branches somewhat ferruginous pubescent. Leaves opposite, membranous, narrowly ovate to elliptical ovate; nerves 6 to 7 on each side of the midrib, curved-ascending; petioles

<sup>1</sup> Perk. Frag. Fl. Philip., 40. 1904.

2 to 4 cm. long, somewhat ferruginous pubescent. Corolla more or less pilose, pale purple or pink, 2.5 cm. long.

Luzon, Province of Rizal, Bosoboso (2156 Ahern's collector), December, 1904.

**Hygrophila phlomoides** Nees, var. **roxburghii** Hook. f. Fl. Brit. Ind. 4:408.

Manila (3941 Merrill), January, 1905; Province of Rizal, Montalban (2453 Ahern's collector), January, 1905.

*Antirrhinum molle* Blanco, non Linn., Fl. Filip. ed. 1, 503, 1837; ed. 2, 353, 1845; ed. 3, 2: 258; Merrill, Govt. Lab. Publ. 27:66. 1905, and *Hygrophila undulata* F. Vill. Nov. App. 153. 1883, non Blume, should be cited as synonyms of the above species, Blanco's description of *Antirrhinum molle*, although very short, applying to the above specimens, the habitat, time of flowering, etc., also being the same.

(The above specimens were identified by Mr. Clarke, who states that the variety extends to the Malayan Peninsula and Java. E. D. M.)

**"Justicia Loheri** C. B. Clarke, MS.

"(Loher Nos. 4245, 4246.) Fruticulus glaber, divaricatus ramosus, foliis distantibus, anguste oblongis, 2 cm. longis; floribus axillaribus, 1-3-nis fasciculatis; sepalis 4 mm. longis, linearibus; corolla 7-8 mm. longa; capsula 6 mm. longa, oblonga, glabra, basi vix stipitata; seminibus 4, complanatis, verrucoso-tuberculatis." C. B. Clarke in lit.

A prostrate suffrutescent plant, shrubby at the base, the spreading branches forming dense mats. Branches slender, somewhat pubescent at the nodes. Leaves subcoriaceous, 3 to 5 mm. wide, blunt or acute, the margins revolute; nerves 4 on each side of the midrib, obscure, anastomosing; petioles very short. Corolla 9 mm. long, white, the lobes equal in length, the broader one 3-lobed, the narrower ones entire or notched. Stamens 2. Ovary glabrous the style slightly hirsute.

Luzon, Province of Benguet, Mount Santo Tomas (6530 Elmer), June, 1904.

**"Justicia luzonensis** C. B. Clarke, sp. nova.

"Foliis oppositis, aequalibus, fere glabris; lamina usque ad 2 dm. longa, 1 dm. lata, ovata, acuminata; petiolo 3-5 cm. longo; panicula laxa, terminali, pubescente, 18 cm. longa, 8 cm. lata, bracteis inconspicuis; corolla vix 1 cm. longa; staminibus 2, antherae loculis altero paullo inferiore, basi albi-mucronato; capsula 20-25 mm. longa, in parte inferiore lineari-cylindrica, apice clavata, 4-sperma, a basi usque ad apicem 4-sperma." C. B. Clarke in lit.

Erect, herbaceous, usually about 1 m. high, simple or branched above. Leaves membranous, the base acute or acuminate; nerves 8 to 10 on each side of the midrib, curved-ascending, or the lower ones spreading. Corolla green or greenish yellow, with dull purple or reddish lines and spots. Capsule pubescent with scattered spreading hairs.

Luzon, Province of Bataan, Mount Mariveles (3252 Merrill), October, 1903; (2363 Borden), January 1905; (6151 Leiberg), July, 1904; (6727 Elmer), November, 1904; Province of Tayabas, Binangonan (381 Whitford),

September, 1904. Mindoro, Baco River, (1778 Merrill), April, 1903. A species growing on exposed ridges and slopes on Mount Mariveles at an altitude of 1,300 m., extending below to an altitude of 50 m., in damp shaded ravines along streams.

**"*Lepidagathis tenuis* C. B. Clarke, sp. nova.**

"*Tenuis*; repens, radicans, ramosa, 10–15 cm. longa, obscure ramosa; foliis oppositis, inaequalibus, petiolatis, 1–4 cm. longis, ovatis; spicis terminalibus 1–3-nis, anguste oblongis, 1–2 cm. longis, laxiusculis; calyce 3–4 mm. longo." C. B. Clarke in lit.

A small plant 10 cm. long or less, the branches with few scattered hairs. Leaves membranous, acute, the base broad, abruptly more or less acuminate; nerves 4 to 5 on each side of the midrib, rather prominent beneath; petioles 2 to 10 mm. long. Calyx lobes lanceolate, long slender acuminate, clothed with few scattered long white hairs.

Luzon, Province of Benguet, Sablan (6212 Elmer), April, 1904. On moist moss-covered rocks in ravines. Mindanao, District of Davao, (623 Copeland), March, 1904. A species closely related to several Malayan forms, differing in the rather loose, not densely packed, one-sided spikes.

**"*Rungia philippinensis* C. B. Clarke, MS.**

"(Cuming No. 1276, Loher No. 4283.) Foliis linearibus; spicis terminalibus, strobilatis; foliis floralibus arete imbricatis, apice rotundatis, imo in margine scariosis, fere glabris.

"*R. longifolia* Nees in DC. Prodr. V. p. 471, partim.

"*Rungia* sp. a *R. longifolia* Nees et Arn. (sp. *Zeylanica*) diversa. Hook. f. Fl. Brit. Ind. IV. p. 547." C. B. Clarke in lit.

A weak, slender, unbranched, suberect herb 20 to 30 cm. high. Leaves 2 to 4 cm. long, 4 to 6 mm. wide, membranous, glabrous, the base acute, the apex blunt or acute; nerves 3 to 4 on each side of the midrib, ascending, anastomosing, the reticulations lax; petioles 2 to 3 mm. long. Spikes subglobose or ovoid, about 1 cm. long, the bracts obovate, cleft at the apex, the margins broad, membranous. Calyx lobes linear lanceolate, pale, glabrous, long slender acuminate, 2.5 mm. long.

Luzon, Province of Benguet, Bagnio (6,000 Elmer), March, 1904.

**"*Strobilanthes Merrillii* C. B. Clarke, sp. nova.**

"Glabra, ramis exalatis, foliis oppositis, inaequalibus, usque ad 15 cm. longis, 5 cm. latis, late oblanceolatis; spicis 5–15 cm. longis; bracteis in paribus distantibus, inferioribus ovatis, usque ad 3 cm. longis, 2 cm. latis; sepalis 7 mm. longis, oblongis; corolla 25 mm. longa, alba; staminibus 4, filamentis glabris, polline ellipsoideo, longitudinaliter multi-striato; stylo longe hirsuto." C. B. Clarke in lit.

An erect branched shrub 1 to 2 m. high the branches nearly black when dry, glabrous. Leaves firmly membranous, subentire or obscurely irregularly distantly crenate, the base acuminate or acute, the apex slender acuminate, the acumen blunt; nerves 8 to 9 on each side of the midrib, ascending, prominent beneath; petioles 0.5 to 1 cm. long.

Mount Mariveles, Province of Bataan, Luzon (3713 Merrill), January, 1904; (1581, 2094 Borden), August and September, 1904; (6815 Elmer),

November, 1904. No. 4248 Loher, in Herb. Kew, is the same, according to Clarke.

Common on exposed ridges and slopes at from 1,200 to 1,300 m. above the sea, at once recognizable by its elongated spikes and numerous leaf-like bracts.

**"*Strobilanthes pluriformis* C. B. Carke, MS., in Herb. Kew.**

"Hirta vel fere glabrata, foliis oppositis non raro inaequalibus, lamina 6 ad 10 cm. longa, lanceolata aut elliptico-lanceolata, utrinque angustata; fasciculis paucifloris laxius paniculatis aut densius cymulosis; bracteis usque ad 1 cm. longis, lineari-oblongis, hirsutis, aut puberulis, caducis; sepalis 5 ad 8 mm. longis, lineari-oblongis; corolla 22 mm. longa, tenera, alba, paullo purpureo-maculata; filamentis a pilis longis ornatis; staminibus 4, polline ellipsoideo, longitudinaliter multi-striato; stylo a pilis paucis insperso vel densissime piloso; capsula 13 mm. longa, spathulato-ellipsoidæ hirta-pubescente vel fere glabrata; seminibus 4, hirtulis aut sericeis, parum hygroscopice villosis.

"Luzon, Vidal, Nos. 1630, 1633, 3406; Loher, Nos. 4254, 4255, 4256, 4264, 4265, 4266." C. B. Clarke in lit.

A much-branched shrub 1 to 3 m. high. Leaves serrate or crenate-serrate, 2 to 4 cm. wide, long acuminate, the acumen blunt, the base acute or acuminate; nerves 8 to 10 on each side of the midrib, prominent, ascending.

Luzon, Province of Benguet (5921 Elmer), March, 1904; (38 Topping), January, 1903; Province of Tayabas, Mount Banahao (877 Klemme), June, 1904; (954 Whitford), October, 1904; Mount Mariveles, Province of Bataan, Luzon (3956 Merrill), March, 1905; (1092 Whitford), February, 1905.

Common on exposed ridges and slopes, growing with *S. Merrillii* on Mount Mariveles at an altitude of from 1,200 to 1,300 m. above the sea.





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[Synonyms are in italics.]

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<sup>1</sup>The first four Bulletins in the ornithological series were published by the Ethnological Survey under the title "Bulletins of the Philippine Museum." Future ornithological publications of the Government will appear under the title "Publications of the Bureau of Government Laboratories."



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No. 36.—JANUARY, 1906

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DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

# A HAND-LIST OF THE BIRDS OF THE PHILIPPINE ISLANDS

BY

RICHARD C. MCGREGOR

AND

DEAN C. WORCESTER

MANILA  
BUREAU OF PRINTING  
1906

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## ERRATA.

- Page 4. In line 14 for *loriculus* read *Loriculus*.  
Page 13. For **STREPOPELIA** read **STREPTOPELIA**.  
• Page 14. In line 4 for *humulis* read *humilis*.  
Page 67. In lines 24 and 35 of footnote for Clark read Clarke.  
Page 67. In last line of footnote for this read the former.  
Page 101. For **LIMONDROMUS** read **LIMONIDROMUS**.



No. 36.—JANUARY, 1906

DEPARTMENT OF THE INTERIOR  
BUREAU OF GOVERNMENT LABORATORIES

# A HAND-LIST OF THE BIRDS OF THE PHILIPPINE ISLANDS

LIBRARY  
NEW YORK  
BOTANICAL  
GARDEN.

BY

RICHARD C. MCGREGOR

AND

DEAN C. WORCESTER

MANILA  
BUREAU OF PRINTING  
1906



# INTRODUCTION

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The appearance of the first volume of Dr. R. B. Sharpe's admirable "Hand-List of Birds" suggested to me the desirability of preparing a list, similar in form, of the birds of the Philippine Islands. The need of such a list was especially great in view of the fact that among the Americans scattered through every province of the Philippine Archipelago there were a number of members of the American Ornithologists's Union who were attempting to take up the study of Philippine birds, as well as numerous amateur ornithologists, whose attention was attracted by the unusual opportunities for ornithological work and who desired to identify the birds to be found in the vicinity of their several stations.

While the necessary literature for the identification of the known species of Philippine birds is on file in the general scientific library of the Bureau of Government Laboratories, its use by persons unfamiliar with Philippine ornithology is naturally attended with some practical difficulties. It therefore seemed to me highly desirable that there should be prepared a hand-list giving references to descriptions of all species known to inhabit the Philippines and stating accurately the known distribution of each species within the Archipelago. I began work upon such a list four years ago, but manifold official duties prevented rapid progress.

When the services of Mr. Richard C. McGregor were secured as collector of natural-history specimens this work, which had then been little more than begun, was turned over to him, as was an unpublished manuscript prepared by Dr. Frank S. Bourns and myself, from which it was hoped that he would be able to derive information of value. It is only fair to Mr. McGregor to say that from that time until August 15, 1905, on which date he left for a well-earned rest in the United States, most of the work upon the Hand-List was performed by him. My own subsequent connection with it has been confined to consultation with him on doubtful points and to the final editing of the manuscript. As some of the footnotes were written by Mr. McGregor prior to his departure and others which he has had no opportunity to see have been subsequently written by me, I have deemed it desirable to give, in each instance, the authorship of the footnotes.

It has been our purpose to include all species which are known to

inhabit the geographical area known as the Philippine Islands, as fixed by the treaty of Paris and the supplementary purchase of islands by the United States Government. The species of the Palawan Islands (Balabac, Palawan, Calamianes, and Cuyos groups) have accordingly been included.

The Distribution List of Philippine Birds prepared by Dr. Frank S. Bourns and myself (Proceedings of the United States National Museum, Vol. XX, pp. 549-566, 1898) enumerated 243 genera and 596 species for this same area. The work of Mr. John Whitehead, Dr. Edgar A. Mearns, Mr. Walter Goodfellow, Mr. John Waterstradt, and of Mr. McGregor and his Filipino assistants, together with such fragmentary work as I myself have been able to carry on in connection with official trips through the Islands, has raised this total to 284 genera, 691 identified species, and two species (*Oceanodroma* sp. and *loriculus* sp.) not identified. Some knowledge has been gained of the avifauna of the Islands of Ticao, Lubang, Cagayanillo, Agutaya, Calayan, Cresta de Gallo, Maestro de Campo, Semirara, East Balud, West Balud, and Sibay, the birds of which were heretofore entirely unknown.

The highlands of Mindanao have yielded a number of most interesting new genera and species, and additional knowledge has been gained relative to the birds of Luzon, Mindoro, Masbate, Negros, Samar, Cuyo, Culion, Cagayan-Sulu, Fuga, Romblon, and Sibuyan.

From the information now available we may deduce the following conclusions relative to the zoölogical relationships of these several islands:

Ticao belongs with the central group (Panay, Guimaras, Negros, and Masbate) rather than with Luzon.

Lubang must be considered a detached fragment of Luzon, as it has a number of characteristic Luzon species and entirely lacks those which are especially characteristic of Mindoro. One species (*Aethopyga rubrinota* McGregor) is, so far as we at present know, confined to this island.

On Cagayanillo is found *Cinnyris aurora*, but no other of the characteristic Palawan forms are known to exist there, while the occurrence of such species as *Centropus viridis*, *Hypotaenidia torquata*, *Rallina euryzonoides*, *Limnoblecanus fuscus*, and *Hierococcyx fugax*, and the conspicuous absence of many of the species which are most common on the neighboring islands, lead to the conclusion that Cagayanillo is an oceanic island of recent formation and that its bird population is composed of the descendants of stragglers, most of which have probably come in from Negros or Mindanao, although *C. aurora* is evidently a wanderer from Cuyo or Palawan.

Agutaya belongs to the Palawan group.

Calayan has a strong Formosan element. Probably it will ultimately prove that the Batanes and Babuyan Islands form a group by themselves.

Semirara belongs with Mindoro.



The islands may therefore be divided into zoologically distinct groups as follows:

(1) The Palawan group, consisting of Palawan and the small islands adjacent to it, Balabac, Cagayan Sulu, and the Cuyos and Calamianes Islands. The birds of this group show a very strong Bornean element. The line of demarcation between the Philippines, zoologically speaking, and the Palawan Islands passes between Sibutu and the coast of Borneo and extends thence northward through the Sulu Sea east of the Cuyos group and through Mindoro Strait.

(2) The central Philippines, comprising the Islands of Negros, Panay, Guimaras, Masbate, and Ticao. They form a well-defined natural group, although in the case of Masbate and Ticao there are indications of immigration from Luzon.

(3) Mindoro and some of the islands immediately adjacent to it, including Semerara and doubtless also Ylin.

(4) Luzon, Catanduanes, Marinduque, and Lubang.

(5) Samar, Leyte, and Bohol. The *Loriculus* on Bohol proves to be *Loriculus worcesteri* and not *Loriculus apicalis*, while the presence of *Orthotomus frontalis* and *Phabotrerom brevirostris* among birds and of *Galeopithecus philippinensis* and *Tarsius spectrum* among mammals points unequivocally to the closest zoological relationship between Bohol and Leyte.

(6) Mindanao and the islands immediately adjacent to it form a group by themselves.

(7) Basilan must be separated from Mindanao on account of the fact that it has a number of representative forms of Mindanao species and lacks a number of species characteristic of Mindanao.

(8) Bongao, Tawi Tawi, Lapac, Siasi, and Sulu form a well-marked natural group, to which Sibutu must probably be added.

(9) Tablas, Romblon, and Sibuyan show no evidence of having been connected with any of the neighboring larger islands. They have a number of peculiar species of birds, and Tablas and Romblon should probably be classed together.

(10) Cebu can not be regarded as one of the central Philippine group, but must be classed by itself.

(11) The Batanes Islands have a strong Formosan element among their birds. It remains to be seen whether the Babuyan Islands must be grouped with them or must be considered as detached fragments of northern Luzon.

(12) Siquijor, Cagayancillo, and Cresta de Gallo are islands of recent origin, and their bird faunae have been derived from stragglers from neighboring islands.

While these several groups are by no means zoologically equivalent, each has its highly characteristic species and forms a fairly natural division.

In preparing the Hand-List no species has been recorded definitely from any island except upon authority believed to be unimpeachable. Where doubt exists as to the occurrence of a given species on any island the fact is indicated by an interrogation point placed after the name of such island. Several species for which no specific habitat within the Archipelago can be assigned have been included, upon the authority of the "Hand-List of Birds," in the belief that so eminent an authority as Dr. Sharpe would not have recorded them as occurring in the Philippines without sufficient evidence. On the other hand, a number of the Philippine species included in Sharpe's Hand-List have been excluded for reasons stated at the proper places in the text.

To and including the Family *Certhiidae* the sequence of families is that of Sharpe's Hand-List, Volumes I to IV; for the succeeding families we have followed the scheme proposed by Dr. R. V. Shufeldt in the *American Naturalist*, XXXVIII, pages 856-857. Thanks are due to Dr. Charles W. Richmond for suggested corrections in the nomenclature of various genera and species. Dr. Edgar A. Mearns has kindly furnished a MS. list of new localities for a number of species based upon his collections from Mindanao and neighboring islands.

The work of the collectors regularly employed by the Insular Government, as well as that of residents of the Islands and of collectors representing scientific institutions of other countries, will doubtless make frequent additions and corrections necessary if this Hand-List is to be kept up to date. Supplemental pages containing addenda will be published from time to time until sufficient matter has been accumulated to justify the revision of the entire list.

It is hoped that students of Philippine ornithology will aid us, not only by calling attention to any errors which they may note in this list but by communicating authentic facts relative to the occurrence in the Philippines of species not included in it, and to the recording from any new islands in the Archipelago of species already known to inhabit the Philippines. Due credit will be given to all persons furnishing such information.

Attention is invited to the fact that the ornithological books and papers in the general scientific library of the Bureau of Government Laboratories<sup>1</sup> and the bird collection of some 6,000 carefully identified specimens may be used, under reasonable restrictions, by any properly accredited person.

DEAN C. WORCESTER.

MANILA, P. I., September 9, 1905.

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<sup>1</sup>The Bureau of Government Laboratories, after November 1, 1905, will be known as the Bureau of Science.

# Class AVES.

## Subclass CARINATÆ.

### Order GALLIFORMES.

#### Suborder MEGAPODII.

#### Family MEGAPODIIDÆ.

#### MEGAPODIUS *Q. & G.*

(Grant, Cat. Bds., XXII, p. 446.  
1893.)

*cumingi* *Dillw.* (p. 449.)

Celebean Islands  
Islands of northwestern Borneo

---

Balabac	Mindoro
Basilan	Palawan
Cagayancillo	Romblon
Calayan	Samar
Cebu	Sibutu
Cresta de Gallo	Sibuyan
Fuga	Sulu
Luzon	Tablas
Marinduque	Tawi Tawi
Mindanao	Ticao

#### Suborder PHASIANI.

#### Family PHASIANIDÆ.

#### EXCALFACTORIA *Bp.*

(Grant, Cat. Bds., XXII, p. 249.  
1893.)

*lineata* (*Scop.*). (p. 253.)

Borneo                      Java  
Sumatra                    Australla

---

Calamlanes	Negros
Cebu	Palawan
Lubang	Panay
Luzon	Samar
Masbate	Sibuyan
Mindanao	Sulu
Mindoro	Ticao

**GALLUS** *Briss.*

(Grant, Cat. Bds., XXII, p. 343,  
1893.)

**gallus** (*Linn.*). (p. 344.)

Malay Peninsula  
Indian Peninsula  
Indo-Malayan Islands  
Indo-Chinese countries

Balabac	Mindanao
Basilan	Mindoro
Bongao	Negros
Calamianes	Palawan
Calayan	Panay
Cebu	Romblon
Fuga	Samar
Guimaras	Sibuyan
Lubang	Siquijor
Luzon	Sulu
Marinduque	Tablas
Masbate	Ticao

**POLYPLECTRON** *Temm.*

(Grant, Cat. Bds., XXII, p. 353,  
1893.)

**napoleonis** *Less.* (p. 361.)  
[*uehrkornæ* *Blasius.*]

Palawan

Order **HEMIPODII.**Family **TURNICIDÆ.****TURNIX** *Bonn.*

(Grant, Cat. Bds., XXII, p. 526,  
1893.)

**fasciata** (*Temm.*). (p. 535.)

Calamianes      Negros  
Cebu              Palawan  
Luzon             Panay  
Masbate          Sibuyan  
Mindoro

**ocellata** (*Scop.*). (p. 548.)

Luzon

**whiteheadi** *Grant*, Hand-Book Game Birds,  
II, p. 276 (1896).

Luzon

**worcesteri** *McGregor*, Bull. Phil. Mus., No. 4,  
p. 8 (1904).

Luzon

**suluensis** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 83 (1905).

Sulu

## Order COLUMBIFORMES.

## Suborder COLUMBÆ.

## Family TRERONIDÆ.

## Subfamily TRERONINÆ.

**SPHENOCERCUS** *Gray.*

(Salvadori, Cat. Bds., XXI, p. 4,  
1893.)

**formosæ** (*Swinh.*). (p. 13.)

Mountains of Formosa

Calayan

**TRERON** *Vieill.*

(Salvadori, Cat. Bds., XXI, p. 33,  
1893.)

**nipalensis** (*Hodgs.*). (p. 34.)

Nepal to Burma  
Malay Peninsula  
Eastern Bengal Sumatra  
Siam Borneo  
Tenasserim Cochin China

Mindoro Palawan

**OSMOTRERON** *Bp.*

(Salvadori, Cat. Bds., XXI, p. 38,  
1893.)

**axillaris** (*Bp.*). (p. 48.)

Basilan Negros  
Catanduanes Panay  
Cebu Romblon  
Dinagat Samar  
Guimaras Semirara  
Lubang Siquijor  
Luzon Tawi Tawi  
Masbate Ticao  
Mindanao Verde  
Mindoro

**everetti** *Rothschild*, Nov. Zool., I, p. 41  
(1894).

Bongao Sulu  
Sibutu

**vernans** (*Linn.*). (p. 60.)

Celebes  
Malay Peninsula  
Indo-Malayan Islands  
Indo-Chinese provinces

Basilan Mindoro  
Bohol Negros  
Bongao Palawan  
Calamianes Panay  
Cebu Siasi  
Guimaras Sibutu  
Luzon Siquijor  
Masbate Sulu  
Mindanao

**PHAPITRERON** *Bp.*

(Salvadori, Cat. Bds., XXI, p. 66,  
1893.)

<b>amethystina</b> <i>Bp.</i> (p. 66.)	Dinagat Leyte Luzon	Mindanao Panaon Samar
<b>cinereiceps</b> <i>Bourns &amp; Worcester</i> , Occ. Papers Minnesota Acad., 1, No. 1, p. 8 (1894).	Tawi Tawi	
<b>brunneiceps</b> <i>Bourns &amp; Worcester</i> , <i>t. e.</i> , p. 9.	Basilan	
<b>frontalis</b> <i>Bourns &amp; Worcester</i> , <i>t. e.</i> , p. 10.	Cebu	
<b>maculipectus</b> <i>Bourns &amp; Worcester</i> , <i>t. e.</i> , p. 10.	Negros	
<b>leucotis</b> ( <i>Temm.</i> ). (p. 67.)	Catanduanes Lubang	Luzon Mindoro
<b>occipitalis</b> <i>Salvad.</i> (p. 68.)	Basilan	
<b>nigrorum</b> <i>Sharpe</i> . (p. 68.)	Cebu Guimaras Masbate Negros	Panay Sibuyan Tablas Ticao
<b>brevirostris</b> <i>Tweedd.</i> (p. 69.)	Bohol Dinagat Leyte Mindanao	Samar Siquijor Sulu

Subfamily **PTILOPODINÆ.****LEUCOTRERON** *Bp.*

(Salvadori, Cat. Bds., XXI, p. 71,  
1893.)

<b>occipitalis</b> <i>Bp.</i> (p. 72.)	Basilan Cebu Leyte Luzon Mindanao	Mindoro Negros Samar Sibuyan
<b>marchei</b> ( <i>Oust.</i> ). (p. 75.)	Luzon	
<b>leclancheri</b> ( <i>Bp.</i> ). (p. 79.)	Cagayancillo Calamianes Calayan Catanduanes Cebu Guimaras Lubang Luzon	Mindoro Negros Palawan Romblon Samar Semirara Sibuyan Tablas



**LAMPROTRERON** *Bp.*

(Salvadori, Cat. Bds., XXI, p. 112.  
1893.)

**temmincki** (*Des Murs & Prév.*). (p. 115.)

Celebes

Sulu

**SPILOTRERON** *Salvad.*

(Salvadori, Cat. Bds., XXI, p. 111.  
1893.)

**bangueyensis** (*A. B. Meyer*). (p. 143.)

Banguay

Basilan

Bongao

Cagayan Sulu

Mindanao

Palawan

Sibutu

Sulu

Tawi Tawi

Subfamily **CARPOPHAGINÆ.**

**MUSCADIVORA** *Schlegel.*

(*Carpophaga* Selby; Salvadori, Cat.  
Bds., XX, p. 181, 1893.)

