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PHILIPPINE CICADELLIDÆ (HOMOPTERA)

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FOUR PLATES

INTRODUCTION

The Nearctic and Palæarctic species of the family Cicadellidæ, which includes many pests of crops, have been well worked. However, the Oriental species, especially those of the Malayan region, have been very little studied. Distant [1] thinks the Cicadellidæ, being practically unworked in certain sections of the world, may prove to be the most extensive family of the Homoptera.

The description of Philippine species started with miscellaneous collections by early collectors. Most of the specimens described were from the British Museum. Among the early workers were Walker, Stål, and Signoret. Later Melichar, Kirkaldy, Matsumura, Distant, and Baker became prominent as describers of eastern Palæarctic, Oriental, and Australian, as well as Indian, Cicadellidæ. Baker collected and described more Philippine species of this family than all of the other above-mentioned workers together. All of Baker's work on Philippine Cicadellidæ was published in the Philippines. His collection in the United States National Museum is practically untouched.

The nucleus of the present work on Philippine Cicadellidæ was the few specimens that I took from the Islands, and material subsequently sent to me, from time to time, by my associates

[1] Fauna Brit. Ind. Rhynch. 3 (1906) 52-54.

in the Bureau of Plant Industry. The collection of Professor Osborn contributed several new species and many interesting old forms. Later my studies were extended to the United States National Museum, primarily for the purpose of comparing my types and determinations with the extensive Baker collection from the Philippine Islands. Several additional forms were studied and are described in this paper.

In general I have followed Distant [2] in the arrangement of these insects. It has been necessary, of course, to include some genera subsequently erected by Baker, Kirkaldy, Matsumura, and others, under divisional groupings according to Distant's synopsis. For structural characteristics and descriptions with reference to the names of sclerites and the wing venation of species, the excellent plates of Edwards [3] and Osborn [4] were consulted and adopted.

In this work I have described or determined eighty-three species, thirty-four of which are new; thirty-nine are old species of known Philippine distribution, and fourteen are species reported for the first time from the Philippines. In checking Baker's material and comparing it with the original descriptions, nine more species were listed for the Philippines for the first time. With the descriptions of the species I have recorded the distribution, the host plant, and the economic status where such information was available. *Agallus* DeLong and Davidson, with a known Australian and Nearctic distribution, is here recorded for the first time in the Orient. Four species are described. *Macropsis* was believed to be exclusively Nearctic, Palaearctic, and Ethiopian in distribution, but nine species of this genus came to light in the Philippine material and are herewith described. *Cicadula* is here first recorded as a Philippine genus.

Two genera are erected, one to receive two species, and the other, three. One genus is given a new name. This preoccupied and monotypic genus of Distant,[5] *Alituras* (now *Alituralis*), receives another species in this paper.

ACKNOWLEDGMENT

The present study of Philippine Cicadellidæ was made possible by the encouragement and unfailing assistance of Prof. Herbert Osborn, of Ohio State University, under whose direction this

[2] Op. cit. 4 (1908).
[3] Hemiptera-Homoptera of the British Isles. L. Reeves & Co. (1896).
[4] Ohio Biol. Surv. 3 No. 4 (1928).
[5] Fauna Brit. Ind. Rhynch. 4 (1908) 398, No. 2667.

work was undertaken. He placed at my disposal his collection of Philippine cicadellids and his private library, which contains a wealth of invaluable literature on this group of insects.

My thanks are also due to Mr. P. W. Oman, taxonomist of the order Homoptera in the United States National Museum, for valuable suggestions and help at the museum, and for the loan of some specimens from the Baker collections; to Dr. H. L. Morrison, in charge of the insect division of the United States National Museum (now of the Bureau of Entomology and Plant Quarantine), for furnishing me with working space and equipment; to Dr. D. M. DeLong for aid, especially in the genus *Agellus;* to Dr. E. P. Breakey, of the department of zoölogy and entomology, Ohio State University, for valuable suggestions and criticism during the early part of this work, the reading of the manuscript, and the checking of some of the specimens, especially those of the genus *Macropsis;* to my colleague in the Bureau of Plant Industry, Mr. F. Q. Otanes, of Manila, who from time to time sent me specimens collected in various parts of the Islands by the inspectors of the Philippine Bureau of Plant Industry; and above all to Dr. Manuel L. Roxas, who did everything possible to enable me to complete my work.

During the preparation of this paper I was guided by the excellent publications of W. L. Distant, C. F. Baker, and H. Osborn. I have occasionally referred to the works of F. Edwards, D. M. DeLong, and E. P. Van Duzee.

Most of the drawings were made by Mrs. C. W. Taft, some by Mr. F. B. Whittington under my supervision, and the rest were drawn by myself.

In the preparation of the check list with the original bibliography and synonymy, I am indebted to Baker's unpublished notes for the names of some species and their synonyms.

ECONOMIC IMPORTANCE OF THE CICADELLIDÆ

The Homoptera are of great concern to man. Among them are insects causing extensive injury to plant life. They are mostly of small size, multiply rapidly, and adapt themselves readily to all climatic conditions. Their attack goes unnoticed until the plants have lost so much vitality that they are either stunted or killed. The Cicadellidæ, therefore, are probably the most important family in this group of insects.

Their astounding breeding capacity, their mode of attack, which is to keep themselves always under the leaves of the host plants, together with their small size and protective coloring,

result in large numbers of them not being noticed until the plants attacked are ready to die.

Usually, however, these attacks do not cause the death of the host plants, but only greatly reduced vitality and productivity. For this reason their presence often escapes notice.

Serrano and Palo[6] estimated the loss of mango fruit due to the persistent attack of the mango leaf hoppers *Idiocerus clypealis* and *Chunra niveosparsa* for 1932 in three mango-growing provinces of Luzon to be 75.32 per cent of the crop.

These small insects occur in great numbers and feed especially on the sap of the young growing shoots. When the hoppers are numerous the amount of sap extracted by them is sufficient to prevent growth and to cause the loss of the entire crop of fruits. Lefroy[7] found that *Nephotettix apicalis* and *N. bipunctatus* multiply enormously and are a distinct plague to rice in India. *Cicadella spectra* Distant is another of the cicadellids that is numerous and ranks as a major pest of rice in India. These three species also occur in abundance in the Philippines and are certainly as bad rice pests here as in India.

Impousea flavescens, the well-known green fly of tea, whose distribution is world-wide, is a serious pest in India. This species damages cotton and various solanaceous crops in the Philippines.

LIFE HISTORY

Life-history work in this family is practically untouched. It is a field of considerable interest, as these insects have well-defined habitats and plant hosts and seem to be readily affected by such ecologic factors as temperature, moisture, and natural enemies.

Aside from work on the mango leaf hoppers *Idiocerus clypealis* Lethierry and *Chunra niveosparsa* Lethierry, for whose damaged Serrano and Palo[8] proposed the name "blossom-blight of the mango" to distinguish them from the less abundant leaf hoppers found on mango, no life history has ever been attempted on Homoptera in the Philippines.

The cicadellids have multifarious habits. Some are arboreal, some live and breed on herbs and bushes, some on reeds, and many of them feed and breed on old or green pasture grass. Some are solitary, others swarm in great numbers. It is

[6] Philip. Journ. Sci. 50 (1933) 211–277.
[7] Indian Insect Life. Thacker, Spink & Co., London (1909) 738.
[8] Philip. Journ. Sci. 50 (1933) 211–277.

supposed that most of them breed the year round with more or less predominance in certain favorable seasons. Certain species multiply during the dry season, and others appear in great numbers during the rainy season.

The preponderance of a species, however, depends more or less on the abundance of its hosts, and the stage of the host which is succulent to the species concerned. The grass types multiply in great numbers during the rainy season when grasses are growing most vigorously. In the Philippines *Nephotettix apicalis* and *N. bipunctatus* are numerous in the early part of the rainy season, during June, when rice is beginning to grow vigorously. *Idiocerus clypealis* and *Chunra nivcosparsa* are abundant on forced mangoes in November and December and on mango blossoms during the regular season; that is, from January to April.

GEOGRAPHIC DISTRIBUTION

The cicadellids have well-defined habitats and plant hosts. Their distribution is limited by climatic conditions and the distribution of their host plants.

In the Tropics plant distribution seems to limit the distribution of the species. The mango pests of India are of the same subfamily as those that attack mangoes in the Philippines, the Idiocerinæ. Whether or not the species of *Idiocerus* on the mango in India are distinct from those in the Philippines is questioned. Sugar canes and bananas have specific leaf-hopper pests that are more or less widely distributed. Some of the species attacking rice are as widely distributed as the area where rice is the commonest crop. *Nephotettix apicalis* Motchoulsky is present from India to Japan, including, of course, the countries and islands intervening.

The distribution of cicadellids is limited by land barriers, high mountains, large bodies of water, and climatic conditions. Each faunal region, unless affected by certain agencies of dissemination, has its own faunal characteristics. The Philippine cicadellids are distinctly Indo-Malayan, tinged with certain Palæarctic elements, which were introduced by commerce. It is possible that some Neotropical species are present due to the early importation of plants from Mexico. However, such introductions are doubtful in view of the distance, the slow transportation at the time, and the bringing of seeds mostly instead of living plants. Some leafhoppers from China and Japan may have gained a foothold through constant importations of or-

namental plants. Perhaps some are due to a land bridge, which may have existed between continental Asia and some part of the Philippines, or a similar connection between Indo-Malayan regions and Palawan and adjacent islands. Some Australian species have been recorded in the Philippines.

Although the species of *Makilingia* are distinctly Philippine, the Idiocerini are most likely of Indian origin. It is difficult to determine the origin of most of these species unless we know their habits and their host plants, as well as the native homes of such hosts. We know that most of the existing species of wide distribution are arboreal. The Tartessusaria, Idiocerini, and most of the well-known Typhlocybinæ and Cicadellinæ are arboreal insects, possibly transported by commerce.

SYSTEMATIC RELATIONS OF THE HOMOPTERA AND DIVERSITY OF OPINION CONCERNING THEM

In the classification of Homoptera first consideration was given to the number of the tarsal and antennal joints, and the character of the wings. Thus Westwood, according to Distant,[9] divided the Homoptera as follows:

Trimera. Tarsi 3-jointed and antennæ minute; wings areolate.
Dimera. Tarsi 2-jointed and antennæ moderate, 6- to 10-jointed; wings areolate.
Monomera. Tarsi 1-jointed, antennæ 6- to 25-jointed; wings not areolate.

Monomera is represented by one family, the Coccidæ; Dimera includes the Psyllidæ, the Aleurodidæ, and the Aphididæ; and Trimera includes the Auchenorrhyncha, on the phylogenetic position of which the authorities disagree.

It is admitted by all that among the trimerous insects the Cicadidæ are the lowest and most generalized, due to the presence of the three ocelli, the venation of the wings, and the poor development of the nervous system.

Here the question arises whether the Membracidæ should follow the Cicadidæ or the Fulgoridæ. It is the opinion of some writers that the Cicadellidæ, because their morphological characteristics and mode of development, occupy the highest rank among the Auchenorrhyncha. Funkhauser,[10] however, suggests that the membracids should be placed between the Cicadidæ and the Cicadellidæ, because the treehoppers have strong affinities with the leafhoppers, and probably came from the same

[9] Fauna Brit. Ind. Rhynch. 3 (1906) 52.
[10] Conn. Geol. & Nat. Hist. Surv. Bull. 34 (1923).

stem as the Cicadellidæ. Lawson,[11] in having the Cicadellidæ follow the Membracidæ, bases his opinion on the New World insect known as *Aethalion*, which looks very much like the Cicadellidæ and has certain characteristics that led Stål and Van Duzee to place it with the Membracidæ and Ashmead to place it under the Bythoscopidæ. Again he bases his reason for such arrangement on Fenton's [12] work on leaf-hopper parasites, according to which *Aphelopus* is the only genus of the Anteoninæ that parasitizes the Typhlocybinæ and is also the only genus that was found on the Membracidæ, and as such the Typhlocybinæ are considered the lowest subfamily of the Cicadellidæ, closest to the Membracidæ. Fenton shows that the Anteoninæ parasitize the Membracidæ, Cicadellidæ, and Fulgoridæ. Thus the three above families show close affinities. Because of the protective froth which envelops the young, the Cercopidæ escape parasitism.

Imms [13] also is of the opinion that the Membracidæ are most nearly related to the Cicadellidæ. Edwards [14] arranged the families so that the Membracidæ follow the Cicadellidæ, and the Fulgoridæ (Issidæ) follow the Cicadellidæ (Tettigometridæ). DeLong [15] places the Cicadellidæ between the Membracidæ and the Fulgoridæ. However, he admits the close relationship between the Cercopidæ and the Cicadellidæ. He says that *Penthimia americana* Fitch and certain species of *Gyponas* and the Acocephalini closely resemble the cercopids. The most striking of the Australian forms are the much larger species of the *Eurymela* group of genera comprising *Eurymela*, *Eurymeloides*, and *Eurymelops*. According to Tillyard,[16] these handsome wedge-shaped species superficially resemble the Cercopidæ. In my collection I have a *Poophilus*, a cercopid, that is so similar to this group that only examination of the tibial spurs will prevent its confusion with the leafhoppers. As a group, DeLong adds, the Fulgoridæ are most easily confused with the Cicadellidæ. Distant,[17] however, had the families arranged as follows:

[11] Kansas Univ. Bull. 12 (1920) 28.

[12] Ohio Journ. Sci. 18 (1918).

[13] A General Textbook of Entomology. Dutton & Co. Inc., New York (1929) 357.

[14] Hemiptera-Homoptera of the British Isles. L. Reeves & Co. (1896) 15.

[15] Conn. Geol. & Nat. Hist. Surv. Bull. 34 (1923) 58.

[16] The Insects of Australia and New Zealand. Angus & Robertson, Ltd. (1926) 164.

[17] Fauna Brit. Ind. Rhynch. 3 (1906) 52–54.

Cicadidæ, Fulgoridæ, Membracidæ, Cercopidæ. I do not clearly see the purpose of such arrangement. It seems that with the position and development of the ocelli, the antennæ, the pronotum, the wing texture, and the tibial spurs (spines), the following arrangement might be followed: The Cicadidæ are the lowest and most generalized of the Homoptera. The Membracidæ, due to the poor development of the nervous system and the peculiar absence of the forms, which explains the absence of the third ocellus (wings very generalized, simple genital organs), and the peculiar and useless development of the scutellum, come second. The Cercopidæ, with less bizarre form and texture of the wings, scutellum, the arrangement of the tibial spurs (nearer to Cicadidæ), the ocelli, and the antennæ, might be subordinated to the Cicadellidæ. They should be preceded by the Membracidæ, however, for the reason that some of them generally resemble the Membracidæ more closely. The species of *Machaerota* have the scutellar process long and arched, its apex extending in the same manner as that of the membracids. In *Machaeropsis* the scutellar process gradually shows recession. Distant[18] claims that the subfamily Machaerotinæ is the connecting link between the Membracidæ and the Cercopidæ, and the Cercopidæ should be subordinated to the Cicadellidæ. The Fulgoridæ, with the location of the antennæ (which are lower than in the Cicadellidæ) and the scutellar development, may be considered the most modern and specialized family of the Homoptera.

The Cicadellidæ belong to the division Trimera, and are one of the five families in this group; namely, the Cicadidæ, or "harvest flies," the members of which are the largest species of the group; the Fulgoridæ, or "lantern flies," which feed on the leaves and stems of herbaceous plants; the Membracidæ, or "treehoppers," which feed on twigs; the Cercopidæ, or "froghoppers," also known as "spittle bugs" because of the frothy masses that they make on the stems of grasses; and the Cicadellidæ, or "leafhoppers," which feed mostly on the leaves of plants. Kirkaldy[19] defines "leafhoppers" as a convenient, nontechnical term, to express auchenorhynchous Homoptera, excluding the Cicadidæ, but including the sternorhynchous family Psyllidæ (Chermidæ), generally known as "jumping plant lice."

[18] Op. cit. 4 (1908) 79.

[19] Rep. Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906).

The large family Cicadellidæ is separated from the other related groups by the more or less closely spinulose condition of the posterior tibia and the position of the ocelli. The position of this important family is still the subject of considerable difference of opinion among workers. Westwood recognized only three families in the order Homoptera; namely, Cicadidæ, Fulgoridæ, and Cercopidæ. Stål, supported by Hansen, recognized four; namely, Stridulantea, Cercopida, Fulgorida, and Jassida which include Membracida (Distant[20]). Edwards,[21] excluding Psyllina, enumerated fifteen families, which come under the present consideration of the group: Cicadellidæ, Ledridæ, with one genus; Ulopidæ, with one genus; Paropidæ, with one genus; Bythoscopidæ, Tettigonidæ, Acocephalidæ, Jassidæ, and Typhlocybidæ are considered families. Kirkaldy[22] placed under the superfamily Tettigonioidæ the family Tettigoniidæ with its subfamilies: Tettigoniinæ, Jassinæ, Agalliinæ, Penthimiinæ, Eupteryginæ, Ledrinæ, Stenocotinæ, Kahavaluinæ, and Megophthalminæ.

Baker[23] opposed what he termed the "antiquated artificial system" originally proposed for a few species formerly known in Europe; namely, if the ocelli are located on the disk, the specimen is a tettigoniellid; if on the margin, a jassid; and if on the face, a bythoscopid. He listed under the superfamily Jassoidea fifteen families; namely, the Tettigoniellidæ, the characteristics of which comprise those of the members of the *Tettigoniella* of Distant,[24] excluding the genera *Signoretia, Preta, Eucanthus,* and *Bundera;* the Gyponinæ, without the genus *Penthimia;* Penthimidæ, those of the genus *Penthimia;* Thaumatoscopidæ taking in the genera of Kirkaldy, *Thaumatoscopus* (allied to *Gypona,* and *Penthimia* and *Vulturnus* which I would consider a *Thaumatoscopus* itself—there is hardly sufficient reason for raising *Vulturnus* to the category of a genus); Ledridæ, those of the subfamily Ledrinæ; Paropidæ, taking the genera *Mesoparopia* of Matsumura and *Paropia;* Stenocotidæ with the genera *Stenocotes* and *Kyphocotes;* Koebelidæ, the genus *Koebelia;* the Ulopidæ, under which belong the genera *Ulopa* and *Moonia;* Signoretiidæ, *Signoretia* of Stål and *Preta*

[20] Fauna Brit. Ind. Rhynch. 3 (1906) 52–54.
[21] Hemiptera-Homoptera of the British Isles. L. Reeves & Co. (1896).
[22] Rep. Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 2 (1906).
[23] Philip. Journ. Sci. 24 (1923) 57–71.
[24] Fauna Brit. Ind. Rhynch. 4 (1908) 201–202.

of Distant; Eucanthidæ, *Eucanthus* and *Bundera;* Pythamidæ, consisting of *Onukia, Pythamus,* and *Oniella;* Nirvanidæ, having *Kana* Distant, *Ophuchus* Distant, *Stenometopius* Matsumura, and *Nirvana* Kirkaldy; and the genera recently erected by Baker—*Pseudonirvana, Nirvanoides, Pythonirvana,* and *Jassonirvana.*

DeLong,[23] considering the Connecticut species, divides the Cicadellidæ into four subfamilies based principally upon the location of the ocelli and the shape of the body: Bythoscopinæ, Jassinæ, Cicadellinæ, and Gyponinæ. The Typhlocybini becomes a tribe of the Jassinæ. Distant, following in the main the classification of Van Duzee, divided the Cicadelli into seven subfamilies: Ledrinæ, Bythoscopinæ, Tettigoniellinæ, Gyponinæ, Acocephalinæ, Jassinæ, and Typhlocybinæ. However, the Acocephalinæ are absorbed by the Jassinæ in his synopsis of the genera.

Lastly, Melichar [26] divided this family into two large sections, based mainly upon the shape and sculpture of the vertex and pronotum; the Proconiaria with 54 genera, and the Cicadellaria with 100 genera. However, according to China,[27] many of Melichar's generic names were preoccupied. Inasmuch as Melichar's types and discussed species were from southern America, and in view of this radical change in classification, I shall mention his work only as a reference.

CHIEF CHARACTERISTICS OF THE CICADELLIDÆ

In the classification of the Philippine species described herein, the main features or characteristics of the groups were taken into consideration according to different authorities with special reference to the work of Distant [28] and of Osborn.[29]

Family CICADELLIDÆ Latreille

Cicadellæ LATREILLE, Fam. Nat. Reg. An. (1825) 427.
Cicadellina BURMEISTER, Handb. d. Ent. 11 (1835) 103.
Cicadellines BLANCHARD, Hist. des Ins., Hemip. (1840) 187.
Tettigoniidæ FITCH, Homop., Fourth Ann. Rep. N. Y. State Coll. Nat. Hist. (1841) 55.
Jassina STÅL, Stet. Ent. Zeit. 19 (1858) 234.
Jassidæ FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 500.
Jassoidæ VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 296.
Tettigonioidæ KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 295.

[23] Conn. Geol. & Nat. Hist. Surv. Bull. 24 (1923).
[26] Ann. Mus. Nat. Homop. 21 (1924) 195-243.
[27] Ann. & Mag. Nat. Hist. IX 20 (1927) 281.
[28] Fauna Brit. Ind. Rhynch. 4 (1908).
[29] Ohio Biol. Surv. 3 No. 4 (1928).

The family Cicadellidæ was divided into seven subfamilies; namely, Ledrinæ, Bythoscopinæ, Tettigoniellinæ, Gyponinæ, Acocephalinæ, Jassinæ, and Typhlocybinæ. As a matter of convenience, the groups under the subfamily Acocephalinæ were placed under Jassinæ.

The insects are comparatively small, ranging from 2 millimeters in length, including the tegmina, among the Typhlocybinæ, to 18 millimeters among the Ledrinæ; tibia more or less elongated, hind tibia characteristically armed with a double row of spurs; tarsi 3-jointed; ocelli two, placed on the anterior just slightly above the margin of apex, in the Bythoscopinæ in front, below the margin; in the Tettigoniellinæ, Gyponinæ, and Ledrinæ, on the vertex (sometimes variable in the Ledrinæ); and in the Typhlocybinæ the ocelli are wanting; the antennæ setaceus, 2-jointed, and terminated by fine long hairs, invariably placed between the frons and the eyes; the tegmina, or superior wings, are thicker than the membranceous, or inferior, wings, which are folded at rest.

In the Cicadellidæ the position of the ocelli; the shape, size, and sculpture of the vertex, pronotum, and scutellum; the shape and size of the frons and the clypeus; the arrangement of the venation; the coloration or markings; and the external and internal characters of the genitalia are the principal taxonomic features for the grouping and the separation of species.

LEDRINÆ

Head broad; face moderately concave or somewhat convex; vertex spatulate, horizontally reclined, narrowly depressed or moderately convex; cheeks flat and white, frons and clypeus narrowly produced; antennæ inserted under the anterior part of head above the line of the eyes and far from them.

The only species studied was a *Petalocephala* in the Osborn collection.

Genus PETALOCEPHALA Stål

Petalocephala STÅL, Öfv. Vet.-Akad. Förh. (1853) 206.
Ledropsis MELICHAR (nec White), Hom. Fauna Ceylon (1903) 141.

Type, *P. bohemani* Stål, from Java.

Distribution: Ethiopian, Oriental, Malayan, and Australasian Regions.

Body very oblong or a little elongate, depressed; head clypeated, foliaceously produced anteriorly; vertex somewhat flattened; face beneath eyes strongly and abruptly, thence gradually, narrowed, margins very slightly defined; front small, narrow, flattish; eyes small; ocelli situated towards base of vertex, farther removed from the eyes than from each other; pro-

notum transversely sexangular, not, or only slightly, narrowed anteriorly, the lateral margins acute, anterior lateral much longer than posterior lateral, anterior margin slightly rounded; scutellum triangular, subequilateral; tegmina subcoriaceous pellucid, densely punctate, tectiform, anteriorly conjointly convex, clavus very broad before the middle, corium obliquely rounded at apex, veins somewhat irregularly anastomosed towards apex, legs somewhat short, anterior coxæ free, posterior tibiæ remotely dentate.—STÅL, translated by DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 162–163.

PETALOCEPHALA CULTELLIFERA Walker.

Petalocephala cultellifera WALKER, Journ. Linn. Soc. Zool. 1 (1856) 98.
Ledra punctifera WALKER, List. Hom. Suppl. (1858) 249; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 95.

Originally known from Sikhim; Mungphu (Atkinson collection); Darjiling (Brit. Mus.); Malay Peninsula; Perak (*Doherty*); Singapore (*Wallace*, Brit. Mus.) Distant.[39]

Length excl. tegmina, 15 to 17; exp. tegmina 28 to 32 millimeters.

Virescent or ochraceous; vertex about as long as breath between eyes, conically produced towards apex, thickly finely punctate, centrally longitudinally carinate; pronotum finely punctate, posteriorly finely rugulose, centrally longitudinally linearly impressed; tegmina thickly punctate; posterior tibiæ inwardly strongly dentate.—DISTANT, Fauna Brit. Ind. 4 (1908) 164.

LUZON, Mountain Province, Haight's Place, Balbalan (Osborn collection). This is the first Philippine record.

BYTHOSCOPINÆ

This subfamily is readily recognized by having the ocelli on the face below the anterior edge of the head, the vertex narrow or apparently wanting, the head being entirely deflexed.

Key to the Philippine genera of the subfamily Bythoscopinæ.

a^1. Tegmina without an appendix.
  b^1. Pronotum distinctly produced beyond the anterior margin of the eyes, and oblique rugæ ..... *Macropsis* Lewis.
a^2. Tegmina with a distinct appendix.
  b^1. Pronotum not produced beyond the anterior margins of the eyes.
    c^1. Vertex with eyes much broader than pronotum, head rounded.
      d^1. Ocelli nearer the eyes than each other..... *Idiocerus* Lewis.
      d^2. Ocelli equidistant from each other and the eyes. *Idiocerinus* Baker.
    c^2. Vertex with eyes slightly broader than pronotum, transverse, head blunt, transversally depressed. .. .. *Bythoscopus* Germar.
  b^2. Pronotum shorter and narrower than the scutellum and vertex together .... *Chunra* Distant.

[39] Fauna Brit. Ind. Rhynch. 4 (1908) 164.

Genus MACROPSIS Lewis

Macropsis LEWIS, Trans. Ent. Soc. Lond. 1 (1835) 49.
Pediopsis BURMEISTER, Gen. Ins. (1838) pl. 10.

The very narrow vertex is distinctly produced beyond the anterior margins of the eyes. The head is as wide as the pronotum. The lateral margins of the pronotum are short, the anterior margin as in *Tartessus*, the posterior concave, and the surface obliquely striated; the scutellum with a transverse depression before the apical angle, slightly broader than long; the tegmina thin and folded over the body as in *Bythoscopus*.

In this genus the males are darker and occasionally spotted (although the males of Nearctic species often show fewer markings than the females). The markings are not found in females of this genus, whereas in *Idiocerus*, a genus of the same subfamily, the spots are found in the females.

This genus, although apparently of world-wide distribution, has not been recorded from the Malayan region. Stål [31] described one species, *Macropsis maculipennis*, which is said to be a *Bythoscopus*. In Baker's collection there are several Japanese species determined by Matsumura under *Pediopsis*, which is a synonym of *Macropsis*. There are three specimens labeled *Macropsis*, but they belong to the genus *Bythoscopus*.

Breakey,[32] speaking of the geographic distribution, says that the genus is best known from the North Temperate Zone, and according to references found by him, ten species are described from the Ethiopian Region, four from Australia, one from Santo Domingo, eleven from the British Isles, outside of the thirty-two species and three varieties recognized by him as present in North America. Oshanin [33] recorded four species and one variety from Europe (one of them is a *Prosima* which was also recorded from Siberia), one from Japan, and two from China. Fowler [34] records two species of *Stragania* Stål, from Mexico, which were treated as a subgenus of *Gypona* and subsequently placed under the Jassinæ by Stål himself as being synonymous with *Macropsis* Lewis. In this paper (Hemiptera Africana 4: 126–127) he renamed *Bythoscopus olivaceous* Stål *Macropsis subolivaceous* Stål. Distant [35] described three species of *Pediop-*

[31] Öfv. Vet.-Akad. Förh. 27 (1870).
[32] Ann. Ent. Soc. Am. 25 (1932) 4.
[33] Ann. Mus. Zool. de Sci. 11 (1906) 67–69.
[34] Biol. Cen. Am. Rhynch. 2 pt. 1 (1909) 271.
[35] Fauna Brit. Ind. Rhynch. 6 (1916) 238–240.

sis (*Macropsis*) from India. These so far are the only *Macropsis* species known in the Indian fauna. Cogan [36] described one more species from Africa (*Pediopsis capensis*).

Specimens of the following nine new species were compared with Nearctic and Palearctic species at the United States National Museum:

MACROPSIS BREAKEYI sp. nov.

Female, length, including tegmina, 3 millimeters; male, length, including tegmina, 2.8.

Very small, robust, ochraceous all over, vertex regularly and transversely punctured with brown punctures, and transversely striated, about one-fourth as long as the distance between eye and middle of vertex; pronotum extended anteriorly, right-angled, median line indistinct, oblique striation rugulose, regularly punctured with brown, posterior angles in line with scutellum, oblique; posterior side slightly concave. Scutellum lightly punctured; face slightly tumid, appearing rugose from the side, clypeus minute, lora and gena almost invisible, ochraceous; plates of male long and spindling; the last ventral segment of female almost truncate, slightly projected at middle; pygofers very large; tegmina sordid hyaline, profusely and finely punctured with brown punctures.

MINDANAO, Zamboanga (holotype, Baker collection, U. S. N. M.).

I take pleasure in naming this beautiful species for Dr. E. P. Breakey, of the Department of Zoölogy and Entomology, Ohio State University, a homopterist to whom I am indebted for valuable suggestions and criticism during the progress of this work.

MACROPSIS RIZALI sp. nov.

Female, length, 4.5 millimeters.

Head, pronotum, and scutellum yellow; face, legs, and body beneath ochraceous, with brownish markings on the abdominal segments and pygofer, somewhat slender in form. Tegmina long, greenish transparent, with venation prominent, deeper green and yellowish green. Slender and medium-sized species. Pronotum regularly rugose, lightly marked with brownish patch on the anterolateral angle, prominently produced, anteriorly almost right angled, posterior side slightly concave. Median line obsolete; scutellum subtriangular, slightly broader than long, finely punctured; face broad, slightly tumid when viewed from

[36] Ohio Journ. Sci. 14 (1916).

side, forehead regularly and finely striated; frons elongated, slightly differentiated by shallow sulci; clypeus short and broadly rounded; lora minute, narrow, and elongated; gena narrow and elongated, depressed below the area of face, broader at apex; last ventral segment a projecting semicircular plate, slightly notched.

MINDANAO, Zamboanga Province, Dapitan (type and paratype, Baker collection, U. S. N. M.).

I am naming this species for the foremost Philippine hero, Dr. Jose Rizal, physician and scientist, who spent a few years in Dapitan as a political exile during the Spanish domination of these Islands.

MACROPSIS BENGUETENSIS sp. nov.

Female, length, 6 millimeters; male, length, 5.

Pale ochraceous with profuse brown and fuscous markings on the pronotum and scutellum, tegmina light brown with profuse fuscous markings. Male slightly darker.

Vertex almost invisible from dorsal view, obtuse-angled, at the middle much narrower than the portions close to the eyes, appearing as a line; pronotum obtuse-angled, broader than long, moderately convex, with a very distinct fuscous blotch or marking on each side of the anterior line, midway between the anterolateral and the median line which is slightly carinate or ridged, the oblique ruga, starting from the upper middle portion to the lower side and gradually to the umbral angle, very prominent and roughly punctured; middle portion of the pronotum profusely marked with brown; scutellum ochraceous, roughly punctured, posterior angle sharply pointed and separated by an arcuate suture, somewhat striated with transverse striæ on upper-lateral angle, with obliquely triangular fuscous markings; face ochraceous, broad, almost flat, slightly tumid on the clypeal portion, contour slightly rough, coarsely and profusely punctured; frons sordid, tinged with ferruginous, especially in males; eyes brown with slight fuscous blotch on inner portion, loræ and genæ minute, ocelli on the face between eyes and frons; antennæ minute, beneath the inner posterior angle of the eyes, above the deeply sulcated cheek; pectus and venter ochraceous with fuscous markings on the portions of the prosternum and metasternum, femora, tibiæ, and tarsi, especially noticeable in males, tegmina membranous brown, strongly corrugate, sordidly marked with irregular fuscous markings; venation prominent, ochraceous, stippled with fuscous. A robust species.

LUZON, Benguet Subprovince, Baguio (type and allotype, Baker collection, U. S. N. M.).

MACROPSIS FUSCOVENOSA sp. nov.

Male and female, length, 4 millimeters.

Pronotum and scutellum of the female grass green, the pronotum of the male pale brown with profuse fuscous punctures, the scutellum of the same color and with the same punctures, and with one fuscous triangular marking on each of the three angles; eyes grayish with crimson tinge; the face, pectus, legs, and venter of female greenish ochraceous, with brown markings on the legs; those of the male ochraceous, with brown punctures on the face, and brownish markings on the legs. Dimorphism is distinct in this species.

Pronotum convex, slightly less than a right angle, oblique impressions prominent, median line present, about two-thirds as long as broad, the posterior side narrowed and concave; scutellum almost as long as broad, as long as the pronotum, median line present, posterior angle separated with arcuated suture, with coarse brown punctures, face with median line also, rough surface, slightly longitudinally carinate on the middle; gena small and depressed, narrow margin extended to the base of clypeus, which is also small and narrowed at apex; the plates of the genitalia slender and elongate (filiform), the last ventral segment of the female small, wedge-shaped; tegmina long, smoky pale brown with very prominent fuscous venation.

LUZON, Benguet Subprovince, Baguio (type and allotype, Baker collection, U. S. N. M.).

MACROPSIS FUSCOPUNCTATA sp. nov.

Female, length, about 4.75 millimeters.

Greenish ochraceous with sordid brown promiscuous punctures all over head, face, pronotum, scutellum, and tegmina, quite similar in form to *M. fuscovenosa*, but slightly larger; pectus and legs with brownish markings.

Pronotum distinctly angulate anteriorly, rectangular, median line distinct, striæ profusely punctured with brown dots, rugulose, posterolateral angles rounded, middle posterior side slightly concave; scutellum greenish ochraceous, with median line profusely punctured with brown spots, especially the three angles, the posterior separated by an arcuated suture; face roughly striated and punctured, sordidly marked with brown markings, oblique striation from middle to the eyes deep, median line present, reaching nearly to clypeus; frons distinguished by two

parallel, semicircular, brown lines, clypeus broadly rounded; lora and gena small; pectus and legs with brown markings; venter greenish ochraceous; last ventral segment transversely triangular, wedge-shaped; tegmina smoky hyaline, long, with profuse brown punctures, especially the commissural region; venation punctured all over with brown.

LUZON, Benguet Subprovince, Baguio (type and paratype, Baker collection, U. S. N. M.).

MACROPSIS OTANESI sp. nov.

Female, length, 4.25 millimeters; male, length, 4.25.

Testaceous to fuscous, medium-sized; face, pectus, legs, and venter ochraceous, with a brown tinge, the upper portion of the head semitransparent fuscous. Vertex very narrow and projected in front, about one-fifth as broad as the distance between the eye and one-half of the vertex; pronotum testaceous, with short, fine, oblique striation, regularly and profusely punctured with fuscous punctures, median line absent, acutely angled, slightly more than right-angled, about three-fourths as long as wide between humeral angles, posterior side subtruncate; area of scutellum more testaceous and less thickly punctate, lateral angles smoothly brown, transversal suture separating the posterior angle; face smoothly rugose, ocelli ochraceous, situated between and near the eyes; legs and venter ochraceous with brownish tinge; pygofer orange-brown; the plates castaneous; tegmina fuscous to castaneous, with irregular fuscous markings.

BASILAN (type and allotype). MINDANAO, Zamboanga (paratypes, Baker collection, U. S. N. M.).

I take pleasure in naming this species for my friend and loyal assistant Mr. F. Q. Otanes, of Manila, who from time to time has supplied me with homopterous insects for determination.

MACROPSIS BASILANA sp. nov.

Female, length, including tegmina, 5 millimeters.

Dark brownish ochraceous, vertex, pronotum, and scutellum ochraceous with a brown marking on each basal angle of scutellum; tegmina sordid hyaline, brown with fuscous markings at the ends of principal veins, and division of principal cells, face, pectus, venter, and legs ochraceous, pygofer with a brown patch on the middle of each sheath; ovipositor exceeds the length of the pygofer considerably, as long as tegmina or slightly longer; vertex acutely produced, slightly more than right-angled, about one-fourth as long as the distance from the middle to the eyes;

transversely and briefly striated, finely punctured, with fine testaceous dots; pronotum with same color ornamentation and sculpture as the vertex, produced slightly more than a right angle in front, posterior side somewhat concave, markings on center and posterior side darker than rest, median line absent; face, forehead center semihyaline, brown, rugose; clypeus, lora and gena minute, similar to *M. otanesi*, but relatively slenderer and longer, especially the ovipositor.

BASILAN (type). MINDANAO, Zamboanga (paratype, Baker collection, U. S. N. M.).

MACROPSIS LUZONENSIS sp. nov.

Female, length, including tegmina, 4.5 millimeters; male, length, including tegmina, 4.

Yellowish brown; pectus and legs of female brownish ochraceous, with brown tinge on venter and pygofer; those of male greenish ochraceous; tegmina similar to those of *M. basilana*, but the markings finer, the colors similar to *M. basilana*, but size and general conformations similar to those of *M. otanesi*.

Vertex very short, about one-fourth as long as the distance from the center to the eye, greatly produced in front, slightly more than right-angled; anterior side of pronotum greatly produced, median line absent, oblique striation and punctures fine and concolorous, about two-thirds as long as broad, anterior angle concave; scutellum slightly lighter, posterior angle impressed before apex.

LUZON, Laguna Province, Mount Maquiling (type and paratypes, Baker collection, U. S. N. M.).

MACROPSIS DAPITANA sp. nov.

Female, length, including tegmina, 5.5 millimeters.

Vertex short, longer at the side near the eye, middle portion a mere line, olive-brown, regularly punctured; pronotum roundly produced, less than right-angled, about twice as broad as the length, coarsely and regularly punctured; posterior side roundly and gradually concave, scutellum orange-brown, equilaterally triangular, regularly and finely punctured; face roundly tumid, olive-brown; pectus black; legs and venter brown; last abdominal segment trisinuate; tegmina olive-brown, venation orange-brownish.

MINDANAO, Zamboanga Province, Dapitan (type and paratypes, Baker collection, U. S. N. M.).

MACROPSIS DAVAOENSIS sp. nov.

Female, length, including tegmina, about 3 millimeters.

Similar in size and shape to *M. mindanaoensis*. Vertex and pronotum greenish ochraceous, fine striation and punctures concolorous, median line indistinct; scutellum yellowish ochraceous with fine brown punctures all over, apical angle with shallow and short impressed suture; tegmina hyaline, sordid brown with profuse brown to fuscous spots; face greenish ochraceous, slightly tumid and finely stippled; pectus, legs, and venter brownish ochraceous with brown markings.

MINDANAO, Davao Province, Davao (type); Lanao Province, Iligan (paratype, Baker collection, U. S. N. M.).

Genus IDIOCERUS Lewis

Idiocerus LEWIS, Trans. Ent. Soc. Lond. 1 (1836) 47.
Idioscopus BAKER, Philip. Journ. Sci. § D 10 (1915) 338.

Type, *I. adustus* H. S., a Palæarctic species.

The head is broad and very short, the vertex merging into the front. The eyes prominent, the elytra long, usually narrowing toward the tip, the body appearing wedge-shaped and the nervures are strong, often being set with tubercles or papillæ alternately. The male antennæ are peculiar in having swollen disc-like portions near the tips of the setæ.—OSBORN and BALL, Proc. Davenport Acad. Nat. Sci. 7 (1898) 124.

According to Osborn,[37] "the larvae differ from other tree inhabiting forms in having broad heads and thorax and long slender cylindrical abdomen." They are found most abundant and in swarms during the dry weather from February to April.

Baker [38] made *Idiocerus clypealis* Lethierry the type of a new genus *Idioscopus* and included therein two new species, *palawanensis* and *tagalicus*, because, he states, the head is larger, narrower, and longer as seen from above. He says that it is distinctly longer at the middle than at the eyes, that it is long in proportion to width between eyes, and that the first apical and first subapical cells are confluent. The generic characteristics of this species seem to tally exactly with those of *Idiocerus*, as given by Distant from Osborn and Ball.[39]

IDIOCERUS CLYPEALIS Lethierry.

Idiocerus clypealis LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 252; ATKINSON, Ind. Mus. Notes 4 (1891) 187; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 187.

[37] Ohio Biol. Sur. 3 (1923) 209.
[38] Philip. Journ. Sci. § D 10 (1915) 317–343.
[39] Proc. Davenport Acad. Nat. Sci. 7 (1898) 124.

Idiocerus nigroclypeatus MELICHAR, Hom. Fauna Ceylon (1903) 148, pl. 5, fig. 1, *a*, *b*.
Idioscopus clypealis Lethierry, BAKER, Philip. Journ. Sci. § D 10 (1915) 339-340.

Female.—Length, including tegmina, 4 millimeters.

Head, viewed from above, large, broad, and short, the eye exceeding the pronotum, the vertex being only one-half as long as broad from the middle to the eye; apical cells four; anteapical three; tegmina wedge-shaped, longer than the abdomen, being narrowed and folded behind, the exact characteristics for the genus. Distant, however, in describing it, did not state that it is the male that lacks the two spots on the anterior margin of head, a sexual characteristic. Neither did he mention the fact that it is the male that has the immaculate face, and that the female has two small spots on the frons between the eyes, another sexual differentiation.

Distant [10] stated that the clypeus is flavescent with a central longitudinal black facia; this feature is also absent. All of my specimens, male and female, have a uniform clypeus. The two spots on the apex of the vertex and the two on the frons are absent in the male.

"Habitat: Bengal, Calcutta, Pusa, Madras, Ceylon, Peradiniya, Colombo." (Distant.)

LUZON, Laguna Province, Los Baños (*Baker*). MINDANAO, Occidental Misamis Province, Oroquieta (*Merino*), on mango. Baker believes that this species occurring in swarms is as injurious to the mango plant as *C. niveosparsa*.

Genus IDIOCERINUS Baker

Idiocerinus BAKER, Philip. Journ. Sci. § D 10 (1915) 241.

Type, *I. melichari* Baker.

This genus was erected by Baker [11] on the form of the frons which, according to him, is different from any other Philippine idiocerine insect. The clypeus is shorter compared to its width than in the other nearly related groups. Perhaps also the absence of the upper cubital branch of the wing veins and the reduction in size of the second apical cell are unique. Other characteristics are typical of *Idiocerus*.

[10] Fauna Brit. Ind. Rhynch. 4 (1908) 187.
[11] Philip. Journ. Sci. 10 (1915) 241.

IDIOCERINUS BAKERI sp. nov.

Female, length, including tegmina, 4.5 millimeters.

Vertex virescent with olivaceous area on the median occupying two-thirds of the apex; frons and clypeus orange, cheeks and lora ochraceous, clypeus short and wide; pronotum with slightly more than two-thirds of the posterior area testaceous and the anterior third virescent, transversely more than twice as long as the vertex; anterior margin rounded, posterior broadly truncate; scutellum equilateral, longer than the pronotum, testaceous; body beneath and legs ochraceous; last ventral segment truncate; tegmina long, apical cells four, the second outer reduced, upper cubital branch inconspicuous with distinct appendix, claval area olive-green, the rest brown, venation fuscous, a longitudinal fuscous fascia from humeral angle to apical margin, a fuscous patch at margin within the first and second apical cells.

LUZON, Laguna Province, Los Baños (type in my collection).

I am naming this species in honor of the late Prof. Charles Fuller Baker, under whom I did my first field work in entomology.

Genus BYTHOSCOPUS Germar

Bythoscopus GERMAR, Silb. Rev. Ent. 1 (1833) 180; LEWIS, Trans. Ent. Soc. Lond. 1 (1836) 48; FIEBER, Verh. Zool.-Bot. Ges. Wien 18 (1868) 450–456; Rev. Mag. Zool. (3) 3 (1875) 389; KIRKALDY, Ent. 34 (1901) 340; Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 (1906) 345; 3 (1907) 31; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 190; VAN DUZEE, Ottawa Nat. 26 (1912) 69.

Batrachomorphus LEWIS, Trans. Ent. Soc. Lond. 1 (1835) 51; WESTWOOD, Intr. Mod. Classif. Insects 2 Synop. (1840) 117; KIRKALDY, Ent. 34 (1901) 219 (names *irroratus* type).

Macropsis AMYOT and SERVILLE, Hem. (1843) 585; FIEBER, Verh. Zool.-Bot. Ges. Wien 18 (1868) 449; STÅL, Hem. Afr. 4 (1866) 126; KIRSCHBAUM, Cicad. 5 Wiesbd. (1868) 16; SAHLBERG, Cicad. (1871) 113; FIEBER, Cicad. d'Eur. 1 (1875) 101; MAYER, Tabellen (1884) 26; EDWARDS, Trans. Ent. Soc. Lond. (1886) 104; ASHMEAD, Ent. Am. 5 (1889) 126; VAN DUZEE, Ent. Am. 5 (1889) 165; Trans. Am. Ent. Soc. 21 (1894) 250; BALL, Psyche 9 (1900) 128; OSHANIN, Verz. Palae. Hem. 2 (1900) 67; Kat. Palae. Hem. (1912) 101; DELONG, Tenn. St. Bd. Ent. Bull. 17 (1916) 9.

Stragania STÅL, Rio Jan. Hem. 2 (1862) 49; FOWLER, Biol. Centr. Am. Hom. 2 (1903) 316.

Pachyopsis UHLER, Bull. U. S. Geol. Surv. 3 (1877) 466 (type *lætus* Uhler); ASHMEAD, Ent. Am. 5 (1889) 165.

Gargaropsis FOWLER, Biol. Centr. Am. Hom. 2 (1896) 167.

Type, *B. lanio* Linnæus.

Distribution: Universal.

General appearance broad and robust, head short and bluntly rounded, face broad and short; frons greatly raised from cheeks; pronotum slightly wider than long, coarsely transversely striated, anterior margin rounded, posterior margin slightly concave, almost truncate; posterolaterals oblique, slightly rounded at corners; tegmina moderately long and tapering towards the end, the tip narrow and rounded: venation reticulated or longitudinally punctured.

Distribution: Bengal, Calcutta, Ceylon, Tenassarim.

BYTHOSCOPUS CHLOROPHANUS Melichar.

Bythoscopus chlorophanus LETHIERRY (*Pachyopsis*), Bull. Soc. Zool. Fr. (1892) 209; MELICHAR, Hom. Fauna Ceylon (1903) 153; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 191, fig. 124; MELICHAR, Notes Leyd. Mus. 35 (1914) 121; OSBORN, Pacific Ent. Pub. 7 (1934) 241.

Male, length, about 4.5 millimeters; female, length, about 5.

Vertex, pronotum, and scutellum light green to stramineous, tegmina greenish ochraceous with piceous spots at end of clavus, face yellowish ochraceous to stramineous, body beneath and legs greenish ochraceous. Vertex narrow and broad, its length about one-sixth the distance between the eyes. Vertex with the eyes narrower than the pronotum; pronotum slightly broader than long, transversely striated, anterior margin rounded, posterior margin almost truncate; scutellum subtriangular, slightly narrower than broad, apical angle impressed with transverse line and separated by an arcuate impressed line, the rest finely punctured; eyes brick red; ocelli nearer to the eyes than to each other, face broad and short, surrounded by short striæ; venation longitudinally punctured.

This species is here reported from the Philippines for the first time.

LUZON, Laguna Province, Los Baños, Mount Banahao: Bataan Province, Mount Limay. MINDANAO. PALAWAN.

Genus CHUNRA Distant

Chunra DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 193; BAKER, Philip. Journ. Sci. § D 10 (1915) 324–326.

Type, *C. punctiosta* Walker.

Distribution: Oriental and Malayan Regions.

Vertex very short and broad, with eyes distinctly broader than pronotum; face narrowed between eyes, the ocelli about as near to each other as to eyes and placed a little below middle of eyes, which are obliquely long and narrow and extend along the lateral margins of the pronotum; pronotum twice as long as vertex, the posterior margin concavely sinuate;

scutellum very long and broad, longer than pronotum and vertex together, transversely impressed before apical area which is moderately raised, the apical margin broadly subacute; legs moderately slender, the posterior tibiæ thickly spinulose, tegmina with the clavus posteriorly broadened to middle and then angularly narrowed to the clavul apex, apical areas four, the upper or postcostal area short and moderately broad; wings ample.

—DISTANT, loc. cit.

CHUNRA NIVEOSPARSA Lethierry.

Chunra niveosparsa LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 252; ATKINSON, Ind. Mus. Notes 1 (1889) 5; No. 4 (1891) 187, pl. 12, fig. 6; Journ. As. Soc. Bengal 72 pt. 11 (1903) 7; BAKER, Philip. Journ. Sci. § D 10 (1915) 318; 324–326.

Idiocerus basalis MELICHAR, Hom. Fauna Ceylon (1903) 147.

Idiocerus niveosparsus DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 186, fig. 121.

Female, length, including tegmina, 4.25 millimeters.

Vertex ochraceous with large discal fuscous or olivaceous spots; front, clypeus, lora, and rostrum brown, cheeks ochraceous, ocelli fuscous, located just above the suture of the rounded frons, the distance between them twice the distance between ocelli and eyes; eyes olivaceous; pronotum transverse, about three times as long as length of vertex, rounded anteriorly, the lateral margin oblique and the posterior broadly sinuate, with olivaceous marking posteriorly, anterior margin lighter; scutellum equilateral, bronzy olive, as long as the pronotum, posterior angles light ochraceous, almost white, three spots of similar color above this; tegmina darker bronzy olive, white transversal band from humeral angle to the posterior angle of scutellum, white marking at the posterior tip of the scutellum, and at posterior extremity of costal area; white marking of costal area preceded by fuscous; venation and posterior margin fuscous.

Habitat: Saharanpur, Calcutta, Madras, Bombay Province, Jutalpur, Ceylon, Peradenya, Pattipola.—DISTANT, loc. cit.

Baker [42] reported this insect from the Philippines and other Malayan countries, where it attacks mango flowers in swarms. He disagrees, however, with the description and the illustration of Distant, and places the Philippine species under the genus *Chunra*. Of this species he described three new varieties; namely, *Chunra niveosparsa* Leth. var. *philippinensis*, var. *palawensis*, and var. *lagunensis*.

The species described above from Oroquieta, Mindanao, tallies somewhat with the synopsis for var. *palawensis* Baker. The

[42] Philip. Journ. Sci. § D 10 (1915) 324-326.

frontoclypeal suture as shown in Distant's figure is not quite visible, moreover the marking on the scutellum is different from that of Distant.[43] Baker, however, was apparently in error in the discussion of this species. His citation referred to *Idiocerus niveosparsus* Lethierry, but his discussion was about the genus *Chunra* Distant. The Philippine species, however, is a *Chunra* and not an *Idiocerus*.

This species is associated in the Philippines with *Idiocerus clypealis* Lethierry, which is destructive to mango trees, sucking the juices of the young shoots and the flowers, and causing the latter to wither and fall. Trees severely attacked produce few or no fruits. Mango growers in the Philippines smudge their trees daily long before inflorescence, some during the months of March and April. Spraying with soap solution or with nicotine sulphate just before the mango flower opens has been successful.

These two leaf hoppers are the most pernicious mango pests in the Philippines.

TETTIGONIELLINÆ

This subfamily is easily recognized by the presence of the ocelli on the disk of the vertex, the large and prominent convex face, with long narrow cheeks, and the rounded or obtuse edge of the head.

Distant's synopsis includes eleven genera. Two other genera were described under this subfamily, making thirteen genera in all. I have added *Makilingia* by Baker.[44] I have followed, in the main, the great work of Distant. The following is a tentative key to the genera considered in this paper:

Key to the Philippine genera of the subfamily Tettigoniellinæ.

a^1. Face neither centrally carinate nor foveate.
  b^1. Lateral margins of vertex at the central margin of the eyes.
    c^1. Vertex not foveate ..... *Cicadella* Latreille.
a^2. Face globose; two carinations united posteriorly on basal area.
  b^2. Lateral margins of vertex at the central margin above the eyes.
    c^1. Vertex flattish or concave..... *Makilingia* Baker.
  b^2. Lateral margins of vertex at the central margin of the eyes.
    c^1. Vertex with a fine central longitudinal carination and an oblique carination on each side of anterior area..... *Mileewa* Distant.

Genus CICADELLA Latreille

Cicadella LATREILLE, in Cuvier, Regne Animal 3 (1817) 406; KIRKALDY, Can. Ent. 39 (1907) 249; VAN DUZEE, Check List Hem. (1916) 66.

[43] Fauna Brit. Ind. Rhynch. 4 (1908) 193–194.
[44] Philip. Journ. Sci. 24 (1924) 67–70.

Tettigonia REAUMUR, Memoirs 5 (1740) 150 (pre-Linnean); GEOFFROY, Hist. Abreg. des Ins. 1 (1762) 429, nom. praeoc.
Cicada FABRICIUS, Syst. Ent. (1775) 682 (name cited in error); *Cicada viridis* LINNÆUS, Syst. Nat. 1 (1758) 438.
Ablycephalus CURTIS, Brit. Ent. 1 (1833) 193.
Tettigoniella JACOBI, Zool. Jahrb. 19 (1903) 778, nom. nov.; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 201.

Type, *C. viridis* Linnæus, a Palæarctic species.

Vertex anteriorly convexly or subangularly produced, the lateral margins in a line with the inner margins of the eyes; face moderately globose, neither carinate nor foveate, moderately elongate, lateral areas transversely striate; pronotum longer than vertex, the anterior margin more or less convex, posterior margin truncate; scutellum somewhat small, transversely impressed before the apical area; tegmina longer than abdomen, apical areas five; posterior tibiæ longly spinulose.—DISTANT, loc. cit.

Most of the specimens in this collection are dark chocolate-brown with ferrugineous head and upper third of pronotum; eye pitch black, apex of tegmina dark copper brown; the frons somewhat triangular, about as long as broad between eyes, ferruginous with the middle depressed and slightly streaked with light brown, laterally slightly striated; division of clypeus hardly visible, gena and lora light ochraceous; pectus ochraceous, legs ferruginous, two anterior pairs of tibia and tarsal joints fuscous; venter orange with black band on the anterior halves of every segment; the last ventral segment ochraceous. There is a gradation of color from chocolate to dark brown among the specimens in my collection.

CICADELLA (TETTIGONIA) LONGA Walker.

Male, length, about 13 millimeters; female, length, about 14.

Ferruginous, slender, linear, pale, tawny beneath; head convex in front; face obtuse with a tawny disk; sides of the abdomen luteous; forewings with a black interrupted stripe near the hind border, and another more indistinct in the disk, hind-wings coppery.—WALKER, List. Hom. 11 (1851) 740.

LUZON, Rizal Province, Novaliches: Laguna Province, Los Baños.

According to Distant[45] this species is synonymous with *C. ferruginea*. However, China in one of his determinations in the Baker collection labeled this species as distinct from *C. ferruginea*.

[45] Fauna Brit. Ind. Rhynch. 4 (1908) 202–203.

CICADELLA FERRUGINEA Fabricius.

Tettigoniella ferruginea FABRICIUS (*Cicada*), Ent. Syst. 4 (1794) 32; Syst. Rhyng. (1803) 62; GERMAR (*Tettigonea*), Mag. Ent. 4 (1821) 69; SIGNORET, Ann. Soc. Ent. Fr. (1853) 676, pl. 22, fig. 5; WALKER, List Hom. Suppl. (1858) 218; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 98.

Tettigonia apicalis WALKER, List Hom. 3 (1851) 736.

Tettigonia confinis WALKER, List Hom. 3 (1851) 736.

Tettigonia addita WALKER, List Hom. 3 (1851) 737.

Tettigonia gemina WALKER, List Hom. 3 (1851) 737; MELICHAR, Hom. Fauna Ceylon (1903) 165.

Tettigonia obscura WALKER, List Hom. 3 (1851) 738.

Tettigonia duplex WALKER, List Hom. 3 (1851) 738.

Tettigonia reducta WALKER, List Hom. 3 (1851) 739.

Tettigonia immaculata WALKER, List Hom. 3 (1851) 740.

Male, length, including tegmina, about 13 millimeters.

The last ventral segment of the female is deeply sinuate at the middle and roundly angled at the extremities of the lateral side. That of the male is almost truncate, with the anal plates acutely triangular. It almost entirely covers the pygofer. Of the distinguishing characteristics of this species the yellow abdomen with a semicircular black spot at the base of both lateral sides of each segment is unique.

Habitat: India, Burma, Malay Peninsula, Java, Sumatra, Borneo, Philippines, China, and Japan.

LUZON, Manila.

CICADELLA IMPUDICA Signoret.

Tettigonia impudica SIGNORET, Ann. Soc. Ent. III 1 (1853) 132 and 677 (Manila); STÅL, Hem. Ins. Philippinarum 2 (1870) 733; TASCHENBERG, Zeits. Natur 57 (1884) 430 (Siam).

Tettigoniella impudica Signoret, BAKER, Philip. Journ. Sci. § D 4 (1909) 553; 5 (1910) 60 (Palawan).

Female, length, including tegmina, 13 millimeters; male, length, including tegmina, 5.

Reddish brown, slender, linear, head convex in front; face obtuse; frons and clypeus reddish brown; gena and lora grayish brown; frons with reddish orange longitudinal band on the center, dimly laterally and perpendicularly striated; vertex sulcated between eyes and ocelli; eyes fuscous; tegmina long, fuscous, brown at apex; body beneath pectus reddish brown in female and ochraceous in male; venter reddish brown, dorsally black; posterior wings black.

This species is similar to the two preceding species, but is slightly smaller and slenderer and lighter brown. The last ventral segment of the female is obtusely and somewhat roundly pro-

duced with a ridge at the center that is slightly lobed. The anal plates of the male are longer with a long filiform appendage about two-thirds as long as the rest of the plate slightly passing the pygofer; pygofer is more robust and profusely pilose.

Cicadella impudica has been found associated with *C. longa*.

Described by Signoret from a specimen collected in Manila. It is not known from anywhere else.

CICADELLA PHILIPPINA Walker.

Cicadella philippina Walker, List Hom. Ins. 3 (1851) 740.
Tettigonia philippina Signoret, Ann. Soc. Ent. III 1 (1853) 122 and 674, pl. 22, fig. 3; Stål, Öfv. Vet.-Akad. Förh. 27 (1870) 733.

Female, length, including tegmina, 15 millimeters; males, length, including tegmina, 14.

Head, pronotum, and scutellum pitch black; vertex anteriorly rounded and bluntly produced, with a lateral marginal yellow fascia just before each eye, a median marginal fascia extending from the outer part of the vertex forward on to the front; ocelli amber yellow; eyes black, surrounded by a narrow ochraceous line; frons tumid, about one and one-half times as long as broad, margined by black fascia uniting just above the clypeus; frons separated by a compressed black line, hardly discernible; gena and lora yellow; pronotum slightly transverse, slightly broader than long, basal side bluntly rounded, lateral side almost parallel, the marginal somewhat inwardly sinuate, the two lateral yellow markings occupying almost two-thirds of area of the pronotum; scutellum and equilateral triangle with large, median, basal yellow marking; tegmina cherry red to fuscous. In males the commissure region and the costal area margined with black bands. The females with yellow patches as on the basal claval and on the basal costal regions, surrounded by dark fuscous areas, the rest of tegmina brown to cherry red; venation fuscous; body beneath, pectus, and legs ochraceous-brown; abdominal region above black; venter fuscous with ochraceous terminal band on each segment; last ventral segment in female acutely angled on the lateral edges, slightly more acute than in *Cicadella longa*. Anal plates of the male similar to those of *C. longa*, *C. ferruginea*, and *C. impudica*. Female darker than the male ventrally.