**nuchalis** (*Cab.*). (p. 190.)

Calayan

Fuga

Luzon

Mindanao

Mindoro

**ænea** (*Linn.*). (p. 190.)

Indian Peninsula

Ceylon

Indo-Chinese countries

Malay Peninsula

Sunda Islands

Balabac

Basilan

Bongao

Calamianes

Catanduanes

Cebu

Dinagat

Guimaras

Leyte

Lubang

Luzon

Marinduque

Masbate

Mindanao

Mindoro

Negros

Palawan

Panay

Samar

Semirara

Sibutu

Sibuyan

Siquijor

Sulu

Tablas

Tawi Tawi

Ticao

Verde

**pickeringi** (*Cass.*) (p. 201.)

Mantanani Islands

Lawas River, northwest Borneo

Cagayanillo

Cagayan Sulu

Sibutu

Sulu

**langhornei** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 84 (1905).

East Bolod

West Bolod

**PTILOCOLPA** *Bp.*

(Salvadori, Cat. Bds., XXI, p. 205.  
1893.)

**carola** *Bp.* (p. 206.)

[*griseipectus* *Bp.* = ♂ ; *Cf.* Grant, Ibis,  
1895, p. 117; also Whitehead, Ibis,  
1899, p. 489.]

Luzon  
Mindoro  
Mindanao  
Sibuyan

**nigrorum** *Whitehead*, Bull. B. O. C., VI, p.  
34 (1897).

Negros

**ZONOPHAPS** *Salvad.*

(Salvadori, Cat. Bds., XXI, p. 207.  
1893.)

**poliocephala** (*Hartl.*). (p. 209)

Basilan	Mindoro
Cebu	Negros
Dinagat	Panay
Leyte	Samar
Luzon	Sibuyan
Masbate	Tawi Tawi
Mindanao	

**mindorensis** (*Whitehead*), Ann. & Mag. Nat.  
Hist., (6) p. 189 (1896). Fig., Grant,  
Ibis, 1896, pl. xi.

Mindoro

**MYRISTICIVORA** *Reichenb.*

(Salvadori, Cat. Bds., XXI, p. 227.  
1893.)

**bicolor** (*Scop.*). (p. 227.)

Andamaus	Nicobars
Malay Peninsula	
Indo-Malayan Islands	
Moluccas	
Tenimber Islands	
Siam	Cochin China
Balabac	Negros
Bohol	Nipa
Bongao	Palawan
Cresta de Gallo	Sakujok
Guimaras	Samar
Leyte	Sibay
Malanipa	Siquijor
Marinduque	Sulu
Masbate	Tawi Tawi
Mindanao	Ticao
Mindoro	West Bolod

Family **COLUMBIDÆ**.Subfamily **COLUMBINÆ**.**COLUMBA** *Linn.*

(Salvadori, Cat. Bds., XXI, p. 241,  
1893.)

**griseigularis** (*Wald. & Layard*), (p. 313.)

Northern Borneo

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Basilan	Mindoro
Cagayan Sulu	Negros
Calayan	Romblon
Guimaras	Sibutu
Lubang	Sibuyan
Luzon	Sulu
Mindanao	West Holod

Subfamily **MACROPYGIINÆ**.**MACROPYGIA** *Strauss.*

(Salvadori, Cat. Bds., XXI, p. 335,  
1893.)

**tenuirostris** *Bp.* (p. 346.)

Balabac	Mindoro
Basilan	Negros
Bongao	Palawan
Leyte	Romblon
Luzon	Sibutu
Marinduque	Sibuyan
Masbate	Sulu
Mindanao	Tawi Tawi

**phæa** *McGregor*, Bull. Philippine Mus., No. 4, Calayan  
p. 9, 1904.

Family **PERISTERIDÆ**.Subfamily **TURTURINÆ**.**STREPOPELIA** *Bp.*

(Salvadori, Cat. Bds., XXI, p. 413,  
1893.)

**dussumieri** (*Temm.*), (p. 423.)

Northern Borneo  
Marianne Islands

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Agutaya	Mindoro
Basilan	Negros
Bohol	Palawan
Cagayancillo	Panay
Calayan	Romblon
Calamianes	Samar
Catanduanes	Semirara
Cebu	Sasl
Cuyo	Sibay
Guimaras	Sibutu
Leyte	Sibuyan
Lubang	Siquilfor
Luzon	Sulu
Maestro de Campo	Tablas
Marinduque	Ticao
Masbate	Verde
Mindanao	

**ONOPELIA** *Blanf.*

(Blanf., Faun. Brit. Ind., Birds, IV,  
p. 47, 1898.)

*humulis* (*Temm.*). (Salvad., Cat. Bds.,  
XXI, p. 434.)

Andamans	
Eastern Bengal	
Indo-Chinese countries	
China	Japan
Calayan	Luzon
Lubang	Mindoro

**SPILOPELIA** *Sunder.*

(Salvadori, Cat. Bds., XXI, p. 439,  
1893.)

*tigrina* (*Temm. & Knip.*). (p. 440.)

Burma	
Malay Peninsula	
Greater and Lesser Islands	Sunda
Celebes	Moluccas
Balabac	Palawan

Subfamily **GEOPELIINÆ.****GEOPELIA** *Swains.*

(Salvadori, Cat. Bds., XXI, p. 455,  
1893.)

*striata* (*Linn.*). (p. 458.)

Siam	
Southern Tenasserim	
Malay Peninsula	
Greater and Lesser Islands	Sunda
Celebes	Amboina
Lubang	Samar
Luzon	Verde
Mindoro	

Subfamily **PHABINÆ.****CHALCOPHAPS** *Gould.*

(Salvadori, Cat. Bds., XXI, p. 510,  
1893.)

*indica* (*Linn.*). (p. 514.)

Indian Peninsula	
Nicobars	
Indo-Chinese countries	
Malay Peninsula	
Sunda Islands	New Guinea
Celebes	Moluccas
Ceylon	Andamans
Basilan	Negros
Cagayancillo	Palawan
Calamianes	Panay
Calayan	Romblon
Cebu	Samar
Cuyo	Sibuyan
Guimaras	Siquijor
Lubang	Sulu
Luzon	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	Verde
Mindoro	

Subfamily **GEOTRYGONINÆ**.**PHLOGENAS** *Reichenb.*(Salvadori, Cat. Bds., XXI. p. 583,  
1893.)

<b>luzonica</b> ( <i>Scop.</i> ). (p. 585.)	Luzon	
<b>crinigera</b> ( <i>Jacq. &amp; Pucher.</i> ). (p. 587.)	Basilan Leyte Mindanao	Samar Sulu? <sup>1</sup>
<b>keayi</b> <i>Clarke</i> , Ibis, 1900, p. 359.	Negros	
<b>menagei</b> <i>Bourns &amp; Worcester</i> , Occ. Papers Minnesota Acad., 1, No. 1. p. 10 (1894).	Tawi Tawi	
<b>platenæ</b> <i>Hartert.</i> (p. 588.)	Mindoro	

Subfamily **CALÆNADINÆ**.**CALÆNAS** *Gray.*(Salvadori, Cat. Bds., XXI, p. 614,  
1893.)

<b>nicobarica</b> ( <i>Linn.</i> ). (p. 615.)	Nicobar Islands Mergui Archipelago Greater Sunda Islands Bismarck Archipelago Moluccas to New Guinea	
	Luzon Mindoro Negros Palawan	Sibutu Sulu Tawi Tawi

Order **RALLIFORMES**.Family **RALLIDÆ**.Subfamily **RALLINÆ**.**HYPOTÆNIDIA** *Reichenb.*(Sharpe, Cat. Bds., XXIII p. 32,  
1894.)

<b>striata</b> ( <i>Linn.</i> ). (p. 33.)	Southern India Ceylon Formosa Celebes Malay Peninsula Indo-Malayan Islands Burmese countries to China	
	Calamianes Cebu Guimaras Leyte Luzon Mindanao Mindoro	Negros Panay Samar Sibuyan Siquilfor Sulu

<sup>1</sup> See *Pucher. & Jacq., Voy. Pôle Sud, III, Ous.*, p. 18 (1853). *P. crinigera* was not met with in Sulu by Platen or by Dr. Bourns and myself. — WORCESTER.

**philippinensis** (*Linn.*). (p. 39.)

Pacific Islands  
Australia      New Zealand  
Entire Malayan Archipelago

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Luzon

**torquata** (*Linn.*). (p. 43.)

Bongao	Mindanao
Cagayancillo	Mindoro
Catanduanes	Negros
Cebu	Panay
Dinagat	Romblon
Guimaras	Samar
Leyte	Sibuyan
Luzon	Siquijor
Marinduque	Ticao
Masbate	Verde

**RALLINA** *Reichenb.*

(Sharpe, Cat. Bds., XXIII, p. 74,  
1894.)

**fasciata** (*Raffl.*). (p. 75.)

Burmese provinces  
Malay Peninsula  
Indo-Malayan Islands  
Halmahéra      Pelew Islands

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Balabac      Palawan

**euryzonoides** (*Lafr.*). (p. 78.)

Cagayancillo	Mindoro
Cebu	Negros
Leyte	Panay
Luzon	Sulu
Mindanao	

**PORZANA** *V.*

(Sharpe, Cat. Bds., XXIII, p. 92,  
1894.)

**pusilla** *Pall.* (*Cf.* Reichenb., J. f. O., 1898,  
p. 139.)

[*intermedia* (*Herm.*). (p. 103.)]

Central Europe  
East to Lake Baikal  
Africa and Madagascar (*winter*)

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Luzon

**plumbea** *Gray.*

[*tabuensis*, pt. (pp. 111, 335.)]

New Hebrides      Australia  
New Caledonia  
New Zealand  
Chatham Islands  
Samoa Islands      Fiji Islands

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Luzon



**POLIOLIMNAS** *Sharpe*.(Sharpe, Cat. Bds., XXIII, p. 130,  
1894.)**cinereus** (V.). (pp. 130, 337.)

Oceania	
Malayan Peninsula	
Greater and Lesser Sunda Islands	
Buru	Australia
Basilan	Mindanao
Calayan? <sup>1</sup>	Mindoro
Cebu	Negros
Dinagat	Panay
Guimaras	Sibuyan
Leyte	Siquijor
Luzon	Ticao
Marinduque	

**LIMNOBÆNUS** *Sunder*.(Sharpe, Cat. Bds., XXIII, p. 115,  
1894.)**fuscus** (Linn.). (p. 146.)

Indian Peninsula	
Ceylon	
Burmese countries to China and Japan	
Malay Peninsula	
Christmas Island	
Java	Borneo
Cagayancillo	Mindanao
Leyte	Mindoro
Luzon	Negros

**paykulli** (*Ljungh.*). (p. 149.)

China	
Malay Peninsula	
Eastern Siberia	
Java	Borneo
Basilan	

**AMAURONIS** *Reichenb.*(Sharpe, Cat. Bds., XXIII, p. 152,  
1894.)**olivacea** (*Meyen.*). (p. 153.)

Calayan	Mindoro
Cebu	Negros
Leyte	Panay
Luzon	Samar
Masbate	Siquijor
Mindanao	Ticao

<sup>1</sup>A rail, probably *P. cinereus*, was seen but not obtained by Mr. McGregor in Calayan.—WORCESTER.

**phœnicura** (*Forster*). (p. 156.)

Celebes	
Indian Peninsula	
Indo-Burmese provinces	
Malay Peninsula	
Greater and Lesser Sunda Islands	
Ceylon	China
<hr/>	
Basilan	Mindoro
Bongao	Palawan
Cagayan Sulu	Panay
Calamianes	Siquijor
Marinduque	Sulu
Mindanao	Tawi Tawi

**GALLINULA** *Briss.*

(Sharpe, Cat. Bds., XXIII, p. 167.  
1894.)

**chloropus** (*Linn.*). (p. 169.)

Europe	
Asia	Africa
Madagascar	Mauritius
<hr/>	
Calayan	Mindanao
Cebu	Mindoro
Guimaras	Negros
Leyte	Panay
Luzon	Samar

**GALLICREX** *Blyth.*

(Sharpe, Cat. Bds., XXIII, p. 183.  
1894.)

**cinerea** (*Lath.*). (p. 183.)

Ceylon	
Burmese provinces to China and Japan	
Malay Peninsula	
Indian Peninsula	
Greater Sunda Islands	
<hr/>	
Catanduanes	Mindoro
Cebu	Negros
Luzon	Panay
Marinduque	Sibuyan
Masbate	Sulu
Mindanao	Ticao.

**PORPHYRIO** *Briss.*

(Sharpe, Cat. Bds., XXIII, p. 192,  
1894.)

**pulverulentus** *Temm.* (p. 207.)

Luzon	Mindoro
Mindanao	

Subfamily **FULICINÆ**.**FULICA** *Linn.*(Sharpe, Cat. Bds., XXIII. p. 209,  
1891.)**atra** *Linn.* (p. 210.)

Europe	
Indian Peninsula	
Mediterranean countries	
Northern and central Asia	
China	Celebes
Java	Sumatra

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Luzon

Order **PODICIPEDIFORMES**.Family **PODICIPEDIDÆ**.**PODICIPES** *Lath.*(Grant, Cat. Bds., XXVI. p. 502,  
1898.)**philippinensis** (*Bonn.*), (p. 511.)

Borneo	
Southern China	
Burmese provinces	
Formosa	Hainan

---

Calayan	Luzon
Guimaras	Mindanao

Order **PROCELLARIIFORMES**.Family **PROCELLARIIDÆ**.Subfamily **PROCELLARIINÆ**.**OCEANODROMA** *Reichenb.*(Salvin, Cat. Bds., XXV. p. 317,  
1896.)**sp.** *McGregor*, Bull. Philippine Mus., No. 4, Luzon  
p. 12 (1904).Family **PUFFINIDÆ**.Subfamily **PUFFININÆ**.**PUFFINUS** *Briss.*(Salvin, Cat. Bds., XXV. p. 368,  
1896.)**leucomelas** *Temm.* (p. 370.)

Japan and Korea south to Aus-	
tralia	

---

Luzon

## Order LARIFORMES.

## Family LARIDÆ.

## Subfamily STERNINÆ.

**HYDROCHELIDON** *Boie.*

(Saunders, Cat. Bds., XXV. p. 5,  
1894.)

**leucoptera** (*Meisn. & Schinz*). (p. 6.)

Africa (*winter*)  
Australia            New Zealand  
Central and southern Europe to  
central Asia and China

---

Mindanao

**hybrida** (*Pall.*). (p. 10.)

Malay Archipelago  
Australia            Africa  
Southwestern    central,    and  
southern Europe to China

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Luzon                    Palawan  
Mindanao                Negros

**STERNA** *Linn.*

(Saunders, Cat. Bds., XXV, p. 40.  
1896.)

**fluviatilis** *Naum.* (p. 54.)

Countries on both sides of At-  
lantic Ocean  
Indian and African coasts  
(*winter*)  
Brazilian coasts (*winter*)

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Calayan

**boreotis** (*Bangs*), Bull. Mus. Comp. Zool.,  
XXXVI, No. 8, 256 (1901).

Red Sea  
African and Indian Oceans to  
China, Japan, Australia, and  
the Pacific Islands.

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Agutaya	Negros
Balabac	Palawan
Bohol	Panay
Calamianes	Pata off Sulu
Cebu	Romblon
Cuyo	Samar
Guimaras	Sibuyan
Leyte	Siquijor
Luzon	Sulu
Masbate	Tablas
Mindanao	Tawi Tawi

**anæstheta** *Scop.* (p. 101.)

African and Indian seas to Chi-  
na, Japan, Moluccas, north-  
ern Australia, and Pacific  
Islands.

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Gulf of Mexico    Western Indies  
Panay

**fuliginosa** *Gm.* (p. 106.)Tropical and juxtatropical seas  
of the world

---

Siquijor**sinensis** *Gm.* (p. 113.)Chinese and Indian seas to  
Australia

---

Mindanao Palawan  
Mindoro**melanauchen** *Temm.* (p. 126.)Tenasserim  
Nicobars Andamans  
Malay Peninsula  
Northern Australia  
Pacific Islands to Liu Kiu  
Islands  
Northern Mascarene Islands

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Palawan Cresta de Gallo**ANOUS** *Steph.*(Saunders, Cat. Bds., XXV, p. 136,  
1896.)**stolidus** (*Linn.*), (p. 136.)Tropical and juxtatropical seas  
of the world

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Cagayan Sulu PalawanSubfamily **LARINÆ**.**LARUS** *Linn.*(Saunders, Cat. Bds., XXV, p. 169,  
1896.)**ridibundus** *Linn.* (p. 207.)Europe and northern Asia  
Africa Indian Ocean  
China to Malay Archipelago  
(winter)

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Luzon Samar  
Mindanao**vegæ** *Palmén.* (p. 270.)Chinese coasts (winter)  
Japan and Formosa (winter)  
Bonin Islands (winter)  
Arctic Siberia  
Bering Sea

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Luzon

## Order CHARADRIIFORMES.

## Suborder CHARADRII.

## Family CHARADRIIDÆ.

## Subfamily ARENARIINÆ.

**ARENARIA** *Briss.*

(Sharpe, Cat. Bds., XXIV, p. 91,  
1896.)

*interpres* (*Linn.*). (p. 92.)

Cosmopolitan, breeding in high  
northern latitudes

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Bohol	Masbate
Cagayancillo	Mindanao
Cagayan Sulu	Negros
Lubang	Palawan
Luzon	Siquijor

## Subfamily CHARADRIINÆ.

**SQUATAROLA** *Leach.*

(Sharpe, Cat. Bds., XXIV, p. 182,  
1896.)

*helvetica* (*Linn.*). (p. 182.)

Subarctic regions south to Aus-  
tralia, Cape, and South  
America (*winter*)

---

Cuyo	Negros
Luzon	Palawan
Mindanao	Siquijor

**CHARADRIUS** *Linn.*

(Sharpe, Cat. Bds., XXIV, p. 191,  
1896.)

*fulvus* (*Gm.*). (p. 195.)  
[*dominicus* (P. L. S. Müll.).]

Subarctic regions south to Aus-  
tralia  
New Zealand Africa  
South America (*winter*)

---

Balabac	Masbate
Bohol	Mindanao
Calamianes	Mindoro
Calayan	Negros
Cebu	Palawan
Cuyo	Sibay
Fuga	Sibuyan
Leyte	Siquijor
Lubang	Sulu
Luzon	Ticao



**OCHTHODROMUS** *Reichenb.*(Sharpe, Cat. Bds., XXIV, p. 209,  
1896.)**geoffroyi** (*Wagl.*). (p. 217.)Eastern Asia (Japan, Formosa)  
Africa, Indian Peninsula, and  
Australia (*winter*)

---

Bohol	Mindanao
Cagayancillo	Mindoro
Cuyo	Palawan
Leyte	Panay
Lubang	Pata off Sulu
Luzon	Siquijor
Negros	

**mongolus** (*Pall.*). (p. 223.)Northeastern Asia  
Coasts of Bering Sea, Alaska  
China to Australia (*winter*)

---

Bohol	Luzon
Cagayancillo	Mindanao
Calayan	Negros
Cuyo	Palawan
Leyte	Ticao
Lubang	

**veredus** (*Gould.*). (p. 232.)Mongolia  
China to Moluccas and Australia  
(*winter*)

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 Palawan
**ÆGIALITIS** *Boïc.*(Sharpe, Cat. Bds., XXIV, p. 251,  
1896.)**dubia** (*Scop.*). (p. 263.)Africa (*winter*)  
Alaska to California (*casual*)  
Europe and northern Asia to  
Japan  
India and the Malay Archipelago  
(*winter*)

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Bohol	Luzon
Cagayancillo	Mindanao
Calaynn	Mindoro
Catanduanes	Negros
Cebu	Palawan
Guimaras	Panay
Leyte	Sibuyan
Lubang	Tablas

**peroni** (*Bp.*). (p. 273.)

Greater Sunda Islands to Celebes

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Bohol	Negros
Calaynn	Palawan
Fuga	Romblon
Leyte	Sibutu
Lubang	Sibuyan
Luzon	Siquijor
Mindanao	Ticao

**alexandrina** (*Linn.*). (p. 275.)

Africa  
Indian Peninsula and Australia  
(*winter*)  
Europe and central Asia to  
China and Japan

Calayan	Panay
Cuyo	Siquijor
Mindanao	Ticao
Palawan	

Subfamily **HIMANTOPODINÆ.**

**HIMANTOPUS** *Briss.*

(Sharpe, Cat. Bds., XXIV, p. 309,  
1896.)

**leucocephalus** *Gould.* (p. 317.)

Molucca Islands  
Greater Sunda Islands  
Australia      New Guinea

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Mindanao

Subfamily **TOTANINÆ.**

**NUMENIUS** *Briss.*

(Sharpe, Cat. Bds., XXIV, p. 340,  
1896.)

**arquata** (*Linn.*). (p. 341.)

India      Africa  
Europe east to Lake Baikal  
Southern China and Malay Pen-  
insula (*winter*)

Luzon	Samar
Masbate	Ticao
Palawan	

**cyanopus** *L.* (p. 350.)

Japan  
Eastern Siberia  
Australia (*winter*)

Mindoro	Negros
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**variegatus** (*Scop.*). (p. 361.)

Japan  
Eastern Siberia  
Southern China to Australia  
(*winter*)

Cagayancillo	Mindoro
Cebu	Negros
Cuyo	Palawan
Lubang	Panay
Luzon	Samar
Malanipa	Siquijor
Mindanao	

**MESOSCOLOPAX** *Sharpe.*(Sharpe, Cat. Bds., XXIV, p. 371.  
1896.)**minutus** *Gould.* (p. 371.)China  
Eastern Siberia  
Corea and Mongolla  
Japan to Australia (*winter*)

Marinduque      Mindanao

**LIMOSA** *Briss.*(Sharpe, Cat. Bds., XXIV, p. 372.  
1896.)**novæ-zealandiæ** *Gray.* (p. 379.)Alaska  
Eastern Siberia south to Aus-  
tralia  
New Zealand, Oceania (*winter*)Bohol      Cuyo  
Negros**limosa** (*Linn.*), (p. 381.)Central and northern Europe  
to Valley of Ob River  
Mediterranean countries and  
northeastern Africa (*winter*)

Negros      Samār

**TOTANUS** *Bechst.*(Sharpe, Cat. Bds., XXIV, p. 409.  
1896.)**eurhinus** (*Oberh.*), Proc. U. S. N. M., XXII,  
p. 207 (1900).India      Africa  
Europe and central Asia to  
eastern Siberia  
Burmese countries to Malay  
Archipelago (*winter*)Bohol      Negros  
Cebu      Palawan  
Cuyo      Siquiljo  
Mindanna**HELODROMAS** *Kaup.*(Sharpe, Cat. Bds., XXIV, p. 437.  
1896.)**ochropus** (*Linn.*), (p. 437.)Africa  
Europe and northern Asia  
Indian Peninsula to Malay Ar-  
chipelago (*winter*)

Luzon      Samār

**HETERACTITIS** *Stejn.*(Sharpe, Cat. Bds., XXIV, p. 449.  
1896.)**brevipes** (V.). (p. 449.)Eastern Siberia  
China to Malay Archipelago  
and Australia (*winter*)

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Bohol	Luzon
Cagayancillo	Malanipa
Calayan	Negros
Cebu	Palawan
Cuyo	Siquijor
Leyte	Ticao
Lubang	

**ACTITIS** *Illiger.*(*Tringoides* Bp.; Sharpe, Cat. Bds.,  
XXIV, p. 456. 1896.)**hypoleucus** (Linn.). (p. 456.)Africa  
Europe and northern Asia  
Indian Peninsula to Australia  
(*winter*)

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Agutaya	Lubang
Balabac	Luzon
Basilan	Masbate
Bohol	Mindanao
Cagayancillo	Mindoro
Cagayan Sulu	Negros
Calamianes	Palawan
Calayan	Panay
Camiguin	Samar
Cebu	Sibay
Cuyo	Ticao
Guimaras	Verde

**TEREKIA** *Bp.*(Sharpe, Cat. Bds., XXIV, p. 474.  
1896.)**cinerea** (Güldenst.). (p. 474.)Northern Siberia  
Northeastern Europe  
Africa and Indian Peninsula to  
Australia (*winter*)

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Bohol	Negros
Masbate	Palawan

**GLOTTIS** *Koch.*(Sharpe, Cat. Bds., XXIV, p. 480.  
1896.)**nebularius** (Gunn.). (p. 481.)Africa  
Northern Europe and northern  
Asia  
Indian Peninsula to Australia  
(*winter*)

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Luzon	Negros
Mindanao	Samar
Mindoro	

**RHYACOPHILUS** *Kaup.*(Sharpe, Cat. Bds., XXIV, p. 490,  
1896.)**glareola** (*Gm.*). (p. 491.)Africa  
Europe and northern Asia  
Indian Peninsula to Australia  
(*winter*)

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Bohol	Mindanao
Cagayan Sulu	Mindoro
Calamianes	Negros
Calayan	Palawan
Cebu	Panay
Guimaras	Siquijor
Lubang	Ticao
Luzon	

Subfamily **SCOLOPACINÆ.****CALIDRIS** *Illiger.*(Sharpe, Cat. Bds., XXIV, p. 526,  
1896.)**abba** (*Pall.*). (p. 526.)[*Cf.* Richmond, Smithsonian, Miscel. Colls.,  
47, p. 347 (1905).]Africa  
Arctic regions  
South America  
Indian Peninsula to Australia  
(*winter*)  
Marshall Islands (*winter*)

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Luzon
**LIMONITES** *Kaup.*(Sharpe, Cat. Bds., XXIV, p. 531,  
1896.)**minuta** (*Leister*). (p. 538.)Africa  
Ceylon (*winter*)  
Indian Peninsula  
Northern Europe  
Northern Asia to Lake Balkal

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Mindanao
**ruficollis** (*Pall.*). (p. 545.)Eastern Siberia  
Japan China  
Burmese countries to Australia  
(*winter*)

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Bohol	Luzon
Calayan	Mindanao
Cebu	Negros
Cuyo	Palawan

**damacensis** (*Horsf.*). (p. 553.)

Japan  
Eastern Siberia  
Islands of Bering Sea  
China to northeastern Bengal  
Burma to Australia (*winter*)

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Luzon Palawan  
Mindanao

**temmincki** (*Leisl.*). (p. 555.)

Northern Europe and Asia  
Northern and northeastern  
Africa  
Indian Peninsula  
China (*winter*)

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Negros

## **HETEROPYGIA** *Coues.*

(Sharpe, Cat. Bds., XXIV, p. 561,  
1896.)