The Baker collection from various parts of Mindanao contains a female of the coloration of the male described with specimens collected in Iligan, Kolambugan, and Butuan. Some

of the specimens from Butuan are still darker with lighter areas on the middle extending down to the apices. This is true also of the specimens from Surigao. Some of these have the pronotal markings continuous, while those of the vertex are indistinct.

MINDANAO, Zamboanga Province, Port Banga: Lanao Province, Mumungan (Osborn collection).

CICADELLA SPECTRA (Distant).

Tettigonia albida WALKER, List Hom. Insects 3 (1853) 767; SIGNORET, Ann. Soc. Ent. France (1853) pl. 21, fig. 3; STÅL, Hem. Afr. 4 (1866) 117; Öfv. Vet.-Akad. Förh. 27 (1870) 734; KIRKALDY, Entomologist 23 (1900) 294; BREDDIN, Albi. Senah Nat. Ges. 25 (1900) 192; Albi. Naturf. Ges. Halli 24 (1901) 31; MELICHAR, Hom. Fauna Ceylon (1903) 157; Wien. Ent. Zeits. 24 (1905) 29; KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 319; BIERMAN, Notes Leyd. Mus. 29 (1907); 33 (1910) 52 (nec Walker).

Tettigonia negrilinea STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 735.

Tettigoniella spectra DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 211–212, fig. 137; MATSUMURA, Insek. Zuckerrohr Formosa (1910) 27; DISTANT, Ins. Transvaal pt. 10 (1910) 233, fig. 41 (South Africa); MELICHAR, Notes Leyd. Mus. 36 (1913) 123 (Java); DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 3; FLETCHER, Proc. 3d Ent. Meeting, Pusa (1918) 177; DAMMERMAN, Landbouwdierk, Oost. Ind. (1919) 170; FLETCHER, Proc. 3d Ent. Meeting, Pusa 1 (1920) 274.

The four black spots on the vertex do not appear in Walker's description.

Distant [46] gives a new name for *spectra*, and according to him the localities are the following: Calcutta, E. Bengal, Pusa, Nepal, Janakpur, Uagpur, Surat, Bombay, Ceylon, Peradeniya, North Australia, etc. No mention is made of the Philippines. He quotes E. E. Green about this insect, who says, "Makes itself a nuisance, swarming round lamps in the rooms at night," and N. Annandale, "Common at the edge of tanks. It is able to walk." Kirkaldy [47] gives us additional records of Queensland, Celebes, and the Philippines, where it is found on sugar cane and various grasses, and Stål [48] of Madagascar and West and South Africa.

In the Philippines this species is very common, swarming around lamps during the early part of the rainy season. It has been collected from Luzon to Mindanao.

[46] Fauna Brit. Ind. Rhynch. 4 (1908) 211.
[47] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 319.
[48] Öfv. Vet.-Akad. Förh. 27 (1870) 734.

CICADELLA WHITEHEADII (Distant).

Tettigoniella whiteheadii DISTANT, Rhynch. Malayana, Rec. Ind. Mus. 11 pt. 1 (1908) 142-143; BAKER, Philip. Journ. Sci. § D 9 (1914) 418, fig. 9.

Female, length, about 11 millimeters.

Greenish pale ochraceous with fuscous venation. Tibiæ and tarsi fuscous; vertex with two black spots on apical margin; one black dot on each lateral margin, and one median angulated spot connected with a narrow black line to the base of the vertex; pronotum rounded in front and slightly concave, the lateral sides oblique, almost as long as broad, a longitudinal median black fascia attenuate on anterior third of pronotum; scutellum small with a longitudinal median fascia, anterior third almost indiscernible; a black margin on each upper claval area bordering commissural line down to tip of clavus; face strongly tumid, with a broad flattened front, lateral sides striated, striæ perpendicular to median parallel lines; tibiæ and tarsi fuscous.

LUZON, Laguna Province, Mount Banahao: Mountain Province, Benguet Subprovince, Mount Santo Tomas (*J. Valdez*; Osborn collection).

CICADELLA DIFFERENTIALIS Baker.

Cicadella differentialis BAKER, Philip. Journ. Sci. § D 9 (1914) 420.

Female, length, including tegmina, 7.5 millimeters.

Head, pronotum, and scutellum yellowish green. Vertex anteriorly convex, sordidly striated with light brown stria at apex; three black spots on disc, one on middle near base of vertex, and two on lateral margin near basal angle of face; pronotum with a semilunar dark green line on middle upper edge, and three fairly large square green spots on middle part; tegmina with pale fuscous veins; body beneath pale green with yellowish spots at places; legs pale ochraceous; lateral sides of last ventral segment notched, clipped, with middle slightly indented at center.

LUZON, Laguna Province, Los Baños, Mount Banahao: Rizal Province, Alabang (*J. Valdez*); Mountain Province, Baguio (Osborn collection).

CICADELLA BIPUNCTIFRONS Stål.

Cicadella bipunctifrons STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733-734.

Female, length, including tegmina, about 8 millimeters.

Ochraceous. Vertex rounded, as long as half the distance between the eyes; foveate between eyes and ocelli; with two black

spots on apex of vertex equidistant from each other to eyes and above ocelli; two parallel brown fascie running longitudinally from apex down to clavus; frons broad and tumid, ochraceous, faintly striated with short perpendicular lines, one oblique brown marking on each lateral side; ocelli and eyes fuscous; face and clypeus ochraceous; pronotum transverse, basal and lateral sides rounded and margins truncate, four broad brown bands running longitudinally; scutellum triangular, acutely pointed at base, two central pronotal bands split on pronotum, dividing into four parallel longitudinal bands; clavus ochraceous with brown markings projected from head and notal regions, margined from claval suture by a red fascia which is one-third as wide as clavus; tip of tegmina transparent fuscous, rest of tegmina red with fuscous margin; wings fuscous, almost black; body and notal and abdominal dorsal region concolorous with wings; ventral side and legs yellowish ochraceous; last ventral segment with triangular-lobed sides and rounded central margin.

LUZON, Laguna Province, Los Baños (*S. S. Gonzales*), Mount Banahao. MINDANAO, Surigao (Osborn collection).

CICADELLA QUINQUENOTATA Stål.

Cicadella quinquenotata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734.
Kolla tripunctifrons BANKS, Philip. Journ. Sci. § D 5 (1910) 52, Palawan.

Length, including tegmina, about 9.25 millimeters.

Uniformly yellowish green. Vertex somewhat anteriorly produced, as long as wide between eyes, with discal black spots, two at apex, and two on margin in front of eyes; ocelli ochraceous-amber; eyes fuscous, with a distinct black spot on the lateral edge; face about one and one-half times as long as broad; frons swollen and somewhat flat on the middle, somewhat striate laterally; clypeus swollen and clearly separated by a suture; cheeks and lora pale pink; pronotum hexagonal, almost as long as broad with a curved transverse groove at anterior fourth, just back of the area of pronotal surface distinctly transversely wrinkled; scutellum small, somewhat wider than long; tegmina pale green to hyaline with brown venation.

One of the specimens has a faint spot on each lateral apex of vertex.

LUZON, Bataan Province, Mount Limay; Laguna Province, Mount Maquiling, Los Baños. MINDANAO, Zamboanga (Osborn collection).

CICADELLA ALTICOLA sp. nov.

Length, about 8 millimeters.

Greenish ferruginous. Vertex roundly produced, as long as one-half the width between eyes, greenish brown with a round black marking on apical center; one on each vertical edge, and two on the side below; ocelli equidistant from each other and eyes; margin between eyes and apical center occupied by deeply striated portions which are continuous on each side to margin of frons; frons tumid and flat, on the center marked with fuscous striæ; center greenish brown; cheeks and clypeus greenish ochraceous; pronotum transverse, base slightly rounded, about one-half as long as broad, anterior half with irregular black markings; scutellum triangular with acutely pointed marginal angle, slightly broader than long, third marginal portion with horizontal fovea, and a longitudinal median sulcus dividing it into two parts, each portion with an apical fuscous dot and a lateral broad fuscous stripe; tegmina long with five apical and three anteapical cells, with distinct brown venation, apex distinctly margined. Body underneath greenish ochraceous; legs light brown.

LUZON, Benguet Subprovince, Mount Santo Tomas, Haight's Place, and Mount Polis: Nueva Vizcaya Province, Imugan (type, Osborn collection).

CICADELLA SUTURELLA (Stål).

Tettigonia suturella STÅL, Öfv. Vet.-Akad. Förh. 5 (1855) 192.

Length to tip of tegmina, 5.5 millimeters.

Vertex short, a little longer than one-half length of pronotum, with bluntly rounded apex, amber yellow, two black spots, one in each angle equidistant between the eye and the anterior portion, one on disc and two black spots surrounding the amber-colored ocelli; frons amber yellow with an elongated black spot on upper portion, disc distinctly foveate and marked on the sides by yellow striæ, lora and gena ochraceous; pronotum light yellow with two oblique lines from basal inner third to posterior base, forming an obtuse angle; scutellum amber orange, a transverse line on the middle, with two broken parallel black lines laterally, the continuation of pronotal lines on edges of tegmina forming the commissural lines; tegmina hyaline, with milky white venation, the borders of which are black and fuscous. Body underneath and legs pale yellow; last ventral segment truncate in male, slightly convex in female.

LUZON, Laguna Province, Pacte, Los Baños, and Pansol. NEGROS, Occidental Negros Province, Dumaguete. MINDANAO, Zamboanga.

Known host *Acalypha* sp., evidently widely distributed in the Philippines.

CICADELLA NIGRIFASCIATA sp. nov.

Male, length, including tegmina, 5.5 millimeters.

This species has morphological characteristics similar to those of *C. suturella* Stál, of about the same size and general appearance. The marking of this species is more accentuated. There are more spots and markings on the vertex. The notal markings are consolidated into a semicircle, in contradistinction to those of *C. suturella*, which are oblique, meeting at an angle. In males frons and clypeus entirely black, in some there is a black fascia on the middle of the frons and on the lateral margins of the frons and cheeks; fasciæ of frons connected by transverse striæ; scutellum with a longitudinal black marking near each lateral angle and confluent with the commissural black lines terminating at the tip of tegmina. Entire lateral margins of tegmina bordered by a black marking. Thoracic and abdominal sclerites marked partially with black at the middle, with the exception of the genital plates, which are ochraceous. The vertex is rounded, about one-third as long as the distance between the eyes; pronotum transverse, slightly wider than long, basal margin rounded, the lateral sides oblique, and posterior almost truncate; scutellum triangular, posterior half separated by an impressed line; body beneath the wings black; legs stramineous.

This species is abundant on cotton in the Philippines.

LUZON, Mountain Province, Mount Santo Tomas (type), Balbalan and Baguio (paratype, Osborn collection).

Genus MILEEWA Distant

Mileewa DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 238; BAKER, Philip. Journ. Sci. § D 9 (1914) 415.

Type, *M. margheritæ* Distant.

According to Distant [48] this genus is known only from Assam. Baker [50] described a new species and a new variety of this species from Mount Maquiling, Luzon, and named the species *M. luzonica*.

[48] Fauna Brit. Ind. Rhynch. 4 (1908) 238.
[50] Philip. Journ. Sci. § D 9 (1914) 415–416.

MILEEWA LUZONICA Baker.

Mileewa luzonica BAKER, Philip. Journ. Sci. § D 9 (1914) 415–416.

Vertex, pronotum and scutellum ferruginous, the front margin of vertex and all below very pale yellowish, the tegmina washed with a shining ferruginous. A large rectangular spot in middle of vertex, 2 round spots near basal margin of pronotum, a varying and indistinct median area on posterior half of pronotum, lateral angles of scutellum broadly, a narrow longitudinal band on clavus within commissural margin and not reaching tip of clavus, a longitudinal band on corium bordering claval suture and passing into inner apical cell, and a band from base of tegmina passing to apex of first anteapical cell, black; area of apical cells smoky translucent. Length ♂ 4.5, ♀ 4.75 mm.

Length of face two and one-fourth times width between eyes, basal clypeal suture distinct, the whole surface faintly shagreened; front and clypeus strongly convex, the former slightly flattened on disc above. Length of vertex about three-fourths of width between eyes, surface smoothly convex. Ocelli nearly on line of anterior margin of eyes, somewhat nearer to eyes than to each other. Pronotum smooth, the pleural carina very fine but complete. Scutellum wider than long, a fine impressed transverse line at middle. Tegmina opaque proximad of apical cells, but not all coriaceous and not at all punctate. If viewed squarely the hind margin of last ventral segment appears to be slightly incurved and with a median projection, the hind angles oblique; if viewed at a slight angle the hind margin appears to be deeply emarginate.—BAKER, loc. cit.

My specimens were all collected near Los Baños, at the foot of Mount Maquiling. The color of the vertex, pronotum, and scutellum is orange and not ferruginous; the tegmina is of the same color, except the clavus which is greenish yellow; the ocelli are equidistant from each other and from the eyes; and the scutellum is equilateral. The rest of the characters conform to Baker's description of the insect. In the Osborn collection there is a specimen collected at Subaan, Mindoro, and another collected at Haight's Place, northern Luzon. The latter specimen is pale, slightly larger than the rest, and the pronotal markings are quite indiscernible.

Genus MAKILINGIA Baker

Makilingia BAKER, Philip. Journ. Sci. § D 9 (1914) 409–410; 24 (1924) 57–58.

Type, *M. nigra* Baker.

This genus was erected by Baker [51] for a group of small Tettigoniellinæ colored principally black and red, rarely whitish, collected on Mount Maquiling and Mount Banahao, which later on

[51] Tom. cit. 410–411.

Baker [52] believed should belong to the subfamily Gyponinæ instead. It is, however, my opinion that *Makilingia* species, having unique characteristics which warrant placing them under a separate genus, are more closely related to the Tettigoniellinæ than to the Gyponinæ, for the following reasons:

The general shape of the head and the body of *Makilingia* appear more like those of *Kolla* of the Tettigoniellinæ than like those of *Bhooria* of the Gyponinæ. It is true that *Bhooria* has a considerable affinity to the Tettigoniellinæ, but due to the structure of the face, Distant [53] thought it wise to locate it with the Gyponinæ. It is these peculiar characteristics of the face that separate *Makilingia* from *Bhooria*. The vertex of *Makilingia* is slightly longer than broad, similar to the vertex of *Kolla*, while that of *Bhooria* is much longer than broad, prominently acutely narrowed. It is even as rounded in front as *Bhandara*, of the Tettigoniellinæ. *Kolla* is a Tettigoniellini, closely allied to *Tettigoniella*, but differing by the structure of the vertex, which is subconically narrowed anteriorly and which is also more or less foveate, characteristics of most of the species of *Makilingia*. Again the vertex of *Bhooria* has a central longitudinal ridge, while that of *Makilingia* is sulcate.

In the arrangement and venation of the tegmina *Makilingia* is nearer to *Tettigoniella* than to any other genus. The folding of the anterior wings and the four apical cells and two or three anteapical cells are also found in the Tettigoniellinæ.

The elongated and gradually tapering clypeal sclerite is more that of a *Tettigoniella* than of a *Gypona*. It is certainly closer to *Tettigoniella whiteheadii* Distant (Baker [54]) than to *Bhooria modulata* Distant.[55] The absence of the frontoclypeal suture coupled with the exaltation of the lateral vertical angles over the eyes are the unique and distinguishing characteristics of this genus. The absence of the frontoclypeal suture denotes antiquity of the group. This suture is, however, present in an indiscernible condition in the species *M. pruinosa* Baker which shows the direct line from *Makilingia* to *Tettigoniella* or *Cicadella*. The clypeal structure is more specialized in the Gyponinæ. In *Tettigoniella longa* and allied species, such as *Cicadella philippina* Walker, the clypeal sutures are quite indiscernible. I be-

[52] Idem 24 (1924) 57.
[53] Fauna Brit. Ind. Rhynch. 4 (1908) 256.
[54] Philip. Journ. Sci. § D 9 (1914) 412–419.
[55] Fauna Brit. Ind. Rhynch. 4 (1908) 256–257.

lieve that *Makilingia* is an older group with *Tettigoniella* as an intermediate group between it and *Gypona*.

Five species were described in 1914. In 1924 Baker [56] described ten more species which were collected not only from the mountains of northern Luzon but also from the lowlands and from other islands. However, he believed that this genus is confined to the Philippine Islands.

Small tettigoniellids, colored principally black and red, rarely whitish, with head much narrower than pronotum, anterior margin very shortly sublaminate and strongly rounded in front between the eyes. Face rather long and narrow. Basal clypeal suture usually entirely obsolete. Loræ small and narrow. Lateral frontal margins passing close to eyes. Vertex flattish or concave, variously impressed or excavated, and always longer than half width between eyes. Ocelli placed before the line of anterior margins of eyes. Pronotum longer than the vertex, of a sexangular type in form, but anteriorly strongly, quite evenly, and narrowly rounded from the lateral angles to between the eyes, the posterior lateral margins short, the posterior margin gently incurved, the pleural area with a strong complete carina. Scutellum usually large, longer than wide or wider than long, and with an acuminate tip, the posterior area more or less swollen. Tegmina normal in outline or somewhat narrowed distad, with four apical cells and 2 or 3 anteapicals, sometimes with indistinct and irregular cross-veins in the costal area; clavus without cross-veins, its 2 sectors joining the commissure; appendix very short or extending to near tip of inner apical cell. Armature of hind tibia dense and heavy. Sculpturation largely a heavy and conspicuous puncturation.—BAKER, Philip. Journ. Sci. § D 9 (1914) 409–410.

MAKILINGIA NIGRA Baker.

Makilingia nigra BAKER, Philip. Journ. Sci. § D 9 (1914) 411, fig. 1; 24 (1924) 68–69.

This species has all the appearance of a *Kolla*.

Body and tegmina deep black, the legs and two basal antennal articles lemon yellow. Length ♂ 5, ♀ 6 mm.

Length of face twice the width between eyes; basal clypeal suture obsolete; front a little swollen and with disc flattened, transversely impressed above, beneath margin of vertex; front coarsely sparsely punctate on disc, lateral margins and clypeus coarsely shagreened; lorœ and genæ with very large confluent punctures. Length of vertex about five-sixths of the width between eyes, its anterior lateral margins slightly bisinuate; surface coarsely sparsely punctate, the entire lateral areas between ocelli and eyes deeply excavated, as is also the anterior median area. Ocelli somewhat in front of anterior line of eyes, and about as far from each other as from eyes. Pronotum coarsely sparsely punctate, and posteriorly with indistinct transverse rugæ. Scutellum wider than long; longer than pronotum.

[56] Philip. Journ. Sci. 24 (1924) 57–71.

transverse impressed line at middle very strong and medially widened; posterior to impressed line the surface is distinctly longitudinally striolate. Tegmina opaque, coriaceous proximad including the clavus, the entire coriaceous portion strongly sparsely punctate. Last ventral segment of female rectangularly emarginate, the lateral posterior borders strongly curved.—BAKER, Philip. Journ. Sci. § D 9 (1914) 411.

LUZON, Laguna Province, Mount Banahao and Mount Maquiling (type, Baker collection); Batangas Province, Santo Tomas (Osborn collection). NEGROS, Cuernos Mountain. PANAY. MINDANAO, Surigao Province, Surigao. BASILAN.

MAKILINGIA TETTIGONOIDES Baker.

Makilingia tettigonoides BAKER, Philip. Journ. Sci. 24 (1924) 60–61.

Female, length, 8 millimeters. Ochraceous to yellowish; abdomen black with pale segmental margins; tegmina, except costal margins greenish to near apical cross veins, the apices slightly smoky; vertex with four black spots, two marginal near apex, and two surrounding ocelli; on infero-posterior surfaces of eyes, beneath posterior margin of vertex and entirely hidden from view without separating the head from pronotum, are two black spots; pronotum with two black spots just behind eyes; large black spots also occur on basal angles of scutellum; basal lateral angles of front narrowly black.

Front strongly convex, medially shallowly depressed, very faintly shagreened, smooth, shining. Clypeus strongly roundly umbonate basally, with surface like that of front. Genæ and lorœ with shallow separated punctures. Vertex strongly depressed before the sharp anterior margin, as usual in this genus, the remainder of surface separated into three portions by low rounded longitudinal prominences along the lines of the ocelli, the lateral concavities much the deeper; the median area minutely and sparsely punctured, the lateral areas wrinkled next eyes. Ocelli large, equidistant from basal and antero-lateral margins of vertex and nearer to eyes than to each other. Pronotum uniformly covered with separated punctures, the interspaces smooth, and transverse rugæ not evident. Tegminal punctures well separated, the interspaces smooth. Genital segment apically broadly, deeply, arcuately emarginate.

Male, length, 7.5 millimeters. Vertex more broadly rounded apically. Color inclining to testaceous (as is sometimes the case in females). Meso- and metasternal sclerites black. Spots of vertex enlarged and variously coalesced. A common type is represented in males from Baguio, though many minor variations of this occur. A male color form from Dapitan shows complete coalescence of the black spots across disk of vertex. Females occasionally have the male type of marking, and one Baguio female is selected which is similar to Dapitan males. The vertex is finely wrinkled anteriorly also, and has two small deep depressions near basal margin. Genital segment as long as broad, roundly swollen, shining black, hind margin nearly truncate except for a short, acute, median projection; base of the long slender plates very broad, undivided, and swollen.—BAKER, loc. cit.

LUZON, Benguet Subprovince, Baguio and Pauai (Haight's Place): Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (*Baker*).

According to drawings presented by Baker [37] for this species there are four characteristic groups of markings (Plate 1, fig. 1, *a*). Head ochraceous, vertex with four black spots, two marginal near apex, and two surrounding the ocelli. This variety, according to specimens collected on Mount Polis, Luzon, is light yellow or ochraceous, with two anterior pronotal and two anterior angular markings; two anterior tegminal black markings and two apical vertex markings are confluent with the two marginal apices; the entire face is amber yellow. The variety represented by Plate 1, fig. 1, *b*, head black, and the one with four antero- and three posterovertical yellow markings, two anterior black spots on pronotum and two very conspicuous anterior angular black spots of the scutellum, has entirely black face and the general color of the tegmina is greenish ochraceous. The other, represented by Plate 1, fig. 1, *c*, has head black, vertex with two semitransverse and three posteromarginal ochraceous markings, and two more or less rectangular pronotal black markings just below the eyes, and the upper half of the scutellum black; the frons black, the clypeus castaneous brown; cheeks ochraceous.

Female, 8 millimeters, and male, 7.5, four specimens, three males, two from Mount Polis and one from Baltaiason, Luzon, and one female from Mount Polis, northern Luzon, are available for study. These specimens are uniformly ochraceous and the markings are also uniform. They all conform to Plate 1, fig. 1, *a* (Osborn collection).

One female and one male collected at Santo Tomas, Batangas Province, near Mount Maquiling, also conform to Baker's Plate 1, fig. 1, *b*. These specimens are ochraceous, slightly darker than the above variety.

The markings of the female differ slightly from those in Plate 1, fig. 1, *b*, of Baker, as there is on this specimen a distinct dot on each lateral angle of the vertex just above the anterior edge of the eyes. Also the two ochraceous spots above the ocelli are larger and more confluent. In the male these two spots are enlarged with a projection directed towards the apex of the vertex, and the black markings on the anterior and on the poste-

[37] Philip. Journ. Sci. 24 (1924) 60–61, pl. 1, fig. 1 *a–d*.

rior sides of the vertex coalesced, just above the inner margins of the eyes.

In specimen *c*, collected at Santo Tomas, Batangas Province, Luzon, the marking on the apical margin of the vertex is cut by two vertical ochraceous lines, so that it appears as three black spots on the apical end. The black markings on the lateral angles of the vertex just above the inner margins of the eyes are almost indiscernible and are not united with the posterior markings. The scutellar spots have coalesced into a band or fascia occupying the anterior portion of the scutellum.

In specimen *d*, collected on Mount Polis, Mountain Province, Luzon, the two anterior markings are separated from the posterior median markings surrounding the ocelli. The anterior pronotal spots as appearing on all of the varietal forms are reduced. All other markings mentioned are also reduced.

There seem to be no definite markings on the vertex, pronotum, or scutellum in this species (*M. tettigonoides*).

All specimens studied are from the Osborn collection.

MAKILINGIA SPECIOSA Baker.

Makilingia speciosa BAKER, Philip. Journ. Sci. 24 (1924) 61–62, pl. 1, fig. 2, *a–f*.

A single specimen collected at Santo Tomas, Batangas Province, Luzon (Osborn collection) is perhaps the largest of the group. It is a female about 10 millimeters long. It is tricolored above, black from head to tip of scutellum, and the area parallel to the costal margin, one-fourth the distance to the base of the tegmina; the following one-eighth is reddish and the rest pale brown; lateral margin of the cheeks, and anterior margin of vertex, and the posterior margin of pronotum as well as the legs and venter are pale brown. Baker states that his specimens, taken in Benguet, Mountain Province, were only four. Although it is the most conspicuous, it is a rare species, he considers.

MAKILINGIA INTERMEDIA Melichar.

Makilingia intermedia MELICHAR, Wiener Ent. Ztg. 40 (1923) 119.
Makilingia variabilis BAKER, Philip. Journ. Sci. 24 (1924) 63–64, pl. 1, figs. 4, 5.

This lone male specimen, 4.75 millimeters long, is the smallest *Makilingia* in the collection. Melichar is credited with having named the species before Baker.[28]

Makilingia intermedia is black with four equidistant brown spots on the extreme anterior part of the vertex; eyes and ocelli

[28] Idem 27 (1926) 159.

brown; tegmina with a cup-shaped yellow marking at the middle of the clavus, the posterior part or tip of clavus yellow, one yellow dot on the middle margin of corium near the claval suture; base of antennæ and legs yellow; scutellum small, broader than long. Originally described from Trinidad, Mountain Province, Luzon.

LUZON, Mountain Province, Balbalan (Osborn collection).

MAKILINGIA INTERMEDIA Melichar var. SIMILLIMA Baker.

Makilingia intermedia Melichar var. *simillima* BAKER, Philip. Journ. Sci. 24 (1924) 63–64.

One female and two males were collected on Mount Polis, northern Luzon (Osborn collection). The female is 5.25 millimeters long and the males about 5.

This variety is somewhat larger than the species *intermedia* Melichar. The tegminal markings are continued on the commissural line, with complete absence of the spot on the corium, the vertex having two marginal spots in the female and none in the male. Other coloration is the same as that of *intermedia* Melichar.

LUZON, Mountain Province, Mount Polis and Baguio: Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (*Baker*).

MAKILINGIA BANAHAOENSIS Baker.

Makilingia banahaoensis BAKER, Philip. Journ. Sci. 24 (1924) 64–65, pl. 2, figs. 6, 7.

Two males, about 5 millimeters long, one of the variety *montalbanensis*.

Black; vertex with two small reddish apical spots and two large lateral spots. In variety *montalbanensis* each of these lateral spots coalesces with one of the apical spots, forming two lateral bands; clavus with a yellow spot on each lateral angle, claval area from the area adjoining the posterior angle of the scutellum to the tip where commissural line and the claval suture meet yellow; legs and base of antennæ reddish yellow. Dorsal side of insect coarsely punctured.

MINDORO, Saban (Osborn collection).

Previously reported by Baker from Mount Banahao, Laguna Province, and Montalban, Rizal Province, both in Luzon.

MAKILINGIA HAIGHTIANA Baker.

Makilingia haightiana BAKER, Philip. Journ. Sci. 24 (1924) 65.

Female, length, about 8 millimeters.

Black, vertex with two large reddish lateral and one median apical spot, about one and one-fourth as long as the breadth

between the eyes; pronotum and scutellum jet black, coarsely punctured and striated; tegmina black, clavus margined both at commissural line and claval suture; corium and costal margins with ochraceous bands; tip of tegmina cloudy hyaline with fuscous margin; frons with a reddish spot, venter black; legs ochraceous.

LUZON, Benguet Subprovince, Haight's Place (Osborn collection).

MAKILINGIA LINEATA Baker.

Makilingia lineata BAKER, Philip. Journ. Sci. 24 (1924) 65–66, pl. 2, fig. 9.

Female, length, 6 millimeters.

Black; vertex obtusely produced with two large reddish lateral spots occupying two-thirds of the lateral margins; eyes and ocelli orange; tegmina black, coarsely punctured, with reddish commissural lines, with anchorlike curve on upper one-third of the clavus; tip of tegmina smoothly fuscous; legs and the base of the antennæ reddish ochraceous.

LUZON, Nueva Vizcaya Province, Imugan (*Baker*): Benguet Subprovince, Mount Polis (Osborn collection).

MAKILINGIA FLAVIFRONS Melichar.

Makilingia flavifrons MELICHAR, Wiener Ent. Ztg. 40 (1923) 119.
Makilingia binaculata BAKER, Philip. Journ. Sci. 24 (1924) 67, pl. 2, fig. 12.

Male, length, about 7.5 millimeters.

Black; vertex subacutely pointed with large yellow lateral spots; pronotum, scutellum, and tegmina, except the tips, black, coarsely punctured all over, eyes and whole front yellow, legs yellow; venter yellow with median black markings.

LUZON, Benguet Subprovince, Baguio; Ifugao Subprovince, Mount Polis (Osborn collection): Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (*Baker*).

MAKILINGIA PALLIDA Baker.

Makilingia pallida BAKER, Philip. Journ. Sci. § D 9 (1914) 414–415, fig. 5; 24 (1924) 68.

Female, length, about 5 millimeters.

Body pale ochraceous; tegmina milky white with smoky brown margins at the tip; vertex rounded, about as long as the breadth between the eyes; two-thirds of lateral sides sulcate; eyes and ocelli ochraceous to fuscous, ocelli surrounded by a black margin; two black spots, one on each posterior angle of vertex, next to eyes; vertex, pronotum, scutellum, and anterior half of tegmina

sparsely punctured and the apical half smooth and somewhat transparent. Crown almost flat and square; frons almost rectangular and about twice as long as the breadth between the eyes. Last ventral segment sinuate at posterior middle and with black markings.

LUZON, Laguna Province, Mount Maquiling (type), Los Baños: Tayabas Province, Malinao: Benguet Subprovince, Baguio (var. *benguetensis* (Baker collection).

MAKILINGIA MACULATA Baker.

Makilingia maculata BAKER, Philip. Journ. Sci. § D 9 (1914) 412–413, fig. 3; 24 (1924) 62.