**acuminata** (*Horsf.*). (p. 566.)

Eastern Siberia  
Alaska  
China south to Australia and  
New Zealand (*winter*)

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Mindanao

## **ANCYLOCHILUS** *Kaup.*

(Sharpe, Cat. Bds., XXIV, p. 585,  
1896.)

**subarquatus** (*Güldenst.*). (p. 586.)

Northern Siberia  
Africa  
Indian Peninsula to Australia  
(*winter*)

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Luzon Negros

## **TRINGA** *Linn.*

(Sharpe, Cat. Bds., XXIV, p. 593,  
1896.)

**crassirostris** *T. & S.* (p. 600.)

Eastern Siberia  
Japan  
China to Australia and western  
Indian Peninsula (*winter*)

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Negros



**LIMICOLA** *Koch.*(Sharpe, Cat. Bds., XXIV, p. 612.  
1896.)**platyrhyncha** (*Temm.*). (p. 612.)Northern Europe and Siberia  
Mediterranean and Red Seas  
Indian Peninsula  
China to Moluccas (*winter*)

Bohol	Negros
Cuyo	Palawan

**GALLINAGO** *Leach.*(Sharpe, Cat. Bds., XXIV, p. 616.  
1896.)**stenura** (*Kuhl*). (p. 619.)Eastern Siberia to the Yenesei  
China to Malay Peninsula  
(*winter*)

Calayan	Mindanao
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**megala** *Swinh.* (p. 624.)Eastern Siberia  
Japan  
China south to Molucca Islands  
(*winter*)

Basilan	Mindoro
Calamianes	Negros
Cebu	Palawan
Leyte	Panay
Lubang	Samar
Luzon	Sibuyan
Masbate	Siquijor
Mindanao	Tawi Tawi

**gallinago** (*Linn.*). (p. 633.)Europe to northern Asia  
Senegambia and northeastern  
Africa (*winter*)  
Indian Peninsula to the Malay  
Peninsula and the Moluccas  
(*winter*)

Bohol	Luzon
Leyte	Mindoro

**ROSTRATULA** *L.*(Sharpe, Cat. Bds., XXIV, p. 683.  
1896.)**capensis** (*Linn.*). (p. 683.)Africa  
Indian Peninsula  
Burmese provinces to China  
and Japan south to Malay  
Peninsula  
Greater Sunda Islands

Catanduanes	Mindanao
Leyte	Panay
Lubang	Samar
Luzon	Sibuyan
Marinduque	Siquijor

Suborder **PARRÆ.**Family **PARRIDÆ.****HYDROPHASIS** *Sharpe.*(Sharpe, Cat. Bds., XXIV, p. 69,  
1896.)**chirurgus** (*Scop.*). (p. 69.)Indian Peninsula  
Indo-Chinese countries to Ma-  
lay Peninsula and Greater  
Sunda IslandsCalayan                      Mindanao  
Luzon                        Mindoro**HYDRALECTOR** *Wagler.*(Sharpe, Cat. Bds., XXIV, p. 79,  
1896.)**gallinaceus** (*Temm.*). (l. c.)Australia  
Celebes  
Southern Borneo

Mindanao

Suborder **CURSORI.**Family **GLAREOLIDÆ.****GLAREOLA** *Briss.*(Sharpe, Cat. Bds., XXIV, p. 53,  
1896.)**orientalis** *Leach.* (p. 58.)China  
Eastern Siberia  
Indian Peninsula  
Indo-Chinese countries  
Malay Peninsula and Archipel-  
ago to Australia (*winter*)Calayan                      Mindanao  
Fuga                        Negros  
Luzon                        PalawanSuborder **ÆDICNEMI.**Family **ÆDICNEMIDÆ.****ORTHORHAMPHUS** *Salvad.*(Sharpe, Cat. Bds., XXIV, p. 22,  
1896.)**magnirostris** (*V.*). (p. 22.)Australia to Bismarck Archipel-  
ago and north to Borneo and  
islands of Bay of BengalCalayan                      Mindanao  
Fuga                        Mindoro  
Luzon                        Palawan

## Order GRUIFORMES.

## Suborder GRUES.

## Family GRUIDÆ.

**ANTIGONE** *Reichenb.*

(Sharpe, Cat. Bds., XXIII, p. 262,  
1894.)

**sharpei** *Blanf.*, Bull. B. O. C., V, p. VI (1895).

Malay Peninsula  
Burma and Cochin China  

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Luzon

## Suborder PLATALEÆ.

## Family IBIDIDÆ.

**PLEGADIS** *Kaup.*

(Sharpe, Cat. Bds., XXVI, p. 29,  
1898.)

**falcinellus** (*Linn.*), (l. c.)

China  
Africa  
Jamaica  
Australia  
Eastern United States  
Southern Europe to India  

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Mindanao

## Order ARDEIFORMES.

## Suborder CICONIÆ.

## Family CICONIIDÆ.

## Subfamily CICONIINÆ.

**DISSÖURA** *Cab.*

(Sharpe, Cat. Bds., XXVI, p. 294,  
1898.)

**episcopus** (*Bodd.*), (p. 294.)

Tropical Africa  
Indian Peninsula  
Malay Peninsula  
Indo-Malayan Islands  
Indo-Chinese countries  
Celebes Ceylon  

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Calayan	Mindoro
Leyte	Negros
Luzon	Panay
Masbate	Samar
Mindanao	

Suborder **ARDEÆ.**Family **ARDEIDÆ.****PYRRHERODIAS** *Finsch & Harth., Vog.*

Ost-Afr., p. 676 (1870).

| *Phoyr* Stejn. (Sharpe, Cat. Bds.,  
XXVI, p. 60, 1898.) |**manillensis** (*Meyen*). (p. 64.)Celebes  
Indian Peninsula  
Malay Peninsula  
Ceylon                      China  
Greater Sunda Islands

Basilan	Negros
Calamianes	Palawan
Catanduanes	Panay
Cebu	Romblon
Leyte	Samar
Luzon	Sibuyan
Marinduque	Siquijor
Masbate	Tablas
Mindanao	Tawi Tawi
Mindoro	Ticao

**ARDEA** *Linn.*(Sharpe, Cat. Bds., XXVI, p. 66,  
1898.)**sumatrana** *Raffl.* (p. 68.)Australia  
Malay Peninsula  
Sunda Islands                      Celebes  
Aracan                      Tenasserim

Negros                      Palawan

**cinerea** *Linn.* (p. 74.)Europe                      Asia  
Africa                      Australia

Guimaras

**MESOPHOYX** *Sharpe.*(Sharpe, Cat. Bds., XXVI, p. 85,  
1898.)**intermedia** *Wagl.* (p. 85.)Indian Peninsula  
Malayan Archipelago  
China                      Japan

Bohol	Mindoro
Calayan	Palawan
Luzon	Samar
Mindanao	

**HERODIAS** *Boie.*

(Sharpe, Cat. Bds., XXVI, p. 88,  
1898.)

**timoriensis** (*Cur.*). (p. 98.)

Northern China and Japan to  
Australia

Mindanao

**EGRETTA** *Forster.*

(*Garzetta* Kaup; Sharpe, Cat. Bds.,  
XXVI, p. 118, 1898.)

**garzetta** (*Linn.*). (p. 118.)

Africa  
China Japan  
Southern Europe to central  
Asia  
Indian Peninsula  
Malay Peninsula and Archipel-  
ago

Bohol	Mindanao
Cagayancillo	Negros
Leyte	Panay
Lubang	Romblon
Luzon	Siquijor

**DEMIEGRETTA** *Blyth.*

(Sharpe, Cat. Bds., XXVI, p. 136,  
1898.)

**sacra** (*Gm.*). (p. 137.)

Coast of Bay of Bengal to  
Australia and Oceania north  
to Japan and Corea

Balabac	Mindanao
Bohol	Mindoro
Bongao	Negros
Cagayancillo	Panay
Cagayan Sulu	Pata (off Sulu)
Calayan	Romblon
Cebu	Semirara
Cuyo	Sibuyan
Fuga	Siquijor
Lubang	Sulu
Luzon	Tablas
Malanipa	Tawi Tawi
Marinduque	Ticao
Masbate	

**NYCTICORAX** *Rafin.*

(Sharpe, Cat. Bds., XXVI, p. 145,  
1898.)

**nycticorax** (*Linn.*). (p. 146.)

Africa  
Malay Peninsula  
China and Japan  
Greater Sunda Islands to  
Celebes  
Northern and Central America  
to Columbia and Ecuador  
Central and southern Europe to  
Indian Peninsula

Calayan	Mindanao
Luzon	

*manillensis* Vig. (p. 162.)

Western Celebes  
Northern Borneo

Basilan	Mindoro
Catanduanes	Negros
Cebu	Panay
Leyte	Samar
Luzon	Sibuyan
Marinduque	Siquijor
Masbate	Tablas
Mindanao	Ticao

## GORSACHIUS Bp.

(Sharpe, Cat. Bds., XXVI, p. 166.  
1898.)

*melanolophus* (Raffl.). (p. 166.)

Ceylon  
Southern India  
Assam to Hainan  
Greater Sunda Island  
Formosa south to Malay Penin-  
sula

Balabac	Mindanao
Basilan	Palawan
Cebu	Samar
Guimaras	Siquijor
Luzon	Ticao
Masbate	

*goisagi* (Temm.). (p. 169.)

Japan	Formosa
Luzon	Mindanao

## BUTORIDES Blyth.

(Sharpe, Cat. Bds., XXVI, p. 172,  
1898.)

*javanica* (Horsf.). (p. 177.)

Southern China  
Malay Peninsula  
Indian Peninsula  
Celebes Ceylon  
Mascarene Islands  
Greater Sunda Islands

Bongao	Mindoro
Cagayancillo	Negros
Calamianes	Nipa
Calayan	Palawan
Cebu	Panay
Cuyo	Romblon
Dinagat	Samar
Guimaras	Semirara
Leyte	Sibuyan
Lubang	Siquijor
Luzon	Sulu
Marinduque	Tablas
Masbate	Tawi Tawi
Mindanao	Ticao

*amurensis* (Schrenck) (p. 181.)

Greater Sunda Islands  
Japan China  
Amur-land Celebes  
Cebu Palawan



**BUBULCUS** *Bp.*

(Sharpe, Cat. Bds., XXVI, p. 213,  
1898.)

**coromandus** (*Bodd.*). (p. 217.)

Ceylon  
Eastern Siberia  
Indian Peninsula  
Corea                      China  
Indo-Chinese countries south to  
Celebes and Moluccas

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Balabac	Masbate
Bohol	Mindanao
Bongao	Mindoro
Calayan	Negros
Catanduanes	Palawan
Cebu	Panay
Cuyo	Sulu
Guimaras	Tablas
Lubang	Ticao
Luzon	

**ARDETTA** *Gray.*

(Sharpe, Cat. Bds., XXVI, p. 220,  
1898.)

**sinensis** (*Gm.*). (p. 227.)

Japan  
Indian Peninsula  
China                      Korea  
Indo-Chinese countries  
Malay Peninsula and islands  
to Australia (*winter*)

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Calayan	Panay
Luzon	Sulu
Mindanao	Tablas
Mindoro	

**cinnamomea** (*Gm.*). (p. 236.)

China  
Eastern Siberia  
Celebes (*winter*)  
Indian Peninsula  
Indo-Malayan subregion

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Catanduanes	Mindoro
Cebu	Palawan
Guimaras	Panay
Leyte	Sibuyan
Luzon	Tablas
Marinduque	Tawi Tawi
Mindanao	Ticao

**NANNOCNUS** *Stejn.*

(Sharpe, Cat. Bds., XXVI, p. 242,  
1898.)

**eurythmus** (*Swinh.*). (p. 242.)

Eastern Siberia  
Japan                      China  
Borneo                      Celebes

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Mindanao	Negros
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**DUPETOR** *Heine & Reichen.*

(Sharpe, Cat. Bds., XXVI, p. 246.  
1898.)

**flavicollis** (*Lath.*). (p. 247.)

Malay Peninsula  
Celebes                      Ceylon  
Indo-Chinese countries  
Indian Peninsula  
Greater Sunda Islands  
Southern and central China

---

Cebu                      Mindanao  
Luzon                      Negros  
Marinduque              Samar

**BOTAURUS** *Briss.*

(Sharpe, Cat. Bds., XXVI, p. 253.  
1898.)

**stellaris** (*Linn.*). (l. c.)

Northwestern India  
Burma                      China  
Temperate Palæarctic region

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Luzon

## Order ANSERIFORMES.

## Family ANATIDÆ.

## Subfamily PLECTROPTERINÆ.

**NETTOPUS** *Brandt.*

(Salvadori, Cat. Bds., XXVII, p. 64,  
1895.)

**coromandelianus** (*Gm.*). (p. 68.)

Indian Peninsula  
Burmese countries  
Greater Sunda Islands  
China                      Celebes

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Luzon

## Subfamily ANATINÆ.

**DENDROCYGNA** *Swains.*

(Salvadori, Cat. Bds., XXVII, p. 144.  
1895.)

**viduata** (*Linn.*). (p. 145.)

Tropical Africa  
Tropical South America  
West Indies              Madagasear

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Luzon

*arcuata* (*Horsf.*). (p. 153.)

New Guinea	
Indo-Malayan Islands	
Australia	Oceania
Celebes	Moluccas
<hr/>	
Basilan	Mindanao
Bohol	Mindoro
Catanduanes	Panay
Cebu	Samar
Guimaras	Sibuyan
Leyte	Siquijor
Luzon	Ticao
Masbate	

*guttulata* *Wallace*.

[*guttata* *Forst.* (p. 164.)]

Celebes	
Tenimber Islands	
Moluccas	New Guinea
<hr/>	
Mindanao	

**ANAS** *Linn.*

(*Salvadori*, *Cat. Bds.*, XXVII, p. 181,  
1895.)

*luzonica* *Fraser*. (p. 205.)

Catanduanes	Mindanao
Guimaras	Mindoro
Lubang	Panay
Luzon	Samar
Marinduque	Siquijor
Masbate	Ticao

**POLIONETTA** *Oates*.

(*Oates*, *Man. Game Bds. Ind.*, pt. 11,  
p. 151, 1899.)  
[*Anas* *Linn.* pt.]

*zonorhyncha* (*Swinh.*). (p. 211.)

Eastern Siberia	
Mongolia	Japan
China	Kurile Islands
<hr/>	
* Calayan	

**MARECA** *Steph.*

(*Salvadori*, *Cat. Bds.*, XXVII, p. 221,  
1895.)

*penelope* (*Linn.*). (l. c.)

Persia ( <i>winter</i> )	
Marshall Islands ( <i>winter</i> )	
North America ( <i>occasional</i> )	
Northeastern Africa ( <i>winter</i> )	
Northern Europe and Siberia to Kamchatka	
Northern Indian Peninsula and Burma to Borneo ( <i>winter</i> )	
<hr/>	
Calayan	

**NETTION** *Kaup.*

(Salvadori, Cat. Bds., XXVII, p. 238,  
1895.)

**crecca** (*Linn.*). (p. 243.)

Persia  
China (*winter*)  
Indian Peninsula  
Europe and northern Asia  
Eastern United States (*occasional*)  
Northern and northeastern  
Africa  

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Calayan Mindoro  
Luzon

**DAFILA** *Steph.*

(Salvadori, Cat. Bds., XXVII, p. 240,  
1895.)

**acuta** (*Linn.*). (p. 270.)  
[*modesta* Tristr. (p. 275, note.)]

Northern Asia  
North America  
Northern Europe  
Mediterranean countries (*winter*)  
Indian Peninsula and China  
(*winter*)  
Central America and West Indies  
(*winter*)  
Indo-Malayan Archipelago and  
Oceania (*winter*)  

---

Luzon

**QUERQUEDULA** *Steph.*

(Salvadori, Cat. Bds., XXVII, p. 290,  
1895.)

**querquedula** (*Linn.*).  
[*circia* Linn. (p. 293.)]

China (*winter*)  
Indian Peninsula (*winter*)  
Northeastern Africa (*winter*)  
Malayan Archipelago (*winter*)  
Northern Europe and northern  
Asia  

---

Calayan Luzon

**SPATULA** *Boie.*

(Salvadori, Cat. Bds., XXVII, p. 306,  
1895.)

**clypeata** (*Linn.*). (p. 306.)

North America  
Africa (*winter*)  
West Indies (*winter*)  
Southern China (*winter*)  
Indian Peninsula (*winter*)  
Arabia and Persia (*winter*)  
Hawaiian Archipelago (*winter*)  
Central America to Colombia  
(*winter*)  
Europe Western Asia  

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Calayan Luzon  
Mindoro

Subfamily **FULIGULINÆ**.**FULIGULA** *Steph.*(Salvadori, Cat. Bds., XXVII, p. 354,  
1895.)**fuligula** (*Linn.*). (p. 363.)

Northern Asia  
 Northern Europe  
 Greater Sunda Islands (*winter*)  
 Marianne and Pelew Islands  
 (*winter*)  
 Mediterranean Sea and Abyssinia  
 (*winter*)  
 Northern Indian Peninsula and  
 Southern China (*winter*)

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Calayan                      Mindanao  
 Luzon

Order **PELECANIFORMES**.Family **PHALACROCORACIDÆ**.**PHALACROCORAX** *Briss.*(Grant, Cat. Bds., XXVI, p. 330,  
1898.)**carbo** (*Linn.*). (p. 340.)

Europe                      Africa  
 Greenland                Northern Asia  
 Eastern North America to  
 Georgia  
 Indian Peninsula to China and  
 Australia

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Calayan                      Ticao  
 Luzon

Family **PLOTIDÆ**.**ANHINGA** *Briss.*(*Plotus* *Linn.*; Grant, Cat. Bds.,  
XXVI, p. 410, 1898.)**melanogaster** (*Pennant*). (p. 414.)

Mesopotamia  
 Indian Peninsula  
 Indo-Chinese countries  
 Indo-Malayan Peninsula  
 Borneo                      Celebes

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Luzon                      Mindoro  
 Mindanao                Negros

Family **SULIDÆ**.**SULA** *Briss.*(Grant, Cat. Bds., XXVI, p. 423,  
1898.)**piscator** (*Linn.*). (p. 432.)

Oceania  
 Southern Atlantic  
 Indian and Australian Seas

---

Mindanao

*sula* (Linn.). (p. 436.)

Tropical Atlantic, Indian, Australian, and Pacific Oceans

Calayan? <sup>1</sup>  
Dinagat

Luzon  
Mindanao

Family **FREGATIDÆ.**

**FREGATA** Briss.

(Grant, Cat. Bds., XXVI, p. 442.  
1898.)

*aquila* (Linn.). (p. 443.)

Tropical and subtropical oceans  
of both hemispheres

Cagayancillo

*ariel* (Gould). (p. 447.)

Tropical and subtropical Indian  
and Pacific Oceans

Cagayancillo  
Luzon  
Mindanao

Negros  
Palawan

Family **PELECANIDÆ.**

**PELECANUS** Linn.

(Grant, Cat. Bds., XXVI, p. 460.  
1898.)

*philippensis* Gm. (p. 471.)

Indian Peninsula to China

Luzon

Mindanao

Order **ACCIPITRIFORMES.**

Suborder **ACCIPITRES.**

Family **FALCONIDÆ.**

Subfamily **ACCIPITRINÆ.**

**CIRCUS** Lacép.

(Sharpe, Cat. Bds., I, p. 50, 1874.)

*spilonotus* Kaup. (p. 58.)

Eastern Siberia  
China and Indo-Burmese countries (*winter*)  
Malay Archipelago (*winter*)

Calayan  
Luzon  
Mindanao  
Mindoro

Palawan  
Sibay  
Sulu

<sup>1</sup> A pair of birds, in all probability *S. sula*, were observed near Calayan by Mr. McGregor in September, 1903.—WORCESTER.



**melanoleucus** (*Forst.*). (p. 61.)

Eastern Siberia  
Mongolia                      China (*winter*)  
Northeastern Indian Peninsula  
and Indo-Chinese countries  
(*winter*)

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Calayan	Mindanao
Basilan	Negros
Guimaras	Sulu
Luzon	Ticao

**æruginosus** (*Linn.*). (p. 69.)

Temperate Europe  
Northern Africa (*winter*)  
Indian Peninsula (*winter*)  
Siberia                      China (*winter*)

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Cagayan Sulu	Mindoro
Luzon	

## ASTUR *Lacép.*

(Sharpe, Cat. Bds., I, p. 92, 1874.)

**trivirgatus** (*Temm.*). (p. 105.)

Indian Peninsula  
Indo-Malayan Islands  
Ceylon                      Formosa

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Balabac	Palawan
Leyte	Samar
Mindanao	

**soloensis** (*Lath.*). (p. 114.)

China  
Indo-Chinese countries  
Molucca Islands (*winter*)  
Malay Peninsula (*winter*)  
Indo-Malayan Islands (*winter*)

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Cagayancillo	Mindanao
Luzon	

**cuculoides** (*Temm.*). (p. 115.)

China, south to Malay Archipelago (*winter*)

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Cagayancillo

## ACCIPITER *Briss.*

(Sharpe, Cat. Bds., I, p. 132, 1874.)

**gularis** (*Temm. & Schl.*). (p. 160, pt.)

Japan  
Northern China  
Malay Peninsula  
Malay Archipelago

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Calayan	Palawan
Fuga	

**manillensis** (*Meyen*). (p. 150, pt.)

Guimaras	Mindanao
Leyte	Mindoro
Luzon	Negros

**LOPHOTRIORCHIS** *Sharpe*.

(Sharpe, Cat. Bds., I, p. 255, 1874.)

**kieneri** (*Geoffr.*). (p. 255.)

Malay Peninsula	
Indian Peninsula	
Lesser Sunda Islands	
Indo-Malayan Islands	
Indo-Chinese provinces	
Ceylon	Celebes
<hr/>	
Luzon	Marinduque
Panay	Mindanao

**SPIZAËTUS** *Vill.*

(Sharpe, Cat. Bds., I, p. 259, 1874.)

**philippinensis** *Gurney*. (p. 261, note.)

Basilan	Negros
Luzon	Palawan
Masbate	Siquijor

**limnaëtus** (*Horsf.*). (p. 272.)

Burmese provinces	
Malayan Peninsula	
Northeastern Bengal	
Greater Sunda Islands	
Assam	Himalayas
<hr/>	
Calamianes	Mindoro
Lubang	Palawan
Mindanao	

**PITHECOPHAGA** *Grant*.

(Grant, B. O. C., VI, p. 17, 1896.)

**jefferyi** *Grant*, Bull. B. O. C., VI, p. 17, 1896; id. *Ibis*, 1897, pl. v.

Leyte? <sup>1</sup>	Mindanao
Luzon	Samar

**SPILORNIS** *Gray*.

(Sharpe, Cat. Bds., I, p. 287, 1874.)

**bacha** (*Daud.*). (p. 290.)

Malayan Peninsula	
Greater Sunda Islands	
<hr/>	
Calamianes	Palawan
Balabac	

**holospilus** (*Vig.*). (p. 293.)

Basilan	Marinduque
Bongao	Mindanao
Catanduanes	Mindoro
Cebu	Samar
Leyte	Sulu
Luzon	Tawi Tawi

**panayensis** *Steere*, List. Bds. & Mams. Steere Exp., p. 7 (1890).

Guimaras	Romblon
Masbate	Sibuyan
Negros	Tablas
Panay	

<sup>1</sup> *P. jefferyi* was probably heard, although not seen, by Whitehead in Leyte. As it has been killed in Samar and Mindanao its occurrence in Leyte is hardly open to doubt.—WORCESTER.

**BUTASTUR** *Hodgs.*

(Sharpe, Cat. Bds., I, p. 294, 1874.)

**indicus** (*Gm.*). (p. 297.)

Ussuri-land  
Japan                      Celebes  
China to Malay Peninsula

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Balabac	Masbate
Basilan	Mindanao
Bohol	Mindoro
Cagayancillo	Negros
Cagayan Sulu	Palawan
Calamianes	Panay
Calayan	Samar
Cebu	Sibay
Cuyo	Siquijor
Fuga	Sulu
Guimaras	Tawi Tawi
Lubang	Verde
Luzon	

**HALIAËTUS** *Savign.*

(Sharpe, Cat. Bds., I, p. 301, 1874.)

**leucogaster** (*Gm.*). (p. 307.)

Indian Peninsula  
Indo-Chinese provinces  
Malay Peninsula to Australia  
and Oceania

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Basilan	Romblon
Bongao	Samar
Calamianes	Semirara
Calayan	Sibuyan
East Bolod	Siquijor
Fuga	Sulu
Luzon	Tablas
Masbate	Tawi Tawi
Mindanao	Ticao
Mindoro	Verde
Palawan	

**HALIASTUR** *Selby.*

(Sharpe, Cat. Bds., I, p. 312, 1874.)

**intermedius** (*Gurney.* (p. 314.)

Celebes  
Malay Peninsula  
Greater Sunda Islands  
Indo-Chinese provinces

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Basilan	Marinduque
Bohol	Masbate
Bongao	Mindanao
Calamianes	Mindoro
Catanduanes	Negros
Cebu	Panay
Cuyo	Romblon
Guimaras	Samar
Leyte	Sibuyan
Lubang	Siquijor
Luzon	Sulu
Maestro de	Tablas
Campo	Tawi Tawi
Malanipa	Ticao

**ELANUS** *Savign.*

(Sharpe, Cat. Bds., I, p. 336, 1874.)

**hypoleucus** *Gould.* (p. 338.)

Celebes	
Greater Sunda Islands	
Basilan	Mindoro
Bongao	Negros
Calamianes	Samar
Cebu	Sibuyan
Guimaras	Sulu
Luzon	Tawi Tawi
Mindanao	

**PERNIS** *Cur.*

(Sharpe, Cat. Bds., I, p. 343, 1874.)

**ptilonorhynchus** (*Temm.*). (p. 347.)

Ceylon	
Malay Peninsula	
Indian Peninsula	
Indo-Chinese countries	
Greater Sunda Islands	
Cebu	Palawan
Luzon	Samar
Mindanao	Sibuyan
Mindoro	Sulu

**BAZA** *Hodge.*

(Sharpe, Cat. Bds., I, p. 351, 1874.)

**magnirostris** *Gray.* (p. 356.)

Luzon	Mindanao
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**leucopais** *Sharpe*, Ibis, 1888, p. 195.