Female, length, about 5.75 millimeters.

Black; vertex somewhat triangular, somewhat pointed, about two-thirds as long as breadth between eyes, shallowly concave, with four yellow markings on lateral margins; eyes and ocelli fuscous, frons twice as long as breadth between eyess, clypeal suture obsolete; pronotum distinctly rounded in front, transverse coarsely and sparsely punctured, posterior margin almost truncate; humeral angles pointed; scutellum small, nearly smooth; tegmina black and coarsely punctured, posterior two-thirds of lateral sides of clavus margined with greenish yellow markings, center costal margin ochraceous, tip of tegmina fuscous; legs and base of antennæ yellow, body black beneath.

LUZON, Batangas Province, Santo Tomas (Osborn collection): Laguna Province, Mount Banahao, Mount Maquiling, and Los Baños: Tayabas Province, Malinao. MINDORO, Surigao Province, Surigao: Zamboanga. BASILAN and SIBUYAN (Baker collection).

MAKILINGIA PRUINOSA Baker.

Makilingia pruinosa BAKER, Philip. Journ. Sci. § D 9 (1914) 412; 24 (1924) 68.

Length, about 6.5 millimeters.

Long and slender, tegmina narrow and overlapped at tips. Black, except legs, base of antennæ, and eyes, which are brown to fuscous. Vertex slightly produced, pointed, with four yellow markings, two at the apex and two on lateral sides adjoining eyes; frons coarsely striated; frons to clypeal suture distinctly visible; pronotum anteriorly rounded, lateral angles pointed, posterior margin sinuate, coarsely and sparsely punctured; scutellum very small; tegmina sparsely punctured, apices of clavus and corium fuscous.

LUZON, Batangas Province, Santo Tomas (Osborn collection): Laguna Province, Mount Maquiling, Mount Banahao: Mountain

Province, Baguio: Nueva Vizcaya Province, Imugan. MINDANAO, Zamboanga Province, Dapitan (Baker collection).

MAKILINGIA COLORATA Baker.

Makilingia colorata BAKER, Philip. Journ. Sci. § D 9 (1914) 412–413, fig. 3; 24 (1924) 62.

Female, length, about 5.5 millimeters.

Vertex with six coalescing reddish yellow spots forming a marginal border from the posterior margin to two-thirds side of vertex, and one similar spot on middle of posterior margin; anterior side of face with yellow marginal stripe; base of antennæ yellow; frons and clypeus black, suture between them obsolete, together they are about three times as long as space between the underpart of eyes; rostrum and femora pale ochraceous, front femora with three black markings, tibia reddish; prosternal and metasternal episternum black. Venter ochraceous, the last ventral segment deeply sinuated, middle part black; tegmina reddish brown.

LUZON, Laguna Province, Los Baños (Merino collection); Tayabas Province, Malinao: Mountain Province, Haight's Place. NEGROS, Occidental Negros Province, Cuernos de Negros. MINDANAO, Agusan Province, Butuan: Surigao Province, Dapa (Osborn collection).

GYPONINÆ

Ocelli on the disc as in the Tettigoniellinæ, but the face flat or slightly convex, and the body decidedly flattened dorsoventrally.

There are two divisions of cicadellids in this subfamily: Penthimiaria, with a short vertex, considerably broader than long, transversely rounded anteriorly, and not produced; and Hylicaria, with the vertex not broader than long, and more or less angularly produced.

According to this arrangement the genus *Thaumatoscopus* Kirkaldy, represented by a new species, *roxasi*, herein described, fits very well in the division Penthimiaria with the other two species studied, *Penthimia hemifuscata* sp. nov. and *Neordatus acocephaloides* Melichar.

Key to the genera of the division Penthimiaria.

a^1. Scutellum longer than vertex, its basal margin considerably longer than lateral margin.

b^1. Length of vertex equal to about one-half breadth between eyes, short, transverse, anteriorly convexly rounded and depressed.

Penthimia Germar.

*b*¹. Length of vertex equal to about two-thirds breadth between eyes, subelongate, anteriorly obliquely rounded and reflexed. *Neodartus* Melichar.

*a*¹. Scutellum shorter than the vertex, its basal margin only slightly longer than the lateral margin..... *Thaumatoscopus* Kirkaldy.

Genus PENTHIMIA Germar

Penthimia Germar, Mag. Ent. 4 (1821) 46; Stål, Hem. Afr. 4 (1866) 107; Fieber, Rev. Mag. Zool. 3 (1875) 392; Atkinson, Journ. As. Soc. Bengal 54 (1885) 112; Van Duzee, Trans. Am. Ent. Soc. 21 (1894) 287; Melichar, Hom. Fauna Ceylon (1903) 161; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 241.

Type, *P. atra* Fabricius, a Palæarctic species.

Distribution: Nearctic, Palæarctic, Ethiopian, Oriental, and Australian Regions.

Body ovate, compact; head short, broad, narrower than pronotum, rounded anteriorly; vertex sloping anteriorly, equal to one-half the breadth between eyes; pronotum large, transverse, and faintly, transversely striated, sloping towards the front, rounded anteriorly; tegmina short with enlarged appendix, inclined posteriorly from the truncated apex of clavus, femora compressed posteriorly and hind tibia strongly spinose.

PENTHIMIA HEMIFUSCATA sp. nov.

Length, 5 millimeters.

Vertex ochraceous, profusely spotted with fuscous markings; pronotum transverse, ochraceous; vertex broader than long; ochraceous with fuscous markings, an impressed line on the anterior half; upper half of tegmina ochraceous, sparsely spotted with fuscous markings at the humeral angle, posterior half profusely spotted with fuscous markings, apex ochraceous with exception of inner apical cell and appendix which are partially and horizontally marked with short fuscous lines; face black; hind legs black, tibial spurs ochraceous; pectus, venter, and legs fuscous with ochraceous markings.

Luzon, Mountain Province, Mount Santo Tomas (type, Osborn collection).

Genus NEODARTUS Melichar

Neodartus Melichar, Hom. Fauna Ceylon (1903) 162.

Type, *N. acocephaloides* Melichar.

Distribution: Oriental Region.

Vertex about two-thirds as long as the breadth between the eyes, broad, obtuse, slightly sloping towards the front, the apex being slightly reflexed; ocelli nearer to the eyes than to each other; pronotum transverse, anterior margin strongly rounded,

posterior broadly concave, almost truncate; scutellum transverse; tegmina broad and short, posteriorly inclined from truncated apex of clavus. The appendix is well developed, as in *Penthimia*, to which this genus is most closely allied.

NEODARTUS ACOCEPHALOIDES Melichar.

Neodartus acrocephaloides MELICHAR, Hom. Fauna Ceylon (1903) 163; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 246, fig. 155.

The characteristics of the specimen at hand more or less tally with Distant's description,[39] which has been changed here to fit more accurately the Philippine specimen.

Length, including tegmina, 4 millimeters.

Vertex, pronotum, and scutellum black; pronotum margined exteriorly with faint white stripe, scutellum with two white spots on each lateral side and one on the middle of the anterior margin; tegmina black, with thick ochraceous spots, the apex smoky gray where the veins are fuscous and preceded by an irregular transverse series of four white spots, clavus with a series of four irregular spots and middle of costal region with a large white spot; femora and pectus black, tibia and venter paler, spotted with black; pronotum finely, transversely wrinkled, scutellum very finely, transversely striate, a transverse impression before apical area, anterior middle third with pubescence, apical margin of clavus distinctly incrassate; posterior tibia strongly spinulose, the spines ochraceous.

Hitherto known only in the Punjab, Calcutta, Ceylon, Peradeniya, Negombo.

LUZON, Benguet Subprovince, Mount Santo Tomas (Osborn collection). The species is here reported for the first time from the Philippines.

Genus THAUMATOSCOPUS Kirkaldy

Thaumatoscopus KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 422.

Type, *T. galeatus* Kirkaldy, an Australian species.

This genus is closely related to *Penthimia*. The head is more produced and the vertex has a thin border anteriorly; ocelli small, discal just above anterior margin of eyes; pronotum transverse, shorter than vertex or scutellum; vertex roughly shagreened; pronotum and scutellum coarsely striate; tegmina short and broad; scutellum apically truncate, just as in *Penthimia* and *Neodartus*.

[39] Fauna Brit. Ind. Rhynch. 4 (1908) 246.

Kirkaldy [69] erected this genus for a species collected in Queensland, Australia, by Koebele and Perkins (1904 or 1905).

THAUMATOSCOPUS ROXASI sp. nov.

Male, length, including tegmina, 7 millimeters; width, 3.

Fuscous above, piceous below. The face below and the prosternum and mesosternum piceous; the hind legs fuscous; vertex slightly convex, roundly produced, one and one-half times as long as broad, greatly depressed, margined by a narrow brown band, rim slightly produced above the upper margin of eyes, middle rufous from base to two-thirds the distance from middle to the eyes, and ascending upward protruding towards the median line; eyes almost piceous, fuscous in female; upper half of face inflexed and flat, piceous, gena separated from lora by a ridge; clypeus small, almost oblong; frons greatly depressed, upper fourth narrow; cheeks broad, foliaceous, thinly produced; pronotum transverse, anterior and lateral sides rounded, oblique; lateral sides truncate, posterior side distinctly concave, rounded dorsally, greatly inclined anteriorly; scutellum small, slightly broader than long, transversely divided by a suture on the middle, this being the highest level so that the insect has a humped appearance; tegmina broad, rounded at the apex, areoles with lighter color, wing veins in male piceous above and fuscous at the ends; ends, vertex, pronotum, scutellum, and tegmina roughly and coarsely shagreened; hind legs extraordinarily developed, depressed, armed with large spurs. The flat and rounded shape, the foliaceous vertex curved downward, the impressed mouth parts, and the dark coloration seem to indicate that this insect is a ground type. It is possible that this species feeds on roots of plants, but our specimen was collected from shrubbery.

LUZON, Rizal Province, Alabang (type in my collection).

I am naming this peculiar and uncommon insect for Dr. Manuel L. Roxas, former director of the Bureau of Plant Industry and former under secretary of the Philippine Department of Agriculture and Commerce, in appreciation of his great interest in entomological development for the benefit of agriculture.

THAUMATOSCOPUS REFLEXUS Stål.

Penthimia reflexa STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 738.

Female, about 8.5 millimeters.

Species lighter and slightly larger than *roxasi*. Ferruginous all over except the face, prosternum, and mesosternum, which

[69] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 0 (1906) 422.

are black; hind femora and tibia fuscous, vertex foliaceous, rounded, slightly longer than width between eyes, apex slightly reflexed, lateral edges above line of eyes; ocelli quite inconspicuous, on middle of vertex; eyes relatively small; pronotum transverse, distinctly hexagonal, shorter than vertex, anterior side rounded, posterior concave, lateral sides parallel, posterior angles truncate, finely, transversely striated; scutellum slightly broader than long; tegmina coriaceous, small portion of posterior part somewhat transparent, wing veins fuscous.

Stål does not give the distribution of this insect. The type was a Philippine specimen.

LUZON, Manila (*J. Valdez*).

JASSINÆ (including ACOCEPHALINÆ)

The Acocephalinæ are regarded as a distinct subfamily by many authors, as a separate family by some, and as merely a tribe or even a genus by others.

The reason for this simplification or union of the two subfamilies is the difficulty of separating them on the basis of the location of the ocelli. Distant [91] said that *Xestocephalus*, placed by Van Duzee, its founder, in the Acocephalinæ, is placed by Melichar and Matsumura in the Jassinæ. *Hecalus*, which is included by Stål, its founder, in the Acocephalinæ, is considered a member of the Jassinæ by Van Duzee. The main distinguishing feature of the two is as follows:

Ocelli placed superiorly close to the anterior edge of the head. *Acocephalinæ.*

Ocelli on the anterior edge of the head or wanting..... *Jassinæ.*

Distant included the genera belonging to the Acocephalinæ in his synopsis of the Jassinæ. The following is a tentative key for the groups or divisions of the Jassinæ-Acocephalinæ based on characteristics given by Distant:

Key to the divisions of the Jassinæ and the Acocephalinæ.

a^1. Face not strongly impressed across base.

b^1. Body depressed, vertex flatly produced..... *Hecalusaria.*

b^2. Body not depressed.

c^1. Vertex produced beyond eyes; lateral margins of vertex not ridged, obliquely narrowed basally at inner margins..... *Jassusaria.*

c^2. Vertex shorter than breadth between eyes, not produced, one-half as long as breadth between eyes, rounded anteriorly. *Selenocephalaria.*

c^3. Vertex about, or more than three times as long as distance between eyes ..... *Tartessusaria.*

[91] Fauna Brit. Ind. Rhynch. 4 (1908) 265–266.

c^4. Vertex one-half or less than one-half as long as distance between eyes; lateral margins not so narrowed.
d^1. Anterior margin of vertex roundly produced, wider than long at middle ..... *Cicadulariæ*
d^2. Anterior margin acutely or subacutely produced; face longer than broad at base..... *Thamnotettixaria.*
c^5. Vertex more or less angularly produced in front of eyes; face not longer than broad at base..... *Athysanusaria.*
c^6. Vertex as long as or longer than breadth between eyes; tegmina usually covering dorsum of abdomen..... *Deltocephalusaria.*

Division HECALUSARIA

The general characteristics for this division are the depressed body, the more or less flatly produced vertex, and the placement of the ocelli on the apical margin of the vertex near the eyes. The following key to the genera is from Distant's synopsis of the division: [62]

Key to the Philippine genera of the division Hecalusaria.

a^1. Vertex not prominently angulate in front.
b^1. Tegmina with five apical cells..... *Hecalus* Stål.
b^2. Tegmina with about six posterior discoidal arcolets or cells. *Thomsoniella* Signoret.
a^2. Vertex twice as long as pronotum; face about three times the length of clypeus, tegmina with four apical cells, lateral margins of face convex ..... *Nirvana* Kirkaldy.

Genus HECALUS Stål

Hecalus Stål, Ann. Soc. Ent. Fr. (1864) 65.
Glossocratus Fieber, Verh. Zool.-Bot. Ges. Wien 16 (1866) 502.

Type, *H. paykulli* Stål.

Distribution: Nearctic, Oriental, Australasian, and Ethiopian Regions. (Probably widely distributed.)

Body oblong or elongate, depressed; head somewhat so, produced apical margin acute, more or less broadly foliaceous; front dilated, somewhat deeply sinuate below the eyes; face a little convex; eyes small or moderate; ocelli placed on the apical margin of the head at or near the eyes; pronotum transverse, very obtusely rounded at apex; scutellum triangular, a little broader than long; tegmina almost as long as abdomen, margined at apex, valvate behind the clavus, with five apical cells; legs moderate; posterior tibiæ very spinose.—Stål, cited by Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 273–274.

HECALUS GRAMINEUS sp. nov.

Length, including tegmina, 7 millimeters.

Grass green all over. Vertex about as long as breadth between eyes, or slightly longer; margined by two reddish brown

[62] Tom. cit. 273.

lines, one passing just above the edge and the other below, both crossing eyes longitudinally; eyes ochraceous with two longitudinal red lines; ocelli ochraceous, located on edge of vertex, just above eyes; face tumid, cheeks slightly inflexed just below eyes; pronotum transverse, about twice as broad as long, anterior margin slightly rounded, posterior slightly concave, lateral sides parallel; scutellum about one and one-half times as broad as long, an almost indiscernible ochraceous square at the center, a horizontal curved groove at apical third; tegmina not reaching tip of abdomen, two small black spots on posterior angles of clavus; last ventral segment shallowly bisinuate, almost truncate; genital parts green, except ovipositor, which is pink.

LUZON, Manila (*F. Q. Otanes;* type in my collection).

HECALUS CAPITATUS Distant.

Hecalus capitatus DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 30.

Male, length, including tegmina, 8.5 millimeters.

Dirty ochraceous; vertex flat, impressed, and anterior margins slightly inflexed, continuously spotted with fuscous markings along border, profusely, finely punctured with brown specks, except a longitudinal, carinate, ochraceous median fascia, as long as breadth between eyes; face impressed across base, flat, sparsely marked; frons, cheeks, clypeus, and lora slightly tumid, frons broader at base, gradually tapering, clypeus oblong, body beneath including legs punctured or with brown markings, two profuse markings above eyes; pronotum transverse, about twice as broad as long, anterior margin almost truncate, posterior broadly sinuate, sparsely and slightly marked with minute punctures; scutellum about one and one-half times as broad as long, with a median, longitudinal, light brown band, and four horizontal, median, light brown spots, posterior angle acute and with curved impression on upper third; tegmina broad, posterior margin rounded, sparsely and irregularly marked with brown markings, wing veins amber color; eyes fuscous; ocelli ochraceous above eyes, surrounded by brown spots.

LUZON, Laguna Province, Los Baños (*S. Gonzales*). NEGROS, Occidental Negros Province, Victoria (*Baker*).

Originally described from northern Bengal. This species is here reported from the Philippines for the first time.

Genus THOMSONIELLA Signoret

Thomsonia SIGNORET, Ann. Soc. Ent. Fr. (1879) 51.

Thomsoniella SIGNORET, Ann. Soc. Ent. Fr. (1880) 52; MELICHAR, Hom. Fauna Ceylon (1903) 171; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 277–278.

Type, *T. porrecta* Walker.

The original name *Thomsonia* was changed to *Thomsoniella*, because *Thomsonia* had been used in the Crustacea. This genus is close to *Hecalus*, from which it is separated by having six discoidal areolæ and the following characteristics:

Body depressed; head prolonged in front, foliaceous on the anterior margin of the vertex, with a groove throughout its entire length, vertex depressed, also the frons, the latter with the grooves and lateral sutures extending to the anterior border of the head; gena sinuate, rounded in the middle, the lora occupying the entire space between the margin of the gena and the frontal suture; sides of clypeus almost parallel, rounded at the tip, one and a half times longer than broad; pronotum transverse, almost broader than the head including the eyes; tegmina hyaline with a narrow marginal limbus.—SIGNORET, Ann. Soc. Ent. Fr. (1879) 51.

THOMSONIELLA PORRECTA Walker.

Thomsoniella porrecta WALKER (*Acocephalus*), List Hom. Suppl. (1858) 262; MELICHAR (*Thomsoniella*) part., Hom. Fauna Ceylon (1903) 173; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 278–279, fig. 178; BIERMAN, Notes Leyd. Mus. 3 (1913) 61, Java; DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 31; BAKER, unpublished notes.

Platymetopius bicolatus MUTSCH., Etud. Ent. 8 (1859) 114; KIRKALDY (*Thomsonia*), Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 337.

Hecalus kirschbaumii STÅL, Öfv. Vet.-Akad. Förh. (1870) 737; SIGNORET (*Thomsoniella*), Ann. Soc. Ent. Fr. (1880) 52, pl. 1, fig. 4; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 104.

Length, including ovipositor, 6.5 millimeters.

Pale ochraceous or greenish ochraceous, with small spot at the apex of clavus and another on the middle of the first apical area black; anterior margin of vertex usually blackish; some obscure longitudinal orange-red fasciæ which are sometimes obsolete, in other specimens visible as in the one here figured, these fasciæ number when fully discernible four on vertex, six on pronotum, and three on scutellum; vertex considerably shorter than breadth between eyes, its anterior margin distinctly reflexed, ocelli in groove very close to the eyes.—DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 278–281.

Habitat: Calcutta, Ceylon, Pusa, Peradeniya, Negombo, Burma, Maldive Islands, Queensland, Philippines.

THOMSONIELLA ALBOMACULATA Distant.

Thomsoniella albomaculata DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 280–281.

Length of male, including tegmina, 5 millimeters.

Pale ochraceous or greenish-ochraceous; apical areas of tegmina brownish with white spots; vertex of head with the lateral and apical margins somewhat strongly reflexed, extreme apical edge piceous; pronotum finely trans-

versely striate; scutellum with an angulate line before the apical area; in some specimens as the one here figured there are two darker basal spots, but generally these are obsolete; abdomen above black, the lateral margins somewhat broadly ochraceous and inwardly angulated, a sub-apical narrow greyish transverse fascia, the anal segment castaneous.—DISTANT, tom. cit., 281.

Originally known only in eastern Bengal, Calcutta, and Ceylon.

LUZON, Rizal Province, Alabang; Laguna Province, Los Baños (*J. Valdez*, in my collection).

This is the first Philippine record for this species. Apparently very common around Manila. Some of the specimens are parasitized by a dryinid.

Genus NIRVANA Kirkaldy

Nirvana KIRKALDY, Ent. 33 (1900) 293; MELICHAR, Hom. Fauna Ceylon (1903) 165; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 281.

Type, *N. pseudommatos* Kirkaldy.

Distant [83] places the members of this genus under the division Hecalusaria. Kirkaldy [84] founded this genus in 1900, which he states may be placed provisionally near the American genus *Spangbergiella* Signoret, a genus allied to *Hecalus* under Jassinæ. However, later on Kirkaldy [85] changed his opinion and placed it under the genus *Eupterigine*, which belongs to the Typhlocybinæ. Baker [86] has raised this genus to the category of a family, separated into three subfamilies mainly according to the position of the antennæ; namely, Macroceriinæ, Nirvaniinæ, and Stenometopiinæ. The Macroceratogoniinæ include the genera *Macroceratogonia* Kirkaldy, *Balbilus* Distant, and *Stenotortor*, a new genus erected by Baker, the characteristics of which were based upon the more highly specialized *Balbilus*. The type species is *Stenotortor inocarpi* Baker, collected in Singapore, Straits Settlements, on *Inocarpus edulis*, the Otaheite chestnut, supposed to have been introduced from Polynesia.

The Stenometopiinæ take in one genus, *Stenometopius* Matsumura, with the species *S. formosanus* Matsumura and *S. mindanaoensis* Baker. Baker believed that this genus may be represented in the islands between Formosa and Mindanao.

The Nirvaniinæ take in *Didius* Distant, which is provisionally placed in this subfamily by Baker, *Kana* Distant, *Nirvana* Kir-

[83] Tom. cit. (1908) 281 and 299.
[84] Ent. 33 (1900) 293.
[85] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 3 (1907) 68.
[86] Philip. Journ. Sci. 23 (1923) 345–401.

kaldy, *Ophiuchus* Distant, and the four genera separated by him; namely, *Pseudonirvana*, *Nirvanoides*, *Pythonirvana*, and *Jassonirvana*. These separations were based largely on the shape and characteristic sculptures of the vertex, on the position of the ocelli on the varying points of the crown, accompanied by peculiar surrounding structures, and in many cases the sizes and shapes of the tegminal cells.

In Baker's[47] synopsis the vertex of *Kana* is as long as or usually shorter than the anteocular width, which did not tally with any species. It should have been relatively shorter than the vertex of *Nirvana*. I have examined the species of *Kana* and found them to have the vertex longer than the distance between the eyes, tallying with Distant's synopsis which gives the face slightly longer than broad.

NIRVANA PHILIPPINENSIS Baker.

Nirvana philippinensis BAKER, Philip. Journ. Sci. 23 (1923) 385–386, pl. 4, fig. 31.

Length, including tegmina, 5 millimeters.

Very pale ochraceous; the delicate complete median carina of vertex is black, and a median stripe a little paler in color continuous across the pronotum and scutellum, and in some specimens the full length of clavai commissure; ocellus seated in an orange spot. Tegmina milky translucent, three oblique fuscous stripes over the corresponding cross veins in apical half of subcostal area; a large orange spot covers apical portions of radial and medial areas; apical submargin fuscous, this extending into outer apical cell; a large round black spot at base of second apical cell; extreme apex of clavus fuscous. Length, female, 5 mm; male, 4.25 mm.—BAKER, loc. cit.

Baker's specimens were from Mount Maquiling, Luzon; and Dapitan, Zamboanga, Lanao, and Surigao, Mindanao.

LUZON, Laguna Province, Los Baños, Mount Banahao: Rizal Province, Alabang. NEGROS, Occidental Negros Province, La Carlota. The specimens were compared with the type in the United States National Museum. It is evident that this species is well distributed.

Division SELENOCEPHALARIA

The general characteristics of the species belonging to this division are as follows: Vertex short, about one-half as long as distance between the eyes, more or less rounded anteriorly, the ocelli near the anterior margin of the eye and near the eyes.

[47] Tom. cit. 379.

The following key may serve to separate the genera determined in this paper:

Key to the Philippine genera of the division Selenocephalaria.

a^1. Veins of tegmina very distinctly brown-margined, the cellular areas pronounced, the frons more or less rounded; vertex not apically transversely sulcate, the apical margin more or less reflexed and ridged. *Parameesus* Fieber.

a^2. Veins of tegmina very distinct and cellular areas not all brown-margined, frons more or less elongated.

b^1. Vertex moderately transversely sulcate near apex and ridged at the edge, more than one-half as long as width between eyes, ovipositor and pygofer short and stout..... *Roxasella* gen. nov.

b^2. Vertex moderately transversely sulcate near apex and ridged at the edge, more than one-fourth as long as width between eyes, ovipositor and pygofers more or less long and slender. *Omanella* gen. nov.

a^3. Veins of tegmina normal, claval veins not connected, apical areas of tegmina reticularly veined.

b^1. Vertex almost as long as width between eyes, body elongated and slender, wings very much longer and tapering. *Parabotocratus* Uhler.

b^2. Vertex moderately transversely sulcate near apex and ridged at the edge, one-half as long as width between eyes..... *Krisna* Kirkaldy.

Genus PARAMESUS Fieber

Parameesus Fieber, Verh. Zool-Bot. Ges. Wien 16 (1866) 506.

Type, *P. nervosus* Fall., a Palæarctic species.

Distribution: Nearctic, Palæarctic, and Oriental Regions.

Margin of vertex linear, ridged above and below margin with short fine transverse wrinkles parallel to margin, hollowed out on the upper surface, the margin of vertex consequently somewhat raised; the whole face very finely shagreened; clypeus somewhat long, gradually widened to apex, almost spatulate, "Zügel," not extending to end of clypeus, cheeks and middle of the sides very obtusely angulated, almost round; pronotum in front very flatly carved; face to vertex on ridge nearly subright-angularly obtuse, to the clypeus suddenly narrowed; ocelli on the ridge of vertex near the eyes; veins of tegmina distinct, the brown bordering of the veins strongly pronounced, the inner forked branch of first sector connected with the internal vein by two transverse veins so that there are two discal cells, three middle cells and five terminal cells are also formed; no marginal appendage. Direction of veins in tegmina as in *Selenocephalus*.—Melichar, cited by Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 293.

PARAMESUS LINEATICOLLIS Distant.

Parameesus lineaticollis Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 294, fig. 186.

Length, 5 to 6 millimeters.

Vertex, pronotum and scutellum ochraceous; vertex with an arcuated transverse black fascia between the eyes, behind the fascia is a short

medial incised dark line extending to base; pronotum with five longitudinal narrow fasciæ, the central narrowest and darkest, those on each side paler, broader and more brownish in hue; body beneath and legs pale ochraceous; face transversely brownly striate, medially longitudinally palely interrupted, on each side of clypeus a pale elongate spot outwardly margined with black; abdomen beneath with a marginal series of small piceous spots; posterior tibiæ streaked and spotted with piceous; tegmina dull pale ochraceous, the veins very prominent and much paler, a central prominent discal brown spot sometimes preceded nearer base by one or two smaller and linear dark spots; vertex short, transverse, rounded anteriorly, about three times as broad as long; face sub-convex; tibiæ longly spinulose.—DISTANT, loc. cit.

LUZON, Rizal Province, Alabang (Merino collection); Nueva Vizcaya Province, Bayombong. BASILAN (Osborn collection).

This species was originally described by Distant from Bengal, and is now reported for the first time from the Philippines where it may be of wide distribution.

Genus ROXASELLA novum

Type, *R. camusi* sp. nov.

Body oblong; vertex produced in front, slightly longer than one-half the distance between eyes, flat, finely diagonally striated; face dilated, depressed at base, antennæ located in impressions at base of cheek between eyes and space below base of frons; ocelli situated at apex of vertex, close to eyes and above the sulcated area of antennal base; pronotum transverse, distinctly quadrilateral, anterior margin rounded, slightly produced to between eyes, sides short and oblique; posterior margin slightly arcuated, two-thirds of posterior area roughly striated, anterior third slightly irregularly elevated; scutellum triangular, slightly broader than long; tegmina extending beyond tip of abdomen, venation similar to that of *Selenocephalus*. Closely related to *Selenocephalus*, differing mainly in shape of vertex, which in *Selenocephalus* is broadly rounded at the apex, and about one-half as long as half of distance between eyes, and the shape of pronotum which is rounded on anterior margin, and slightly more arcuated at posterior margin, and with the shallower excavation of cheek at base of antennæ.

LUZON, Laguna Province, Mount Maquiling. There are specimens of this genus in the Baker collection from Borneo and Singapore.

This genus is erected in honor of Dr. Manuel L. Roxas, chairman of the National Research Council, because of his interest in insect control.

ROXASELLA CAMUSI sp. nov.

Female, length, about 7.25 millimeters; male, length, about 7.

Vertex brown, with a narrow ochraceous band at extreme anterior margin, preceded by a fuscous band two and two-thirds times as long as distance between the eyes; ocelli at apex of vertex just above and close to eyes; eyes fuscous; face ochraceous; base of frons rounded with fuscous band, a deep excavated part above cheek, between base of frons and eyes, where antennæ are located, clypeus narrower at base; pronotum brown, roughly and transversely striate at posterior two-thirds, scutellum triangular, slightly wider than long, anterior portion brown, posterior angle ochraceous; tegmina semitransparent pale brown, long veins brown, crimson bands on commissural region, on clavalsuture region, and on costal and first apical cells; pectoral and abdominal regions ochraceous with a light brown tinge, posterior legs spinulose and regularly marked with brown; last ventral segment longitudinally carinate, protruding slightly at center.

LUZON, Laguna Province, Los Baños (holotype, *S. Gonzales*; allotype, Baker collection, U. S. N. M.).

This species is named for Mr. Jose S. Camus, ex-director of the Bureau of Plant Industry and now undersecretary of the Department of Agriculture and Commerce, in recognition of his interest in promoting entomological work in this bureau.

ROXASELLA LOSBAÑOSA sp. nov.

Female, length, 8 millimeters; male, length, 7.