Palawan	Samar
Romblon	

**MICROHIERAX** *Sharpe.*

(Sharpe, Cat. Bds., I, p. 366, 1874.)

**erythrogeus** (*Vig.*). (p. 369.)

Luzon	Mindoro
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**meridionalis** *Grant*, Ibis, 1897, 220.

Cebu	Mindanao
Luzon	Samar

**FALCO** *Linn.*

(Sharpe, Cat. Bds., I, p. 374, 1874.)

**peregrinus** *Tunst.*[*communis* Gm. (p. 376.)]

Africa ( <i>winter</i> )	
Northern America	
Europe	Asia
Indian Peninsula ( <i>winter</i> )	
Calayan	Mindoro
Catanduanes	Negros
Fuga	Palawan
Luzon	Sibuyan
Mindanao	

**ernesti** *Sharpe*, Ibis, 1894, p. 545.

Greater Sunda Islands	
New Guinea	Fiji Islands
Luzon	Negros

**melanogenys** *Gould.* (p. 385.)

Australia

Luzon

**severus** *Horsf.* (p. 397.)

Malay Peninsula

Burmese provinces

Himalayas Ceylon

Southern Indian Peninsula

Greater Sunda Islands to New

Guinea and New Britain

Calamianes

Palawan

Cebu

Romblon

Luzon

Sibuyan

Mindanao

Siquijor

Mindoro

Sulu

Negros

Tawi Tawi

**CERCHNEIS** *Boie.*

(Sharpe, Cat. Bds., I. p. 423, 1874.)

**tinnunculus** (*Linn.*). (p. 425.)Africa (*winter*)Indian Peninsula (*winter*)

Europe Northern Asia

Luzon

Suborder **PANDIONES.**Family **PANDIONIDÆ.****PANDION** *Savign.*

(Sharpe, Cat. Bds., I. p. 418, 1874.)

**haliaëtus** (*Linn.*). (p. 449.)

Eastern Hemisphere

Luzon

Palawan

Mindoro

**leucocephalus** *Gould.* (p. 451.)

Australia

Austro-Malayan Islands

Balabac

Marinduque

**POLIOAËTUS** *Kaup.*

(Sharpe, Cat. Bds., I. p. 452, 1874.)

**ichthyaëtus** (*Horsf.*). (p. 452.)

Malay Peninsula

Burmese provinces

Indian Peninsula

Greater Sunda Islands

Celebes

Ceylon

Basilan

Mindoro

Bongao

Negros

Luzon

Samar

Mindanao

## Order STRIGIFORMES.

## Family BUBONIDÆ.

## Subfamily BUBONINÆ.

**PSEUDOPTYNX** *Kaup.*

(*Bubo*, pt., Sharpe, Cat. Bds., II, p.  
12, 1875.)

<b>philippinensis</b> <i>Kaup.</i> (p. 43.)	Luzon
<b>gurneyi</b> <i>Twedd.</i> , P. Z. S., 1878, p. 940.	Mindanao

**OTUS** *Pennant.*

(Stone, Auk, XX, p. 215, 1903.)  
(*Scops*, Sharpe, Cat. Bds., II, p. 43,  
1875.)

<b>megalotis</b> ( <i>Gray.</i> ) (p. 69.)	Luzon	
<b>everetti</b> ( <i>Twedd.</i> ), P. Z. S., 1878, p. 492.	Basilan Mindanao	Palawan Samar
<b>fuliginosus</b> ( <i>Sharpe</i> ), Ibis, 1888, p. 197.	Palawan	
<b>sibutuensis</b> ( <i>Sharpe</i> ), Bull. B. O. C., II, p. ix (1893).	Sibutu	Sulu
<b>longicornis</b> ( <i>Grant</i> ), Bull. B. O. C., III, p. li (1894).	Luzon	Mindoro? <sup>1</sup>
<b>mindorensis</b> ( <i>Whitehead</i> ), Ibis, Jan., 1899, p. 98.	Mindoro	
<b>whiteheadi</b> ( <i>Grant</i> ), Bull. B. O. C., IV, p. xl (1895.)	Luzon	
<b>rufescens</b> ( <i>Horsf.</i> ) (p. 102.)	Malay Peninsula Greater Sunda Islands	
	Sulu	
<b>cuyensis</b> <i>McGregor</i> , Bull. Philippine Mus., No. 4, p. 17 (1904).	Cuyo	
<b>calayensis</b> <i>McGregor</i> , l. c., p. 18.	Calayan	
<b>romblonis</b> <i>McGregor</i> , Govt. Lab. Publ., No. 25, p. 12 (1905).	Romblon	

<sup>1</sup>An undetermined specimen of *Scops* collected by Whitehead in Mindoro, is doubtfully referred by Grant to *S. longicornis* (Ibis, Oct., 1896, p. 462).—  
WORCESTER.



**NINOX** *Hodgs.*

(Sharpe, Cat. Bds., II, p. 151, 1875.)

**lugubris** (*Tickell*). (p. 154.)Himalayas  
Indian Peninsula  
Burmese countries

Basilan	Negros
Luzon	Panay
Masbate	Sulu
Mindanao	

**scutulata** (*Raffl.*). (p. 156.)Southern India  
Malay Peninsula  
Greater Sunda Islands  
Ceylon      Tenasserim

Palawan

**japonica** (*Temm. & Schl.*).(Scutulata pl. Sharpe, Cat. Bds., II, p. 156; *florencis* Wall., P. Z. S., 1863, p. 488; *macroptera* W. Blasius, Ornith., 1888, p. 545.)Celebes (*winter*)  
Ternate (*winter*)  
Sangi Islands (*winter*)  
Japan      China  
Indo-Malayan Islands

Calayan	Fuga
Cebu	Mindanao
Cuyo	Mindoro
Basilan	

**philippensis** *Bp.* (p. 167.)Guimaras      Negros  
Leyte      Panay  
Luzon      Samar  
Marinduque      Siquijor  
Masbate      Ticao**everetti** *Sharpe*, Bull. B. O. C., VI, p. 42 (1897).

Siasi

**spilcephala** *Tweed.*, P. Z. S., 1878, p. 940.

Basilan      Mindanao

**spilonota** *Bourne & Worcester*, Occ. Papers Minnesota Acad., I, No. 1, p. 8 (1894).Cebu      Mindoro  
Luzon      Tablas  
Mindanao**reyi** *Oust.*, Bul. Assoc. Sc. France, 1880, No. 39, p. 206.

Bongao      Sulu

**mindorensis** *Grant*, Ibis, 1896, p. 463.

Mindoro

**plateni** *Blas.* (in litt.) *Hartl.*, Abh. Nat. Ver. Brem., XVI, p. 271 (1899).

Mindoro

Subfamily **SYRNIINÆ**.**SYRNIUM** *Savign.*

(Sharpe, Cat. Bds., II, p. 244, 1875.)

**whiteheadi** *Sharpe*, Ibis, 1888, p. 196, pl. iii. [*wiepkeni* W. Blasius, Ornith., 1888, p. 304.]

Palawan

Family **STRIGIDÆ.****STRIX** *Linn.*

(Sharpe, Cat. Bds., II, p. 290, 1875.)

**candida** *Tick.* (p. 308.)[*oustaleti* Hartl., P. Z. S., 1879, p. 295.]

Indian Peninsula	
Burmese provinces	
Northern Australia	
Fiji Islands (Viti Levu)	
Formosa	Celebes

Calamianes	Mindoro
Cebu	Sibuyan
Luzon	Siquijor

Order **PSITTACIFORMES.**Family **LORIIDÆ.****TRICHOGLOSSUS** *Vig. & Horsf.*

(Salvad., Cat. Bds., XX, p. 49, 1891.)

**johnstoniæ** *Hartert*, Bull. B. O. C., XIV, Mindanao  
p. 10 (1903).Family **CACATUIDÆ.****CACATUA** *Vicill.*(Salvadori, Cat. Bds., XX, p. 115,  
1891.)**hæmaturopygia** (*P. L. S. Müll.*). (p. 130.)

Balabac	Mindoro
Basilan	Negros
Bongao	Nipa
Calamianes	Palawan
Cebu	Panaon
Guimaras	Panay
Lapac	Samar
Leyte	Siquijor
Lubang	Sulu
Luzon	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	

Family **PSITTACIDÆ.**subfamily **PALÆORNITHINÆ.****PRIONITURUS** *Wagl.*(Salvadori, Cat. Bds., XX, p. 414,  
1891.)**verticalis** *Sharpe*, Bull. B. O. C., III, p. x  
(1893).

Bongao	Tawi Tawi
Sibutu	

**montanus** *Grant*, Bull. B. O. C., IV, p. xli  
(1895).

Luzon

<b>discurus</b> ( <i>Vieill.</i> ). (p. 417.)	Basilan	Mindanao
[ <i>P. sulucensis</i> W. Blasius, J. f. O. 1890,	Catanduanes	Negros
p. 140.]	Cebu	Samar
	Guimaras	Sibuyan
	Leyte	Sulu <sup>1</sup>
	Luzon	Tablas
	Masbate	
<b>waterstradti</b> <i>Roths.</i> , Bull. B. O. C., XIV.	Mindanao	
p. 72 (1904).		
<b>mindorensis</b> <i>Steere</i> . (p. 419.)	Mindoro	
<b>cyaneiceps</b> <i>Sharpe</i> . (p. 419.)	Balabac	Palawan
	Calamianes	
<b>luconensis</b> <i>Steere</i> . (p. 420.)	Luzon	Marinduque

### TANYGNATHUS *Wagl.*

(Salvadori, Cat. Bds., XX, p. 422,  
1891.)

<b>luconensis</b> ( <i>Linna.</i> ). (p. 424.)	Basilan	Mindoro
	Bongao	Negros
	Cagayan Sulu	Palawan
	Calamianes	Panay
	Cebu	Romblon
	Guimaras	Samar
	Lapac	Sibutu
	Leyte	Sibuyan
	Luzon	Siquijor
	Maestro de Sulu	
	Campo	Tablas
	Malanipa	Tawi Tawi
	Marinduque	Ticao
	Masbate	Verde
	Mindanao	
<b>everetti</b> <i>Twedd.</i> (p. 432.)	Luzon	Negros
	Mindanao	Panay
	Mindoro	Samar
<b>burbidgei</b> <i>Sharpe</i> . (p. 432.)	Bongao	Tawi Tawi
	Sulu	

### BOLBOPSITTACUS *Salvad.*

(Salvadori, Cat. Bds., XX, p. 503,  
1891.)

<b>lunulatus</b> ( <i>Scop.</i> ). (p. 504.)	Luzon	
<b>intermedius</b> <i>Salvad.</i> (p. 505.)	Leyte	Samar
<b>mindanensis</b> ( <i>Steere</i> ). (p. 506.)	Mindanao	Panaon

<sup>1</sup>W. Blasius has separated the Sulu birds as a new variety under the name *P. discurus suluensis*, stating that they differ from the typical *P. discurus* in the greater extent of the blue coloring on the head and in the more slender and longer beak. A careful examination of the specimens obtained by Bourns and myself in Sulu failed to disclose any differences between them and typical *P. discurus*, and I am of the opinion that Blasius's "variety" can not stand.

**LORICULUS** *Blyth.*(Salvadori, Cat. Bds., XX, p. 515,  
1891.)

<b>chrysonotus</b> <i>Scl.</i> (p. 522.)	Cebu	
<b>regulus</b> <i>Souancé.</i> (p. 523.)	Guimaras Masbate Negros	Panay Ticao
<b>bournsi</b> <i>McGregor</i> , Govt. Lab. Publ. No. 25, p. 16.	Romblon Sibuyan	Tablas
<b>philippensis</b> ( <i>P. L. S. Müll.</i> ). (p. 524.)	Catanduanes Luzon	Marinduque
<b>mindorensis</b> <i>Steere.</i> (p. 526.)	Mindoro	
<b>siquijorensis</b> <i>Steere.</i> (p. 526.)	Siquijor	
<b>apicalis</b> <i>Souancé.</i> (p. 528.)	Basilan Bazol	Dinigat Mindanao
<b>worcesteri</b> <i>Steere.</i> (p. 528, pt.)	Bohol Leyte	Samar
<b>bonapartei</b> <i>Souancé.</i> (p. 530.)	Bongao Sulu	Tawi Tawi
<b>sp.</b> <i>Salvad.</i> , Cat. Bds. XX, p. 530, note.	Mindanao	
<b>galgulus</b> ( <i>Lin.</i> ). (p. 531.)	Malay Peninsula Sumatra Banka	Nias Borneo
	Cagayan Sulu	

## Order CORACIIFORMES.

## Suborder PODARGI.

## Family PODARGIDÆ.

**BATRACHOSTOMUS** *Gould.*(Hartert, Cat. Bds., XVI, p. 636,  
1892.)

<b>septimus</b> <i>Twedd.</i> (p. 638.)	Basilan? <sup>1</sup>	Mindanao
<b>microrhynchus</b> <i>Grant</i> , Bull. B. O. C., IV, p. xli (1895.)	Luzon	

<sup>1</sup> A *Batrachostomus*, probably of this species, was seen by me in Basilan in 1891.—WORCESTER.

*menagei* Bourns & Worcester, Occ. Papers  
Minnesota Acad., 1, No. 1, p. 11 (1894).

*javensis* (Horsf.). (p. 640.)

Negros?<sup>1</sup> Panay

Borneo Sumatra  
Java

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Palawan

*affinis* Blyth. (p. 643.)

Malay Peninsula  
Southern Tenasserim  
Borneo Sumatra

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Palawan

## Suborder CORACIÆ.

### Family CORACIIDÆ.

#### Subfamily CORACIINÆ.

## EURYSTOMUS Vieill.

(Sharpe, Cat. Bds., XVII, p. 28,  
1892.)

*orientalis* (Linn.). (p. 33.)

Malay Peninsula  
Burmese provinces  
Cachar Java  
Borneo Sumatra  
Andaman and Nicobar Islands

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Basilan	Mindoro
Cagayancillo	Negros
Calamianes	Palawan
Calayan	Panaon
Cebu	Panay
Cuyo	Romblon
Dinagat	Samar
Fuga	Sibutu
Guimaras	Sibuyan
Leyte	Siquijor
Luzon	Sulu
Maestro de Campo	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	Verde

## Suborder HALCYONES.

### Family ALCEDINIDÆ.

#### Subfamily ALCEDININÆ.

## PELARGOPSIS Gloger.

(Sharpe, Cat. Bds., XVII, p. 96,  
1892.)

*leucocephala* (Gm.).<sup>2</sup> (p. 98.)

Borneo  

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Palawan?

<sup>1</sup> A female *Batrachostomus*, probably referable to this species, was shot in Negros by Keay in April, 1899 (See Ibis, April, 1900, p. 353.)—WORCESTER.

<sup>2</sup> The Palawan record is based on Whitehead's collection; Sharpe, Ibis, 1888, p. 197; Whitehead records *P. gouldi* not *P. leucocephala*, Ibis, 1893, p. 45.—MCGREGOR.

**gouldi** *Sharpe*. (p. 100.)

Balabac	Luzon
Calamianes	Mindoro
Lubang	Palawan

**gigantea** *Walden*. (p. 100.)

Basilan	Negros
Bongao	Panay
Cebu	Samar
Dinagat	Sibutu
Guimaras	Sibuyan
Lapac	Sulu
Leyte	Tablas
Masbate	Tawi Tawi
Mindanao	Ticao
Malanipa	

**ALCEDO** *Linnaeus*.

(Sharpe, Cat. Bds., XVII, p. 141, 1892.)

**bengalensis** *Briss.* (p. 141.)

Molucca Islands	
Malay Peninsula	
Indian Peninsula	
Burmese provinces	
Greater Sunda Islands	
China	Hainan
Europe	Northern Asia

Balabac	Masbate
Basilan	Mindanao
Bohol	Mindoro
Cagayancillo	Negros
Cagayan Sulu	Palawan
Calamianes	Panay
Calayan	Romblon
Catanduanes	Samar
Cebu	Sibuyan
Cuyo	Siquijor
Guimaras	Sulu
Leyte	Tablas
Lubang	Tawi Tawi
Luzon	Verde

**meninting** *Horsf.* (p. 157.)

Sumatra	
Malay Peninsula	
Southern Tenasserim	
Java	Borneo

Balabac	Palawan
Bongao	Sulu
Calamianes	Tawi Tawi

**ALCYONE** *Swains.*

(Sharpe, Cat. Bds., XVII, p. 167, 1892.)

**cyanoptectus** (*Lafr.*) (p. 185.)  
[*steerii* (Sharpe). (p. 187.)]

Luzon	Mindoro
Marinduque	Sibuyan
Masbate	Ticao

**argentata** (*Twedd.*) (p. 187.)

Basilan	Mindanao
Dinagat	



**flumenicola** (Steere). (p. 187.)      Leyte      Samar

**nigrirostris** (Bourne & Worcester), Occ. Papers Minnesota Acad., I, No. 1, p. 13 (1894).      Cebu  
Negros      Panay

Subfamily **DACELONINÆ**.

**CEYX** Lacép.

(Sharpe, Cat. Bds., XVII, p. 173, 1892.)

**melanura** Kaup. (p. 180.)      Luzon

**mindanensis** Steere. (p. 181, note.)      Basilan      Mindanao  
[*basilanica* Steere,<sup>1</sup> (p. 181.)]

**euerythra** Sharpe. (p. 179.)      Malay Peninsula  
Sumatra      Borneo

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Balabac      Palawan  
Bongao      Sulu?<sup>2</sup>  
Calamianes      Tawi Tawi  
Mindoro

**bournsi** Steere. (p. 185.)      Basilan      Romblon  
[*malamaui* Steere,<sup>3</sup> (p. 184.)]      Bongao      Sibuyan  
Cebu      Siquijor  
Malamaui      Sulu  
Mindanao      Tablas  
Negros      Tawi Tawi

**samarensis** Steere, List Bds. & Mams. Steere      Leyte      Samar  
Exp., p. 10 (1890).

<sup>1</sup> I have already recorded my opinion elsewhere that *C. basilanica* Steere is a synonym for *C. mindanensis* (Occ. Papers Minnesota Acad., No. 1, p. 457).—WORCESTER.

<sup>2</sup> *Ceyx euerythra* is recorded by Sharpe, Hand-List of Birds, p. 353, from the Sulu Islands. This species has been obtained on Bongao and Tawi Tawi, but so far as I can learn has not yet been met with on Sulu.—WORCESTER.

<sup>3</sup> As a result of the examination of a series of sixty-six specimens, Bourne and I reached the conclusion that *C. malamaui* Steere was a synonym of *C. bournsi* Steere. From the specimens collected by us it was possible to select a practically unbroken series between a bird with a magnificent deep-blue upper surface and a bird with a silvery white upper surface which had not a blue feather on it [Occ. Papers Minnesota Acad., I, No. 1, p. 47 (1894)].—WORCESTER.

**HALCYON** *Swains.*(Sharpe, Cat. Bds., XVII, p. 213,  
1892.)**coromandus** (*Lath.*). (p. 217.)

Sangi Islands	
Liu Kiu Islands	
Malay Peninsula	
Eastern Himalayas	
Korea	Japan
Formosa	China
Sumatra	Celebes
Java	Borneo
Indo-Chinese countries	
<hr/>	
Calayan	Mindoro
Guimaras	Palawan
Luzon	Sibuyan
Masbate	Tawi Tawi
Mindanao	

**gularis** (*Kuhl.*). (p. 227.)

Basilan	Mindanao
Cebu	Mindoro
Guimaras	Negros
Leyte	Panaon
Lubang	Panay
Luzon	Samar
Maestro de Campo	Siquijor
Marinduque	Tablas
Masbate	Ticao
	Verde

**pileatus** (*Bodd.*). (p. 229.)

Ceylon	
Malay Peninsula	
Southern India to Canara	
Java	Borneo
Sumatra	Celebes
Indo-Chinese countries to China and north to Korea	
<hr/>	
Balabac	Palawan
Basilan	Tawi Tawi

**winchelli** *Sharpe.* (p. 255.)

Basilan	Samar
Bongao	Sibuyan
Cebu	Siquijor
Mindanao	Sulu
Negros	Tablas
Panay	Tawi Tawi
Romblon	

**chloris** (*Bodd.*). (p. 273.)

Molucca Islands  
 Tenimber Islands  
 Lesser Sunda Islands  
 Sula Islands      Celebes  
 Java               Sumatra  
 Mysol              Aru Islands

Basilan	Marinduque
Bohol	Masbate
Bongao	Mindanao
Cagayancillo	Mindoro
Cagayan Sulu	Negros
Calamianes	Palawan
Camiguin	Panay
Catanduanes	Romblon
Cebu	Samar
Cuyo	Semirara
Dinagat	Sibay
Fuga	Sibuyan
Gulmaras	Siquijor
Leyte	Sulu
Lubang	Tablas
Luzon	Tawi Tawi
Maestro de Campo	Ticao Verde

**hombroni** (*Bp.*). (p. 284.)

Mindanao

**lindsayi** (*Vig.*). (p. 286.)

Luzon

**moseleyi** *Steele*. (p. 288.)

Negros

## Suborder BUCEROTES.

### Family BUCEROTIDÆ.

#### **HYDROCORAX** *Briss.*

(Grant, Cat. Bds., XVII, p. 357,  
 1892.)

**hydrocorax** (*Linn.*). (p. 358.)

Luzon      Marinduque

**mindanensis** (*Tweedd.*). (p. 359.)

Basilan      Mindanao

**semigaleatus** (*Tweedd.*). (p. 360.)

Leyte      Samar  
 Panaon

#### **ANTHRACOCEROS** *Reichenb.*

(Grant, Cat. Bds., XVII, p. 361,  
 1892.)

**montani** (*Oust.*). (p. 370.)

Sulu      Tawi Tawi

**GYMNOLÆMUS** *Grant.*

(Grant, Cat. Bds., XVII, p. 370,  
1892.)

**lemprieri** *Sharpe.*

[*marchei* Oust. (p. 370.) *Cf.* Everett,  
Ibis, 1895, p. 30.]

Balabac  
Calamianes

Palawan

**PENELOPIDES** *Reichenb.*

(Grant, Cat. Bds., XVIII, p. 371,  
1892.)

**panini** (*Bodd.*). (p. 372.)

Guimaras  
Masbate  
Negros

Panay  
Ticao

**manillæ** (*Bodd.*). (p. 373.)

Luzon

Marinduque

**talisi** *Finsch*, Notes Leyden Mus., XXIII,  
No. 4, pp. 190-193 (1903).

Luzon (Cagayan)

**mindorensis** *Steere.* (p. 374.)

Mindoro

**affinis** *Twedd.* (p. 375.)

Dinagat

Mindanao

**basilanica** *Steere.* (p. 375.)

Basilan

**samarensis** *Steere.* (p. 376.)

Leyte

Samar

**CRANORRHINUS** *Cab. & Heine.*

(Grant, Cat. Bds., XVII, p. 377,  
1892.)

**leucocephalus** (*Vicill.*). (p. 378.)

Camiguin

Mindanao

**waldeni** *Sharpe.* (p. 380.)

Guimaras  
Negros

Panay

Suborder **MEROPES.**Family **MEROPIDÆ.****MEROPS** *Linn.*

(Sharpe, Cat. Bds., XVII, p. 58,  
1892.)

**americanus** *P. L. S. Müller*, Syst. Nat.  
Suppl., p. 95 (1776); teste Sharpe.  
[*bicolor* Bodd. (p. 60.)]

Cagayancillo  
Calamianes  
Catanduanes  
Cebu  
Cresta de Gallo  
Fuga  
Guimaras  
Leyte  
Lubang  
Luzon  
Marinduque  
Masbate  
Mindanao  
Mindoro  
Negros  
Panay  
Samar  
Semirara  
Sibuyan  
Tablas

**philippinus** *Linn.* (p. 71.)

Malayan Islands  
Malay Peninsula  
Indian Peninsula  
Indo-Chinese provinces  
Ceylon                      Celebes

Basilan	Mindoro
Bazol	Negros
Bohol	Panay
Cebu	Samar
Guimaras	Sibuyan
Leyte	Siquijor
Luzon	Sulu
Masbate	Tawi Tawi
Mindanao	

## Suborder CAPRIMULGI.

### Family CAPRIMULGIDÆ.

#### Subfamily CAPRIMULGINÆ.

## LYNCORNIS *Gould.*

(Hartert, Cat. Bds., XVI, p. 603; id.  
Tierr., p. 24.)

**macrotis** (*Vig.*). (p. 605.)  
[*mindanensis* Tweed. (l. c.)]

Basilan	Mindanao
Luzon	Mindoro

## CAPRIMULGUS *Linn.*

(Hartert, Cat. Bds., XVI, p. 521; id.  
Tierr., p. 37.)

**griseatus** *Wald.* (p. 550.)

Catanduanes	Negros
Luzon	Sibuyan
Mindoro	

**mindanensis** (*Mearns*), Proc. Biol. Soc.  
Wash., XVIII, p. 85 (1905).

Mindanao

**manillensis** *Wald.* (p. 544.)

Basilan	Negros
Luzon	Palawan
Masbate	Romblon
Mindanao	Ticao
Mindoro	

**macrurus** *Horsf.* (p. 537.)

Papuan Islands  
Northeastern Australia  
Greater Sunda Islands (Java)

Calamianes	Palawan
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**jotaka** *Temm. & Schl.* (p. 552.)

Northeastern Siberia  
China                      Japan  
New Guinea (*winter*)  
Indo-Chinese provinces  
Malay Peninsula (*winter*)  
Greater Sunda Islands (*winter*)

Calayan	Palawan
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Suborder **CYPSELI**.Family **MACROPTERYGIDÆ**.**MACROPTERYX** *Swains.*

(Hartert, Cat. Bds., XVI, p. 512,  
1892; id. Tierreich, Lief. I, p. 63,  
1897.)

**major** Hartert, Nov. Zool., IV, p. 11, ex  
Dubois.  
[*comata* Temm.; Cat. Bds., XVI, p. 512,  
pt.]

Basilan	Negros
Cebu	Panay
Guimaras	Samar
Luzon	Sibutu
Marinduque	Sulu
Masbate	Tablas
Mindanao	Tawi Tawi
Mindoro	

Family **CYPSELIDÆ**.Subfamily **CHAETURINÆ**.**SALANGANA** *Geoffr. St.-Hilaire.*

(*Collocalia* Gray; Hartert, Cat Bds.,  
XVI, p. 498, 1892; id. Tierr.,  
p. 66.)

**whiteheadi** Grant, Ibis, 1895, p. 459.  
(Tierr., p. 6.)

Cagayancillo	Sibuyan
Luzon	Palawan
Mindanao	Verde
Mindoro	

**lowi** (*Sharpe*). (p. 498.)

Northern Borneo	
Nias Island	Sumatra
Palawan	

**fuciphaga** (*Thunb.*). (p. 498.)

Seychelles Islands
Islands of western Polynesia
Indo-Malayan and Papuan Is-
lands

Cebu	Negros
Luzon	Palawan
Mindanao	Panay
Mindoro	

**francica** (*Gm.*). (p. 503.)

Mauritius	
Solomon Islands	
Molucca Islands	
Reunion Island	
Northern Australia	
Southern New Guinea	
Islands of western Polynesia	
Cagayancillo	Cuyo
Cagayan Sulu	Negros
Calamianes	Panay



*inexpectata* Hume. (p. 505.)

Andaman Islands  
Southern Tenasserim  
Western Malay Peninsula

Cagayan Sulu

*troglodytes* Gray. (p. 507.)

Cebu	Negros
Guimaras	Palawan
Leyte	Panay
Luzon	Romblon
Marinduque	Samar
Masbate	Sibuyan
Mindanao	Siquijor
Mindoro	

*linchi* Horsf. & Moore. (p. 508.)

Sumatra  
Nicobar Islands  
Andaman Islands  
Malay Peninsula  
Java

Borneo

Bongao	Mindanao
Luzon	Mindoro

*marginata* Salvad. (p. 508.)  
[*cebuensis* Kutter, teste Dubois, Syn.  
Av., p. 130.]

Calayan	Masbate
Cebu	Mindoro
Luzon	Sibuyan

## CHÆTURA Steph.

(Hartert, Cat. Bds., XVI, p. 470,  
1892; id. Tierr., p. 70, 1897.)

*gigantea* (Temm.). (p. 475.)

Sumatra  
Malay Peninsula  
Java

Borneo

Calamianes Palawan

*celebensis* Sel. (p. 476.)

Celebes

Basilan Negros

*dubia* McGregor, Govt. Lab. Publ. No. 34,  
p. 15, pl. xii (1905).

Mindoro

*picina* Tweed. (p. 487.)

Leyte

Mindanao

## Subfamily CYPSELINÆ.

## TACHORNIS Gosse.

(Hartert, Cat. Bds., XVI, p. 462,  
1892.)

*pallidior* McGregor, Govt. Lab. Publ. No. 25,  
p. 27 (1904).

Luzon

Ticao

## Order TROGONES.

## Family TROGONIDÆ.

**PYROTROGON** *Bp.*, *Consp. Av., Zygod.* p. 14  
(1854).

[*Harpactes* Swains. (nec. Templeton):  
Grant, *Cat. Bds.*, XVII, p. 480, 1892. *Cf.*  
Oberholser, *Proc. Philad. Acad.*, 1899, p.  
206.]

**ardens** (*Temm.*). (p. 487.)

Basilan  
Dinagat  
Leyte  
Luzon

Marinduque  
Mindanao  
Samar

## Suborder CUCULI.

## Family CUCULIDÆ.

## Subfamily CUCULINÆ.

**COCCYSTES** *Gloger.*

(Shelley, *Cat. Bds.*, XIX, p. 211,  
1891.)

**coromandus** (*Linn.*). (p. 214.)

Malay Peninsula  
Burmese countries  
Sumatra                  Borneo  
Java                      Celebes  
Indian Peninsula and Ceylon  
Southern and central China

Mindanao                  Siquijor  
Palawan

**SURNICULUS** *Less.*

(Shelley, *Cat. Bds.*, XIX, p. 226,  
1891.)

**lugubris** (*Horsf.*). (p. 227.)

South China  
Malay Peninsula  
Indian Peninsula  
Burmese provinces  
Java                      Borneo  
Ceylon                    Sumatra  

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Balabac                  Palawan

**velutinus** *Sharpe.* (p. 230.)

Basilan                  Negros  
Luzon                    Samar  
Malamaui                Sulu  
Mindanao                Tawi Tawi  
Mindoro

**HIEROCOCCYX** *S. Müll.*

(Shelley, Cat. Bds., XIX, p. 231,  
1891.)

**sparveroides** (*Vig.*). (p. 232.)

Borneo  
Eastern Siberia  
Malay Peninsula  
Indian Peninsula  
Burmese provinces  
Japan                      China

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Calamianes              Negros  
Luzon                      Palawan

**fugax** (*Horsf.*). (p. 236.)

Greater Sunda Islands (Sumatra, Java, Borneo)

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Basilan                      Mindanao  
Cagayancillo              Mindoro  
Cebu                      Sulu  
Luzon

**CUCULUS** *Linn.*

(Shelley, Cat. Bds., XIX, p. 240,  
1891.)

**micropterus** *Gould.* (p. 241.)

Sumatra  
Malay Peninsula  
Indian Peninsula  
Andaman Islands  
Burmese provinces  
Ceylon                      Java  
China                      Borneo  
Japan                      Ternate

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Negros

**canorus** *Linn.* (p. 245.)

Africa (*winter*)  
Europe and northern Asia  
Indian Peninsula (*winter*)  
Malayan subregion to Australia  
(*winter*)

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Calayan                      Siquijor  
Palawan

**saturatus** *Hodgs.*

[*intermedius* Vahl. (p. 252.) Cf. Blanf.,  
Faun. Brit. Ind., Birds, III, p. 207  
(1895).]

Eastern Siberia  
Indian Peninsula  
Andaman Islands  
Malay Archipelago  
Burmese provinces  
Northeastern Australia  
Japan                      China  
New Guinea              New Britain

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Mindanao                      Palawan

**PENTHOCERYX** *Cab.*

(*Cuculus*, pt., Shelley, Cat. Bds.,  
XIX, p. 262, 1891.)

**sonnerati** *Lath.* (p. 262.)

Malay Peninsula  
Indian Peninsula  
Burmese provinces  
Java                      Borneo  
Ceylon                      Sumatra

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Calamianes              Tablas  
Palawan                      Timor

**CACOMANTIS** *S. Müll.*(Shelley, Cat. Bds., XIX, p. 265,  
1891.)**merulinus** (*Scop.*). (p. 268.)

Sumatra	
Malay Peninsula	
Burmese provinces	
Eastern Himalayas	
Northeastern Bengal	
Central India (Ruipor)	
Borneo	Java
Ternate	Celebes
<hr/>	
Balabac	Masbate
Basilan	Mindanao
Bohol	Mindoro
Bongao	Negros
Cagayancillo	Palawan
Calamianes	Panay
Catanduanes	Samar
Cebu	Sulu
Leyte	Tablas
Lubang	Tawi Tawi
Luzon	Ticao

**CHALCOCOCCYX** *Cab.*(Shelley, Cat. Bds., XIX, p. 288,  
1891.)**xanthorhynchus** (*Horsf.*). (p. 289.)

Nicobar Islands	
Andaman Islands	
Malay Peninsula	
Indo-Chinese provinces	
Java	Borneo
Assam	Sumatra
<hr/>	
Cebu	Palawan
Mindoro	Samar

**malayanus** (*Raffl.*). (p. 298.)

New Guinea	
Solomon Islands	
Malay Peninsula	
Northern Australia	
Borneo	Timor
Java	Flores
Sumatra	Celebes
<hr/>	
Bongao	Negros
Luzon ? <sup>1</sup>	Tawi Tawi
Mindanao	

**EUDYNAMIS** *Vig. & Horsf.*(Shelley, Cat. Bds., XIX, p. 315,  
1891.)**honorata** (*Linn.*). (p. 315.)

Malay Peninsula	
Andaman Islands	
Indian Peninsula	
Burmese provinces	
Ceylon	Java
Sumatra	Flores
China	Borneo
<hr/>	
Palawan	

<sup>1</sup> Cf. Sharpe's Hand-List of Birds, Vol. II, p. 162, 1900.—WORCESTER.

**mindanensis** (*Linn.*). (p. 321.)

Sangi Islands

Basilan	Mindoro
Bongao	Negros
Cagayancillo	Palawan
Calayan	Panay
Cebu	Romblon
Cuyo	Samar
Fuga	Semirara
Guimaras	Sibutu
Leyte	Sibuyan
Luzon	Siquijor
Malanipa	Sulu
Marinduque	Tablas
Masbate	Tawi Tawi
Mindanao	Ticao
Calayan	Fuga

**frater** *McGregor*, Bull. Philippine Mus., No. 4, p. 21 (1904).

Subfamily **CENTROPODINÆ**.

**CENTROPUS** *Illiger*.

(Shelley, Cat. Bds., XIX, p. 331, 1891.)

**mindorensis** (*Steere*). (p. 339.)

Mindoro Semirara

**steerii** *Bourne & Worcester*, Occ. Papers Minnesota Acad., I. No. 1, p. 14 (1894).

Mindoro

**sinensis** (*Steph.*). (p. 343.)

Malay Peninsula  
Burmese countries  
India Java  
China Borneo  
Ceylon Sumatra

Balabac Palawan  
Cagayan Sulu Sulu  
Luzon Tawi Tawi

**viridis** (*Scop.*). (p. 349.)

Basilan Masbate  
Bohol Mindanao  
Cagayancillo Mindoro  
Calayan Negros  
Catanduanes Panay  
Cebu Romblon  
Dinagat Samar  
Fuga Siasi  
Guimaras Sibuyan  
Leyte Siquijor  
Lubang Sulu  
Luzon Tablas  
Marinduque Ticao

**javanicus** (*Dumont*). (p. 354.)

Sumatra  
Molucca Islands  
Malay Peninsula  
Assam Java  
Burma Borneo  
China Celebes  
Bohol Palawan  
Calamianes Panay  
Cebu Samar  
Luzon Semirara  
Mindanao Siquijor  
Mindoro Sulu  
Negros Tawi Tawi

**melanops** *Less.* (p. 365.)Basilan  
Leyte  
MindanaoNipa  
Samar**unirufus** (*Cab. & Heine*). (p. 367.)

Luzon

Subfamily **PHÆNICOPHAINÆ.****DRYOCOCCYX** *Sharpe.*(Shelley, Cat. Bds., XIX, p. 400,  
1891.)**harringtoni** *Sharpe.* (p. 400.)Balabac  
Calamianes

Palawan

**DASYLOPHUS** *Swains.*

(Shelley, Cat. Bds., p. 403, 1891.)

**superciliosus** (*Cur.*). (p. 403.)Catanduanes  
Luzon

Marinduque

**LEPIDOGRAMMUS** *Reichenb.*

(Shelley, Cat. Bds., p. 404, 1891.)

**cumingi** (*Fraser*). (p. 404.)

Luzon

Marinduque

Order **SCANSORES.**Suborder **CAPITONES.**Family **CAPITONIDÆ.****XANTHOLÆMA** *Bp.*(Shelley, Cat. Bds., XIX, p. 88,  
1891.)**hæmatocephalum** (*P. L. S. Müll.*). (p.  
89.)Malay Peninsula  
Indian Peninsula  
Burmese provinces  
Ceylon                      SumatraCalamianes ? <sup>1</sup> Mindanao  
Leyte                      Mindoro  
Luzon                      Samar**roseum** (*Dumont*). (p. 96.)Bali  
Java                      SumatraCebu                      Negros  
Guimaras              Romblon  
Masbate<sup>1</sup> A barbet, probably *X. hæmatocephalum*, was observed by me in the Calamianes Islands in 1893, but was, unfortunately, not obtained.—WORCESTER.

## Order PICIFORMES.

## Suborder PICI.

## Family PICIDÆ.

## Subfamily PICINÆ.

**YUNGIPICUS** *Bp.*

(Hargitt, Cat. Bds., XVIII, p. 309,  
1890.)

<b>maculatus</b> ( <i>Scop.</i> ). (p. 332.)	Cebu Guimaras	Negros Panay
<b>fulvifasciatus</b> <i>Hargitt.</i> (p. 333.) [ <i>basilanicus</i> Steere, List Bds. & Mams. Steere Exp., p. 9 (1890).]	Basilan	Mindanao
<b>menagei</b> <i>Bourne &amp; Worcester</i> , Occ. Papers Minnesota Acad., I, No. 1, p. 14 (1894.)	Sibuyan	
<b>ramsayi</b> <i>Hargitt.</i> (p. 334.)	Bongao Sulu	Tawi Tawi
<b>validirostris</b> ( <i>Blyth.</i> ). (p. 332.)	Catanduanes Lubang Luzon	Marinduque Mindoro
<b>leytensis</b> <i>Steere</i> , List Bds. & Mams. Steere Exp., p. 9 (1890).	Leyte	Samar

**TIGA** *Kaup.*

(Hargitt, Cat. Bds., XVIII, p. 411,  
1890.)

<b>everetti</b> <i>Tweedd.</i> (p. 418.)	Balabac Calamianes	Palawan
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**CHRYSOCOLAPTES** *Blyth.*

(Hargitt, Cat. Bds., XVIII, p. 442,  
1890.)

<b>erythrocephalus</b> <i>Sharpe.</i> (p. 452.)	Balabac Calamianes	Palawan
<b>hæmatribon</b> ( <i>Wagl.</i> ). (p. 454.)	Luzon	Marinduque
<b>lucidus</b> ( <i>Scop.</i> ). (p. 455.)	Basilan	Mindanao
<b>rufopunctatus</b> <i>Hargitt.</i> (p. 457, pl. xii.)	Leyte Panaon	Samar
<b>xanthocephalus</b> <i>Wald. &amp; Layard.</i> (p. 457.)	Guimaras Masbate Negros	Panay Ticao



**MICROSTICTUS** *Hargitt.*

(Hargitt, Cat. Bds., p. 489, 1890.)

**fuliginosus** (*Twedd.*). (p. 492.)Leyte  
Mindanao

Samar

**funebriis** (*Valenc.*). (p. 492.)Catanduanes  
Luzon

Marinduque

**MULLERIPICUS** *Bp.*<sup>1</sup>[*Hemilophus* Swains. (*nec* Serville),

Hargitt, Cat. Bds., XVIII, p. 494,

1890, Cf. Oberholser, Proc. Philad.

Acad., 1899, p. 204.]

**pulverulentus** (*Temm.*). (p. 494.)Sumatra  
Cochin China  
Malay Peninsula  
Burmese provinces  
Northwestern India  
Java  
Borneo  
Himalayas (Kumaun to Assam)Balabac  
Palawan**THRIPONAX**<sup>2</sup> *Cab. & Heine*, XVIII.

(Hargitt, Cat. Bds., p. 497, 1890.)

**javensis** (*Horsf.*). (p. 498.)[*suluensis* W. Blasius, J. f. O. 1890,  
p. 140.]Malay Peninsula  
Southern Tenasserim  
Sumatra  
Banka  
Java  
BorneoBasilan  
Bougao  
Cebu  
Lapac  
Luzon

Mindanao

Sulu

Surigao

Tawi Tawi

**pectoralis** *Twedd.* (p. 500, pl. xviii.)Leyte  
Panaon

Samar

<sup>1</sup> Sharpe adopts *Atoponercus* Reichenb., rejecting the earlier name *Mulleripicus* because of its bad formation.—McGREGOR.

<sup>2</sup> Much uncertainty exists as to the distribution of the Philippine species of the genus *Thriponax*. Sharpe, in his Hand-List of Birds, includes *T. javensis* (*Horsf.*) from Luzon, Negros, Mindanao, and Basilan; *T. suluensis* W. Blasius from Sulu; *T. pectoralis* *Twedd.* from Leyte and Panaon; *T. philippensis* *Steere* from Panay, Guimaras, and Masbate; *T. hargitti* *Sharpe* from Palawan, and *T. mindorensis* *Steere* from Mindoro. This arrangement leaves entirely out of account the Samar bird, which is undoubtedly typical *T. pectoralis*, as well as the Bongao, Tawi Tawi, and Cebu representatives of the genus.

Sharpe has himself identified three specimens from Bongao and Tawi Tawi as *T. javensis* (Ibis, Apr., 1894, p. 249), and the specimens collected in Tawi Tawi by Bourns and myself were by us referred to this species [Occ. Papers Minnesota Acad., I, No. 1, p. 36 (1894)].

**hargitti** Sharpe. (p. 505.)

[*philippensis* Steere, List Bds. & Mams.  
Steere Exp., p. 8 (1890).]

Guimaras  
Masbate  
Negros

Panay  
Palawan

**mindorensis** Steere, List Bds. & Mams. Mindoro  
Steere Exp., p. 8 (1890).

The name *T. suluensis* has been given to the Sulu representatives of the genus by W. Blasius (J. f. O. 1890, p. 140), who bases his determination on five specimens collected by Platen. He separates *T. suluensis* from *T. javensis* on the ground that the bills and wings of the Sulu birds are shorter than are those of typical representatives of *T. javensis*. If the latter species, which ranges through Borneo, Bongao, Tawi Tawi, and Lapae, really gives way in Sulu to a distinct species only to reappear again in Basilan and Mindanao, it would be remarkable, although perhaps not more remarkable than that *T. javensis* of Mindanao should be replaced by *T. pectoralis* in Panaon, Leyte, and Samar, and should reappear in Luzon. In point of fact, Bourns and I were quite unable to differentiate our Sulu specimens from typical *T. javensis*, and I must therefore decline to recognize *T. suluensis* of Blasius as a valid species.

The question presented by the central Philippine representatives of the genus can not be so readily disposed of. Dr. Steere separated the birds from Guimaras and Masbate under the name of *T. philippensis*, differentiating them from *T. javensis* on the strength of their possessing buffy white rumps and cheeks largely scarlet [List Bds. & Mams. Steere Exp., p. 8 (1890)]. Bourns and I assigned our Panay specimens to this species, which we described somewhat more fully than did Steere [Occ. Papers Minnesota Acad., 1, No. 1, p. 53 (1894)].

Later, however, in preparing our distribution list, having noted that Hargitt, in Volume XVIII of the Catalogue of Birds, did not recognize *T. philippensis*, we discarded the species and recorded all the central Philippine representatives of the genus, including our Negros specimens, under *T. javensis*.

William Eagle Clark unhesitatingly identified an adult male bird collected in Negros by Keay as *T. hargitti* (Ibis, Oct., 1894, p. 534). In Ibis, Oct., 1895, p. 474, Clarke quotes Hargitt's views as to the identity of this specimen. Hargitt failed to reach any definite conclusion, but suggested that it resembled *T. philippensis* more closely than *T. hargitti*, and added that he regarded the only other specimen that he had seen from Negros as *T. javensis*.

Grant (Ibis, Oct., 1894, p. 473) asserts that *T. philippensis* Steere is identical with *T. hargitti* Sharpe, and later reiterates this statement (Ibis, Oct., 1896, p. 558), but adds to our confusion by saying that the bird from Negros recorded by Hargitt under the name of *T. javensis* (Cat. Bds., XVIII, p. 500, specimen X) should, in his opinion, be referred to *T. pectoralis*, all the feathers of its breast being widely margined with whitish buff. Finally Clark (Ibis, Jan., 1898, p. 121) identifies three additional specimens from Negros as *T. hargitti*.

As above noted, Sharpe, in his Hand-List of Birds, refers the Negros birds to *T. javensis* and retains Steere's *T. philippensis*, to which species he refers the birds from Panay, Guimaras, and Masbate.

The question of the identity of the central Philippine representatives of the genus can hardly be satisfactorily settled without comparing a good series of specimens with a similar series from Palawan. Meanwhile, in view of Grant's positive statement that the types of *T. hargitti* and *T. philippensis* have been compared and agree in all particulars, I refer the central Philippine representatives of the genus to this species.—WORCESTER.

## Order EURYLÆMIFORMES.

## Family EURYLÆMIDÆ.

## Subfamily EURYLÆMINÆ.

**SARCOPHANOPS** *Sharpe*.

(Selater, Cat. Bds., XIV, p. 462,  
1888.)

<b>steerei</b> <i>Sharpe</i> . (p. 462.)	Basilan Dinagat	Mindanao
<b>samarensis</b> <i>Steere</i> , List Bds. & Maus. Steere Exp., p. 23 (1890).	Leyte	Samar

## Order PASSERIFORMES.

## Suborder MESOMYODI.

## Family PITTIDÆ.

**PITTA** *Vicill*.

(Selater, Cat. Bds., XIV, p. 413,  
1888.)

<b>erythrogaster</b> <i>Temm</i> . (p. 432.)	Basilan Bongao Cagayancillo Calamianes Cebu Guimaras Lubang Luzon Marinduque Masbate Mindanao Mindoro	Palawan Panay Romblon Samar Sibutu Sibuyan Siquijor Sulu Tablas Tawi Tawi Ticao
<b>propinqua</b> <i>Sharpe</i> . (p. 433.)	Palawan	
<b>kochi</b> <i>Brüggem</i> . (p. 433.)	Luzon	
<b>atricapilla</b> <i>Less</i> . (p. 438.)	Balabac Basilan Bongao Calamianes Cebu Luzon Marinduque Mindanao Mindoro Negros	Palawan Romblon Samar Semirara Sibuyan Siquijor Sulu Tablas Tawi Tawi
<b>mülleri</b> <i>Bp</i> . (p. 439.)	Banka Borneo  Sibutu	Sumatra
<b>steeri</b> <i>Sharpe</i> . (p. 442.)	Samar	Mindanao

Suborder **ACROMYODI.**Family **HIRUNDINIDÆ.**Subfamily **HIRUNDININÆ.****CHELIDONARIA** *Reichenow.*

(Reichenow, J. f. O. 1889. p. 181.)

(*Chelidon* Boie (*nec* Forst.);

Sharpe, Cat. Bds., X, p. 85, 1885.)

**dasypus** (*Bp.*). (p. 91.)

Japan

Borneo (*winter*)

Calayan

**CLIVICOLA** *Forster.*(*Cotile* Boie; Sharpe, Cat. Bds., X,

p. 96, 1885.)

**riparia** (*Linn.*). (p. 96.)

Northern Asia

Africa (*winter*)

Northern America

Europe China

Indian Peninsula (*winter*)Indo-Burmese countries (*winter*)Central and southern America  
(*winter*)

Calayan

**sinensis** (*J. E. Gray*). (p. 104.)

Formosa

Southern China

Indian Peninsula (*winter*)Indo-Chinese countries (*winter*)Luzon (*winter*)**HIRUNDO** *Schaeffer* (ex Linn.)

(Sharpe, Cat. Bds., X, p. 123, 1885;

Sharpe, &amp; Wyatt, Monogr. Hi-

rundo., I, p. 209.)

**rustica** *Linn.* (p. 128.)

Europe

Northern Asia

Africa (*winter*)

Indian Peninsula

Manchuria China

Indo-Chinese provinces

Malay Peninsula (*winter*)

Mindanao

Palawan

*gutturalis* Scop. (p. 134.)

Malay Peninsula	
Malay Archipelago	
Indo-Chinese provinces	
Southern China ( <i>winter</i> )	
Central and eastern Siberia	
Northern Australia ( <i>winter</i> )	
Kamtchatka	China
Japan	New Guinea
<hr/>	
Basilan	Mindanao
Cagayan Sulu	Mindoro
Calayan	Palawan
Cuyo	Panay
Fuga	Semirara
Guimaras	Sibay
Luzon	Siquijor
Maestro de Sulu	
Campo	Ticao

*javanica* Sparrm. (p. 142.)

New Guinea	
Southern India	
Molucca Islands	
Malay Peninsula	
Islands of Torres Straits	
Java	Borneo
Ceylon	Sumatra
<hr/>	
Basilan	Mindanao
Bohol	Mindoro
Cagayan Sulu	Negros
Calamianes	Palawan
Catanduanes	Panay
Cebu	Romblon
Cuyo	Samar
Dinagat	Sibutu
Guimaras	Sibuyan
Leyte	Siquijor
Lubang	Sulu
Luzon	Tawi Tawi
Marinduque	Ticao
Masbate	

*striolata* Boie. (p. 161.)

Formosa	
Southern China	
Burmese provinces	
Java	Flores
Assam	Cachar
<hr/>	
Calayan	Masbate
Luzon	

#### Family MUSCICAPIDÆ.

**HEMICHELIDON** *Hodgs.*

(Sharpe, Cat. Bds., IV, p. 111, 1879.)

*sibirica* (Gm.). (p. 120.)

Japan	
China ( <i>winter</i> )	
Eastern Siberia	
Altai Mountains	
<hr/>	
Palawan	

**griseisticta** (*Swinh.*). (p. 153.)

New Guinea  
Celebes (*winter*)  
Ussuri Land (Sidemi)  
Molucca Islands. (*Winter*:  
Batchian, Halmahera, Morotai, Ceram)

Japan	China
Cagayancillo	Masbate
Cagayan Sulu	Mindoro
Calamianes	Negros
Calayan	Palawan
Catanduanes	Panay
Cuyo	Siquijor
Lubang	Tawi Tawi
Luzon	

**ferruginea** *Hodgs.* (p. 132.)

[*cinereiceps* Sharpe, *Ibis*, 1887, p. 141;  
*Cf.* Sharpe, *Ibis*, 1894, p. 541.]

Khasi Hills  
Southern China  
Northern Borneo  
Burmese provinces  
Eastern Himalayas (Nepal, Sikkhim)

Assam	Sumatra
-------	---------

Palawan

## **ALSEONAX** *Cab.*

(Sharpe, *Cat. Bds.*, IV, p. 126, 1879.)

**latirostris** (*Raffles*). (p. 127.)

Ceylon  
Indian Peninsula  
Burmese provinces  
Greater Sunda Islands  
Molucca Islands (Buru)  
Eastern Siberia (Sakalin)  
Japan

Bongao ? <sup>1</sup>	Sulu ? <sup>1</sup>
Negros	

## **CYORNIS** *Blyth.*

(*Siphia*, pt., Sharpe, *Cat. Bds.*, IV, p. 441, 1879). [*Cf.* Oates, *Faun. Brit. Ind.*, Birds, II, p. 11 (1890).]

**herioti** *Wardlaw-Ramsay*, *Ibis*, 1886, p. 159 (♀).

[*euganensis* Grant, *Bull. B. O. C.*, IV, p. ii (1895). *Cf.* Sharpe, *Bull. B. O. C.*, XI, p. 60 (1901.)]