Light brown, with fuscous markings on vertex, pronotum, scutellum, commissural region of the clavus, and last third (apical region) of tegmina; venation golden yellow.

Vertex with ochraceous marginal stripe preceded by fuscous band, separated at the middle, anterior half of the vertex ochraceous; posterior two-thirds of pronotum finely, transversely striate and finely punctate; scutellum ochraceous with brown markings on central, lateral, and apical portions; face ochraceous with fuscous marks on basal margin of frons bordering apex of vertex; sternal region dark brown; venter ochraceous with brownish tinge; tegmina ochraceous with fuscous blotches on upper portion of two outer apical cells, and the tip of the wing cover.

LUZON, Laguna Province, Los Baños (type, Baker collection, U. S. N. M.); MINDANAO, Surigao, Lanao, Zamboanga (paratypes). The paratypes are slightly darker brownish.

Genus OMANELLA novum

Type, *O. barberi* sp. nov.

Vertex depressed, slightly produced in front, rounded, slightly, transversely sulcate and reflexed at apex, about one-third as long as distance around posterior margins of eyes; ocelli ochraceous, on the apex of vertex, distance from eye to ocellus one-fourth the distance between ocelli; general shape of frons somewhat triangular, broad at base and tapering towards clypeus. Clypeus elongate, broader at apex than at base. Shape and sculpture of pronotum and scutellum, the position and venation of tegmina similar to that of *Roxasella*, except that the first apical cell is smaller than the first anteapical, while that of *Roxasella* is equal in size to the first anteapical. The main difference from *Roxasella*, however, is in the size and shape of the vertex. The location of the ocelli is immediately above the eyes in *Roxasella*, and the antennal pit is shallower in this genus than in *Roxasella*. The pronotum is less sculptured in *Omanella*. The ovipositor and pygofer of this genus are long and slender; the ovipositor greatly exceeds the pygofer.

The genus is named in honor of Mr. Paul W. Oman, taxonomist in charge of auchenorhynchous Homoptera in the United States National Museum, whose valuable assistance and timely suggestions to the writer in the preparation of this paper are very much appreciated.

OMANELLA BARBERI sp. nov.

Female, length, including tegmina, 6 millimeters; male, length, including tegmina, 5.5.

Body ochraceous, vertex and pronotum slightly greenish ochraceous, each dorsal segment of abdomen with brown bands. Vertex greenish ochraceous with four black spots in a row near apex and two at posterior margin, distance between ocellus and eye almost one-third that of distance between ocelli themselves; pronotum greenish ochraceous, rounded anteriorly, slightly sinuate posteriorly, two-thirds posterior area finely punctate and striate, six dark spots at middle (three on each lateral side); scutellum ochraceous, with an oblique faint brown patch on each anterolateral angle, posterior angle differentiated by a transverse sulcus, finely striate, and with a brown dot on each lateral side; tegmina greenish amber, wing veins transparent amber, with a piceous marking on the ends of the outer and inner claval veins, and the claval suture at the point of union with the vein bound-

ing the commissural region, and brownish markings on veins practically in all angles of every cell; pectus, legs, and abdomen ochraceous, last ventral segment in male truncate, with two smoky semitransparent markings near middle; last ventral segment of female slightly notched at center, abdomen greatly tapering, ovipositor long, pointed, and distended far beyond pygofer, reaching almost to tips of tegmina.

The species is named for Mr. H. G. Barber, taxonomist in charge of the Hemiptera-Heteroptera in the United States National Museum.

MINDANAO, Zamboanga. BASILAN (type, Baker collection, United States National Museum).

OMANELLA PHILIPPINA sp. nov.

Female, length, 8 millimeters; male, length, 6.5.

Olive-green, face greenish ochraceous, pectoral and ventral regions greenish gray, prosternal region with black blotches. Vertex rounded, about one-fourth as long as distance between eyes, which are orange above and dark below, with two confluent orange spots occupying practically the whole frontal half of vertex, three distinct black dots on midsection; frons abruptly tapering towards the clypeal suture; clypeus narrowest at suture, abruptly enlarging towards apex; face greenish yellow; front tibiæ orange; the two posterior with an orange blotch near femora; pronotum slightly wider than long, olive-green, with two small orange spots at middle of anterior margin, two large orange spots on midsection of pronotum, and one small orange spot on each lateral side; scutellum lighter green, with two orange blotches on each of the anterior angles; two on middle of lateral side, and one at apex of posterior angle; tegmina coriaceous smoky hyaline, wing veins testaceous, with orange stripes on commissural region, an orange spot on each humeral angle, and an orange stripe along costal vein.

This is one of Baker's manuscript species the type of which is labeled *Selanocephalus philippinensis* sp. nov. in the Baker collection. It differs from the type of *Selanocephalus* in the general shape of the face, the shape and sulca of the vertex, the shape of the pronotum, and the folding of the tegmina. The robust posterior tibia, which is slightly compressed and densely spinulose, one of the outstanding characteristics of *Selanocephalus*, is not present in this species.

MINDANAO, Zamboanga (type, Baker collection, U. S. N. M.).

OMANELLA JOHNSONI sp. nov.

Female, from middle of vertex to tip of ovipositor, 9.5 millimeters; male, from middle of vertex to tip of tegmina, 8.

Greenish ochraceous dorsad, and ochraceous ventrad, sides of body brown with a narrow pale ochraceous band on the posterior side of each abdominal segment; vertex with four black spots in a row, on depressed portion near apex, and two on posterior side, one-third of the distance from the eye to the distance between the spots; ocelli on the margin of vertex ochraceous. Pronotum, scutellum, and tegmina with the same color and markings as those of *O. barberi*, but the claval suture more golden in color. Very close to *O. barberi*, but larger. Last ventral segment of male a little rounded in front; ovipositor slenderer and relatively longer than that of *O. barberi*. The sheath projecting beyond the tips of tegmina.

I take pleasure in naming this beautiful species for Miss Dorothy Johnson, graduate assistant of the Ohio Biological Survey, whose assistance was gratefully received during the early part of this work.

MINDANAO, Zamboanga. BASILAN (type and paratypes, Baker collection, U. S. N. M.).

Genus PARABOLOCRATUS Uhler

Parabolocratus UHLER, Proc. U. S. Nat. Mus. 19 (1896) 291.
Parabolopona MATSUMURA, Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912).

Type, *P. guttatus* Uhler.

Probable distribution: Oriental.

This genus was erected by Uhler, but later Matsumura [68] gave it the name *Parabolopona*.

Elongate, slender; vertex almost as long as wide, triangularly rounded in front, a little expanded at the margin between the middle and the eyes, the margin a little upturned; eyes blunt, triangularly elongated; ocelli at apex of vertex immediately after the eyes and above the antennæ; pronotum transverse, anterior margin rounded, the lateral obliquely rounded, and the posterior gradually concave, almost as long as vertex which is longer than scutellum, surface finely wrinkled; scutellum with surface finely wrinkled, broader than long, the posterior angle separated by an arcuated suture; tegmina long, slender, and tapering, with four apical cells.

[68] Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912).

This genus is here reported from the Philippines for the first time.

PARABOLOCRATUS GUTTATUS Uhler.

Parabolocratus guttatus UHLER, Proc. U. S. Nat. Mus. 19 (1896) 291.
Parabolopona guttatus MATSUMURA, Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912); 6,000 Illustrated Insects of Japan-Empire (1931).

Length to tip of wing covers, 6 to 7 millimeters; width of pronotum, 2.

Elongated, bright pea-green, polished. Head almost as long as wide; angularly rounded in front, the subacute apex a little upturned; eyes brown, long, bluntly angular on the inner side, the depressed middle crossed by two impressed lines, and a very slender impressed line on the middle; antennæ very long and slender, yellow from base to middle, brown from thence to tip. Pronotum short, sublunate, with the lateral ends diagonal and moderately rounded, the surface very finely wrinkled. Sternum and legs paler, the femora with some black specks, the tibiæ dotted with black and with black spines. Wing covers wedge-shaped when closed, a little tinged with yellow above the margin of the clavus marked with two black, small spots, one of which is on the apex, apical ends of membrane with two or three black traces, the surface highly polished.—UHLER, loc. cit.

LUZON, Mountain Province, Haight's Place (Osborn collection); Baguio (Baker collection, U. S. N. M.).

Genus KRISNA Kirkaldy

Siva SPINOLA, Mem. di Matem. e di Fis. Soc. Ital. Modena (1852) 167; STÅL, Hem. Afr. 4 (1866) 112; SIGNORET, Ann. Soc. Ent. Fr. (1880) 197; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 107; MELICHAR, Hom. Fauna Ceylon (1903) 167, nom. praeocc.
Krisna KIRKALDY, Entomologist 33 (1900) 243, nom. nov.; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 297.
Eogypona KIRKALDY, Entomologist 34 (1901) 38.

Type, *K. strigicollis* (Spinola).
Distribution: Ethiopian and Oriental Regions.

Body oblong, somewhat depressed, above slightly convex; vertex narrower than the pronotum, short, rounded anteriorly or obtusely subangularly rounded, anterior margin somewhat acute but not foliaceous, vertex horizontal, flat, about twice as broad as the eyes; face dilated, frons and clypeus somewhat flat; frons longer than broad; clypeus spatuliform; genæ broad with the angle more or less angular and more or less emarginate; ocelli placed at the eyes on the anterior margin of the head; pronotum transverse, anteriorly narrowed, twice as broad as long slightly rounded at anterior margin, almost straight before the scutellum, lateral margins acute, scutellum triangular, a little broader than long; tegmina barely extending beyond the abdominal apex, apically narrow, irregularly veined; legs moderate, posterior femora compressed; posterior tibiæ very spinose.—ATKINSON, cited by DISTANT, loc. cit.

KRISNA STRIGICOLLIS Spinola.

Acocephalus stramineus WALKER, List Hom. 3 (1851) 847; SIGNORET, Ann. Soc. Ent. Fr. (1879) 88.

Krisna strigicollis SPINOLA (*Siva*), Mem. Mat. Fis. Soc. Modena (1852) 167; SIGNORET, Ann. Soc. Ent. Fr. (1880) 198, pl. 6, fig. 64; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 108; KIRKALDY (*Krisna*), Entomologist 33 (1900) 243; BIERMAN (*Siva*), Notes Leyd. Mus. 29 (1907) 166; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 297–298, fig. 189; MELICHAR, Notes Leyd. Mus. 36 (1913) 131, Java.

Bythoscopus testaceous WALKER, Journ. Linn. Soc. Zool. 1 (1857) 173.

Bythoscopus indicatus WALKER, List Hom. Suppl. (1858) 266.

Scenocephalus costalis STÅL, Freg. Eug. Resa Ins. (1859) 290; (*Siva*), Ann. Soc. Ent. Fr. (1864) 66; Öfv. Vet.-Akad. Förh. (1870) 736.

Length, including tegmina, 10.5 to 13 millimeters.

Greenish ochraceous to pale ochraceous; vertex short, about half as long as distance between eyes, narrower than pronotum, flat, slightly impressed, front margin reflexed, a discontinuous arcuate fuscous fascia bordering margin from eye to eye, crossing them with a longitudinal suture from center of posterior margin to apex of vertex, pronotum transverse, anteriorly rounded transversely and strongly striate; scutellum broad, about one and one-third as broad as long; tegmina with an oblique impression near each lateral angle, an arcuate impression near tegmina profusely punctated, with two small black markings at the apices of the clavus, anterior posterior margin from clavus down smoky white; posterior legs thickly decorated with stout spines.

Known host, *Acalypha* species.

Distant[60] reported the distribution as Bengal, Kangra Valley, Bombay, Nilgiri Hills, Burma, Tenasserim, Malay Peninsula, Cambodia, Java, Borneo, Celebes, North China, Philippines.

LUZON, Laguna Province, Los Baños, Mount Banahao: Rizal Province, Alabang (*Merino*): Tayabas Province, Panaon: Mountain Province, Trinidad (Osborn collection). NEGROS, Negros Occidental Province, La Carlota (*Merino*). BILIRAN (Osborn collection).

KRISNA STRIATA Kirby.

Krisna striata KIRBY (*Gypona*), Journ. Linn. Soc. Zool. 24 (1891) 171; MELICHAR (*Siva*), Hom. Fauna Ceylon (1903) 167; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 298–299, fig. 190.

Eogypona kirbyi KIRKALDY, Entomologist 34 (1901) 39.

Length, including tegmina, about 13 millimeters.

[60] Fauna Brit. Ind. Rhynch. 4 (1908) 298.

Yellowish green, the vertex slightly more angular and more pointed than in the preceding species; the venation is green while that of the closely related *strigicollis* is yellow. The tegmina are not as compact; they are more spread and rather pubescent, and not rugulose or punctate.

The distribution as reported by Distant,[10] is Ceylon, Kandy, Maskeliya, Pundaluoya, Peradeniya, Muruwale, Gumaduwa, Haputale, Keigalle.

LUZON, Nueva Vizcaya Province, Imugan (Osborn collection). Hitherto not recorded in the Philippines.

Division TARTESSUSARIA

To this division belong the species having the vertex about or more than three times broader between eyes than long, and with the ocelli near the anterior margin and nearer to the eyes than to each other. The two genera are separated by the following characteristics:

Vertex and pronotum both angularly produced in front of eyes. *Tartessus* Stål.

Vertex alone angularly produced in front of eyes; pronotum twice, or slightly more than twice, as long as vertex..... *Drabrescus* Stål.

Genus TARTESSUS Stål

Tartessus Stål, Öfv. Vet.-Akad. Förh. (1865) 156; Signoret, Ann. Soc. Ent. Fr. (1878) 347; Spangberg, Öfv. Vet.-Akad. Förh. No. 9 (1877) 3; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 302–303.

Type, *T. ferrugineus* Walker.

Distribution: Eastern British India, Malay Peninsula and Archipelago.

Body oblong; vertex broad, short, in front of eyes strongly angularly roundly produced, shorter or narrower at apex; head beneath strongly reclinated, face moderately flattened, a little narrowed posteriorly; eyes large, oblique; ocelli placed on margin of vertex near eyes; pronotum large, anteriorly very strongly, roundly, and subangularly produced; scutellum longer than broad, about as long as pronotum; tegmina oblong, apex somewhat valvate, apical cells five; posterior densely spinulose.—Distant, loc. cit.

TARTESSUS FERRUGINEUS Walker.

Tartessus ferrugineus Walker (*Bythoscopus*), List Hom. 3 (1851) 865–866; Stål (*Tartessus*), Öfv. Vet.-Akad. Förh. (1870) 738; Spangberg, Öfv. Vet.-Akad. Förh. No. 9 (1877) 7; Signoret, Ann. Soc. Ent. Fr. (1880) 356; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 303, fig. 193; Banks, Philip. Journ. Sci. § D 4 (1909) 553; Melichar, Notes Leyd. Mus. 36 (1913) 131.

[10] Tom. cit. 299.

Bythoscopus malayus STÅL, Freg. Eug. Resa Ins. (1859) 290, *B. binervatus, unilineatus, unifascia* Walker MS.; STÅL (*Tartessus*), Öfv. Vet.-Akad. Förh. (1865) 156; SIGNORET, Ann. Soc. Ent. 1880) 157.

Female, length, including tegmina, 10 millimeters; male, 8.

Tawny, rather narrow, tapering from the head to the tip of the abdomen; head minutely punctured, very short, conical, a little broader than the chest, black along the fore border, extremely concave behind crown, extremely short in the middle where its length is not one-tenth of its breadth, rather broader on each side; under side transversely striated, across scutellum minutely punctured, having on each side of the fore border a triangular compartment, which is partly smooth, partly slightly striated; breast partly black on each side; abdomen black; hind borders of the segment tawny; veins of the forewings few, black, excepting those along the hind border; hind wings gray.—WALKER, List Hom. 3 (1851) 865-866.

This species was originally described from Java, and its distribution is given by Distant [71] as Tenasserim, Malay Peninsula; Perak, Malacca, Java, Mysol, and Japan. Banks [72] made the first Philippine record. The available material indicates that the species is present all over the Philippines. Known host plant, mango.

TARTESSUS MALAYUS STÅL

Tartessus malayus STÅL, Freg. Eug. Resa Ins. 290; Öfv. Vet.-Akad. Förh. (1865) 156.

Tartessus ferrugineus STÅL, Öfv. Vet.-Akad. Förh. (1870) 738; STANGBERG, Öfv. Vet.-Akad. Förh. No. 9 (1877) 7; SIGNORET, Essai sur les Jassides (1878) 357–358, pl. 9c, fig. 82.

Length, including tegmina, as in *ferrugineus*, 8 to 10 millimeters.

This species was described by Stål in 1859, who in 1870 considered it to be a synonym of *T. ferrugineus* Walker. However, Signoret [73] considered it a distinct species. It is very similar to *ferrugineus* in size and color, with certain slight differences of coloration of the tegmina and venation, features that, however, are not very constant. For example, the black band on the costal area is sometimes absent in *ferrugineus*. The venation in *malayus*, which is black or piceous, is also found on at least the lateral area of *ferrugineus*. The main difference is the presence of the double arcuate marginal black bands on the upper region of the frons in this species, instead of the single arcuate

[71] Fauna Brit. Ind. Rhynch. 4 (1908) 303.
[72] Philip. Journ. Sci. § D 4 (1909) 553.
[73] Essai sur les Jassides (1878) 357–358.

marginal black band between the eyes, which sometimes is even absent.

Vertex and pronotum yellowish brown, vertex finely punctate, pronotum transversely striate; scutellum amber brown, quite long, about one and one-half times as long as wide; tegmina bronzy brown, veins black or fuscous, costal area black; face with double marginal black bands on the upper region of face. In some males these markings are even more accentuated by a longitudinal median band which is continuous to the clypeus. In others only certain black markings on the clypeus and lora are present; lateral margins of sternum with a black area.

Distribution: Malacca, Philippines, and Formosa.

LUZON. MINDORO. BASILAN. (Osborn collection). One specimen has been taken in Formosa. I believe that this species is as widely distributed as *T. ferrugineus*.

TARTESSUS FIEBERI Stål.

Tartessus fieberi STÅL, Öfv. Vet.-Akad. Förh. (1865) 153; (1870) 738; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 9 (1877) 9; SIGNORET, Essai sur les Jassides (1878) 359–360; BANKS, Philip. Journ. Sci. § D 5 (1910) 51.

Female, length, including tegmina, 12 millimeters; male, 10.

Vertex chestnut-brown, pronotum black, with a short brown stripe below the eyes, and faint, narrow, brown lateral and posterior marginal stripe, transversely striated; scutellum black, minutely shagreened, except a small lateral triangle which is smooth, about one and one-half times as long as broad, marginal angle pointed, with brown margin, an inverted median anchor-shaped impression on the scutellum; tegmina chestnut-brown with piceous or fuscous venation; black band within the costal area as in the two preceding species; eyes and ocelli brown; black arcuated line below apex of vertex, frons, lora, clypeus, and anterior half of cheek black; the rest of the face golden brown; legs brown, except posterior femora which are black; hind tibia spinulose.

Distribution, according to Signoret,[74] Mysol and Philippines.

LUZON, Bataan Province, Limay (Osborn collection); Laguna Province, Mount Banahao (*Merino*). MINDANAO, Lanao Province, Mumungan; Surigao Province, Surigao. SAMAR, Catbalogan. BILIRAN. BASILAN. These records indicate that this species is as widely distributed in the Philippines as either of the two preceding species.

[74] Op. cit. 359–360.

Genus DRABESCUS Stål

Drabescus Stål, Öfv. Vet.-Akad. Förh. (1870) 738; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 304.

Type, *D. remotus* Walker, from the Philippines.
Distribution: India, Malaya.

Ocelli remote from the eyes, almost more so than the antennæ; anterior tibiæ above broadly subsulcate; superior margin of the anterior tibiæ distinctly dilated (Stål). Vertex broadly transverse, short, moderately concave, the anterior margin ridged; head beneath much broader than long, the face a little longer than broad, somewhat flat; pronotum transverse, much broader than long, anterior margin convex; scutellum large, broad, subtriangular; tegmina with four large distinct apical cells divided by smooth veins, the remaining venation punctate.—Distant, loc. cit.

DRABESCUS REMOTUS (Walker).

Drabescus remotus Walker (*Bythoscopus*), Cat. Hom. Ins. Suppl. 32 (1851) 866; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 304.
Bythoscopus ater Walker, Cat. Hom. Ins. Suppl. 43 (1851) 871; Stål (*Selenocephalus*, subgenus *Drabescus*), Öfv. Vet.-Akad. Förh. (1870) 738; Signoret, Essai sur les Jassides (1870) 208.

Female, length, including tegmina, 10 millimeters; male, 8.

Pale ferrugineus, mottled with fuscous. Vertex broadly transverse, very short, about one-fifth as long as wide, slightly concave in front; pronotum transversely rounded anteriorly and broadly concave posteriorly, deeply, transversely striated; scutellum large, as long as wide; tegmina leathery, hyaline, posterior portion folded in almost perpendicularly, venation punctate, posterior fourth smooth-veined, distinctly four apical cells.

Distribution: Philippines.

Luzon, Laguna Province, Mount Banahao (*Merino*); Nueva Viscaya Province, Imugan: Mountain Province, Haight's Place. Mindanao, Surigao. Biliran (Osborn collection). This species is widely distributed in the Islands.

Division JASSUSARIA

The insects of this division are easily recognized by the nonlaterally ridged and nondiscally foveate or excavate vertex, the lateral margins more or less obliquely, basally narrowed at inner margins of the eyes. *Jassus* is the only genus determined.

Genus JASSUS Fabricius

Jassus Fabricius, Syst. Rhyng. (1803) 85.
Coelidia Germar, Mag. d. Ent. 4 (1821) 38 and 75.
Deridna Walker, List. Hom. Suppl. (1858) 319.

Type, *J. nervosus* Fabricius.
Distribution: Cosmopolitan.

Body oblong, vertex obtuse, longer than width between the eyes, narrower than pronotum, narrow at margin between eyes, then gradually broadened above; pronotum short, greatly transversed, shorter than the scutellum; scutellum large, narrower than long; tegmina apically margined with five apical cells, but no anteapical; vertex with eyes narrower than pronotum, face widened downward; clypeus greatly broadened at base.

JASSUS CONSPERSUS Stål.

Cocldia sparsa STÅL, Öfv. Vet.-Akad. Förh. (1854) 254; Freg. Eug. Resa Ins. (1859) 290–316.

Jassus conspersus STÅL, Hem. Ins. Philip. (1870) 736; SPANGBERG, Öfv. Vet.-Akad. Förh. No. 8 (1878) 25; MELICHAR, Notes Leyd. Mus. 36 (1913) 133; BAKER, Philip. Journ. Sci. § D 10 (1915) 55-56.

Female, length, including tegmina, 9.25 millimeters; male, 8.

This species is brown to fuscous and well marked by yellow spots; vertex slightly longer than width between eyes, with two light brown carinate plates running longitudinally, separated by median groove, narrower at the posterior margin; frons yellowish with reddish lateral stripes at the clypeus strongly broadened apically; upper tip of lora acute; hind margin of last ventral segment of female subtruncate at center and somewhat sinuate at sides.

Habitat: Luzon, Philippine Islands.

LUZON, Laguna Province, Los Baños; Rizal Province, Alabang (1 female and 3 males).

JASSUS MINDANAOENSIS sp. nov.

Female, length, including tegmina, about 10 millimeters.

Greenish ochraceous, quite close to *J. conspersus*. Vertex greenish brown, longer than distance between eyes; ocelli brown; eyes fuscous; pronotum fuscous, thickly covered with greenish ochraceous granules. Scutellum subequilateral, light amber brown, with two broad fuscous areas on center of scutellum equidistant from lateral and basal margins, and thickly covered with greenish ochraceous granules; face greenish ochraceous; frons about twice as long as broad between the eyes, dimly, laterally striate with short, greenish, perpendicular lines; margined above with narrow, longitudinal, greenish fascia between eyes and frons; cheeks and clypeus greenish ocher; body beneath abdomen fuscous; venter ochraceous, except the center of last segment and ovipositor, which are fuscous; thorax stramineous, two anterior legs ochraceous brown; anterior claws brown and the two last pairs fuscous; the posterior legs stramineous, armed with large fuscous spurs.

This species is quite similar in the contours of the parts of the body to *J. conspersus*. The greatest difference is in the last ventral segment of the female genitalia, that of *conspersus* being sinuate at the side and truncate at the center, while that of *Jassus mindanaoensis* is slightly bisinuate. This species is slightly larger than *J. conspersus*.

MINDANAO, Butuan (*Pablo S. Soriano;* type in my collection).

Division ATHYSANUSARIA

This division of cicadellids is distinguished by the three anteapical areoles, the outer branch of the first sector of the elytra with two forks; the vertex only half as long as, or less than, the width between the eyes; face not longer than the breadth between the bases of antennæ.

The only forms described are species of *Athysanus*, and its subgenus *Stirellus*, erected by Osborn and Ball [75] and later raised to the category of a genus.

Genus ATHYSANUS Burmeister

Athysanus BURMEISTER, Gen. Ins. 1–14 Subg. 2 (1840); EDWARDS, Trans. Ent. Soc. Lond. (1888) 35; VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 299; MELICHAR, Hom. Fauna Ceylon (1903) 182; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 343.

Type, *A. argentatus* Fabricius, a Palæarctic species.

Distribution: General.

Robust; vertex with the eyes wider than the pronotum, obtusely produced, convex above, ocelli at apex of vertex, near eyes; frons, clypeus, and cheek wider at their bases; cheek reaches clypeus at end; pronotum transverse; tegmina overlap at apex, appendix well developed.

ATHYSANUS ATKINSONI Distant.

Athysanus atkinsoni DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 345.

Length, including tegmina, 4.5 millimeters.

Smoky ochraceous, vertex triangularly produced, two fuscous markings below ocelli; a black fascia on vertex between eyes; a fine furrow or median sulcus from fascia to posterior margin of vertex. Frons tumid, almost as broad as long, with transverse brown striæ; cheeks abruptly impressed between eyes; pronotum dark grayish with anterior lateral margin ochraceous; posterior lateral margin with a narrow ochraceous line; scutellum ochraceous, with three discernible rectangular brown mark-

[75] Ohio Naturalist 2 (1902) 25, 250.

ings on anterior margin, and one on apical angle; two dark spots below apex of vertex; face with short transverse striæ; body beneath ochraceous, anterior half of each abdominal segment dark brown; tegmina grayish subhyaline; veins pale brownish; hind femora with oblique whitish striæ.

LUZON, Rizal Province, Alabang.

Genus STIRELLUS Osborn and Ball

Stirellus OSBORN and BALL, Ohio Naturalist 2 (1902) 250 (subgenus).

Type, *Athysanus* (*Stirellus*) *bicolor* Van Duzee.

Head about as wide as pronotum, vertex narrow, rarely as wide as the long diameter of an eye, usually longer than its basal width. Front inflated, almost touching eyes above; vertex and front produced into a long, conical point, their margins indistinct. Elytra narrow, about as long as the abdomen; venation as in *Athysanus*, regular.—OSBORN and BALL, loc. cit.

STIRELLUS NIGRIPECTUS sp. nov.

Male, length, including tegmina, 2.5 millimeters; female, 3.

Vertex, pronotum, scutellum, and frons greenish yellow; tegmina smoky gray, legs ochraceous; pectus and venter black, except last ventral segment and anal plates pale ochraceous. Vertex angularly produced, pointed, almost as wide as long; ocelli at the apex of vertex, just above eyes, piceous; eyes black; frons light brown with ochraceous transverse striæ; clypeus small; almost perpendicular; pronotum transverse, shorter than length of vertex, rounded anteriorly with two faint, parallel, transverse, dark grayish lines; scutellum small, broader than long, with one green spot on each basal angle; a transverse suture on middle; venation milky white; last ventral segment almost truncate, pale ochraceous; pygofer profusely bristled.

LUZON, Rizal Province, Alabang (types and paratypes in my collection): Manila (paratypes, Osborn collection).

The species described herewith was collected from Alabang, Luzon. Professor Osborn's specimens, which were determined later, are from Manila.

Division THAMNOTETTIXARIA

This division of cicadellids differs from Athysanusaria in the proportion of the face, which is longer than broad, while that of Athysanusaria is not longer than broad.

In this group, *Nephotettix* Matsumura and *Eutettix* Van Duzee are the representatives studied. The genus *Nephotettix* is separated from other genera of this division by the following

synoptic characters: Breadth of vertex between eyes considerably shorter than length of pronotum and scutellum together. Clypeus broadest at base.

Distant's [16] description of *N. bipunctatus* tallies with the above description.

Genus NEPHOTETTIX Matsumura

Nephotettix MATSUMURA, Termész. Füzetek 25 (1902) 378; MELICHAR, Hom. Fauna Ceylon (1903) 192; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 359.

Type, *N. cincticeps* Matsumura, from Japan.

Distribution: Eastern Palæarctic, Ethiopian, Oriental, Malayan, and Australian Regions.

Body narrow, compressed, vertex short, in front broadly rounded, union of vertex to front rounded, a transverse furrow rather near front margin running from one eye to the other, frontal margin rather upcurved, the disk of vertex arched; ocelli at union of vertex to front, not close to eyes and on the inside of the suture of the face and cheeks; face broad as long or shorter than the width of the cheek-angles, flat, at the ocelli twice as broad as the clypeus, margins of the clypeus flatly curved; clypeus extending beyond the margins of the cheeks, somewhat quadrangular, broadest at base; pronotum longer than the medial length of vertex, on posterior margin very flatly curved, at the sides strongly rounded; tegmina at apices broadly rounded off, with only one discal cell; three middle cells, the first of which is small, and four terminal cells, no transverse vein on clavus, membranal appendix rather broad; wings at apices narrowly rounded: venation as in *Thamnotettix*.—MATSUMURA, cited by DISTANT, loc. cit.

NEPHOTETTIX APICALIS Motschulsky.

Nephotettix apicalis MOTSCHULSKY (*Pediopsis*), Etud. Ent. (1859) 110; MELICHAR, Hom. Fauna Ceylon (1903) 193; Wiener Ent. Zeit. 24 (1905) 303; MATSUMURA, Trans. Sapporo Nat. Hist. Soc. 1 (1905) 20; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 360–362, fig. 229; MATSUMURA, Insek. Zuckerrohr Formosa 2 (1910) 1; MELICHAR, Notes Leyd. Mus. 36 (1914) 133; FLETCHER, Proc. Soc. Ent. Mal. Pusa (1918) 177; DAMMERMAN, Landbouwdierk Oöst Ind. (1919) 170; FLETCHER, Proc. Third Ent. Meet. Pusa 1 (1920) 275.

Pediopsis nigromaculata MOTSCHULSKY, Etud. Ent. (1859) 111; MATSUMURA, Termész. Füzetek 25 (1902) 379.

Thamnotettix nigropicta STÅL, Öfv. Vet.-Akad. Förh. (1870) 740; ATKINSON, Journ. As. Soc. Bengal 57 (1889) 338; KIRBY, Journ. Linn. Soc. Zool. 25 (1891) 137.

Selenocephalus cincticeps UHLER, Proc. U. S. Nat. Mus. 19 (1896) 202.

Nephotettix nigropicta KIRKALDY, Rep. Exp. Sta. Haw. Sugar Planters' Assoc. pt. 9 (1906) 333; Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 3 (1907) 54.

[16] Fauna Brit. Ind. Rhynch. 4 (1908) 359–360, fig. 228.

Length, including tegmina, about 4 millimeters.

Vertex greenish virescent with black upper margin, upper half of frons, lora, and middle of gena black; upper and middle part of clypeus with a black stripe, in some the entire face black; a black, somewhat elongated, spot on the middle before claval suture and lower third of tegmina; sternum and abdomen including pygofer more or less black, in some only black middle markings on each segment. In some almost wholly black, posterior oral tarsi with black markings. Head as broad as pronotum, vertex slightly broader than distance from middle to eyes. Last ventral segment somewhat rounded.

Nephotettix apicalis has no definite zoöcentric region. It is found in India, Ceylon, and all of the East Indies as far as the Philippines and Formosa. It is recorded in South and East Africa. In the Philippines this insect is one of the worst pests of rice. Occasionally it appears in great numbers during the later part of the rainy season and attacks young rice until the plants in several hundreds of hectares of paddies are completely destroyed. It is controlled effectively by the use of light traps.

NEPHOTETTIX BIPUNCTATUS Fabricius.

Nephotettix bipunctatus FABRICIUS (*Cicada*), Syst. Rhyng. (1803) 78; STÅL (*Thamnotettix*), Hem. Fabr. 2 (1869) 82; ATKINSON, Journ. As. Soc. Bengal 54 (1885) 111; MATSUMURA (*Nephotettix*), Termész. Füzetek 25 (1902) 379; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 359–360, fig. 228; FLETCHER, Proc. Second Ent. Meet. Pusa (1918) 176; Proc. Third Ent. Meet. Pusa 1 (1920) 275.

Length, including tegmina, about 4 to 4.5 millimeters.

Vertex slightly broader than distance from middle to eye. Margin of vertex slightly convex anteriorly and depressed; entire dorsal side of body yellowish green, except the triangular patch starting from extreme edge of clavus on commissural line to both sides of tegmina, which is pale brown; from head to tip of ovipositor pale yellow and spotless, except prosternum which has a black marking on each side under each femur, and middle lower extremity of last abdominal segment.

The coloration of the males of *Nephotettix apicalis* and *N. bipunctatus* figured by Distant [7] are the complete black face of *apicalis*, whereas that of *bipunctatus* is black only on the basal parts of the frons and the lora; the absence of the arcuated marginal fascia on the vertex which is found in *apicalis;* the black on the pectus and venter are more intensified in *bipunc-*

[7] Tom. cit. 359–361, figs. 228, 229.

latus, the face completely black in the latter species. The middle tegminal marking is only partially black, semilunar in *bipunctatus*, and not in the form of oblique long lines as in *apicalis*. The black apical markings of *bipunctatus* are not as intense as those of *apicalis*.

Nephotettix bipunctatus is here reported for the first time from the Philippines; previously known from Calcutta.

As to this leafhopper being an important potential pest, I shall quote Annandale's information to Distant:[18]

> . . . in Calcutta this species appears in enormous swarms in the air at night about the end of the rains (generally in October). Gas-lamps in the street have to be protected against the green fly, as it is called, to prevent the light being put out by the numbers the dash into it. I have known over three pounds weight of dead "green flies" and other insects to be swept up under a couple of electric lamps in one morning.

In the Philippines this species is a more persistent pest of rice than *N. apicalis*.

Genus EUTETTIX Van Duzee

Eutettix VAN DUZEE, Psyche 6 (1892) 307; MATSUMURA, Termész. Füzetek 25 (1902) 380; KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 (1906) 231; Bull. 3 (1907) 53; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 362; DELONG, Tenn. St. Bd. Ent. Bull. 17 (1916) 65.

Type, *E. lurida* Van Duzee.

Distribution: World-wide.

Intermediate in its characters between *Thamnotettix* and *Athysanus*. In form the species resembles *Phlepsius*, being broader and stouter than in *Thamnotettix*. The vertex is rounded anteriorly and more or less transversely impressed behind the apex; the front is nearly as wide as in *Athysanus;* the elytra are proportionately shorter than in *Thamnotettix*, and moderately valvate at the apex, with one transverse nervure between the first and second sectors. The sides of the pronotum are shorter than in *Thamnotettix* and ecarinate.—VAN DUZEE, cited by DISTANT, loc. cit.

EUTETTIX DISCIGUTTUS (Walker).

Eutettix disciguttus WALKER (*Acocephala*), Journ. Linn. Soc. Zool. 1 (1857) 172; SIGNORET (*Bythoscopus*), Ann. Soc. Ent. Fr. (1879) 88; MATSUMURA, Trans. Sapporo Nat. Hist. Soc. 1 (1905) 20; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 362–363, fig. 320; MELICHAR, Notes Leyd. Mus. 36 (1913) 133, Java.

Thamnotettix sellata UHLER, Proc. U. S. Nat. Mus. 19 (1896) 294; MATSUMURA (*Eutettix*), Termész. Füzetek 25 (1902) 381; MELICHAR, Hom. Faun. Ceylon (1903) 189; Wiener Ent. Zeit. 24 (1905)

[18] Tom. cit. 359–360.

302; KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 3 (1906) 331.

Eutettix sellatus OSHANIN, Ann. Mus. Zool. St. Peters. 11 (1906) 140; MATSUMURA, Journ. Coll. Agr. Sapporo 5 (1914) 190.

Female, length, including tegmina, 4 millimeters.

Vertex greenish yellow, somewhat angularly produced, one-third anterior surface reflexed, tinged grayish with two close light brown spots, below them on the vertex two almost indiscernible yellowish green markings; last half of vertex medially, longitudinally divided by a groove; two fuscous spots, one each between the eyes and median suture; eyes fuscous; face pale white; pronotum transverse, one and one-half times as long as vertex, sordid green to dark gray, marked with irregular fuscous spots; scutellum yellowish green, small, about one and one-half times as broad as long, the third upper lateral side with a fuscous spot, and a dark brown line between transverse sulca and marginal angle of apex; tegmina milky white, with greenish and fuscous spots all over, concentrating at tips; venation light brown; venter and legs pale, last ventral segment centrally sinuated.

Distribution: Throughout the Malayan Archipelago, Queensland, Japan, East Africa. Hitherto not recorded from the Philippines.

LUZON, Rizal Province, Alabang.

EUTETTIX MARQUEZI sp. nov.

Female, length, about 3.75 millimeters.

Vertex depressed, slightly longer than half the distance between eyes, median longitudinal suture not complete, light brown specks between this suture and eyes, two black spots on anterior border, frons ochraceous with darkened area on each side; clypeus wider at apex than at base; pronotum transverse, somewhat stramineous, smooth with irregular dark brown markings; twice as long as vertex; scutellum subtriangular, wider than long, anterior half almost completely brown, posterior angle ochraceous with brown markings at center; tegmina light brown, with light areas on middle and posterior parts, profusely and irregularly marked with fuscous, two longitudinal dark blotches on middle of claval area, and two on middle of corium, two distinct black spots on center of preinterior apical cells and two fuscous markings on innermost apical cells; venter dirty ochraceous, wing veins fuscous.

LUZON, Laguna Province, Mount Banahao (*J. Valdez*; type in my collection).

This species is named for Mr. Severo Marquez, my assistant in plant-pest control work in the Bureau of Plant Industry, Manila.

EUTETTIX BASILANUS sp. nov.

Male, length, including tegmina, 4.5 millimeters; female, 5.

Vertex greenish ochraceous with one fuscous arcuated band on margin of vertex, and one fuscous transverse band connecting eyes, one spot at inner side of eye just above anterior margin of vertex; face, frons, and antennæ ochraceous, the rest of face fuscous; pronotum finely striated and punctured, greenish ochraceous with dirty brownish patch on each of lateral sides; scutellum greenish ochraceous, with an olive-brown patch on each side of upper lateral angles; tegmina olive-brown, wide veins brown with dark spots on inner and outer claval veins, on vein of commissural suture, on claval suture, at tip of tegmina, veins between first and second apical cells, and on costal and discal areas, sometimes these blotches of the costal and discal are absent; body beneath wings and pectoral region fuscous; venter yellowish ochraceous with longitudinal median fuscous line.

MINDANAO, Zamboanga. BASILAN (type and paratypes, Baker collection, U. S. N. M.).

EUTETTIX MORISMUS sp. nov.

Female, length, including tegmina, 5.5 millimeters; male, 5.

Almost as small as *E. basilanus* but more slender and tapering, vertex dark ochraceous with chocolate-brown markings; pronotum dark greenish ochraceous, greatly and roughly striated; profusely marked with fuscous markings, twice as long as vertex and one and one-third as long as scutellum; scutellum yellowish ochraceous; claval region and middle portion clear to tip brown, with fuscous markings, at tip of tegmina three equidistant spots on commissural region, and some of veins, principally on the half posterior part; body beneath, face, pectus, abdomen, and legs greenish ochraceous.

MINDANAO, Zamboanga. BASILAN (types and paratypes, Baker collection, U. S. N. M.).

Division CICADULARIA

This division of the Cicadellidæ is characterized (according to Van Duzee as cited by Distant [79]) by the obsolete or nearly obsolete outer fork, the outer branch of the first sector of the

[79] Tom. cit. 366.

elytra, and the well-rounded vertex, the middle of which is a little longer than the width between the eyes.

There are five species described in this paper belonging to this division; one in the genus *Balclutha* Kirkaldy, one in *Cicadula* Zetterstedt, and five in *Agellus* De Long and Davidson.

The following key, partly adopted from Distant,[50] is formulated for the separation of these three genera:

Key to the Philippine genera of the division Cicadularia.

a'. First two sectors of the wings coalescing before the apex, the resulting nervure uniting with the costa some distance before the tip of the wing, thus forming but two apical areoles..... *Balclutha* Kirkaldy.

a'. First two sectors of the wings united for a greater or less distance but soon again separating and attaining the apex of the wing, thus forming three apical areoles..... *Cicadula* Zett.

a'. The upper and lower cubital branches uniting on the middle of the tegmina, then separating and reuniting before the apical area, thus forming four apical areoles..... *Agellus* DeLong and Davidson.

Genus BALCLUTHA Kirkaldy

Gnathodus Fieber, Verh. Zool.-Bot. Ges. Wien 16 (1866) 504.

Balclutha Kirkaldy, Entomologist 33 (1900) 243, nom. nov.; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 368.

Type, *B. punctata* Thunberg, universally distributed.

Body oblong, obtuse in front, much narrowed behind. Crown very short, about one-fourth as long as pronotum, scarcely longer in the middle than at the sides. Elytra much longer than the abdomen, overlapping at the apex; outer branch of the cubital nerve obsolete; membrane very large, as long as inner margin of clavus; appendix large. Submarginal wing-nerve complete; upper branch of the second wing-nerve confluent with the first, and running into the submarginal nerve as one nerve; third wing nerve joined to the lower branch of the second by a transverse nerve.

—Edwards, cited by Distant, loc. cit.

BALCLUTHA GRAMINEA sp. nov.

Female, length, including tegmina, about 3.25 millimeters.

Whole body green, with some yellowish green tinge. Vertex slightly angulate, about one-half as long as breadth between eyes; ocelli profusely green; eyes partly piceous, the rest fuscous; face almost as broad as long, unmarked; pronotum transverse, almost two and one-half times as long as vertex, slightly arcuate in front and laterally somewhat rounded, almost truncate; behind almost truncate; scutellum fairly large, triangular, almost as long as pronotum, smooth, with triangular semihyaline markings

[50] Loc. cit.

on each of the basal angles, with an impressed transverse line one-third the distance from apical angle; tegmina somewhat broad on middle, narrowed behind, hyaline towards apex; venation dark green, except that of the apex which is semitransparent white; pectus above and beneath green; abdomen above and beneath yellowish green. Near *B. viridis* Matsumura.

LUZON, Manila (*F. Q. Olanes*, holotype in my collection).

Genus CICADULA Zetterstedt

Cicadula ZETTERSTEDT, Ins. Lapp. (1838) 296.
Macrosteles FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 504.
Thamnus FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 505.
Limnolettix SAHLBERG, Cicad. (1871) 224.

Type, *C. variata* Fall, a Palæarctic species, world-wide in distribution.

Cicadula is differentiated from *Balclutha* by having the first two sectors of the wings united for a greater or less distance but soon again separating, thus forming three apical cells, instead of coalescing before the apex, with the resulting union of the nervure with the costa, forming only two apical cells as in *Balclutha*.

CICADULA AREVALOI sp. nov.

Female, length, including tegmina, 3.25 millimeters.

Light greenish yellow, vertex distinctly marked with two black dots near posterior margin slightly nearer to eyes than to each other, two triangular fuscous marks on apex of vertex near eyes, connecting with faint marginal line; inner third of eyes piceous, the rest fuscous; frons striated with fuscous transverse striæ; pronotum with anterior third greenish yellow, the rest dark gray, slightly transverse, anterior and lateral sides rounded, posterior margin almost truncate; scutellum yellowish with two large acute triangular black markings on each lateral angle with distinct incomplete transverse groove equilateral; tegmina smoky hyaline, venation milky white, the outer posterior veins tinged with brownish; body black; ventral segments and pygofer pale yellow; ovipositor black; legs, especially the last tibia, thickly spinuled.

MINDANAO, Occidental Misamis Province, Oroquieta (*P. S. Soriano*, type in my collection).

This species is named in honor of Isaias Arevalo, of the Bureau of Plant Industry, in recognition of his long and efficient service in the plant-pest and disease-control division.

Genus AGELLUS DeLong and Davidson

Agellus DeLong and Davidson, BAKER, Invertebrata Pacifica 1 (1903) 1 (*Eugnathodus*) wrong det.; DELONG and DAVIDSON, Ohio Journ. Sci. 33 (1933).

Type, *A. neglecta* DeLong and Davidson.

Distribution: Idaho, Arizona, Texas, Nebraska, Georgia, Florida, and Colorado, in the United States; Luzon, Negros, Mindanao, and Cebu, in the Philippines. Probably of wider distribution.

Agellus was proposed by DeLong and Davidson for *Eugnathodus* which Baker erected in 1903, citing a wrong species as type. Although the description was correctly based upon the species that Baker apparently had in mind when he described the genus *Eugnathodus*, the type specimens proved to belong to a species of *Balclutha*. Therefore, *Eugnathodus* Baker required a new name, according to opinions 14 and 16 of the International Code of Zoölogical Nomenclature. *Agellus* is closely allied to *Balclutha* and *Cicadula*, but differs in the following characteristics:

Vertex broadly rounded, slightly broader than pronotum, anterior and posterior margins almost parallel, lateral posterior angle not wider than vertex. In *Balclutha*, inner sector of tegmina not forked, two anteapical cells produced. In *Cicadula*, these first two sectors of wings united, but separated at a certain distance and reaching apex of wing, thus forming three apical areoles. In *Agellus* the upper and lower cubital branches unite, separate, re-unite, and separate again, forming four apical cells.

This genus is placed in the division Cicadularia, tribe Macrotelini, the species of which have a shorter vertex, usually rounded. The ædeagus, according to DeLong and Davidson,[81] bears dorsal and basal protruding processes, while in *Balclutha* the basal portion is enlarged and may extend dorsally but without finger-like processes.

A few specimens from the Philippines have been examined and compared with some of the type specimens of DeLong and Davidson at the Ohio State University. The generic characteristics of *Agellus* were those of these specimens, more so because the genitalia of one of them proved to be identical with the genitalia of *Agellus neglecta*, the type species of this genus. A few new species of *Agellus* are here described.

[81] Ohio Journ. Sci. 33 (1933).

In 1906 Kirkaldy [82] described specimens of leafhoppers collected by Koebele and Perkins from the Viti Isles of the Fiji group, for which he erected the genus *Nesosteles*, the type species being *N. habe*. In his description Kirkaldy did not give enough detail to make his genus easily recognizable. He merely stated, "allied to *Macroteles* but radial is not obsolescent and the wing venation is different." Then he continued to describe his species by merely giving the coloration and size of the insect. The description, however, is accompanied by a sketch of wing venation through which his genus may be placed.

I have examined the type specimen of this genus (*Nesosteles*), in the United States National Museum, and it seems that *Agellus* and *Nesosteles* are the same thing. However, because of lack of specimens for the study of the genitalia and the wing venation I do not venture to unite them.

AGELLUS NEGLECTA DeLong and Davidson.

Eugnathodus abdominalis BAKER, Invertebrata Pacifica 1 (1903) 1.
Agellus neglecta DELONG and DAVIDSON (*Eugnathodus*), Ohio Journ. Sci. 33 (1933) 55–56.

Male, length, about 3 millimeters.

Vertex rounded, one-fourth as long as distance between eyes, median longitudinal groove grayish brown, two dark spots below ocelli; ocelli ochraceous at apex; frons rectangular, margined by green stripes and transversely striated by brown striæ; clypeus narrow, rectangular; cheek and lora pale ochraceous; eyes blood red; pronotum transverse, twice as long as vertex, rounded anteriorly, truncate at posterior end, grayish with four longitudinal brownish bands and one darker, grayish, longitudinal, median band; scutellum small, dark gray, with a longitudinal median band of darker gray and two brownish spots on lateral angles; tegmina smoky hyaline with milky-white venation; pectus and dorsum, as well as dorsal part of abdomen, dark; venter greenish, with dark markings; legs pale green, except forelegs, which are brownish.

LUZON, Manila.

Distribution: Widely distributed in the United States. It is here reported from the Philippines for the first time.

AGELLUS BIFOPASCIATUS sp. nov.

Female, length, including tegmina, 4 millimeters.

Vertex pale yellow, about one-fourth as long as broad, rounded in front, with a median, longitudinal suture; ocelli red, on apex

[82] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906).

of vertex near eyes; eyes rufous; frons broad, slightly broader than long, triangular, tapering towards clypeus and confluent with vertex; clypeus narrow, rectangular; cheek greatly impressed under antennæ between eyes and carinate edge of frons; pronotum slightly broader than long, about four times as long as vertex and about twice length of scutellum, rounded at base and truncate at posterior margin, pale ochraceous; scutellum orange-yellow with pale yellow tinge in apical angle; visible bristles at base of second segment of antennæ. Tegmina milky white, with hyaline veins and rufous to crimson-red, longitudinal, parallel fascia within cells and tegminal areas; body beneath with fuscous markings; pygofer milky white, thickly bristled, ovipositor pink; last ventral segment medially notched.

LUZON, Rizal Province, Alabang (*J. Valdez*, holotype in my collection; paratypes, Baker collection, U. S. N. M.).

AGELLUS PHILIPPINENSIS sp. nov.

Male, length, including tegmina, 4 millimeters.

Vertex pale ochraceous, two amber-colored spots at base near eyes, short median carina dividing vertex, which is three times as broad between eyes as long; ocelli hyaline, in margin of vertex near eyes; eyes blood red; frons oval, almost twice as long as wide; lower half of clypeus sordid, rectangular, loræ small, distinctly tumid, cheeks shiny yellow, impressed, fuscosordid; pronotum pale ochraceous, slightly transverse, about three times as long as vertex, rounded in front and on sides, hind margin almost truncate, three parallel, longitudinal, orange lines on center and six orange spots between these lines and sides near anterior margin; scutellum pale ochraceous, with yellow markings on each of three angles; tegmina long, with all cells or areas tinged with orange-fuscous, except appendix and two inner apical cells which are milky white; body beneath, pectus, and legs ochraceous; venter pale ochraceous, except last ventral segment and genital sclerites, which are ochraceous; pygofer profusely bristled.

This species is similar to *A. rufofasciatus*, but the external genitalia are clearly different. The last ventral segment of the female in this species is broadly notched at the center, while that of *rufofasciatus* is slightly notched. The coloration also is different. *Agellus rufofasciatus* has alternating white cells; tegmina pinkish red and wing veins hyaline, while in *philippinensis* the cells are light orange and the veins distinctly milky white.

NEGROS, Occidental Negros Province, La Carlota (*C. T. Buligan*, type and paratypes in my collection).

AGELLUS BIFASCIATUS sp. nov.

Female, length, including tegmina, about 2.3 millimeters.

Very small species, yellowish green, vertex rounded, slightly obtuse on middle, about as long as width between eyes, apex green; face without any marking, almost as long as width between eyes; eyes fuscous; pronotum about twice as long as vertex, anteriorly and laterally rounded, posteriorly truncate, a greenish brown tinge on margin of each basal angle; scutellum triangular, as long as broad, upper half dark gray, apical half yellow; tegmina with reddish brown fascia on each side from upper claval area down to margin, first two apical cells and partly first two subapical cells tinged with reddish brown; body beneath, pectus, and legs pale green, abdomen above dark green, underneath the lateral sclerites yellow, rest of abdomen and genitalia green, entire clavus dark.

The name *bifasciatus* is derived from the two rainbowlike longitudinal fasciæ on the tegmina.

LUZON, Manila (*F. Q. Otanes*, holotype in my collection; paratypes, Baker collection, U. S. N. M.).

AGELLUS BISINUATUS (DeLong).

Agellus bisinuatus DELONG (*Eugnathodus*), Journ. Porto Rico 7 (1923) 266–267.

Male, length, including tegmina, 3 millimeters.

Body elongate, pale green, without any marking; vertex very short and roundly produced, about one-fourth as long as broad, green, frons yellowish green, genæ and loræ pale green; pronotum yellowish green, rounded in front and almost truncate at apex, appearing like a semicircle, about as long as broad; scutellum a yellowish equilateral triangle, about half as long as pronotum; tegmina pale greenish hyaline, with white veins; body underneath uniformly pale green. The female is more or less dirty pale yellowish beneath; ocelli on margin of vertex near eyes rufous.

LUZON, Manila. MINDANAO, Occidental Misamis Province, Oroquieta. CEBU. MINDORO. NEGROS.

Widely distributed in the United States and West Indies. It was collected in large numbers from mango shoots and from grasses. This species is here reported from the Philippines for the first time.

Division DELTOCEPHALUSARIA

In this division the leafhoppers are mostly very small, with the vertex more or less angularly produced in front of the eyes, and as long as, or longer than, the distance between the eyes.

The genera *Scaphoideus*, *Deltocephalus*, and *Xestocephalus* were studied. Distant [63] placed *Xestocephalus* independently under Athysanusaria with no reason other than that its taxonomic position has not been definitely settled.

Key to the Philippine genera of the division Deltocephalusaria.

*a*¹. Face much longer than breadth between eyes, scutellum large, as long as pronotum or slightly longer..... *Scaphoideus* Uhler.

*a*¹. Face much longer than breadth between eyes, scutellum small, shorter than pronotum ..... *Xestocephalus* Van Duzee.

*a*¹. Face scarcely longer than breadth between eyes.

Deltocephalus Burmeister.

Genus SCAPHOIDEUS Uhler

Scaphoideus UHLER, Trans. Maryland Acad. Sci. (1888) 33; PROVANCHER, Pet. Faune. Ent. Can. 3 (1889) 276; VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 299; OSBORN, Journ. Cinc. Soc. Nat. Hist. 19 (1900) 187 (monograph); MATSUMURA, Termész. Füzetek 25 (1902) 383; MELICHAR, Hom. Fauna Ceylon (1903) 194; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 371–372; OSBORN, Ohio Nat. 11 (1911) 249.

Type, *S. immistus* (Say).

Distribution: Nearctic, Palæarctic, Ethiopian, Oriental, Malayan, and Australasian Regions.

Head triangular, flat above, vertex almost as long as the width between the eyes, subacuminate at tip, the base deeply sinuated; front longer than wide, deltoid, with the sides near the tip moderately curved, tylus liguliform; cheeks broad, curved, expanded to behind the middle of the eye, acutely tapering at tip and hardly enclosing the entire lora, the lora diagonal, acute at each end; antennæ long and slender; pronotum sublunate, more curved anteriorly than sinuated posteriorly; wing-covers moderately narrow, longer than the abdomen, curved, valvate, the costal areole long, narrow, destitute of cross-veins, followed by a gradually widening cell, beyond this are four apical cells of large size and mostly broad triangular figure; wings with the two apical middle areoles long and narrowing at base towards the cross-vein; abdomen moderately long and narrow.—UHLER, quoted by DISTANT, loc. cit.

SCAPHOIDEUS MOROSUS Melichar.

Scaphoideus morosus MELICHAR, Hom. Fauna Ceylon (1903) 197, pl. 5, fig. 14, *a–d*; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 373–374.

[63] Fauna Brit. Ind. Rhynch. 4 (1908) 348.

Female, length, including tegmina, 4.75 millimeters.

Vertex, pronotum and scutellum pale greyish white; vertex with a subapical transverse line and a broad fascia between the eyes brownish testaceous; pronotum with four longitudinal testaceous fasciæ (in the specimen figured by Melichar there is an additional fascia on each side); scutellum with three longitudinal fasciæ with dark margins, the two lateral fasciæ darker, shorter, and posteriorly angulated; body beneath and legs pale greyish ochraceous; face with two anterior transversely angulated testaceous lines; posterior tibiæ spotted with piceous tegmina pale greyish white, the veins more or less testaceous, three dark obliquely transverse lines on posterior half of costal area, a piceous spot preceded by a smaller white spot in central apical cell.—DISTANT, loc. cit.

Originally known from Calcutta, Ceylon, Peradeniya, Point de Galle, Henaratgoda, Colombo.

LUZON, Rizal Province, Alabang (*J. Valdez*).

This species is here reported from the Philippines for the first time.

Genus DELTOCEPHALUS Burmeister

Deltocephalus BURMEISTER, Gen. Ins. 1 subg. 3 (1838); FLOR, Rhyn. Livland. 11 (1861) 221, 223; FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 506; EDWARDS, Tr., Ent. Soc. London (1868) 33, 42; VAN DUZEE, Trans. Aus. Ent. Soc. 19 (1892) 290; OSBORN and BALL, Iowa Acad. Sci. 4 (1897) 195; MELICHAR, Hom. Fauna Ceylon (1903) 199; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 380; DELONG, Ohio State Univ. Stu. 2 (1926); OSBORN, Ohio Biol. Sur. 3 (1929) 269.

Type, *D. pulicarius* (Fallven), a Palæarctic species.

Distribution probably universal.

According to Distant,[51] Melichar differentiates this genus as follows:

Vertex pointed or obtusely angularly produced; face symmetrically hexagonal; pronotum broader than long; tegmina longer or slightly shorter than the abdomen, rounded off behind, with distinct veins usually bordered with brown to black; in the clavus a distinct transverse vein running from the outer claval vein to the clavul suture.

DELTOCEPHALUS DORSALIS Motschulsky.

Deltocephalus dorsalis MOTSCHULSKY, Etud. Ent. (1859) 114; MELICHAR, Hom. Fauna Ceylon (1903) 200, pl. 5, fig. 13, *a–d*; OSHANIN, Ann. Mus. Zool. St. Peters. 11 (1906) 133; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 380–381, fig. 239; MATSUMURA, Insekten Zuckerrohrs Formosa (1910) 20; Journ. Coll. Agr. Sapporo 5 (1914) 213; DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918).

Deltocephalus fulguralis MATSUMURA, Termész. Füzetek 15 (1902) 391.

[51] Tom. cit. 380.

Length, including tegmina, 3.5 millimeters.

Vertex, body beneath and legs pale ochraceous; with two obscure spots at the transverse depression and two smaller ones near base; pronotum and scutellum greyish; pronotum with some very obscure darker longitudinal shadings; scutellum with a dark spot near each basal angle; coxæ and abdomen beneath with some dark spots; tegmina greyish, with an irregular broad oblique fuscous fascia commencing near base and continued to clavai apex, its margins are deeply notched or obtusely angulate and enclose a central pale spot on clavai sutures, from apex of clavus there is an oblique series of fuscous-brown spots and the apical cells are margined with the same colour, beyond middle of costal margin is a linear dark spot and there are paler fuscous streaks between the veins and on base of clavai area; face with obscure dark striations and pale central spot at base.—DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 380–381.

Originally known in Bengal, Dacca, Calcutta, Ceylon, Yatiyantota, Peradeniya, Henaratgoda, Colombo, Tenasserim, Myitta, Borneo, and Japan.

LUZON, Rizal Province, Alabang (*J. Valdez*).

This species is reported from the Philippines for the first time.

Genus XESTOCEPHALUS Van Duzee

Xestocephalus VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 298; MATSUMURA, Termész. Füzetek 25 (1902) 402; MELICHAR, Hom. Fauna Ceylon (1903) 205; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 348.

Type, *X. pulicarius* VAN DUZEE, a Nearctic species.

Distribution: Nearctic, eastern Palæarctic, Ethiopian, and Oriental Regions.

Vertex tumid, rounded over the front, the ocelli placed on the rounded apex between the eyes, almost the same distance from the eyes as from each other; pronotum transverse, somewhat wider than head; body elongate, slightly narrower at pronotum than middle dorsal section of wings; tegmina without an appendix with five apical and three anteapical cells.

XESTOCEPHALUS OSBORNI sp. nov.

Length, including tegmina, 4.25 millimeters.