Luzon

**banyumas** (*Horsf.*). (p. 449.)

Java

Luzon (Mariveles)
Palawan

<sup>1</sup> Sharpe records *A. latirostris* from Bongao and Sulu [Hand-List of Birds, Vol. III, p. 206 (1901)]. In his list of the birds of the Sulu Archipelago published in *Ibis*, April, 1894, pp. 257-259, he does not include this species.

**philippinensis** Sharpe. (p. 450.)

[= *simplex* Blyth, Ibis, 1870, p. 165,  
teste Pilsch in litt.]

Basilan	Panay
Bongao	Romblon
Cebu	Samar
Dinagat	Semirara
Guimaras	Sibutu
Leyte	Sibuyan
Luzon	Siquijor
Marinduque	Sulu
Masbate	Tablas
Mindanao	Tawi Tawi
Mindoro	Ticao
Negros	

**lemprieri** Sharpe, Ibis, 1884, p. 319.

[*ramsayi* W. Blasius, Ornith. 1888, p. 308.  
Cf. Everett, Ibis, 1895, p. 25.]

Balabac	Palawan
Calamianes	

**erythaca** Sharpe, Ibis, 1888, p. 199.

[*platene* Blasius, Ornith. 1888, p. 308.]

Palawan

## MUSCICAPULA Blyth.

(Sharpe, Cat. Bds., IV, p. 203, 1879.)

[*Dendrobiastes* Sharpe, Tr. Linn. Soc., (2)  
I, p. 332 (1876).]

**samarensis** Bourns & Worcester, Occ. Papers  
Minnesota Acad., I, p. 24 (1894).

Samar

**luzoniensis** Grant, Ibis, 1894, p. 505.

Calayan	Mindoro
Luzon	Negros ?

**nigrorum** Whitehead, Bull. B. O. C. vi, p.  
xliii (1897).

Negros

**montigena** Mearns, Proc. Biol. Soc. Wash.,  
XVIII, p. 8 (1905).

Mindanao

**basilanica** Sharpe, Tr. Linn. Soc., 2d ser. i, p.  
332 (1876).

Basilan

Mindanao

[*mindanensis* W. Blasius, J. f. O. 1890,  
p. 147. Cf. Sharpe, Bull. B. O. C. xi,  
p. 60 (1901).]

**westermanni** Sharpe, P. Z. S., 1888, p. 270.

Malay Peninsula (Mountains of  
Perak)  
Mountains of northwestern Borneo  
and Celebes

Luzon	Negros
Mindanao	

## GERYGONE Gould.

(Sharpe, Cat. Bds., IV, p. 211, 1879.)

**simplex** Cab. (p. 214.)

Lubang	Mindoro
Luzon	Verde

**rhizophoræ** Mearns, Proc. Biol. Soc. Wash.,  
XVIII, p. 7 (1905).

Bongao ? <sup>1</sup>	Sulu ? <sup>1</sup>
Mindanao	

<sup>1</sup> Sulu and Bongao birds probably belong to the race *rhizophoræ*. Guillemard refers his Sulu birds to *flavicola*. Cf. P. Z. S., 1885, p. 263.—McGREGOR.



**XANTHOPYGIA** *Blyth.*

(Sharpe, Cat. Bds., IV, p. 249, 1879.)

*narcissina* (Temm.). (p. 249.)Japan                      China  
Northern Borneo (*winter*)

Mindanao                      Mindoro

**CYANOPTILA** *Blyth.*(*Xanthopygia* pt., Sharpe, Cat. Bds.,  
IV, p. 249, 1879.)*bella* (A. Hay). (p. 251.)[*Muscicapa cyanomelana* Temm., nec *M.*  
*cyanomelas* Vieill.][*Cf.* Stejn., Pr. U. S. Nat. Mus., xv,  
p. 328 (1892).]Northwestern Borneo  
Japan                      China  
Indo-Chinese countriesPalawan (*winter*)**HYPOTHYMIS** *Boie.*

(Sharpe, Cat. Bds., IV, p. 273, 1879.)

*occipitalis* (Vig.). (p. 275.)Nicobar Islands  
Malay Peninsula  
Java                      Flores  
Formosa                      Hainan  
Borneo                      Lombok

Basilan	Mindoro
Bohol	Negros
Bongao	Palawan
Calamianes	Panay
Cebu	Romblon
Guimaras	Samar
Leyte	Sibutu
Lubang	Sibuyan
Luzon	Siquijor
Maestro de Campo	Sulu
Malanipa	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	Verde

*superciliaris* Sharpe. (p. 278.)

Basilan                      Mindanao

*samarensis* Steere, List Bds. & Mams. Philip-  
pine Exp., p. 16 (1890).

Leyte                      Samar

**CYANOMYIAS** *Sharpe.*

(Sharpe, Cat. Bds., IV, p. 273, 1879.)

*caelestis* (Tweed.). (p. 278.)Basilan                      Mindanao  
Dinagal                      Sibuyan  
Luzon*helenæ* Steere, List Bds. & Mams. Philippine  
Exp., p. 16 (1890).

Samar

**RHIPIDURA** *Vig. & Horsf.*

(Sharpe, Cat. Bds., IV, p. 303, 1879.)

[*Cf.* Büttik. Notes Leyden  
Mus., xv, p. 65 (1893).]**cyaniceps** (*Cass.*). (p. 323.)

Luzon

**sauli** *Bourne & Worcester*, Occ. Papers Min-  
nesota Acad., I, No. 1, p. 26 (1894).

Tablas

**nigrocinnamomea** *Hartert*, Bull. B. O. C.,  
XIV, p. 12 (1903).

Mindanao

**albiventris** *Sharpe*. (p. 324.)Guimaras  
Masbate  
NegrosPanay  
Ticao**nigritorquis** *Vig.* (p. 334.)

Basilan	Negros
Bohol	Palawan
Bongao	Panay
Calamianes	Romblon
Cebu	Samar
Cuyo	Siasi
Dinagat	Sibuyan
Guimaras	Siquijor
Lubang	Sulu
Luzon	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	Verde
Mindoro	

**ZEOCEPHUS** *Bp.*

(Sharpe, Cat. Bds., IV, p. 342, 1879.)

**rufus** (*Gray*). (p. 343.)

Cebu	Panay
Lubang	Romblon
Luzon	Samar
Marinduque	Sibuyan
Mindoro	Tablas
Negros	

**cinnamomeus** *Sharpe*. (p. 343.)

Basilan	Sulu
Bongao	Tawi Tawi
Mindanao	

**cyanescens** *Sharpe*. (p. 343.)

Calamianes Palawan

**CALLAEOPS** *Grant.*(Grant, Bull. B. O. C., IV, pp. xviii,  
xxii, 1895.)**periophthalmica** *Grant.* (l. c.)

Luzon

**TERPSIPHONE** *Gloger.*

(Sharpe, Cat. Bds., IV, p. 344, 1879.)

**affinis** (*Blyth.*). (p. 349.)

Malay Peninsula	
Eastern Himalayas	
Indo-Chinese provinces	
Assam	Java
Borneo	Sumatra

Luzon

**RHINOMYIAS** *Sharpe.*

(Sharpe, Cat. Bds., IV, p. 367, 1879.)

**albigularis** *Bourne & Worcester*, Occ. Papers  
Minnesota Acad., 1, No. 1, p. 27 (1894).

Guimaras      Negros

**ruficauda** (*Sharpe*). (p. 368.)[*samarensis* Steere, List. Bds. & Mams.  
Steere Exp., p. 16 (1890).]

Basilan	Mindanao
Leyte	Samar

**ocularis** *Bourne & Worcester*, Occ. Papers  
Minnesota Acad., 1, No. 1, p. 28 (1894).

Sulu      Tawi Tawi

**insignis** *Grant*, Bull. B. O. C., IV, p. xi  
(1895); id. *Ibis*, 1895, p. 442, pl. xii, fig. 2.

Luzon

**CULICICAPA** *Swinh.*

(Sharpe, Cat. Bds., IV, p. 369, 1879.)

**ceylonensis** (*Swinh.*). (p. 369.)

Khasi Hills	
Indian Peninsula	
Mountains of northwestern Borneo	
Malay Peninsula (Mountains of Perak)	
Ceylon	Java

Palawan

**helianthea** (*Wall.*). (p. 370.)[*panayensis* Sharpe. (p. 371.)]

Celebean Sea	Celebes
Banggai and Saleyer Islands	

Bongao	Negros
Cebu	Palawan
Leyte	Panay
Luzon	Tawi Tawi
Mindanao	

**CRYPTOLOPHA** *Swinh.*

(Sharpe, Cat. Bds., IV, p. 393, 1879.)

[*Cf.* Oates, Faun. Brit. Ind.,  
Birds, 1, p. 421, 1889.]**cebuensis** *Dubois*, Syn. Av. p. 286 (1900).

Cebu

[*flavicularis* Bourne & Worcester, Occ.  
Papers Minnesota Acad., 1, No. 1, p. 23  
(1894, nec Godw.-Aust.).]

*montis Sharpe*, Ibis, 1887, p. 442.

Sumatra  
Mountains of northwestern Borneo

Palawan

*xanthopygia* Whitehead, Bull. B. O. C., 1, p. xxxi (1893); id. Exped. Kina Balu, pl. 16, fig. 2 (1893).

Palawan

*mindanensis* Hartert, Bull. B. O. C., XIV, p. 12 (1903).

Mindanao

## ABRORNIS Hodgs.

(*Cryptolopha*, pt., Sharpe, Cat. Bds., IV, p. 393, 1879.)

*nigrorum* (Moseley), Ibis, 1891, p. 47, pl. ii, fig. 1.

Luzon  
Mindoro

Negros

*olivacea* Moseley, Ibis, 1891, p. 47, pl. ii, fig. 2.

Leyte  
Luzon  
Mindanao  
Negros

Samar  
Sulu  
Tawi Tawi

## EUMYIAS Cab.<sup>1</sup>

(*Stoparola* Blyth; Sharpe, Cat. Bds., IV, p. 435, 1879.)

*panayehsis* (Sharpe). (p. 440.)

Negros

Panay

*nigritentalis* (Grant), Bull. B. O. C., III, p. 50 (1894); id., Ibis, 1894, p. 507, pl. xiv, fig. 2.

Luzon

Mindoro

*nigriloris* (Hartert), Bull. B. O. C., XIV, p. 80 (1904).

Mindanao

## Family CAMPOPHAGIDÆ.

## ARTAMIDES Hartl.

(Sharpe, Cat. Bds., IV, p. 8, 1879.)

*dificilis* Hartert, Nov. Zool., II, p. 470 (1895).

Balabac  
Calamianes

Palawan

*guillemardi* Salvad., Ibis, 1886, p. 154.

[*pollens* (nee Salvad.) Guillem., P. Z. S., 1885, p. 258.]

Bongao  
Lapac  
Sibutu

Sulu  
Tawi Tawi

*striatus* (Bodd.). (p. 18.)

Lubang

Luzon

*kochi* Kutter, Orn. Centralbl., 1882, p. 183; J. f. O. 1883, p. 163.

[*mindanensis* Steere, List Bds. & Mams. Steere Exp., p. 14 (1890).]

Basilan  
Leyte  
Mindanao

Nipa  
Panaon  
Samar

<sup>1</sup> "*Stoparola* Blyth, 1836 means something else!"—RICHMOND.

<b>panayensis</b> <i>Steere</i> , List. Bds. & Mams. Steere Exp., p. 14 (1890).	Guimaras Masbate Negros	Panay Ticao
<b>mindorensis</b> <i>Steere</i> , <i>t. c.</i> , p. 14 (1890).	Mindoro	Tablas
<b>cebuensis</b> <i>Grant</i> , <i>Ibis</i> , 1898, p. 535.	Cebu	

### EDOLIISOMA *Jarq. & Pucher.*

(Sharpe, Cat. Bds., IV, p. 42, 1879.)

<b>cærulescens</b> ( <i>Blyth</i> ). (p. 44.)	Luzon	
<b>alterum</b> <i>Wardlaw-Ramsay</i> , <i>Ibis</i> , 1881, p. 34.	Cebu	
<b>panayense</b> <i>Steere</i> , List Bds. & Mams. Steere Exp., p. 14 (1890).	Guimaras Negros	Panay
<b>everetti</b> <i>Sharpe</i> , Bull. B. O. C., III, p. x (1893).	Bongao Sulu	Tawi Tawi
<b>mindanense</b> ( <i>Tweedd.</i> ) (P. Z. S., 1878, p. 947); <i>Sharpe</i> , Cat. Bds., IV, p. 470 (1879).	Basilan	Mindanao
<b>elusum</b> <i>McGregor</i> , Govt. Lab. Publ. No. 34, p. 19 (1905).	Mindoro	

### PERICROCOTUS *Boie.*

(Sharpe, Cat. Bds., IV, p. 70, 1879.)

<b>marchesæ</b> <i>Guillen.</i> , P. Z. S., 1885, p. 259, pl. xviii, fig. 1.	Sulu	
<b>novus</b> <i>McGregor</i> , Bull. Philippine Mus., No. 3, p. 13 (1904); <i>W. Ramsay</i> , <i>Ibis</i> , 1886, p. 161.	Luzon	Negros
<b>leytensis</b> <i>Steere</i> , List Bds. & Mams. Steere Exp., p. 15 (1890).	Leyte	Samar
<b>igneus</b> <i>Blyth.</i> (p. 78.)	Western China Malay Peninsula Southern Tenasserim Sumatra	Borneo
	Palawan	
<b>cinereus</b> <i>Lafr.</i> (p. 83.)	China Pegu ( <i>winter</i> ) Eastern Siberia Borneo ( <i>winter</i> ) Malay Peninsula ( <i>winter</i> )	
	Calayan Luzon	Mindoro Palawan

**LALAGE** *Boie.*

(Sharpe, Cat. Bds., IV, p. 86, 1879.)

<b>melanoleuca</b> ( <i>Blyth.</i> ) <sup>1</sup> (p. 91.) [ <i>Cf.</i> Wardlaw-Ramsay, <i>Ibis</i> , 1884, p. 334.]	Luzon Mindoro	Semirara ? <sup>1</sup>
<b>minor</b> ( <i>Steere</i> ), List Bds. & Mams. Steere Exp., p. 15 (1890).	Mindanao Leyte	Samar
<b>niger</b> ( <i>Forster</i> ), [ <i>Iterat</i> Bodd.; Sharpe, Cat. Bds., IV, p. 95.]	Sumatra Malay Peninsula Java Nicobar Islands (Camorta, Nancowry)	Borneo
	Basilan	Mindanao
	Bobol	Mindoro
	Cagayancillo	Negros
	Cagayan Sulu	Palawan
	Calamianes	Panay
	Catanduanes	Romblon
	Cebu	Samar
	Cuyo	Sibay
	Guimaras	Sibuyan
	Leyte	Siquijor
	Lubang	Sulu
	Luzon	Tablas
	Marinduque	Ticao
	Masbate	

Family **PYCNONOTIDÆ.****ÆGITHINA** *Vieill.*

(Sharpe, Cat. Bds., VI, p. 4, 1881.)

<b>viridis</b> ( <i>Bp.</i> ). (p. 11.)	Sumatra	Borneo
	Palawan	

**CHLOROPSIS** *Jard. & Selby.*

(Sharpe, Cat. Bds., VI, p. 15, 1881.)

<b>palawanensis</b> <i>Sharpe.</i> (p. 33.)	Balabac Calamianes	Palawan
<b>flavipennis</b> ( <i>Turnedd.</i> ) (p. 34.)	Cebu	Mindanao ? <sup>2</sup>

<sup>1</sup> A bird seen by me on Semirara in April, 1905, but not killed, was in all probability *L. melanoleuca*.—WORCESTER.

<sup>2</sup> *Chloropsis flavipennis* is listed by W. Blasius among the birds collected by Dr. Platen at Davao, in Mindanao, in the summer of 1889 (*J. f. O.*, April, 1890, p. 145). The failure of any other collector to find any representative of this genus in Mindanao is so remarkable that it leads me to doubt the correctness of this record which Sharpe does not recognize in his Hand-List of Birds.—WORCESTER.

**IRENA** *Horsf.*

(Sharpe, Cat. Bds., VI, p. 174, 1881.)

<b>cyanogaster</b> <i>Vig.</i> (p. 175.)	Luzon	
<b>ellæ</b> <i>Steere</i> , List. Bds. & Mams. Steere Exp., p. 18 (1890).	Leyte	Samar
<b>melanochlamys</b> <i>Sharpe</i> , (p. 170.)	Basilan	Mindanao
<b>tweeddalii</b> <i>Sharpe</i> , (p. 178.)	Balabac Calamianes	Palawan

**HYPSIPETES** *Vig.*

(Sharpe, Cat. Bds., VI, p. 35, 1881.)

<b>fugensis</b> <i>Grant</i> , Bull. B. O. C., V, p. ii (1895); id. <i>Ibis</i> , 1896, p. 113.	Calayan	Fuga
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**IOLE** *Blyth.*

(Sharpe, Cat. Bds., VI, p. 54, 1881.)

<b>striaticiceps</b> <i>Sharpe</i> , <i>Ibis</i> , 1888, p. 200.	Palawan	
<b>everetti</b> <i>Tweedd.</i> (p. 57.)	Mindanao Dinagat Leyte	Panaon Samar
<b>haynaldi</b> <i>Blasius</i> , J. f. O., 1890, p. 141; <i>Sharpe</i> , <i>Ibis</i> , 1894, p. 253.	Bongao Sibutu	Sulu Tawi Tawi
<b>rufigularis</b> ( <i>Sharpe</i> ). (p. 57, pl. iii.)	Basilan	Mindanao
<b>philippensis</b> ( <i>Gm.</i> ). (p. 58.)	Bohol Cebu Leyte Lubang Luzon	Marinduque Mindanao Panaon Samar
<b>guimarasensis</b> <i>Steere</i> , Bds. & Mams. Steere Exp., p. 19 (1890).	Guimaras Masbate Negros	Panay Ticao Verde
<b>mindorensis</b> <i>Steere</i> , List. Bds. & Mams. Steere Exp., p. 19 (1890). [ <i>schmackeri</i> Hartert, J. f. O., 1890, p. 155.]	Mindoro	Semirara
<b>siquijorensis</b> <i>Steere</i> , op. cit. p. 19 (1890).	Siquijor	
<b>cincereiceps</b> <i>Bourne &amp; Worcester</i> , Occ. Papers Minnesota Acad., I, No. 1, p. 25 (1894).	Romblon	Tablas
<b>monticola</b> <i>Bourne &amp; Worcester</i> , l. c.	Cebu	

**POLIOLOPHUS** *Sharpe.*

(Sharpe, Tr. Linn. Soc. (2) i, p. 334, 1876.)

<b>urostictus</b> ( <i>Salvad.</i> ). (p. 63.)	Basilan	Luzon
[ <i>basilanicus</i> Steere, List. Bds. & Mams. Steere Exp., p. 19 (1890).]	Catanduanes Dinagat Leyte	Mindanao Panaon Samar



**MICROTARSUS** *Eyton.*

(*Micropus* Swains., *nec* Linn.;  
Sharpe, Cat. Bds., VI. p. 64,  
1881.)

**melanocephalus** (*Gm.*). (p. 66.)

Sumatra  
Malay Peninsula  
Burmese Provinces  
Eastern Bengal (Dacca, Tip-  
pera)  
Java Borneo  
Palawan

**CRINIGER** *Temm.*

(Sharpe, Cat. Bds., VI, p. 70, 1881.)

**frater** *Sharpe.* (p. 79, pl. v.)

Balabac Palawan  
Calamianes

**palawanensis** *Twedd.* (p. 83, pl. vi, fig. 2.)

Palawan

**PYCNONOTUS** *Boie.*

(Sharpe, Cat. Bds., VI, p. 120, 1881.)

[*Pachycephalixus* & *Stictognathus*,  
Büttik. Notes Leyden Mus., xvii,  
p. 249 (1896).

*Gymnocrotaphus* & *Bonapartea*,  
Büttik., *op. cit.* xvii, p. 246,  
xviii, p. 58.]

**goiavier** (*Scop.*). (p. 141.)

Basilan Negros  
Bohol Nipa  
Cebu Panay  
Guimaras Romblon  
Leyte Samar  
Luzon Sulu  
Marinduque Tablas  
Masbate Ticao  
Mindanao Verde  
Mindoro

**cinereifrons** *Twedd.* (p. 153.)

Calamianes Palawan

Family **TIMELIIDÆ.**Subfamily **TIMELIINÆ.****PSEUDOTHARRHALEUS** *Grant.*

(Grant. Bull. B. O. C., IV, p. xl,  
1895.)

**caudatus** *Grant, l. c.*

Luzon

**unicolor** *Hartert*, Bull. B. O. C., XIV, p. 74  
(1904).

Mindanao

**griseipectus** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 2 (1905). Mindanao

**TURDINUS** *Blyth*.

(Sharpe, Cat. Bds., VII, p. 539,  
1883.)

[*Cf.* Büttik. Notes Leyden Mus.  
XVII, p. 68 (1895). *Malacocincla* Büttik. *l. c.* p. 79.  
*Illadopsis* Büttik. *l. c.* p.  
98.]

**rufifrons** *Twedd.* (p. 546.)

Balabac Palawan

[*Malacopteryx palawanense* Büttik.  
Notes Leyden Mus. XVII, p. 104  
(1895).]

**PTILOCICHLA** *Sharpe*.

(Sharpe, Cat. Bds., VII, p. 586,  
1883.)

**falcata** *Sharpe*. (p. 586.)

Balabac Palawan

**basilanica** *Steere*, List. Bds. & Mams. Steere  
Exp., p. 18 (1890); *id.* Ibis, 1891, pl. vii.

Basilan

**mindanensis** *Steere*, *l. c.*; *Cf.* Blasius, J. f. O.  
1890, p. 146.

Mindanao

**minuta** *Bourne & Worcester*, Occ. Papers  
Minnesota Acad., 1, No. 1, p. 24 (1894).

Samar

**ANUROPSIS** *Sharpe*.

(Sharpe, Cat. Bds., VII, p. 588,  
1883.)

**cinereiceps** (*Twedd.*). (p. 590.)

Balabac Palawan

**DASYCROTAPHA** *Twedd.*

(Sharpe, Cat. Bds., VII, p. 574,  
1883.)

**speciosa** *Twedd.* (p. 574.)

Negros

**ZOSTERORNIS** *Grant.*

(Grant, Bull. B. O. C., III, p. i.  
1894.)

<b>striata</b> <i>Grant, l. c.</i> , p. ii (1894); id. <i>Ibis</i> , 1895, pl. iv, fig. 1.	Luzon	
<b>whiteheadi</b> <i>Grant, l. c.</i> , p. i (1894); id. <i>Ibis</i> , 1894, pl. xv, fig. 1.	Luzon	
<b>pygmæa</b> <i>Grant, Bull. B. O. C.</i> , vi, p. xviii (1896); id. <i>Ibis</i> , 1897, pl. vi, fig. 1.	Leyte	Samar
<b>plateni</b> ( <i>W. Blasius</i> ), <i>J. f. O.</i> , 1890, p. 147.	Mindanao	
<b>capitalis</b> ( <i>Tweed.</i> ), (p. 582.)	Basilan Dinagat Leyte	Mindanao Panaon
<b>nigrocapitata</b> ( <i>Steere</i> ), <i>List. Bds. &amp; Mams. Exp. Philipp.</i> , p. 17 (1890).	Luzon? <sup>1</sup>	Samar
<b>dennistouni</b> <i>Grant, Bull. B. O. C.</i> , V, p. ii (1895); id. <i>Ibis</i> , 1896, pl. iii, fig. 2.	Luzon	

**MIXORNIS** *Hodgs.*

(Sharpe, *Cat. Bds.*, VII, p. 575,  
1883.)

<b>woodi</b> <i>Sharpe.</i> (p. 577.)	Balabac	Palawan
<b>cagayanensis</b> <i>Guillem.</i> , <i>P. Z. S.</i> , 1885, p. 419, pl. xxv.	Cagayan Sulu	

**MACRONUS** *Jard. & Selby.*

(Sharpe, *Cat. Bds.*, VII, p. 583,  
1883.)

<b>striaticeps</b> <i>Sharpe.</i> (p. 584.)	Basilan	
<b>mindanensis</b> <i>Steere, List. Bds. &amp; Mams. Steere Exp.</i> , p. 17 (1890).	Dinagat Leyte	Mindanao Samar
<b>montanus</b> <i>Mearns, Proc. Biol. Soc. Wash.</i> , XVII, p. 4 (1905).	Mindanao	
<b>kettlewelli</b> <i>Guillem.</i> , <i>P. Z. S.</i> , 1885, p. 262, pl. xviii, fig. 2.	Bongao Sulu	Tawi Tawi

<sup>1</sup>A single specimen of *Zosterornis*, obtained at Mariveles, in the Province of Bataan, Island of Luzon, can not be differentiated from *Z. nigrocapitata* heretofore recorded from Samar and Leyte without specimens for actual comparison. While it may be ultimately proven to belong to an undescribed species, it has been provisionally assigned by McGregor to *Z. nigrocapitata* [*Govt. Lab. Publ. No. 34*, p. 29 (1905)].

Subfamily **BRACHYPTERYGINÆ.****BRACHYPTERYX** *Horsf.*

(Sharpe, Cat. Bds., VII, p. 25, 1883.)

[*Callene*, pt., Sharpe, t. c. 15.*Cf.* Oates, Faun. Brit. Ind.,

Birds, I, p. 185.]

**brunneiceps** *Grant*, Ibis, 1896, p. 547.

Negros

**poliogyne** *Grant*, Bull. B. O. C., IV, p. xl

Luzon

Mindoro

(1895); id. Ibis, pl. xii, fig. 1.

**mindanensis** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 3 (1905).

Mindanao

**LEONARDINA** *Mearns*.(*Leonardia* Mearns, 1905, *nec* Tappare-  
none-Canevari (1890).)[*Cf.* Mearns, Proc. Biol. Soc.

Wash., XVIII, p. 88

(1905).]

**woodi** *Mearns*, Proc. Biol. Soc. Wash., XVIII,  
p. 2 (1905).

Mindanao

Family **TURDIDÆ.**Subfamily **TURDINÆ.****MERULA** *Leach*.

(Seeböhm, Cat. Bds., V, p. 232, 1881.)