Head very much narrower than the pronotum, vertex produced before, with the apex subacute, rounded above, and smooth; frons rather broad at base, twice as long as wide; pronotum rounded, slightly produced in front, transverse, about twice as broad as long, more or less semilunar in shape, anterior margin truncate; scutellum triangularly transverse, about one and one-third times as wide as long; tegmina broad, tapering, posterior

lateral margin folded in, having the appearance of *Makilingia* Baker or *Kolla* Distant, but the broadness of the notal and anterior half of the body dorsal regions resembles that of *Hecalus* Stål; body beneath amber ochraceous; last ventral segment truncate, with a slight notch at posterior margin; pygofer long, slender, profusely bristled; ochraceous to amber, vertex ochraceous with amber mark on lateral sides; ocelli very small, placed on anterior edge of vertex, equidistant to each other as to the eyes; eyes fuscous, large, face almost rounded, amber; pectus, venter, and legs concolorus with face, slightly fuscous spot at base of each tibial spur and spinules of posterior legs; pronotum with two dark amber spots at anterior margin just below eyes, ochraceous; scutellum amber, with six short, longitudinal, ochraceous lines at center; tegmina ochraceous, sparsely strewn with fuscous markings, prominent of which are one at posterior apical angle of clavus, one at third posterior margin, and another at apex of tegmina.

LUZON, Mountain Province, Mount Polis (holotype, Osborn collection; type, Baker collection, U. S. N. M.).

This species is named in honor of Prof. Herbert Osborn, a great teacher and entomologist, and owner of the type specimen.

XESTOCEPHALUS MAQUILINGENSIS sp. nov.

Female, about 2.25 millimeters.

A small species similar to *X. pulicarius* Van Duzee and *X. guttatus* Motschulsky though slightly smaller and with slightly darker markings than either.

Vertex ochraceous with cross piceous markings near apex, a faint brown median line and four faint brown markings at base (two on each side of median line); frons castaneous, obtusely rounded, with four pale spots in arcuate arrangement on level with eye and two similar spots just above front clypeal suture; pronotum brown, longer than vertex, transverse, with two parallel rows of pale markings, anterior intercalated by fuscous markings; vertex dark ochraceous, with a black semitriangular spot in basal angles, and between them five almost confluent pale dots; tegmina short and rounded anteriorly, brown, with pale transparent spots scattered all over; the three on posterior last half of costal area large, first spot (on middle of costal region of tegmina) milky white; pectus ochraceous; venter purplish brown and spinulose.

LUZON, Laguna Province, Mount Maquiling (type, Baker collection, U. S. N. M.).

Division PARALIMNUSARIA

Distant[85] gives the following characteristics of the hoppers under this division:

Vertex somewhat subacutely produced in front of eyes, about or nearly twice as broad between eyes as long; ocelli on the anterior margin very near the eyes.

Genus ALITURALIS novum

Aliturus DISTANT (preoccupied), Fauna Brit. Ind. Rhynch. 4 (1906) 398.

Type, *A. gardineri* Distant.

This monotypic genus was erected by Distant for specimens taken from the Laccadive Archipelago to which he gave the name *Aliturus gardineri*. However, Distant's generic name is preoccupied by *Aliturus* Fairmaire,[86] a genus of beetles.

Vertex broad, depressed, angularly rounded in front, foveately impressed on each side between eyes, which are large and obliquely cover the anterior angles of the pronotum; ocelli indistinct, near anterior margin and near eyes; face globose, strongly narrowed to clypeus, which is slender and a little more than half the length of face, cheeks rounded; pronotum transverse, longer than vertex, lateral margins nearly straight, anterior margin convex, posterior margin subtruncate; scutellum broad, subtriangular, lateral margins shorter than breadth of basal margin, transversely impressed near middle; legs somewhat slender, posterior tibiæ longly spinulose; tegmina opaque, longer than abdomen, veins imperfectly visible. —DISTANT, loc. cit.

ALITURALIS ALABANGENSIS sp. nov.

Female, length, including tegmina, 4.5 millimeters.

Uniformly dark fuscous, vertex broad, depressed, rounded, slightly angularly produced in front, slightly foveately impressed on each side of eyes, these being indistinctly and finely wrinkled, smooth at the center, anterior margin banded with a dark fuscous, almost black fascia; ocelli stramineous, on the anterior margin near the eyes, and connected by a narrow stramineous band; face globose, strongly narrowed towards the apex; clypeus small, slender, loræ rounded; frons tumid with an ochraceous band at the base abruptly tapering towards the clypeus; cheek broad at base, narrow pieces connecting with the clypeus; pronotum transverse, longer than vertex, slightly rounded anteriorly, truncate at base between eyes; slightly, broadly sinuate at posterior margin, posterior half slightly depressed and faintly

[85] Tom. cit. 395. [86] Ann. Soc. Ent. Fr. 71 (1902) 386.

striate; scutellum subtriangular, slightly broader than long, posterior angle separated by a broadly arcuated suture, two-thirds posterior, profusely, faintly punctured, four ochraceous spots on the lateral sides; tegmina longer than abdomen, six pale ochraceous on the inner margin of clavus close to commissural suture, one at basal area, three at suprabrachial, one at the costal, and eight others on apical and anteapical cells.

LUZON, Rizal Province, Alabang (*J. Valdez*, type and holotype in my collection).

TYPHLOCYBINÆ

Members of this subfamily as described by its author "are readily separated from all the other subfamilies of the Jassidae by the four longitudinal veins defining the apical cells without branching, so that there are no anteapical cells, and also by the absence of supernumerary cells in the wings (Gillette). Tegmina usually without appendix." (Distant.[37])

Division EMPOASCARIA

Sectors of posterior wings ending in marginal vein; no anteapical cells, venation most simple in the whole family; generally very small cicadellids, rarely over 4 millimeters long, including tegmina; pronotum as long as vertex or longer, except in *Homa* in which it is shorter than vertex.

Genus EMPOASCA Walsh

Empoasca WALSH, Proc. Bost. Soc. Nat. Hist. 9 (1864) 316.
Chloroneura WALSH, Proc. Bost. Soc. Nat. Hist. 9 (1864) 316.
Chlorita FIEBER, Verh. Zool.-Bot. Ges. Wien (1866) 508, pl. 7, fig. 25.
Kybos FIEBER, Verh. Zool.-Bot. Ges. Wien (1866) 508, pl. 7, fig. 26.
Chlorita FIEBER, Rev. Mag. Zool. III 3 (1875) 414.
Cicadula KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 9 (1906) 357.

The recognition of species belonging to this genus is practically dependent on the wing venation. The species are small and "usually green, sometimes yellow, red or smoky black. Ocelli present, elytra without appendix, wings with marginal vein, one apical cell. Genital valve in male wanting." (Osborn.[38])

EMPOASCA NIGROPUNCTATA sp. nov.

Very small species, about 2 millimeters long, including tegmina; vertex obtusely angularly produced, almost as long as

[37] Fauna Brit. Ind. Rhynch. 4 (1908) 399.
[38] Ohio Biol. Sur. 3 (1928) 345.

broad between eyes, yellowish green, with two black spots on vertex near apex, temple and upper part of frons yellow, the rest greenish yellow, narrowly striated with fuscous lines; clypeus piceous; ocelli not quite visible, amber-colored; pronotum twice as long as vertex, roundly produced, terminal angle almost truncate, slightly broadly sinuate; yellowish green, with dark gray tinge on center; scutellum concolorous with head and pronotum, small, without markings; tegmina hyaline, with smoky veins; body beneath piceous, legs pale green.

LUZON, Manila: Rizal Province, Alabang (*J. Valdez*, holotype in my collection).

CHECK LIST OF THE PHILIPPINE CICADELLIDÆ WITH THE ORIGINAL BIBLIOGRAPHY AND SYNONYMY*

Family CICADELLIDÆ

Subfamily I. LEDRINÆ

Petalocephala Stål.

**Petalocephala cultellifera* WALKER, List Hom. 3 (1851) 823; Journ. Linn. Soc. Zool. 1 (1856) 98 (*Ledra*); MELICHAR, Hom. Fauna Ceylon (1903) 143 (*Ledropsis*).

Petalocephala conica WALKER, List Hom. 3 (1851) 823; DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 164.

Petalocephala punctatissima STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 732.

Petalocephala philippina STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 732.

Ledra Fabricius.

Ledra gibba WALKER, List Hom. Ins. 3 (1851) 811.

Ledra lævis WALKER, List Hom. Ins. 3 (1851) 827.

Ledra unicolor WALKER, List Hom. Ins. 3 (1851) 819.

Subfamily II. BYTHOSCOPINÆ

Macropsis Lewis.

Macropsis breakeyi sp. nov.

Macropsis rizali sp. nov.

Macropsis benguetensis sp. nov.

Macropsis fuscovenosa sp. nov.

Macropsis fuscopunctata sp. nov.

Macropsis otanesi sp. nov.

Macropsis basilana sp. nov.

Macropsis dapitana sp. nov.

Macropsis davaoensis sp. nov.

* In the preparation of this check list, I am most indebted to the unpublished notes of the late Charles Fuller Baker, deposited in the United States National Museum. I found the notes after this list was already prepared from available literature and new species described in this paper. Many names were added to my list from Baker's notes. An asterisk before a name indicates that the species is here first recorded as Philippine.

Idiocerus Lewis.

Idiocerus elypealis LETHIERRY, Journ. As. Soc. Bengal 57 (1889) 252; BAKER, Philip. Journ. Sci. § D 10 (1915) 339 (*Idioscopus*).

Idiocerus nacreatus BAKER, Philip. Journ. Sci. § D 10 (1915) 342.

Idiocerinus Baker.

Idiocerinus melichari BAKER, Philip. Journ. Sci. § D 10 (1915) 341–342.

Idiocerinus bakeri sp. nov.

Idioscopus Baker.

Idioscopus palawanensis BAKER, Philip. Journ. Sci. § D 10 (1915) 338–339.

Idioscopus tagalicus BAKER, Philip. Journ. Sci. § D 10 (1915) 340–341.

Iposcopus Baker.

Iposcopus breviceps BAKER, Philip. Journ. Sci. § D 10 (1915) 322.

Iposcopus distanti BAKER, Philip. Journ. Sci. § D 10 (1915) 321–322.

Ipocerus Baker.

Ipocerus kirkaldyi BAKER, Philip. Journ. Sci. § D 10 (1915) 323–324.

Baloeha Distant.

Baloeha busonioides BAKER, Philip. Journ. Sci. § D 10 (1915) 330.

Bythoscopus Germar.

**Bythoscopus chlorophanus* MELICHAR, Hom. Fauna Ceylon (1903) 153.

Bythoscopus maculipennis STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 740 (*Macropsis*).

Bythoscopus testaceus sp. nov.

**Bythoscopus ruhrofrontalis* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 209, fig. 125.

Chunra Walker.

Chunra nivcosparsa LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 252 (*Idiocerus*); MELICHAR, Hom. Fauna Ceylon (1903) 143 (*I. basalis*); BAKER, Philip. Journ. Sci. § D 10 (1915) 325 (*Chunra*).

Chunra nivcosparsa Lethierry var. *laguensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 326.

Chunra nivcosparsa Lethierry var. *palawanensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 326.

Chunra nivcosparsa Lethierry var. *philippinensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 325–326.

Busonia Distant.

Busonia mindanaoensis BAKER, Philip. Journ. Sci. § D 10 (1915) 328.

Busonia scutellaris BAKER, Philip. Journ. Sci. § D 10 (1915) 327.

Pedioscopus Kirkaldy.

Pedioscopus angustatus BAKER, Philip. Journ. Sci. § D 10 (1915) 335–336.

Pedioscopus coloratus BAKER, Philip. Journ. Sci. § D 10 (1915) 333.

Pedioscopus coloratus var. *bicoloratus*, BAKER, Philip. Journ. Sci. § D 10 (1915) 333.

Pedioscopus coloratus var. *mindanaoensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 337.

Pedioscopus disjunctus BAKER, Philip. Journ. Sci. § D 10 (1915) 331.

Pedioscopus maquilingensis BAKER, Philip. Journ. Sci. § D 10 (1915) 333–334.

Pedioscopus modestus BAKER, Philip. Journ. Sci. § D 10 (1915) 333.

Pediosceopus similis BAKER, Philip. Journ. Sci. § D 10 (1915) 334–335.
Pediosceopus simplex BAKER, Philip. Journ. Sci. § D 10 (1915) 336.

Subfamily III. TETTIGONIELLINÆ

Cicadella (*Tettigonia*) (*Tettigoniella*) Latreille.
Cicadella argyrops SIGNORET, Ann. Soc. Ent. Fr. (1853) 678 (*Tettigonia*).
Cicadella bipunctifrons STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733–734 (*Tettigonia*).
Cicadella differentialis BAKER, Philip. Journ. Sci. § D 9 (1914) 420 (*Tettigoniella*).
Cicadella ferruginea FABRICIUS, Ent. Syah. 4 (1794) 32 (*Cicada*); GERMAR, Mag. Ent. 4 (1821) 69 (*Tettigonia*); WALKER, List Hom. Ins. 3 (1851) 736 (*T. confinis*); 737 (*T. addita*); 737 (*T. genuina*); 738 (*T. obscura*); 738 (*T. duplex*); 739 (*T. reducta*); 740 (*T. immaculata*); STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 733 (*T. impressipennis*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 202–203 (*Tettigoniella*).
Cicadella impudica SIGNORET, Ann. Soc. Ent. Fr. III 1 (1853) 677 (*Tettigonia*).
Cicadella longa WALKER, List Hom. Ins. 3 (1851) 740 (*Tettigonia*). China determines this species (Baker collection) as distinct from *C. ferruginea*.
Cicadella magallingensis BAKER, Philip. Journ. Sci. § D 9 (1914) 419, fig. 10 (*Tettigoniella*).
Cicadella norma SIGNORET, Ann. Soc. Ent. Fr. (1853) 671 (*Tettigonia*).
Cicadella philippina WALKER, List Hom. Ins. 3 (1851) 740 (*Tettigonia*).
Cicadella quinquepunctata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734, fig. 137 (*Tettigonia quinquenotata*); BANKS, Philip. Journ. Sci. § D 5 (1910) 52 (*Kolla tripunctifrons*).
Cicadella spectra DISTANT, nom. nov., Fauna Brit. Ind. Rhynch. 4 (1908) 211–212 (*Tettigoniella spectra*); WALKER, List Hom. 3 (1851) 767 (*Tettigonia albida*); STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 735 (*T. nigrilinea*).
Cicadella spectra DISTANT var. *nigrilinea* STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 735 (*Tettigonia*).
Cicadella subviridescens STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734 (*Tettigonia*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 212.
Cicadella suturella STÅL, Öfv. Vet.-Akad. Förh. 5 (1855) (*Tettigonia*).
Cicadella nigrifasciata sp. nov.
Cicadella tagalica STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734 (*Tettigonia*); BAKER, Philip. Journ. Sci. § D 10 (1915) 196 (*Tettigoniella*).
Cicadella titonii SIGNORET, Ann. Soc. Ent. Fr. (1855) 783 (*Tettigonia*).
Cicadella alticola sp. nov.
Cicadella unimaculata SIGNORET, Ann. Soc. Ent. Fr. (1854) 25 (*Tettigonia*); WALKER, List Hom. Suppl. (1858) 219 (*T. pauliula*); STÅL, Freg. Eug. Resa Ins. (1859) 258 (*T. klingbergi*); WALKER, Journ.

Linn. Soc. Lond. Zool. 10 (1869) 304 (*T. igniceps*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 224 (*Tettigoniella*) (*Kolla*).

Cicadella whiteheadi DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 142 (*Tettigoniella*).

Kolla Distant.

Kolla trimaculifrons BANKS, Philip. Journ. Sci. § 5 (1910) 51.

Signoretia Stål.

Signoretia malaya STÅL, Öfv. Vet.-Akad. Förh. (1855) 192 (*Thamnotettix*); Freg. Eug. Resa Ins. (1865) 290 (*Signoretia*).

Signoretia tagalica BAKER, Philip. Journ. Sci. § D 10 (1915) 196.

Signoretia carinata BAKER, Philip. Journ. Sci. 23 (1923) 358.

Signoretia benguetensis BAKER, Philip. Journ. Sci. 23 (1923) 359.

Preta Distant.

Preta luzonensis BAKER, Philip. Journ. Sci. 23 (1923) 361–362.

Milcewa Distant.

Milcewa luzonica BAKER, Philip. Journ. Sci. § D 9 (1914) 415.

Milcewa luzonica var. *decolorata* BAKER, Philip. Journ. Sci. § D 9 (1914) 416.

Ujna Distant.

Ujna philippinensis BAKER, Philip. Journ. Sci. § D 9 (1914) 416.

Makilingia Baker.

Makilingia banahaoensis BAKER, Philip. Journ. Sci. 24 (1924) 64.

Makilingia colorata BAKER, Philip. Journ. Sci. § D 9 (1914) 413.

Makilingia costalis BAKER, Philip. Journ. Sci. 24 (1924) 69.

Makilingia flavifrons MELICHAR, Wiener Ent. Zeit. 40 (1923) 119; BAKER, Philip. Journ. Sci. 24 (1924) 67 (*M. bimaculata*).

Makilingia frontalis BAKER, Philip. Journ. Sci. 24 (1924) 69–70.

Makilingia haighiana BAKER, Philip. Journ. Sci. 24 (1924) 65.

Makilingia intermedia MELICHAR, Wiener Ent. Zeit. 40 (1923) 119; BAKER, Philip. Journ. Sci. 24 (1924) 159 (*variabilis*).

Makilingia intermedia var. *bakeri* MELICHAR, Wiener Ent. Zeit. 40 (1923) 120.

Makilingia intermedia var. *similima* BAKER, Philip. Journ. Sci. 24 (1924) 63–64.

Makilingia intermedia var. *suturalis* MELICHAR, Wiener Ent. Zeit. 40 (1923) 119; BAKER, Philip. Journ. Sci. 27 (1925) 150.

Makilingia lineata BAKER, Philip. Journ. Sci. 24 (1924) 66.

Makilingia maculata BAKER, Philip. Journ. Sci. § D 9 (1914) 413.

Makilingia nigra BAKER, Philip. Journ. Sci. § D 9 (1914) 409.

Makilingia pallida BAKER, Philip. Journ. Sci. § D 9 (1914) 414.

Makilingia panayensis BAKER, Philip. Journ. Sci. 24 (1924) 66.

Makilingia pruinosa BAKER, Philip. Journ. Sci. § D 9 (1914) 412.

Makilingia sibuyanensis BAKER, Philip. Journ. Sci. 24 (1924) 62.

Makilingia speciosa BAKER, Philip. Journ. Sci. 24 (1924) 61.

Makilingia surigaoensis BAKER, Philip. Journ. Sci. 24 (1924) 66.

Subfamily IV. GYPONINÆ

Division 1. PENTHIMARIA

Penthimia Germar.

Penthimia albiguttula STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.

Penthimia reticulata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.

Penthimia crebus STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.
Penthimia hemifuscata sp. nov.
Thaumatoscopus Kirkaldy.
Thaumatoscopus roxasi sp. nov.
Thaumatoscopus reflexus STÅL, Öfv. Vet.-Akal. Förh. 27 (1870) 738.
Neodartus Melichar.
**Neodartus acocephaloides* MELICHAR, Hom. Fauna Ceylon (1903) 162.
Vulturnus Kirkaldy.
Vulturnus reticulatus STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.

Division 2. HYLICARIA

Pythamus Melichar.
Pythamus melichari BAKER, Philip. Journ. Sci. § D 10 (1915) 198.
Pythamus melichari var. *mindanaoensis* BAKER, Philip. Journ. Sci. § D 10 (1915) 200.

Subfamily V. JASSINÆ (including ACOCEPHALINÆ)

Division 1. HECALUSARIA

Hecalus Stål.
Hecalus thomsonii STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737.
Hecalus gramineus sp. nov.
Hecalus flori STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
**Hecalus capitatus* DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 30.
Hecalus wallengrenii STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
Thomsoniella Signoret.
**Thomsoniella albomaculata* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 280–281.
Thomsoniella porrecta WALKER, List Hom. Suppl. (1858) 262 (*acocephalus*); MOTSCHULSKY, Etud. Ent. 8 (1859) (*Platymetopius lineolatus*); STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 737 (*Hecalus kirschbaumii*); SIGNORET, Ann. Soc. Ent. Fr. (1880) 52 (*Thomsoniella*); ATKINSON, Journ. As. Soc. Bengal 54 (1885) 104 (*Thomsonia*); DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 31 (*Paraboloceratus*).
Nirvana Kirkaldy.
Nirvana placida STÅL, Freg. Eug. Resa Ins. (1859) 295 (*Jassus*); MELICHAR, Hom. Ceylon (1903) 160 (*N. pallida*).
Nirvana philippinensis BAKER, Philip. Journ. Sci. 23 (1923) 385.
Ophiuchus Distant.
Ophiuchus basilanus BAKER, Philip. Journ. Sci. 23 (1923) 394.
Ophiuchus montanus BAKER, Philip. Journ. Sci. 23 (1923) 395.
Kana Distant.
Kana anomala BAKER, Philip. Journ. Sci. 23 (1923) 385.
Kana maculata BAKER, Philip. Journ. Sci. 23 (1923) 382.
Kana picea BAKER, Philip. Journ. Sci. 23 (1923) 383.
Jassonirvana Baker.
Jassonirvana lineata BAKER, Philip. Journ. Sci. 23 (1923) 399–400.
Pseudonirvana Baker.
Pseudonirvana davaoensis BAKER, Philip. Journ. Sci. 23 (1923) 39.
Pseudonirvana davaoensis var. *luzonensis* BAKER, Philip. Journ. Sci. 23 (1923) 392.

Pseudonirvana sanguinolineata BAKER, Philip. Journ. Sci. 23 (1923) 392–393.

Stenometopius Matsumura.

Stenometopius mindanaoensis BAKER, Philip. Journ. Sci. 23 (1923) 400–401.

Division 2. SELENOCEPHALARIA

Parameesus Fieber.

**Parameesus lineaticollis* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 294, fig. 186.

Krisna Kirkaldy.

Krisna strigicollis SPINOLA, Mem. de Matem. e di Fis. Ital. Modena (1852) 167 (*Siva*); WALKER, List Hom. 3 (1851) 847 (*Acocephalus straminicus*); Journ. Linn. Soc. Zool. 1 (1857) 173 (*Bythoscopus testaceous*); List Hom. Suppl. (1858) 266 (*B. indicatus*); STÅL, Freg. Eug. Resa Ins. (1859) 290 (*Selenocephalus costalis*); Ann. Soc. Ent. Fr. (1864) 66 (*Siva*); SIGNORET, Ann. Soc. Ent. Fr. (1879) 88 (*Acocephalus straminicus*); ATKINSON, Journ. As. Soc. Bengal 54 (1885) 108 (*Siva strigicollis*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 297–298 (*Krisna*).

**Krisna striata* KIRBY, Journ. Linn. Soc. Zool. 24 (1891) 171 (*Gypona*); KIRKALDY, Entomologist 33 (1900) 294 (*kirbyi*); 34 (1901) 39 (*Eogypona kirbyi*); MELICHAR, Hom. Fauna Ceylon (1903) 167 (*Siva*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 298 (*Krisna striata*).

Roxasella gen. nov.

Roxasella camusi sp. nov.

Roxasella lasbañasa sp. nov.

Omanella gen. nov.

Omanella barberi sp. nov.

Omanella philippina sp. nov.

Omanella johnsoni sp. nov.

Parabolocratus Uhler.

**Parabolocratus gutattus* UHLER, Proc. U. S. Nat. Mus. 19 (1896) 291–292 (*Parabolocratus*) (in Baker collection); MATSUMURA, Coll. Agr. Hokuku Imp. Univ. Pub. 4 (1912) (*Parabolopona*); 6,000 Illustrated Insects of Japan-Empire (1931) (*Parabolopona*).

Division 3. TARTESSUSARIA

Tartessus Stål.

Tartessus ferrugineus WALKER, List Hom. 3 (1851) 865 (*Bythoscopus*); STÅL, Freg. Eug. Resa Ins. (1859) 290 (*B. malayus, biareatus, unilineatus, unifascia* Walker, MS.); Öfv. Vet.-Akad. Förh. (1865) 165 (*Tartessus malayus*); 27 (1870) 738 (*T. ferrugineus*).

Tartessus malayus STÅL, Freg. Eug. Resa Ins. (1859) 290.

Tartessus fieberi STÅL, Öfv. Vet.-Akad. Förh. (1865) 156.

Gessius Distant.

Gessius malayensis var. *mindanaoensis* BAKER, Philip. Journ. Sci. 15 (1919) 217.

Drabescus Stål.

Drabescus conspicous DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 306 (in Baker collection).

Drabescus remotus WALKER, Cat. Hom. 3 (1851) 866.
Drabescus straminicus DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 306–307 (in Baker collection).
Tylissus Stål.
Tylissus nitens STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 739.

Division 4. JASSUSARIA

Jassus Fabricius.
Jassus conspersus STÅL, Öfv. Vet.-Akad. Förh. (1854) 254 (*Coelidia sparsa*); 27 (1870) 735 (*Jassus conspersus*).
Jassus dubia WALKER, List Hom. 3 (1851) 781 (*Tettigonia*); STÅL, Öfv. Vet.-Akad. Förh. (1862) 494 (*Coelidia*); DISTANT, Rec. Ind. Mus. 2 (1908) 150 (*Jassus dubia*).
Jassus elegans DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 329.
Jassus obscurus STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
Jassus philippinensis STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 736.
Jassus luzonensis BAKER, Philip. Journ. Sci. § D 10 (1915) 56–57.
Jassus sparsus STÅL, Öfv. Vet.-Akad. Förh. (1854) 254.
Jassus mindanaoensis sp. nov.
Tharra Kirkaldy.
Tharra carinata BAKER, Philip. Journ. Sci. § D 10 (1915) 58.

Division 5. ATHYSANUSARIA

Athysanus Burmeister (*Phrynomorphus* Curtis).
Athysanus atkinsoni DISTANT, Fauna Brit. Ind. Rhynch. 4 (1918) 345 (*Athysanus*).
**Athysanus fusconervosus* MOTSCHULSKY, Bull. Soc. Nat. Moscow 36 (1863) 97 (in Baker collection).
**Athysanus indicus* DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 344 (in Baker collection).
Stirellus Osborn and Bull.
Stirellus nigripectus sp. nov.
Acocephalus Germar.
Acocephalus olivaceous WALKER, List Hom. 3 (1851) 846.
Xestocephalus Van Duzee.
Xestocephalus osborni sp. nov.
Xestocephalus maquilingensis sp. nov.
†*Xestocephalus guttatus* MOTSCHULSKY, Etud. Ent. (1859) 113 (*Deltocephalus*); MATSUMURA, Termész. Füzetek (1902) 25 (*Xestocephalus*) (in Baker collection).
**Xestocephalus pardalinus* DISTANT, Fauna Brit. Ind. 4 (1908) 35 (in Baker collection).

Division 6. THAMNOTETTIXARIA

Nephotettix Matsumura.
**Nephotettix bipunctatus* FABRICIUS, Syst. Rhyng. (1803) 78 (*Cicada*); STÅL, Hem. Fabr. 2 (1869) 82 (*Thamnotettix*); MATSUMURA Termész. Füzetek 25 (1902) 379 (*Nephotettix*).
Nephotettix apicalis MOTSCHULSKY, Etud. Ent. (1859) 110 (*Pediopsis*); UHLER, Proc. U. S. Nat. Mus. 19 (1896) 292 (*Selenocephalus cincticeps*); MATSUMURA, Termész. Füzetek 25 (1902) 379 (*P. nigromaculata*); MELICHAR, Wiener Ent. Zeit. 24 (1905) 305 (*N. apicalis*).

Eutettix Van Duzee.

**Eutettix disciguttus* WALKER, Journ. Linn. Soc. Lond. Zool. 1 (1857) 172 (*Acocephalus*); SIGNORET, Ann. Soc. Ent. Fr. (1879) 88 (*Bythoscopus*); UHLER, Proc. U. S. Nat. Mus. 19 (1896) 244 (*Thâmnotettix sellata*); MATSUMURA, Természr. Füzetek 25 (1902) 381 (*Eutettix sellatus*); MELICHAR, Notes Leyd. Mus. 36 (1913) 130.

Eutettix marquezi sp. nov.

Eutettix basilanus sp. nov.

Eutettix morismus sp. nov.

Division 7. CICADULARIA

Cicadula Zett.

Cicadula arevaloi sp. nov.

Balclutha Kirkaldy.

Balclutha graminea sp. nov.

Balclutha olivacea MELICHAR, Wiener Ent. Zeit. 40 (1923) 100.

Agellus DeLong and Davidson.

Agellus bifasciatus sp. nov.

**Agellus neglecta* DELONG and DAVIDSON, Ohio Journ. Sci. 33 (1933) 55–56 (*Eugnathodus*); 33 No. 3 (1933) (*Agellus*).

**Agellus bisinuatus* DELONG, Journ. Dept. Agr. Porto Rico 7 (1933) 266–267.

Agellus philippinensis sp. nov.

Agellus rufofasciatus sp. nov.

Division 8. DELTOCEPHALUSARIA

Deltocephalus Burmeister.

**Deltocephalus dorsalis* MOTSCHULSKY, Etud. Ent. (1859) 114.

**Deltocephalus distinctus* MOTSCHULSKY, Etud. Ent. (1859) 112; MATSUMURA, Természr. Füzetek 25 (1902) 381 (*fulguralis*).

Scaphoideus Uhler.

**Scaphoideus morosus* MELICHAR, Hom. Fauna Ceylon (1903) 197.

Division 9. PARALIMNUSARIA

Alituralis nom. nov. (*Alitura* Distant).

Alituralis alabangensis sp. nov.

Xestocephalus Van Duzee.

Xestocephalus osborni sp. nov.

Xestocephalus maquilingensis sp. nov.

Subfamily VI. TYPHLOCYBINÆ

Division 1. EMPOASCARIA

Empoasca Walsh.

Empoasca flavescens FABRICIUS, Ent. Syst. 4 (1794) 46 (*Cicada*); MELICHAR, Cicad. Mitt. Europ. (1896) 226 (*Chlorita*); KIRKALDY, Exh. Sta. Haw. Sugar Planters' Assoc. Bull. 9 (1906) 357 (*Cicadula*); DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 405 (*Empoasca*); WORSWORTH, Philip. Agric. 10 (1921) 22.