**nigrorum** (*Grant*), Ibis, 1896, p. 544.

Negros

**thomassoni** *Seeböhm*, Bull. B. O. C., III, p.  
li (1894).

Luzon

**mindorensis** (*Grant*), Ibis, 1896, p. 465.

Mindoro

**kelleri** *Mearns*, Proc. Biol. Soc. Wash., XVIII,  
p. 6 (1905).

Mindanao

**GEOCICHLA** *Temm.*

(Seebohm, Cat. Bds., V, p. 147,  
1881.)

**interpres** (*Temm.*). (p. 166.)

[*arensis* Gray (p. 167). Cf. Oates, Fauna  
Brit. India II, p. 138, 1890.]

Malay Peninsula	
Northwestern Borneo	
Sumatra	Java
Lombok	Sumbawa
<hr/>	
Basilan	Tawi Tawi
Sulu	

**cinerea** *Bourne & Worcester*, Occ. Papers  
Minnesota Acad., I, No. 1, p. 23 (1894).

Mindoro

**OREOCICHLA** *Gould.*

(*Geocichla* pt. Seebohm, Cat. Bds.,  
V, p. 147, 1881.)

[Cf. Seebohm, Monogr. Turdi-  
dae, I, pp. 1-32.]

**varia** (*Pall.*). (p. 151.)

[*hannei* Swinh. (p. 153.)]

Japan  
China (*winter*)  
Burma (*winter*)  
Accidental in Europe  
Western and eastern Siberia

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Luzon

**TURDUS** *Linn.*

(Seebohm, Cat. Bds., V, p. 184,  
1881.)

**pallidus** *Gm.* (p. 274.)

Japan  
Formosa (*winter*)  
Southern China (*winter*)  
Eastern Siberia (Amur-land  
and Ussuri-land)

---

Calayan

**chrysolaus** *Temm.* (p. 275.)

China (*winter*)  
Formosa (*winter*)  
Japan Hainan  
Eastern Siberia (Ussuri-land,  
Sakhalin)

---

Calayan Luzon

**obscurus** *Gm.* (p. 273.)

Japan  
China (*winter*)  
Borneo (*winter*)  
Burma (*winter*)  
Malay Peninsula  
Eastern Himalayas  
Eastern Siberia (Yenesi to  
Amur)

---

Calayan Luzon  
Guimaras Negros

**PETROPHILA** *Swains.*

(*Monticola* pt. Seebohm, Cat. Bds.,  
V, p. 312.)

[*Cf.* Oates, Fauna Brit. India,  
Bds., I, p. 112, 1889.]

**manilla** Bodd.

[*solitaria* (P. L. S. Müll., *nee* Linn.),  
(p. 319.)] [*teste* Stejneger *in litt.*]

Japan  
Eastern Siberia  
Southern China (*winter*)  
Malay Archipelago (*winter*)  
Burmese Provinces (*winter*)

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Agutaya	Negros
Balabac	Palawan
Basilan	Panaon
Cagayancillo	Panay
Calamianes	Romblon
Calayan	Sibay
Cuyo	Sibuyan
Guimaras	Siquijor
Leyte	Sulu
Lubang	Tablas
Luzon	Tawi Tawi
Masbate	Ticao
Mindanao	Verde
Mindoro	

Subfamily **RUTICILLINÆ.**

**CHIMARRHORNIS** *Hodgs.*

(Sharpe, Cat. Bds., VII, p. 47, 1883.)

**bicolor** *Grant*, Bull. B. O. C., III, p. 44    Luzon  
(1894); *id.* Ibis, 1894, pl. xv, fig. 2.

**CALLIOPE** *Gould.*

(*Erithacus* pt. Seebohm, Cat. Bds.,  
V, p. 293, 1881.)

[*Cf.* Oates, Faun. Brit. Ind.,  
Birds, I, p. 101, 1889.]

**calliope** (*Pall.*). (p. 305.)

Europe (*accidental*)  
Southern China (*winter*)  
Burmese provinces (*winter*)  
Siberia                  Northern China  
Northern and Central India  
(*winter*)

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Calayan	Mindoro
Luzon	Negros
Masbate	

**COPSYCHUS** *Wagler.*

(Sharpe, Cat. Bds., VII, p. 60, 1883.)

**mindanensis** (*Gm.*). (p. 60.)

Basilan	Romblon
Bongao	Samar
Cebu	Semirara <sup>1</sup>
Guimaras	Sibuyan
Leyte	Siquijor
Lubang	Sulu
Luzon	Tablas
Masbate	Tawi Tawi
Mindanao	Ticao
Mindoro	Verde
Negros	

**CITTOCINCLA**, *Scl.*

(Sharpe, Cat. Bds., VII, p. 84, 1883.)

[*Cf.* Hartert. Nov. Zool. ix, pp.  
512-513, 1892.]**nigra** *Sharpe.* (p. 90.)

Balabac	Palawan
Calamianes	

**luzoniensis** (*Kittl.*). (p. 91.)

Catanduanes	Marinduque
Luzon	

**cebuensis** *Steere*, List. Bds. & Mams. Steere  
Exp., p. 20 (1890).

Cebu

**superciliaris** *Bourne & Worcester*, Occ. Pa-  
pers Minnesota Acad., I, No. 1, p. 23  
(1894).

Masbate	Ticao
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**nigrorum** *Grant*, Ibis, 1896, p. 547.

Negros

**PRATINCOLA** *Koch.*

(Sharpe, Cat. Bds., IV, p. 118, 1879.)

**caprata** (*Linn.*). (p. 195.)

Persia	
Indian Peninsula	
Burmese provinces	
Java	Borneo
Bohol	Mindoro
Cebu	Negros
Lubang	Panay
Luzon	Siquijor
Masbate	Ticao

**SAXICOLA** *Bechst.*(Seebohm, Cat. Bds., V, p. 362,  
1881.)**oenanthe** (*Linn.*). (p. 391.)[*Cf.* Stejneger, Pr. U. S. Nat. Mus.,  
XXIII, p. 473 (1901); id. Auk, XVIII,  
p. 186 (1901).][*oenanthoides* *Vig.*]

Europe and northern Asia to Alaska	
Indian Peninsula and eastern Africa ( <i>winter</i> )	
Calayan	

<sup>1</sup> A bird seen by me on Semirara in April, 1905, but not killed, was in all probability *C. mindanensis*.—WORCESTER.



**LOCUSTELLA** *Kaup.*

(Seebohm, Cat. Bds., V, p. 107.  
1881.)

**fasciolata** (*Gray*). (p. 109.)

[*Cf.* A. B. Meyer & Wigglesw., B. Celebes,  
p. 524 (1898).]

Talaut Islands  
Sangir Islands  
Eastern Siberia  
Molucca Islands  
China Japan  
Batchian, Halmahera, Morotai  
(*winter*)

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Calayan	Sulu
Luzon	Tablas
Marinduque	Tawi Tawi

**ochotensis** (*Midd.*). (p. 113.)

[*dybourskii* Ridgw., Pr. U. S. Nat. Mus.,  
VI, p. 92 (1883).]

Kurile Islands  
Borneo (*winter*)  
Northeastern Siberia  
Greater Sunda Islands  
Kamchatka Japan

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Calayan	Mindoro
Marinduque	Romblon

**lanceolata** (*Temm.*). (p. 118.)

China (*winter*)  
Eastern Europe (Russia)  
Andaman Islands (*winter*)  
Indian Peninsula (*winter*)  
Burmese provinces (*winter*)  
Siberia Central Asia

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Calayan	Luzon
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**ACROCEPHALUS** *Naum.*

(Seebohm, Cat. Bds., V, p. 87, 1881.)

[*Tatare* Lesson; Sharpe, Cat.  
Bds., VII, p. 524 (1883).  
*Cf.* Zool. Rec., Aves, 1883,  
p. 26; Büttik. Notes Ley-  
den Mus., XIV, p. 13  
(1892).]

**sorgophilus** (*Swinh.*). (p. 94.)

China

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Luzon

**orientalis** (*Temm. & Schl.*). (p. 97.)

Japan  
Northern China  
Eastern Siberia  
Burmese provinces (*winter*)  
Malay Archipelago (*winter*)

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Calayan	Mindanao
Cebu	Mindoro
Luzon	Palawan

**TRIBURA** *Hodgs.*

(*Lusciniola* pt. Seebohm, Cat. Bds.,  
V, p. 120, 1881.)

[*Cf.* Oates, Faun. Brit. Ind.,  
Birds, I. 361, 1889.]

**seebohmi** (*Grant*), Bull. B. O. C., IV, p. xl Luzon  
(1895) ; id. Ibis, 1895, p. 443.

**ORTHOTOMUS** *Horsf.*

(Sharpe, Cat. Bds., VII, p. 219  
(1883).

[*Cf.* Grant, Ibis, 1897, p. 229.]

**frontalis** *Sharpe.* (p. 220.)

Basilan	Leyte
Bohol	Mindanao
Dinagat	Samar

**cinereiceps** *Sharpe.* (p. 222.)

Basilan	Mindanao
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**nigriceps** *Tweedl.* (p. 222.)

Mindanao
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**samarensis** *Steere*, List Bds. & Mams. Steere  
Exp., p. 20 (1890.)

Leyte	Samar
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**castaneiceps** *Wald.* (p. 223.)

[*panayensis* Steere, List. Bds. & Mams.  
Steere Exp., p. 20, 1890. *Cf.* Grant,  
Ibis, 1896, p. 549.]

Guimaras	Panay
Masbate	Ticao
Negros	

**derbianus** *Moore.* (p. 224.)

Luzon
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**chloronotus** *Grant*, Bull. B. O. C., III, p. ii  
(1895).

Luzon
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**ruficeps** (*Less.*). (p. 224.)

Malay Peninsula	
Southern Tenasserim	
Sumatra	Borneo
<hr/>	
Balabac	Palawan
Calamianes	

**cineraceus** *Blyth.* (p. 225.)

Malay Peninsula	
Sumatra	Borneo
<hr/>	
Cagayan Sulu	

**CISTICOLA** *Kaup.*

(Sharpe, Cat. Bds., VII, p. 235,  
1883.)

**cisticola** (*Temm.*). (p. 259.)

Indian Peninsula	
Malay Peninsula	
Southern Europe	
Indo-Chinese countries	
Greater and Lesser Sunda	
Islands	
Ceylon	China
Africa	Celebes
<hr/>	
Balabac	Luzon
Bohol	Mindanao

**exilis** (*Vig. & Horsf.*). (p. 269.)

• [*oryziola* S. Müll. (p. 240, note.) (*Cf.*  
Sharpe, Notes Leyden Mus., VI, p.  
168.)]

[*phragmitoides* Kuhl. (p. 185, note),  
teste Finsch *in litt.*]

[*Cf.* also Oates, Faun. Brit. Ind., Birds,  
I, pp. 371-373, 1889.]

Southern China	
Indian Peninsula	
Burmese provinces	
Malay Peninsula and Archipel-	
ago	
Australia	Formosa
<hr/>	
Calamianes	Panay
Calayan	Romblon
Cebu	Samar
Fuga	Semirara
Lubang	Sibay
Luzon	Sibuyan
Marinduque	Siquijor
Masbate	Sulu
Mindanao	Tablas
Mindoro	Ticao
Negros	Verde

**MEGALURUS** *Horsf.*

(Sharpe, Cat. Bds., VII, p. 122,  
1883.)

**palustris** *Horsf.* (p. 123.)

[*punctatus* De Vis, Ibis, 1897, p. 385.

= *macrurus*, juv. Rotsch. & Hartert, Orn.  
MB, vii, p. 139, 1898.]

Manipur	
Burmese provinces	
Southeastern New Guinea	
Northern and Central India to	
Bhutun and Buxa Doars	
Assam	Java
<hr/>	
Catanduanes	Mindanao
Luzon	Mindoro
Marinduque	Samar
Masbate	Ticao

**ruficeps** *Trcedd.* (p. 125.)

Basilan	Mindoro
Bohol	Negros
Cebu	Panay
Guimaras	Romblon
Lubang	Samar
Luzon	Sibuyan
Marinduque	Siquijor
Masbate	Tablas
Mindanao	Ticao

**ACANTHOPNEUSTE** *Blas.*

(*Phylloscopus* pt. Seebohm, Cat.  
Bds., V, p. 37, 1881.)

**borealis** (*Blas.*). (p. 40.)

Alaska  
Borneo (*winter*)  
Commander Islands  
Malay Peninsula (*winter*)  
China and Formosa (*winter*)  
Indo-Chinese provinces (*winter*)  
Northern Europe and northern  
Asia (Finmark to eastern  
Siberia, Kamtchatka)

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Balabac	Mindanao
Cagayancillo	Marinduque
Calamianes	Mindoro
Calayan	Negros
Cuyo	Palawan
Fuga	Panay
Guimaras	Romblon
Leyte	Samar
Lubang	Sibuyan
Luzon	Tablas
Maestro de Campo	Ticao Verde
Masbate	

**xanthodryas** (*Swinh.*). (p. 62.)

Southern China (*winter*)  
Mongolia Kamtchatka  
Japan Kurile Islands  
Northwestern Borneo (*winter*)

---

Palawan

**lugubris** (*Blyth*). (p. 48.)

Eastern Bengal (*winter*)  
Burmese provinces (*winter*)  
Western China to Chuan-che  
Eastern Himalayas (Sikhim to  
Assam)

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Basilan	Samar
Mindanao	

**HORORNIS** *Hodgs.*

(*Cettia* pt. Seebohm, Cat. Bds., V, p.  
133, 1881.)

[*Cf.* Oates, Faun. Brit. Ind.,  
Birds, I, p. 434, 1889.]

**seebohmi** (*Grant*), Ibis, 1894, p. 507.

Northern Luzon

**canturiens** (*Swinh.*). (p. 141.)

Formosa  
Cachar (*winter*)  
Southern China (*winter*)  
Southern Ussuri-land to Lake  
Chanka

---

Luzon

**minuta** (*Swinh.*). (p. 141.)

Hainan  
Askold Island  
Southern China

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Calayan

## PHYLLERGATES *Sharpe*.

(*Sharpe*, Cat. Bds., VII, p. 229, 1883;  
*cf.* Zool. Rec., 1883, Aves, p. 25,  
note.)

[*Phyllobates* *Oates*, Bds. Brit.  
Burm., I, p. 110 (1883).]

**philippinus** *Hartert*, Nov. Zool., IV, p. 517  
(1897.)

Luzon

**heterolæmus** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 86 (1905).

Mindanao

## Family ARTAMIDÆ.

## ARTAMUS *Vieill.*

(*Sharpe*, Cat. Bds., XIII, p. 2, 1890.)

**leucorhynchus** (*Linn.*), *teste* *Richmond*,  
[*leucogaster* (*Valenc.*), (p. 3.)]

Australia  
Papuan Islands  
Andaman Islands  
Malay Archipelago

---

Basilan	Negros
Bohol	Palawan
Bongao	Panay
Calamianes	Romblon
Catanduanes	Samar
Cebu	Semirara
Cuyo	Sibay
Guimaras	Sibuyan
Leyte	Siquijor
Lubang	Sulu
Luzon	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	Verde
Mindoro	

## Family LANIIDÆ.

### Subfamily LANIINÆ.

## ENNEOCTONUS *Boie*.

(*Lanius* pt. *Gadow*, Cat. Bds., VII,  
p. 232, 1883; *Grant*, Nov. Zool.,  
IX, p. 149, 1902.)

**tigrinus** (*Drap.*). (p. 289.)

Borneo  
Malay Peninsula  
Sumatra Java  
Korea China

---

Sulu

**CEPHALOPHONEUS** *Fitz.*

(*Lanius* pt. Gadow, Cat. Bds., VIII,  
p. 232, 1883; Grant, Nov. Zool.,  
IX, p. 449, 1902.)

**validirostris** (*Grant*). Bull. B. O. C., III,  
p. xlix, 1894).

Luzon Mindoro

**nasutus** (*Scop.*).

[*cephalomelas* Bp. (p. 269.)]  
[*schalowi* Gadow.]

Northern Borneo

Bohol	Mindanao
Calamianes	Mindoro
Cebu	Negros
Guimaras	Panay
Leyte	Samar
Luzon	Siquijor
Masbate	

**suluensis** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 86 (1905).

Sulu

**OTOMELA**, *Bp.*

(*Lanius* pt. Gadow, Cat. Bds., VIII,  
p. 232, 1883; Grant, Nov. Zool.,  
IX, p. 449, 1902.)

**cristata**<sup>1</sup> (*Linn.*). (p. 271.)

Borneo  
Eastern Siberia  
Malay Peninsula  
Indian Peninsula  
Indo-Chinese provinces

Philippine Islands (*winter*)

**lucionensis** (*Linn.*). (p. 274.)

Mongolia  
Northern China  
Malay Archipelago  
Southern India (*winter*)  
Andaman and Nicobar Islands  
Korea Formosa

Agutaya	Masbate
Balabac	Mindanao
Basilan	Mindoro
Bohol	Negros
Cagayancillo	Palawan
Calamianes	Panaon
Calayan	Panay
Camiguin	Romblon
Catanduanes	Samar
Cebu	Sibay
Cuyo	Sibuyan
Fuga	Siquijor
Guimaras	Sulu
Leyte	Tablas
Lubang	Tawi Tawi
Luzon	Ticao
Maestro de Verde	
Campo	

<sup>1</sup> The two shrikes, *O. cristata* and *O. superciliosa*, are included in this list on the authority of Sharpe's Hand-List. Their distribution within the Philippines is not known to me.—McGREGOR.

**superciliosa**<sup>1</sup> (*Lath.*). (p. 273.)

Japan  
Malay Peninsula  
Greater and Lesser Sunda  
Islands

Philippine Islands (*winter*)

Subfamily **PACHYCEPALINÆ**.

**HYLOTERPE** *Cab.*

(*Pachycephala* pt. Gadow, Cat. Bds.,  
VIII, p. 182, 1883.)

**philippinensis** *Walden*. (p. 221.)

Basilan  
Dinagat  
Leyte  
Luzon  
Mindanao  
Samar  
Siquijor

**apoensis** *Mearns*, Proc. Biol. Soc. Wash.,  
XVIII, p. 86 (1905).

Mindanao

**homeyeri** *Blasius*, J. f. O., 1890, p. 141.

Bongao  
Sibutu  
Sulu  
Tawi Tawi

**whiteheadi** *Sharpe*, Ibis, 1888, p. 198.

Palawan

[*plateni* *W. Blasius*, Ornith., 1888, p. 311.]

**winchelli** *Bourne & Worcester*, Occ. Papers  
Minnesota Acad., I, No. 1, p. 21 (1894).

Cebu  
Masbate  
Negros  
Panay  
Sibuyan  
Tablas  
Ticao

[*major* *Bourne & Worcester*, l. c. p. 22.]

**mindorensis** *Bourne & Worcester*, l. c. p. 22.

Mindoro

**albiventris** *Grant*, Bull. B. O. C., III, p. xlix  
(1894).

Luzon  
Mindoro

**fallax** *McGregor*, Bull. Philippine Mus., No. 4,  
p. 27 (1904).

Calayan

Family **PARIDÆ**.

Subfamily **PARINÆ**.

**PARDALIPARUS** *Selys-Longch.*

(*Selys-Longchamps*, Bull. S. Z.  
France IX, p. 73, 1884; Branchi,  
Ann. Mus. St. Petersb., VII, p.  
247, 1902.)

(*Parus* pt. Gadow, Cat. Bds.,  
VIII, p. 3, 1883.)

[*Hellm.*, Tierr., Paridae, p. 80,  
1901.]

**amabilis** (*Sharpe*). (p. 22.)

Balabac  
Palawan

<sup>1</sup> See footnote on page 92.



**elegans** (*Less.*). (p. 22.)

Bongao	Mindoro
Calayan	Negros
Cebu	Panay
Guimaras	Sulu
Luzon	Tawi Tawi
Masbate	Ticao

**mindanensis** *Mearns*, Proc. Biol. Soc. Wash., XVIII, p. 8 (1905).

Mindanao

## **PENTHORNIS** Hellmayr.

(Hellmayr, J. f. O. 1901, p. 173:  
Tierreich, *Paridae*, p. 32, 1903.)

(*Parus* pt. Gadow, Cat. Bds., VIII,  
p. 3, 1883.)

**semilarvatus** (*Salvadori*). (p. 38.)

Luzon

Negros

[*Cf.* Wardlaw Ramsay, Ibis, 1884, p.  
334.]

**luzoniensis** (*Gm.*).

Mindanao

[*Micropus nchrkorni* Blasius, J. f. O.,  
1890, p. 147. *Cf.* Sharpe, Bull. B. O. C.,  
IV, p. ii (1894); Hellmayr, J. f. O.,  
1901, pp. 171, 172.]

## Family **SITTIDÆ**.

## **CALLISITTA** *Reichenb.*

(*Dendrophila* Swains.; *Sitta* pt. Gadow, Cat. Bds., VIII, p. 341, 1883;  
Hellm., Tierr., *Sittidæ*, p. 191,  
1903.)

**frontalis** (*Swains.*). (p. 358.)

Southern India  
Malay Peninsula  
Burmese provinces  
Ceylon                      Java  
Himalayas (Kumaon to Assam)

Balabac

Palawan

**œnochlamys** (*Sharpe*). (p. 359.)

Basilan	Luzon
Cebu	Mindanao
Guimaras	Negros
Leyte	Panay

**mesoleuca** (*Grant*), Bull. B. O. C., III,  
p. xlix (1894).

Luzon

**filacea** (*Whitehead*), Bull. B. O. C., VI,  
p. xlix (1897).

Basilan

Samar

## Family CERTHIIDÆ.

**RHABDORNIS** *Reichenb.**(Climacteris* pt. Gadow, Cat. Bds.,

VIII, p. 333, 1883.)

*(Cf. Grant, Ibis, 1897, p. 235.)***mystacalis** (*Temm.*). (p. 339.)Luzon  
MasbateNegros  
Panay**minor** *Grant*, Bull. B. O. C., VI, p. xvii  
(1896).Basilan  
Dinagat  
LeyteMindanao  
Samar**inornata** *Grant, l. c.* p. xviii; id. *Ibis*, 1897,  
pl. vi, fig. 2.

Samar

## Family ZOSTEROPIDÆ.

**ZOSTEROPS** *Vig. and Horsf.*

(Gadow, Cat. Bds., IX, p. 146, 1884.)

**everetti** *Tweed.* (p. 163.)

Cebu

**nigrorum** *Tweed.* (p. 186.)Cresta de Gallo Panay  
Masbate Ticao  
Negros**siquijorensis** *Bourns and Worcester*, Occ.  
Papers Minnesota Acad., I, No. 1, p. 21  
(1894).

Negros

Siquijor

**luzonica** *Grant*, Bull. B. O. C., No. XXIV,  
p. xxii (1895).

Luzon

**aureiloris** *Grant*, Bull. B. O. C., No. XXVIII,  
p. xl (1895).

Luzon

Mindoro

**basilanica** *Steere*, List. Bds. and Mams.  
*Steere Exp.*, p. 21 (1890).Basilan  
Bongao  
Dinagat  
LeyteMindanao  
Samar  
Sulu**richmondi** *McGregor*, Proc. Biol. Soc. Wash.,  
XVII, p. 165 (1904).

Cagayancillo

[*flavissima* *McGregor*, Bull. Philippine  
Mus., No. 4, p. 26 (1904) *nee* Hartert.]**meyeni** *Bonap.* (p. 180.)[*Cf. Grant, Ibis*, 1895, p. 452.]Calayan  
LubangLuzon  
Verde**whiteheadi** *Hartert*, Bull. B. O. C., XIV,  
No. C, p. 13 (1903).

Luzon (Lepanto)

**vulcani** (*Hartert*), Bull. B. O. C., XIV, No. C,  
p. 14 (1903).

Mindanao

*goodfellowi* Hartert, Bull. B. O. C., XIV, No. C, p. 13 (1903). Mindanao

# **HYPOCRYPTADIUS** Hartert.

(Hartert, Bull. B. O. C., XIV, No. C, p. 13, 1903.)

*cinnamomeus* Hartert. (l. c.) Mindanao

Family **DICÆIDÆ**.

# **DICÆUM** Cur.

(Sharpe, Cat. Bds., X, p. 10, 1885.)

<i>retrocinctum</i> Gould. (p. 35.)	Luzon	Mindoro
<i>hæmatostictum</i> Sharpe. (p. 35.)	Guimaras Negros	Panay
<i>papuense</i> (Gmel.). <sup>1</sup> (p. 36.)	Basilan Cebu Dinagat Leyte Lubang Luzon	Marinduque Masbate Mindanao Samar Ticao Verde
<i>luzoniense</i> Grant, Bull. B. O. C., III, p. 1. (1894).	Luzon	
<i>apo</i> Hartert, Bull. B. O. C., XIV, No. CVII, p. 79 (1904).	Mindanao	
<i>bonga</i> Hartert, t. c. p. 80.	Samar	
<i>davao</i> Mearns, Proc. Biol. Soc. Wash., XVIII, p. 87 (1905).	Mindanao	
<i>flaviventer</i> Meyer, J. für O., 1894, p. 91, ex Du Bois, Syn. Av., p. 679.	Cebu	
<i>dorsale</i> Sharpe. (p. 40.)	Masbate Negros	Panay
<i>pallidior</i> Bourns and Worcester, Occ. Papers, Minnesota Acad. Sci., 1, No. 1, p. 18 (1894).	Cebu	
<i>sibuyanicum</i> Bourns and Worcester. (l. c.)	Sibuyan	
<i>intermedium</i> Bourns and Worcester. (t. c. p. 19.)	Romblon	Tablas
<i>assimilis</i> Bourns and Worcester. (l. c.)	Sulu	Tawi Tawi

<sup>1</sup>This species is usually called *Dicaeum rubriventer* Lesson, Gmelin's name *Pipra papuensis* being misleading.—McGREGOR.

<b>xanthopygium</b> <i>Tweedd.</i> (p. 40.)	Luzon Marinduque	Mindoro
<b>cinereigulare</b> <i>Tweedd.</i> (p. 40.)	Leyte Mindanao	Samar
<b>besti</b> <i>Steere</i> , List. Bds. and Mams. Steere Exp., p. 22 (1890).	Siquijor	
<b>sibutuense</b> <i>Sharpe</i> , Ibis, 1894, pp. 122, 251; ex Dubois Syn. Av., p. 679.	Sibutu	
<b>pygmæum</b> ( <i>Kittlitz</i> ). (p. 43.)	Balabac Calayan Fuga Guimaras Leyte Lubang Luzon Maestro Campo Masbate	Mindoro Negros Palawan Romblon Samar Semirara Sibuyan Siquijor Ticao
<b>nigrilore</b> <i>Hartert</i> , Bull. B. O. C., XV, No. CLX, p. 8 (1904).	Mindanao	
<b>hypoleucum</b> <i>Sharpe</i> . (p. 37.)	Basilan Bongao	Siasi Sulu
<b>mindanense</b> <i>Tweedd.</i> (p. 37.)	Basilan Mindanao	Sulu Tawi Tawi
<b>everetti</b> <i>Tweedd.</i> (p. 47.)	Dinagat Leyte	Panaon Samar
<b>obscurum</b> <i>Grant</i> , Bull. B. O. C., III, p. 1 (1894).	Luzon	

# **PRIONOCHILUS** *Strickl.*

(*Sharpe*, Cat. Bds., X, p. 63 pt., 1885.)

<b>johannæ</b> <i>Sharpe</i> , Ibis, 1888, p. 201.	Balabac Busuanga	Palawan
<b>quidricolor</b> <i>Tweedd.</i> P. Z. S., 1877, p. 762.	Cebu	
<b>olivaceus</b> <i>Tweedd.</i> (p. 75.)	Basilan Dinagat Leyte	Mindanao Samar
<b>bicolor</b> <i>Bourne and Worcester</i> , Occ. Papers Minnesota Acad., I, No. 1, p. 20 (1894).	Mindanao	
<b>inexpectatus</b> <i>Hartert</i> , Nov. Zool., II, pp. 64, 486 (1895).	Leyte Luzon Mindoro	Negros Samar

**PIPRISOMA** *Blyth.*

(Sharpe, Cat. Bds., X, p. 63, pt.  
1885.)

<b>æruginosum</b> ( <i>Bourne and Worcester</i> ), Occ.	Cebu	Mindoro
Papers Minnesota Acad., I, No. 1, p. 20	Lubang	Romblon
(1894).	Luzon	Sibuyan
	Mindanao	

Family **NECTARINIIDÆ.****CHALCOSTETHA** *Cab.*

(Gadow, Cat. Bds., IX, p. 12, 1884.)

<b>insignis</b> ( <i>Jard.</i> ). (p. 12.)	Tenasserim	
	Cochin China	
	Sunda Islands	
	Malay Peninsula	
	Sumatra	Siam
	Celebes	Borneo
	<hr/>	
	Balabac	Palawan

**ÆTHOPYGA** *Cab.*

(Gadow, Cat. Bds., IX, p. 13, 1884.)

<b>magnifica</b> <i>Sharpe.</i> (p. 24.)	Cebu	Sibuyan
	Negros	Tablas
	Panay	
<b>boltoni</b> <i>Mearns</i> , Bull. Biol. Soc. Wash., XVIII, p. 4 (1905).	Mindanao	
<b>shelleyi</b> <i>Sharpe.</i> (p. 29.)	Balabac	Palawan
	Calamianes	
<b>bella</b> <i>Twedd.</i> (p. 29.)	Mindanao	Samar
<b>arolasi</b> <i>Bourne and Worcester</i> , Occ. Papers, Minnesota Acad., I, No. 1, p. 17 (1894).	Sulu	Tawi Tawi
<b>bonita</b> <i>Bourne and Worcester.</i> (l. c.)	Cebu	Panay
	Masbate	Ticao
<b>flavipectus</b> <i>Grant</i> , Bull. B. O. C., III, p. xlix (1894).	Luzon	Mindoro
[ <i>minuta</i> <i>Bourne and Worcester</i> , Occ. Papers Minnesota Acad., I, No. 1, p. 18 (1894).]		
<b>rubrinota</b> <i>McGregor</i> , Govt. Lab. Publ. No. 25, p. 30 (1905).	Lubang	

**EUDREPANIS** *Sharpe.*

(Gadow, Cat. Bds., IX, p. 13 pt.  
1884.)

<b>pulcherrima</b> ( <i>Sharpe</i> ). (p. 31.)	Basilan Dinagat	Leyte Samar
<b>jefferyi</b> <i>Grant</i> , Bull. B. O. C., III, p. 1 (1894).	Luzon	

**CINNYRIS** *Cur.*

(Gadow, Cat. Bds., IX, p. 31, 1884.)

<b>sperata</b> ( <i>Linm.</i> ). (p. 63.)	Calamianes Cebu Dinagat Guimaras Leyte Lubang Luzon Marinduque Masbate Mindanao Mindoro	Negros Nipa Palawan Panay Romblon Samar Sibuyan Siquijor Tablas Ticao
<b>whiteheadi</b> <i>Grant</i> , Bull. B. O. C., II, p. 1 (1894).	Calayan Fuga	Luzon
<b>juliæ</b> <i>Twedd.</i> (p. 64.)	Basilan Malanipa Mindanao	Sulu Tawi Tawi
<b>flagrans</b> ( <i>Oust.</i> ). (p. 88.) [ <i>excellens</i> <i>Grant</i> , Bull. B. O. C., No. XXIII, p. xviii (1895); <i>cf.</i> Whitehead, <i>Ibis</i> , 1899, p. 230.]	Luzon	Catanduanes
<b>guimarasensis</b> <i>Steere</i> , List. Bds. and Mams. Steere Exp., p. 22 (1890).	Guimaras Negros	Panay
<b>jugularis</b> ( <i>Linm.</i> ). (p. 84.) [ <i>dinagatensis</i> <i>Mearns</i> , <sup>1</sup> <i>Proc. Biol. Soc. Wash.</i> , XVIII, p. 5 (1905). <i>obscurior</i> <i>Grant</i> , Bull. B. O. C., III, p. 1 (1894); <i>cf.</i> <i>Grant</i> , <i>Ibis</i> , 1895, p. 451.]	Basilan Bohol Bongao Camiguin Catanduanes Cebu Dinagat Guimaras Leyte Lubang Luzon Maestro de Campo Marinduque Masbate Mindanao	Mindoro Negros Panay Romblon Samar Semirara Sibay Sibutu Sibuyan Siquijor Sulu Tablas Tawi Tawi Ticao Verde
<b>aurora</b> ( <i>Twedd.</i> ). (p. 88.)	Agutaya Balabac Cagayancillo	Calamianes Cuyo Palawan

<sup>1</sup> In view of the great variation of color on the breast of *Cinnyris aurora* and on that of *C. jugularis* we do not recognize *C. dinagatensis* as valid. The latter name is confessedly applied to a specimen intermediate between the two older species.—MCGREGOR AND WORCESTER.

**ARACHNOTHERA** *Temm.*

(Gadow, Cat. Bds., IX, p. 100, 1881.)

<b>flammifera</b> <i>Twedd.</i> (p. 104.)	Basilan Leyte	Mindanao Samar
<b>dilutior</b> <i>Sharpe.</i> (p. 105.)	Palawan	
<b>philippinensis</b> ( <i>Steere</i> ). List. Bds. and Mams. Steere Exp., p. 21 (1890).	Leyte Mindanao	Samar

**ANTHREPTES** *Swinh.*

(Gadow, Cat. Bds., IX, p. 112, 1881.)

<b>malaccensis</b> ( <i>Scop.</i> ). (p. 122.)	Malay Peninsula Siam Sumatra Cochin China	Java Borneo Flores
	Balabac Bongao Calamianes	Palawan Sibutu Tawi Tawi
<b>rhodolæma</b> <i>Shelley.</i> (p. 122, pt.)	Borneo Palawan	
<b>chlorigaster</b> <i>Sharpe.</i> (p. 122, pt.)	Basilan Lubang Cebu Masbate Mindanao Negros	Panay Romblon Sibuyan Tablas Tawi Tawi Ticao
<b>wiglesworthi</b> <i>Hartert.</i> Nov. Zool., IX, p. 209; Dubois Syn. Av., 1113, <i>chlorigaster</i> . pt.	Sulu	
<b>cagayanensis</b> <i>Mearns</i> , Proc. Biol. Soc. Wash., XVIII, p. 6 (1905).	Cagayan Sulu	
<b>griseigularis</b> ( <i>Twedd.</i> ). (p. 126.)	Luzon Mindanao Mindoro	Sakuijoc Samar

Family **MOTACILLIDÆ.****MOTACILLA** *Lin.*(Sharpe, Cat. Bds., X, p. 451, pt.,  
1885.)

<b>ocularis</b> <i>Swinh.</i> (p. 471.)	Burma ( <i>winter</i> ) Aleutian Islands ? Northeastern Siberia China Lower California ( <i>accidental</i> )	
	Balabac Calayan Lubang	Luzon Palawan



**melanope** *Pall.* (p. 497.)

Europe                      Siberia  
India and Burmese countries  
(*winter*)  
Malay Peninsula and Indo-  
Malay Islands (*winter*)

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Balabac	Mindanao
Basilan	Mindoro
Cagayan Sulu	Negros
Calamianes	Palawan
Calayan	Panay
Catanduanes	Romblon
Cebu	Samar
Guimaras	Sibay
Leyte	Sibuyan
Lubang	Sulu
Luzon	Tablas
Maestro de Campo	Tawi Tawi
Marinduque	Ticao
Masbate	Verde

**flava** *Linna.* See Page 110.

### **BUDYTES** *Cur.*

(Sharpe, Cat. Bds., X, p. 457 pt.,  
1885.)

**leucostriatus** *Hom.* (p. 516. pt.)

Eastern Siberia  
Alaska                      Kamchatka  
Eastern China and Moluccas  
(*winter*)

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Balabac	Masbate
Bohol	Mindanao
Cagayan Sulu	Negros
Calayan	Palawan
Catanduanes	Sulu
Lubang	Ticao
Luzon	

### **LIMONDRUMUS** *Gould.*

(Sharpe, Cat. Bds., X, p. 532, 1885.)

**indicus** (*Gm.*). (l. e.)

Eastern Siberia  
Northern China  
Indian Peninsula  
Ceylon, Andaman Islands, Bur-  
mese countries, Cochin China,  
Malay Peninsula, and Java  
(*winter*)

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Balabac	Calayan
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### **ANTHUS** *Bechst.*

(Sharpe, Cat. Bds., X, p. 531, 1885.)

**maculatus** *Hodgs.* (p. 547.)

Eastern Siberia  
Indian Peninsula  
Loo Choo Islands  
China                      Japan  
Indo-Burmese countries

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Calayan	Palawan
Luzon	

**rufulus** *Vieill.* (p. 574.)  
[*malayensis* Eyton.]

Malay Peninsula  
Burmese countries  
Africa India  
Ceylon Java  
Sumatra Borneo

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Bohol	Mindoro
Calamianes	Negros
Calayan	Palawan
Cebu	Panaon
Fuga	Panay
Guimaras	Romblon
Leyte	Samar
Lubang	Semirara
Luzon	Sibuyan
Maestro de Campo	Siquijor
Masbate	Tablas
Mindanao	Ticao

**cervinus** (*Pall.*). (p. 585.)

Kurile Islands  
Borneo (*winter*)  
Alaska Asia  
England Europe  
Northern Africa (*winter*)  
Lower California (*accidental*)  
Formosa and Hainan (*winter*)  
Persia and northwestern India  
(*winter*)  
China and Indo-Burmese countries  
(*winter*)

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Calayan	Mindanao
Luzon	Palawan

**gustavi** *Swinh.* (p. 613.)

Siberia Borneo  
Celebes Kamtchatka  
Timor (*winter*)  
China (*migration*)  
Moluccas (*winter*)  
Commander Islands

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Basilan	Masbate
Cagayancillo	Mindoro
Calayan	Negros
Guimaras	Palawan
Leyte	Romblon
Lubang	Sibuyan
Luzon	Sulu
Maestro de Campo	Tawi Tawi

**richardi** *Vieill.* (p. 564.)

India  
Moluccas  
Ceylon (*winter*)  
Southern China (*winter*)  
Burmese countries (*winter*)  
British Islands (*occasional*)  
Western and southern Europe  
(*winter*)  
Central and eastern Asia (*summer*)

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Balabac

## Family ALAUDIDÆ.

**ALAUDA** *Linn.*

(Sharpe, Cat. Bds., XIII, p. 566,  
1890.)

**wattersi** *Swinh.* (p. 575, pt.)

Formosa	Cochin China
Bohol	Sibuyan
Luzon	Ticao

**MIRAFRA** *Horsf.*

(Sharpe, Cat. Bds., XIII, p. 593,  
1890.)

**philippinensis** *Ramsay.* (p. 605.)

Luzon	Mindoro
Mindanao	

## Family FRINGILLIDÆ.

**LOXIA** *Linn.*

(Sharpe, Cat. Bds., XII, p. 435,  
1888.)

**luzoniensis** *Grant*, Bull. B. O. C., III, p. li  
(1894).

Luzon

**PYRRHULA** *Briss.*

(Sharpe, Cat. Bds., XII, p. 445,  
1888.)

**leucogenys** *Grant*, Bull. B. O. C., IV, p. xli  
(1895).

Luzon

**FRINGILLA** *Linn.*

(Sharpe, Cat. Bds., XII, p. 450,  
1888.)

**montifringilla** *Linn.* (p. 178.)

Europe	Kamtschatka
North China	Northern Asia
Japan ( <i>winter</i> )	
British Islands ( <i>winter</i> )	
Liu Kiu and Bonin Islands	
( <i>winter</i> )	

Calayan

**PASSER** *Briss.*

(Sharpe, Cat. Bds., XII, p. 298,  
1888.)

**montanus** (*Linn.*). (p. 301.)

Malay Peninsula	
Siam	Java
China	Japan
Europe	Persia
Burmah	Siberia
North and central Asia	
Afghanistan	Himalayas
North Africa	Cochin China
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Cebu	Luzon

**SPINUS** *Koch.*

(*Chrysomitris* Boie; Sharpe, Cat.  
Bds., p. 192, 1888.)

**spinus** (*Linn.*). (p. 212.)

Northern Asia	
British Islands	
Japan	(winter)
South China	(winter)
Siberia	Europe
Liu Kiu Islands	(winter)
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Calayan	

**EMBERIZA** *Briss.*

(Sharpe, Cat. Bds., XII, p. 416,  
1888.)

**spodocephala** *Pall.* (p. 522.)

Eastern Siberia	
Japan	(accidental)
Assam and Manipur	(winter)
China and eastern Himalayas	(winter)
<hr/>	
Catanduanes	

**pusilla** *Pall.* (p. 487.)

Siberia	
Northern China	
Northern Europe	
Himalayas	(winter)
Tenasserim	(winter)
Assam and Burma	(winter)
<hr/>	
Luzon	

**sulfurata** *Temm. and Schl.* (p. 519.)

Japan	
Formosa	(winter)
Northern and central China	
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Calayan	Luzon

**CHLORURA** *Reichenb.*

(Sharpe, Cat. Bds., XIII, p. 388,  
1890.)

**brunneiventris** *Grant*, Bull. B. O. C., III, Luzon Mindoro  
p. 1 (1894).

Family **PLOCEIDÆ.****MUNIA** *Hodgs.*

(Sharpe, Cat. Bds., XIII, p. 326,  
1890.)

**oryzivora** (*Linna.*). (p. 328.)

Sumatra	
Java	Malacca
Guimaras	Palawan
Luzon	Panay
Mindanao	Samar

**jagori** *Martens*, (p. 337.)<sup>1</sup>  
[*brunneiceps* *Walden*; cf. *Grant*, *Ibis*,  
1896, p. 554.]

Balabac	Mindanao
Basilan	Mindoro
Bohol	Negros
Bongao	Palawan
Cagayan Sulu	Panay
Calamianes	Romblon
Calayan	Samar
Catanduanes	Semirara
Cebu	Sibay
Fuga	Sibuyan
Guimaras	Siquijor
Leyte	Sulu
Lubang	Tablas
Luzon	Tawi Tawi
Masbate	Ticao

**formosana** *Swinh.* (p. 338.)

Luzon

**cabanisi** *Sharpe*, (p. 353.)

Luzon Panay

**UROLONCHA** *Cab.*

(Sharpe, Cat. Bds., XIII, p. 355,  
1890.)

**everetti** (*Twedd.*). (p. 363.)

Balabac	Mindanao
Basilan	Negros
Calamianes	Palawan
Calayan	Panay
Catanduanes	Romblon
Cebu	Samar
Guimaras	Sibuyan
Leyte	Tablas
Luzon	Tawi Tawi

**fuscans** (*Cass.*). (p. 364.)

Borneo  
Cagayan Sulu

<sup>1</sup>The Philippine records of *Munia atricapilla* were in all probability based upon specimens of *M. jagori*.—McGREGOR.

## ORIOLUS Linn.

(Sharpe. Cat. Bds., III, p. 181, 1877.)

*chinensis* Linn. (p. 203.)

Balabac	Masbate
Basilan	Mindanao
Bohol	Mindoro
Bongao	Negros
Cagayancillo	Palawan
Calamianes	Panaon
Calayan	Panay
Catanduanes	Romblon
Cebu	Samar
Cuyo	Semirara
Dinagat	Sibutu
Fuga	Sibuyan
Guimaras	Siquijor
Lapac	Sulu
Leyte	Tablas
Lubang	Tawi Tawi
Luzon	Ticao
Maestro de Campo	Verde
Marinduque	Sibay

*isabellæ* Grant, Bull. B. O. C., IV, No. XX, p. ii (1894).

Luzon

*albiloris* Grant, Bull. B. O. C., III, p. xlix (1894).

Luzon

*samarensis* Steere, List. Bds. and Mams. Steere Exp., p. 17 (1890).

Leyte

Samar

*steerii*<sup>1</sup> Sharpe. (p. 213 pt.)

Basilan

Mindanao

[*basilanicus* Grant, Ibis, 1896, p. 532.]*cinereogenys* Bourns and Worcester, Occ. Papers Minnesota Acad., I, No. 1, p. 16 (1894).

Bongao

Tawi Tawi

<sup>1</sup> Grant makes the extraordinary statement that a glance at the original description and figure of *O. steerii* is sufficient to show that the *Negros* bird is the one described (Ibis, Oct., 1896, p. 532) and quotes Cat. Bds. III, p. 213, pl. x (1887), in support of his contention that Bourns and I were mistaken in supposing that the type of *O. steerii* comes from Basilan. He therefore rejects our name of *O. nigrostriatus* for the *Negros* bird on the ground that it is a synonym for *O. steerii* and assigns to the Basilan bird, which he agrees with us is quite distinct from the *Negros* bird, the name *O. basilanicus*.

Had Grant followed his own suggestion and glanced at the original description of *O. steerii* which occurs in Trans. Linn. Soc., Ser. II, Vol. 1, p. 329, he would have discovered that two specimens only were collected by Steere; that one specimen (*a*) was an adult male from *Isabela de Basilan*, while the other (*b*) of which the sex was not determined, came from *Negros*. Also that the type described was an adult male. Furthermore, he seems to forget that the type of this species, which, by the way, still bears a label in Dr. Sharpe's well-known hand, is at present in the bird collection of the University of Michigan. It was before Dr. Bourns and myself when our description of *O. nigrostriatus* was written. This type is an adult male from Basilan. Grant's *O. basilanicus* therefore becomes a synonym of *O. steerii*.—WORCESTER.

<b>nigrostriatus</b> <i>Bourns and Worcester</i> , Occ. Papers Minnesota Acad., I, No. 1, p. 16 (1894).	Masbate	Negros
<b>assimilis</b> <i>Tweed</i> , P. Z. S., 1877, p. 760.	Cebu	
<b>xanthonotus</b> <i>Horsf.</i> (p. 213.)	Malacca Java	Sumatra Borneo
	Calamianes ? <sup>1</sup>	Palawan

## Family DICRURIDÆ.

## DICRURUS Vieill.

(Sharpe, Cat. Bds., III, p. 229, 1877.)

<b>balicassius</b> ( <i>Linn.</i> ). (p. 230.)	Lubang Luzon Marinduque	Mindanao Verde
<b>striatus</b> <i>Tweed</i> , P. Z. S., 1877, p. 545.	Mindanao Basilan Leyte	Nipa Panaon Samar
<b>suluensis</b> <i>Hartert</i> , Nov. Zool., IX, p. 441, ex DuBois, Syn. Av., p. 1105.	Sulu	
<b>mirabilis</b> <i>Wald. and Layard</i> , (p. 231.)	Cebu Guimaras Masbate	Negros Panay Ticao

CHIBIA *Hodgs.*

(Sharpe, Cat. Bds., III, p. 234, 1877.)

<b>palawanensis</b> ( <i>Tweed</i> ), P. Z. S., 1878, p. 614.	Balabac Calamianes	Palawan
<b>cuyensis</b> <i>McGregor</i> , Bull. Philippine Mus., No. 1, p. 5 (1903).	Cuyo	
<b>worcesteri</b> <i>McGregor</i> , Govt. Lab. Publ. No. 31, p. 26 (1905).	Semirara	
<b>borneensis</b> <i>Sharpe</i> , P. Z. S., 1877, p. 246.	Borneo	
	Bongao Cagayan Sulu Sibutu	Sulu Tawi Tawi
<b>menagei</b> <i>Bourns and Worcester</i> , Occ. Papers Minnesota Acad., I, No. 1, p. 15 (1894).	Tablas	

<sup>1</sup> An *Oriolus*, in all probability *O. xanthonotus*, was seen by me in the Calamianes Islands in January, 1903, but no specimens were collected. WORCESTER.



**BUCHANGA** *Hodgs.*

(Sharpe, Cat. Bds., III, p. 245, 1877.)

**palawanensis** *Whitehead*, Ibis, 1893, p. 47.

Palawan

Family **STURNIDÆ**.**SPODIOPSAR** *Sharpe*.

(Sharpe, Cat. Bds., XIII, p. 16, 1890.)

[*Poliopsar* Sharpe *nec* Cassin;  
*Spodiopsar* Sharpe, Ibis,  
1889, p. 580. (*cf.* Cat. Bds.,  
XIII, p. 665.)]**sericeus** (*Gm.*). (p. 44.)

Calayan

**STURNIA** *Less.*

(Sharpe, Cat. Bds., XIII, p. 68, 1890.)

**philippensis** (*Forster*). (p. 70.) [*violacea*  
(Bodd.); *cf.* McGregor, Govt. Lab. Publ.  
No. 25, p. 30 (1905).]Japan  
Borneo (*winter*)  
Celebes (*winter*)  
Moluccas (*winter*)

Calayan	Negros
Luzon	Palawan
Mindanao	Tawi Tawi
Mindoro	

**sinensis** (*Gm.*). (p. 68.)Formosa  
Malacca (*winter*)  
Siam  
Pegu (*winter*)  
South China (*winter*)  
Cochin China (*winter*)  
China Hainan

Calayan	Luzon
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**ÆTHIOPSAR** *Sharpe*.(Acridotheres Vieill. pt.; Sharpe, Cat.  
Bds., XIII, p. 79 pt., 1890.)  
[*l. c.* p. 23 (footnote).]**cristatellus** (*Gm.*). (p. 92.)Central and southern China  
Luzon (*introduced*)**GOODFELLOWIA** *Hartert*.(Hartert, Bull. B. O. C., XIV, No. C,  
p. 11, 1903.)**miranda** *Hartert*. (*l. c.*)

Mindanao

**SARCOPS** *Walden.*

(Sharpe, Cat. Bds., XIII, p. 96.  
1890.)

**calvus** (*Linn.*). (p. 97.)

Basilan	Negros
Bongao	Panay
Catanduanes	Romblon
Cebu	Samar
Dinagat	Semirara
Guimaras	Sibay
Leyte	Sibutu
Lubang	Sibuyan
Luzon	Siquijor
Maestro de Campo	Sulu
Marinduque	Tablas
Masbate	Tawi Tawi
Mindanao	Ticao
Mindoro	Verde

**EULABES** *Cur.*

(*Mainatus* Less; Sharpe, Cat. Bds.,  
XIII, p. 98, 1890.)

**palawanensis** (*Sharpe*). (p. 104.)

Palawan

**LAMPROCOCORAX** *Bp.*

(Sharpe, Cat. Bds., XIII, p. 137.  
1890.)

[*Calornis* Gray *nec* Billberg;  
Cf. Oberholser, Proc. Philad.  
Acad. Sci., 1899, p. 215.]

**panayensis** (*Scop.*). (p. 147.)

Agutaya	Mindanao
Balabac	Mindoro
Basilan	Negros
Bohol	Nipa
Bongao	Palawan
Cagayancillo	Panay
Cagayan Sulu	Romblon
Calamianes	Samar
Camiguin	Semirara
Catanduanes	Siasi
Cebu	Sibutu
Cuyo	Sibuyan
Fuga	Siquijor
Guimaras	Sulu
Leyte	Tablas
Luzon	Tawi Tawi
Marinduque	Ticao
Masbate	

**todayensis** *Hearn*, Proc. Biol. Soc. Wash.,  
XVIII, p. 88 (1905).

Mindanao

## Family CORVIDÆ.

**CORONE** *Kaup.*

(Sharpe, Cat. Bds., III, p. 30, 1877.)

**philippina** (*Bonap.*). (p. 42.)

Basilan	Mindoro
Bohol	Negros
Cagayancillo	Palawan
Calayan	Panaon
Camiguin	Panay
Catanduanes	Romblon
Cebu	Samar
Cuyo	Semirara
Dinagat	Sibay
Fuga	Sibutu
Guimaras	Sibuyan
Lubang	Siquijor
Luzon	Sulu
Maestro de Campo	Tablas
Marinduque	Tawi Tawi
Masbate	Ticao
Mindanao	Verde

**CORVUS** *Linn.*

(Sharpe, Cat. Bds., III, p. 13, 1877.)

**pusillus** *Tweedd.*, P. Z. S., 1878, p. 622.

Balabac	Mindoro
Calamianes	Palawan

**samarensis** *Steere*, List. Bds. and Mams.  
Steere Exp., p. 23 (1890).

Samar

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**ADDENDA.**

Add on page 101:

**flava** *Linn.* (p. 516.)

Africa	
Siberia to China	
Molucca Islands	
Alaska	Europe
<hr/>	
Balabac	Masbate
Bohol	Mindoro
Calayan	Negros
Catanduanes	Palawan
Lubang	Sulu
Luzon	Ticao

NOTE.—The addition of *Motacilla flava*, inadvertently omitted from its proper place on page 101, raises the total number of species recorded to 692.

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