Empoasca nigropunctata sp. nov.

Division 2. TYPHLOCYBARIA

Typhlocyba Germar.

Typhlocyba nigrobilineata MELICHAR, Hom. Ceylon (1903) 218.

Erythroneura Fitch.

**Erythroneura nigrobimaculata* MOTSCHULSKY, Bull. Soc. Nat. Moscow 36 (1863) 101; BAKER, unpublished notes (*Typhlocyba*) (in Baker collection).

Insert after the synonymy on page 334:

Very pale yellow; head short conical above, almost straight along the hind border; face flat on the disk, with indistinct, oblique ridges, on each side; dorsal abdominal segments with a puncture on each side; legs yellowish white; wings white. Length of body 3½ lines; of the wings 7 lines.—WALKER, List Hom. Insects 3 (1853) 767.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Idiocerinus bakeri* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.

2. *Macropsis breakeyi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

3. *Macropsis rizali* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

4. *Macropsis benguetensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

5. *Macropis fusconervosa* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

6. *Macropsis fuscopunctata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

7. *Macropsis luzonensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

8. *Macropsis basilana* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

9. *Macropsis otanesi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.

10. *Macropsis davaoensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

11. *Cicadella longa* Walker; front.

12. *Cicadella longa* Walker; *a*, female external genitalia.

13. *Macropsis dapitana* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

PLATE 2

FIG. 1. *Cicadella alticola* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

2. *Penthimia hemifuscata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

3. *Thaumatoscopus roxasi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.

4. *Hecalus graminens* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, lateral view of vertex, pronotum, and scutellum.

5. *Cicadella nigrifasciata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.

6. *Xestocephalus osborni* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

7. *Alituralis alabangensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

FIG. 8. *Cicadella sutnrella* Stål; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
9. *Xestocephalus maquilingensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
10. *Empoasca nigropunctata* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front.

PLATE 3

FIG. 1. *Roxasella* gen. nov. *camusi* sp. nov. (type of the genus); *a*, adult; *b*, front; *c*, male external genitalia.
2. *Roxasella losbañosa* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, external male genitalia.
3. *Omanella* gen. nov. *philippina* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, male external genitalia.
4. *Omanella johnsoni* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
5. *Omanella barberi* sp. nov. (type of the genus); *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
6. *Jassus mindanaoensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, last ventral segment of female.

PLATE 4

FIG. 1. *Cicadula arevaloi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
2. *Stirellus nigripectus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
3. *Eutettix marquezi* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
4. *Agellus rufofasciatus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
5. *Eutettix morismus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
6. *Eutettix basilanus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia; *d*, male external genitalia.
7. *Agellus neglectus* DeLong and Davidson; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
8. *Balclutha graminea* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
9. *Agellus bifasciatus* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
10. *Agellus philippinensis* sp. nov.; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.
11. *Agellus*; tegminal venation.
12. *Agellus neglectus* DeLong and Davidson; internal genitalia.
13. *Agellus biannulatus* DeLong; *a*, vertex, pronotum, and scutellum; *b*, front; *c*, female external genitalia.

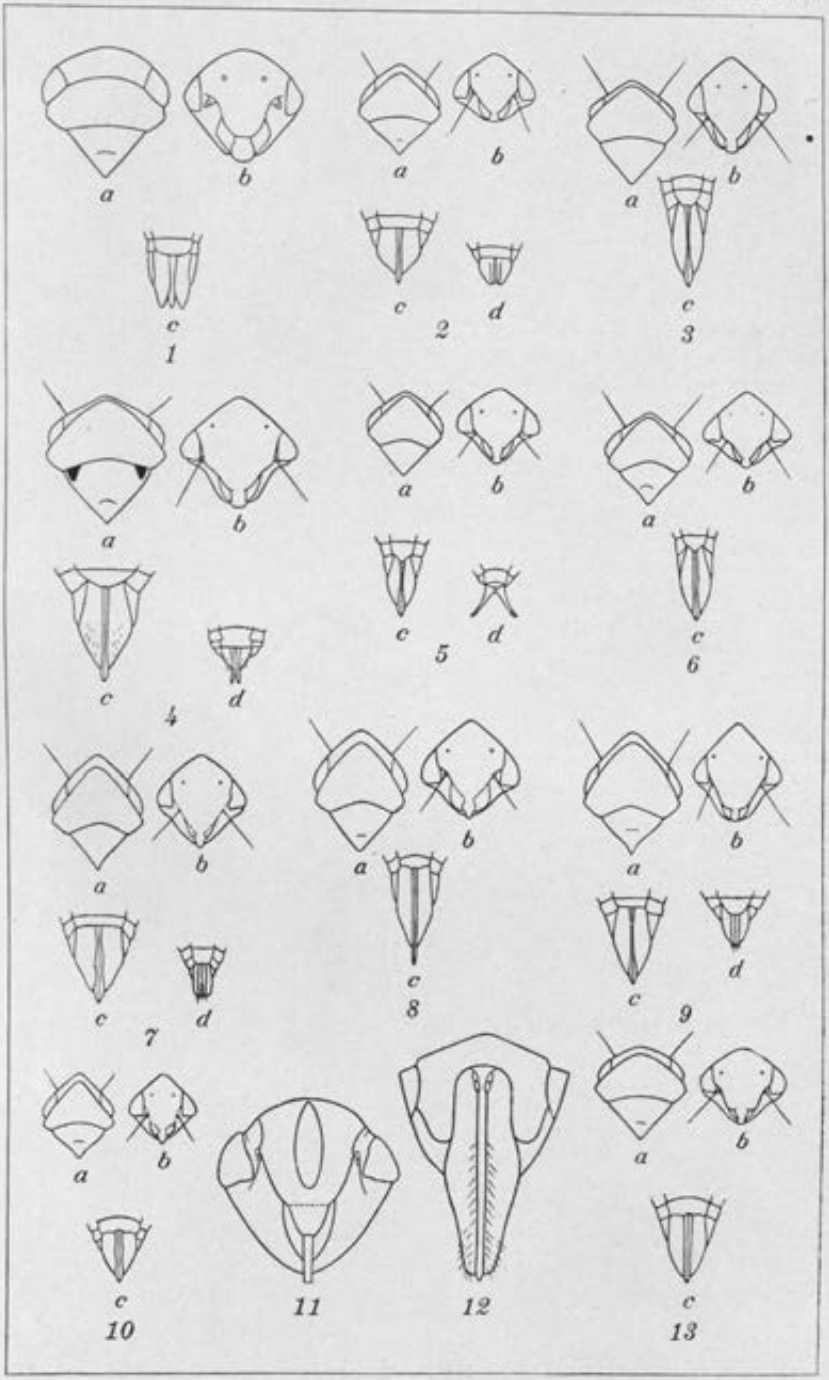
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PLATE 1.

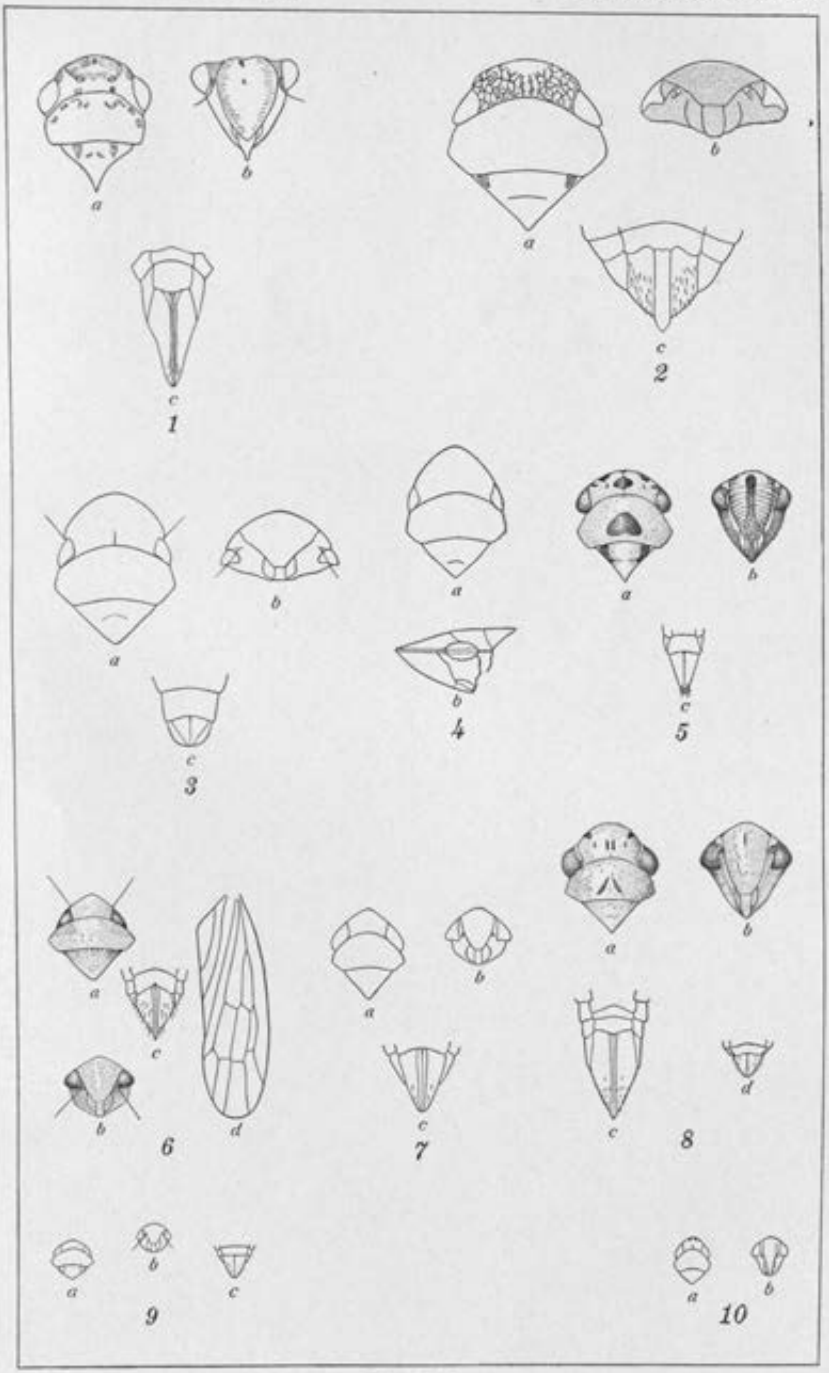

PLATE 2.

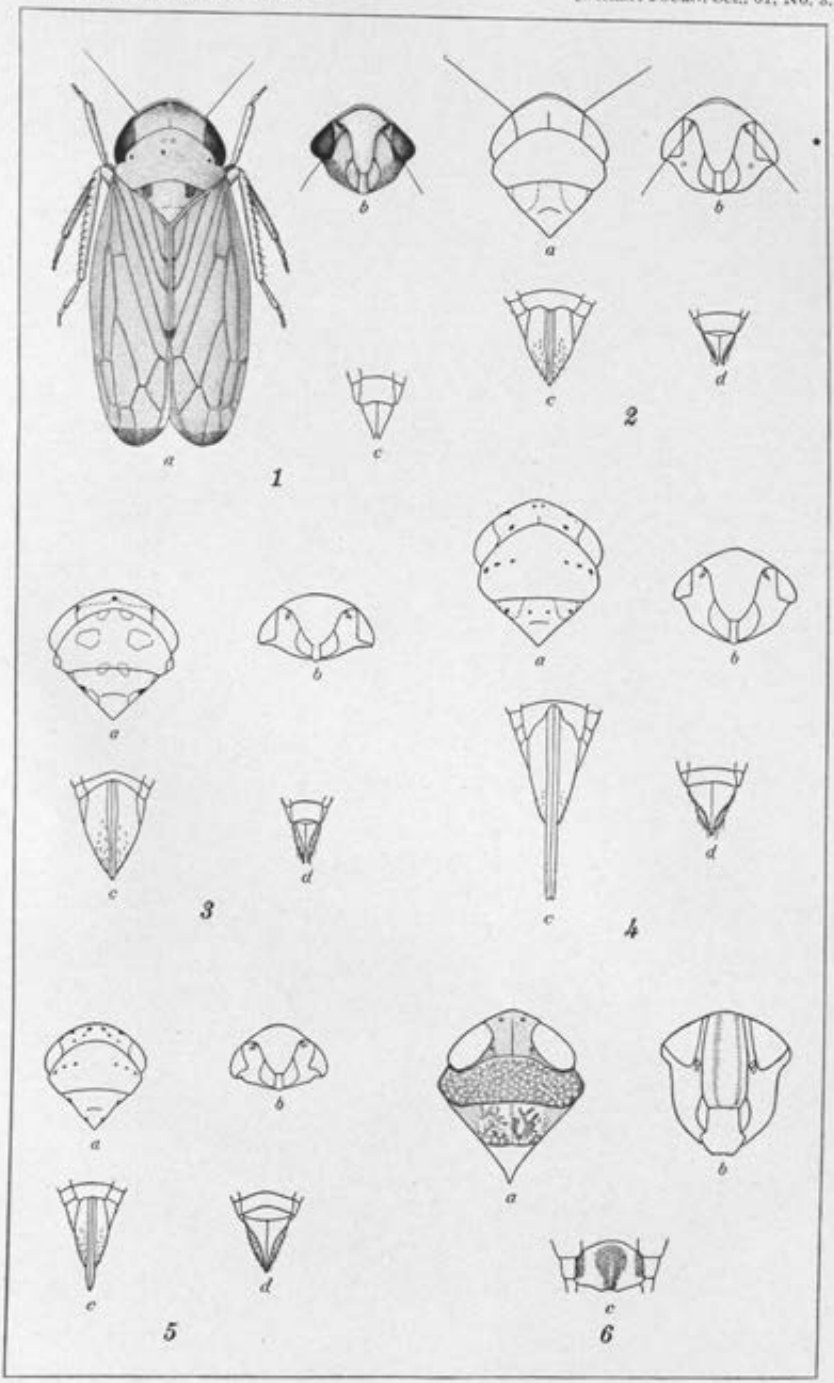

PLATE 3.

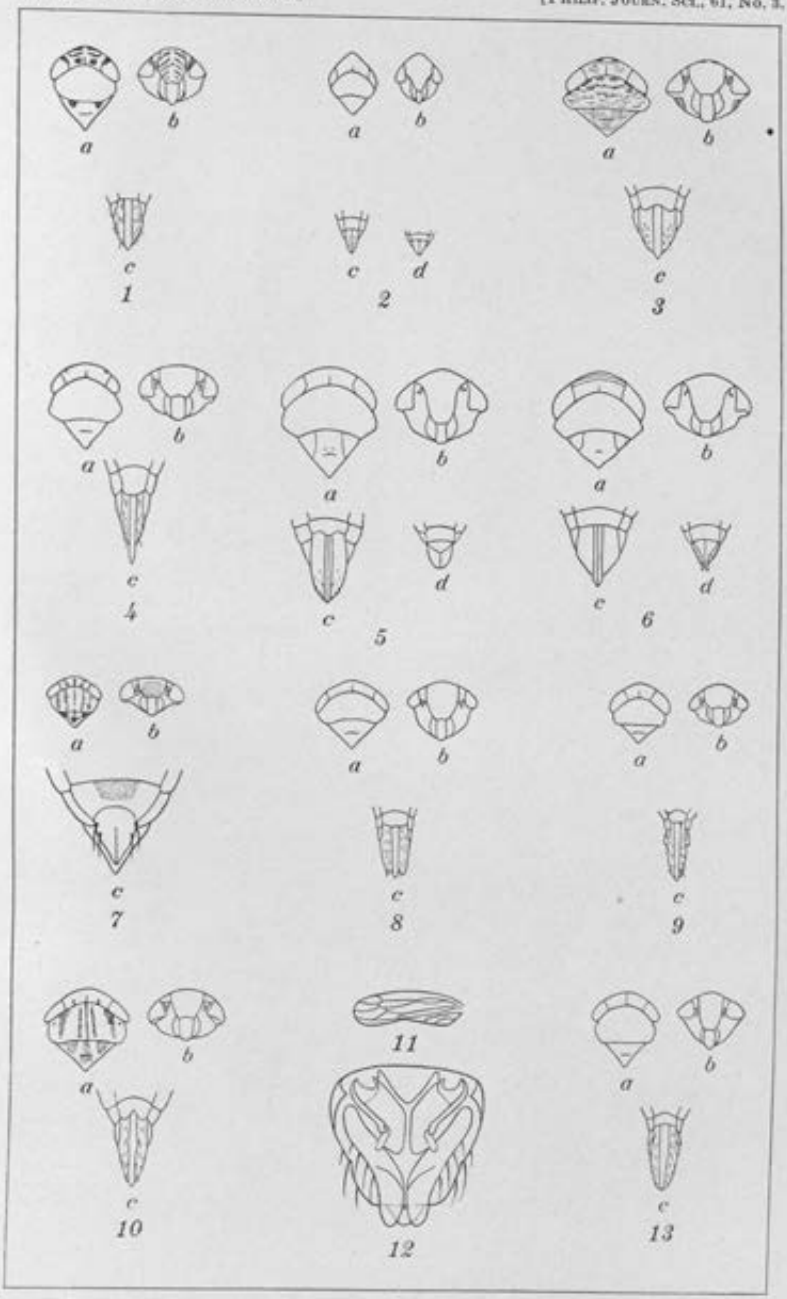
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PLATE 4.

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EXPERIMENTAL STUDIES ON THE CURATIVE TREATMENT OF SURRA IN NATIVE HORSES IN THE PHILIPPINES, II

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The experiments discussed below are a continuation of the investigation on the chemotherapy of surra in Philippine horses, previously published by the writer (1934). Some of the results recorded in that paper demonstrated that naganol given intravenously alone is capable of sterilizing the animal body of surra trypanosomes, provided there is no cerebrospinal involvement. Conversely, it was also shown that when the causative agent has already gained a foothold in the cerebrospinal fluid, the drug fails to effect a cure, due apparently to its lack of power to penetrate the meninges in a concentration deadly to the trypanosome. Rodenwalt and Douwes (1922) and Bubberman, Douwes, and van Bergen (1925) found in their investigations of equine surra in the Dutch East Indies that naganol administered intravenously is likely to effect a cure only in the incipient stage of infection; that is, when clinical symptoms are absent or have just made their appearance, indicating the possibility that the organism has not yet found its way into the nervous system. In recognition of these facts and in view of the present trend of opinion with regard to surra infection, namely, that relapses during the treatment originate mainly from nervous complications, the advantages of the injection of naganol simultaneously into the cerebrospinal canal and into the circulation are not

difficult to appreciate. Moreover, because of the satisfactory results obtained by Edwards (1926) in India from the intrathecal-intravenous treatment of equine surra with naganol alone and later confirmed by Williams (1926), it seems desirable to exploit the possibilities of the treatment in surra as it occurs in the Philippine Archipelago, in spite of the technical difficulties attending its application.

Some of the animals treated by the intrathecal-intravenous method were subsequently subjected to etharsanol-naganol treatment, for reasons that will be noted below.

MATERIALS AND METHODS

The same materials as in the previous experiments were employed in the investigation, but all of the horses were infected experimentally.

PROCEDURE

With the exception of two animals which were infected intrathecally, the horses were infected subcutaneously and treated when the cerebrospinal fluid was positively known to be involved by animal inoculation. The technic employed by Edwards was closely observed. It consisted briefly in casting the animal after the mane in the occipito-atlantal articulation had been clipped close and disinfected with tincture of iodine. With the horse properly secured in a recumbent position, a sterile gauge 16 needle 7½ centimeters long was introduced slowly through the skin and the tissues beneath and directed obliquely following the wing of the atlas. With careful manipulation one would feel and hear a sound similar to the one produced by puncturing a piece of tissue paper with a sharp needle, indicating that the meninges were already perforated. Immediately after, the cerebrospinal fluid dribbled out. With the needle kept in situ, a piece of india-rubber tubing 12 centimeters long and with a bore of 0.3 centimeter was slipped over the butt. After about 15 cubic centimeters of the fluid had oozed out, the free end was engaged to the nozzle of an injection syringe previously filled with naganol solution, the latter being injected subsequently and slowly into the cerebrospinal canal. The syringe was disengaged from the rubber tubing while the latter was firmly pressed with the balls of the index finger and the thumb. The tube was then squeezed towards the needle to drive whatever solution had remained in it into the canal. When this had been accomplished,

the needle was withdrawn and the horse released. Immediately after, the intravenous injection was given.

The dose of naganol for intrathecal injection was 0.045 milligram in 0.1 per cent solution, and for the intravenous injection 15 milligrams in 10 per cent solution per kilogram live body weight, respectively. In general the injections were administered fortnightly until three courses were injected.

As in work previously reported, the simultaneous injections of etharsanol and naganol were employed in the three relapsed animals, observing the same doses and manner of administration.

The complement-fixation test[1] for surra was employed in some of the experimental horses in conjunction with the microscopic examination of the peripheral blood and animal inoculation.

EXPERIMENTS AND RESULTS

To determine the efficiency of the simultaneous intrathecal and intravenous injections of naganol in experimental surra among Philippine horses the following experiments were made.

EXPERIMENT 1. HORSE 67; WEIGHT, 161 KILOGRAMS; A WORN-OUT CASTAWAY CALESA HORSE

January 16, 1934. Inoculated subcutaneously with surra trypanosomes.
January 19. Blood positive (+).
January 20. Blood negative.
January 21. Blood positive (+).
January 22, 23, and 24. Blood positive (+ + + +).
January 25. Blood positive (+ + + +). Animal unable to stand. Given the initial simultaneous treatment of naganol in the doses of 0.7 milligrams in 0.1 per cent concentration for the intrathecal injection and 2.25 grams in 10 per cent solution for the intravenous injection. In the course of the intrathecal injection 6 cubic centimeters of cerebrospinal fluid was obtained and injected immediately into a white rat.
January 26. Animal was found dead; no autopsy made.
February 4. White rat positive (+ +); died five days later.

EXPERIMENT 2. HORSE 68; WEIGHT, 164 KILOGRAMS

February 7, 1934. Infected subcutaneously with surra blood.
February 13. Blood positive (+).
February 14. Blood positive (+ + + +).
February 15. Blood positive (+ +).
February 16. Blood positive (+).
February 17 and 18. Blood positive (+ +).

[1] The author is much indebted to Doctors Topacio and Acevedo, both of the Research Division, Bureau of Animal Industry, for performing the complement-fixation test.

February 19. Blood negative.
February 20. Blood positive (++).
February 21 and 22. Blood positive (+++÷).
February 23. Blood positive (÷++).
February 24 and 25. Blood positive (÷+).
February 26. Blood positive (+). Animal reweighed (121 kilograms) and subjected to the simultaneous intratheeal and intravenous injections of naganol in the doses of 5.445 milligrams in 0.1 per cent solution for the former and 1.82 grams in 10 per cent solution for the latter. Simultaneously two white rats were inoculated intraperitoneally with 7 cubic centimeters each of the cerebrospinal fluid obtained in the process of intratheeal injection. These laboratory animals became positive later and died.
February 27. Blood negative. Horse depressed, appetite poor and edema of the muzzle noted. The temperature rose to 40° C.
March 1. Animal improved in condition and its appetite and body temperature returned to normal. A perirectal eruption developed which, however, healed in the course of ten days.
March 16. Blood positive (÷). Temperature 39.9° C. Treatment repeated.
March 17. Blood negative. Horse depressed again, temperature rising to 40° C. Two white rats were inoculated with cerebrospinal fluid obtained in the process of treatment; these became positive and died in the course of five days.
March 31. A third treatment given. Two white rats were again secured and infected with the cerebrospinal fluid. These laboratory animals succumbed later to the infective inoculation.
April 14. A fourth course of the intratheeal-intravenous injection given. Two other white rats were simultaneously injected with cerebrospinal fluid. Both laboratory animals caught the infective inoculation and died.
June 9 and 16. Complement-fixation tests positive (++++). Blood negative.
June 23. Cerebrospinal fluid tested for surra trypanosomes by inoculating two white rats. Both escaped infection. Susceptibility test made; rats caught surra and died. Complement-fixation test positive (÷+++).
June 30 and July 2 and 13. Complement-fixation tests repeated; all positive (++++).
August 10. One hundred twenty-seven days after last injection, blood positive (+).
August 28. Animal died very much emaciated.

EXPERIMENT 3. HORSE 69; WEIGHT, 166 KILOGRAMS

April 9, 1934. Infected subcutaneously with surra organisms.
April 18 and 19. Blood positive (÷).
April 20. Blood positive (+÷÷+).
April 21. Blood negative.
April 22 and 23. Blood positive (+).
April 24. Blood positive (++).
April 25, 26, 27, 28, and 29. Blood positive (+÷÷+).
April 30. Blood negative.
May 1. Blood negative. Horse weighed (149 kilograms) and subjected to intratheeal-intravenous treatment of naganol, getting the same doses as

in the foregoing experiments. Two white rats were given cerebrospinal fluid obtained incidentally to intrathecal injection. Complement-fixation test negative.

May 2. Horse depressed and took food sparingly; with a high temperature. However, this train of symptoms disappeared in the course of time. A perirectal eruption was observed and behaved in much the same manner as in experiment 2. Blood negative.

May 7. Blood of both white rats positive (++).

May 9. One of the white rats died.

May 10. Complement-fixation test negative; other white rat died.

May 15. Treatment repeated.

May 16. Reaction to the treatment less intense.

May 17. Complement-fixation test positive (+).

May 25. Blood positive (−).

May 30. Treated. One white rat given 10 cubic centimeters cerebrospinal fluid obtained in the process of the treatment. Complement-fixation test positive (±).

June 6. White rat positive (±).

June 7. Complement-fixation test positive (++++).

June 16. White rat died.

June 17. Blood positive (±).

June 18. Blood positive (++). In view of the unfavorable result, the treatment was discontinued.

EXPERIMENT 4. HORSE 70; WEIGHT, 109 KILOGRAMS

April 9, 1934. Inoculated with surra organisms.

April 21. Blood negative. Reinoculated.

April 27. Blood positive (+).

April 28 and 29. Blood positive (+++±).

April 30. Blood positive (++±).

May 1. Blood positive (±±++±). Complement-fixation test positive (+).

May 2. Blood positive (++).

May 3 and 4. Blood negative.

May 5. Blood positive (±).

May 6 and 7. Blood negative.

May 8. Blood not examined.

May 9. Blood positive (+++±+).

May 10. Blood positive (±). Complement-fixation test negative.

May 11. Blood not examined.

May 12. Blood positive (±). Horse reweighed and tipped the scale at 86 kilograms, a decrease of 23 kilograms. The animal was given simultaneous intrathecal and intravenous injections of naganol in doses of 2.87 milligrams and 1.29 grams, respectively, and in the same concentrations as in the above experiment. At the same time two white rats were given cerebrospinal fluid; each received 8 cubic centimeters, developed surra, and died.

May 13. Blood negative. Animal depressed, with impaired appetite. Temperature 40.2° C.

May 15. Horse found dead. Since the body was still warm to the touch, cerebrospinal fluid was obtained and injected into two other white rats,

Both white rats caught the infective inoculation and died. Close inspection of the animal revealed contusions and bruises on the head indicating that the horse must have developed brain disease.

EXPERIMENT 5. HORSE 71; WEIGHT, 151 KILOGRAMS

September 1, 1934. Inoculated subcutaneously with surra organisms.

September 3 and 6. Complement-fixation tests negative.

September 7. Blood positive (+).

September 8 and 9. Blood positive (++++).

September 10. Blood positive (+++−). Complement-fixation test negative.

September 11. Blood positive (+++).

September 12 and 13. Blood positive (+).

September 14. Blood positive (++−++).

September 15. Blood positive (+−++++). Complement-fixation test positive; first tube (+), second tube (++).

September 16. Blood negative.

September 17. Blood negative. Horse subjected to intrathecal-intravenous treatment. At the same time two white rats were inoculated with cerebrospinal fluid, developed surra, and died subsequently.

September 18. Animal depressed with eyes half-closed and eyelids edematous; muzzle swollen and head pendant. Appetite poor; temperature 40° C. The above symptoms soon disappeared; however, perirectal eruption appeared, and subsided in about ten days.

October 1. Treatment repeated.

October 2. Blood positive (+). Instead of being continued as in experiment 3, the treatment was suspended and the horse was used in the second phase of the work.

EXPERIMENT 6. HORSE 72; WEIGHT, 194 KILOGRAMS

December 30, 1934. Infected intrathecally with surra trypanosomes.

January 3 and 4, 1935. Blood positive (+).

January 5. Blood positive (++−++).

January 6. Blood and cerebrospinal fluid positive (++++). Animal reweighed and lost 14 kilograms. Afterwards it was subjected to intrathecal-intravenous injection of naganol, 6.75 milligrams for the intrathecal and 2.25 grams for the intravenous injection in the same concentrations as in the foregoing experiments. Complement-fixation test negative.

January 7. Blood negative.

January 18. Complement-fixation test positive (+++).

January 20. Treatment repeated.

February 1. Complement-fixation test positive (++++).

February 3. Given last simultaneous intrathecal-intravenous injection.

March 5. Complement-fixation test positive (+).

April 1. Complement-fixation test positive (+−+−+).

April 30. Blood positive (−+). Ten cubic centimeters of blood inoculated into a white rat produced the disease in four days; rat died subsequently. The horse being still strong was used in the second phase of the investigation.

EXPERIMENT 7. HORSE 73; WEIGHT, 141 KILOGRAMS

September 14, 1935. Infected intrathecally with surra trypanosomes.

September 19. Blood positive (+++−). Animal depressed; appetite poor.

September 20. Blood positive (+++−). Complement-fixation test negative. Horse lethargic; appetite poor.

September 21. Blood positive (+++±). Animal lethargic; appetite impaired.

September 22. Blood positive (++++). Temperature rose to 40° C. Condition the same as above. The animal was reweighed and tipped the scale at 131 kilograms. Given first treatment.

September 23. Blood negative. Appetite improved although animal is still depressed. Temperature returned to normal.

September 25. Blood negative. A perirectal eruption noted.

October 6. Blood negative. Treatment repeated. Complement-fixation test negative. Perirectal eruption almost healed; œdema of pendant portion appeared.

October 16. Blood negative. Eruption of the rectum disappeared entirely. Appetite fair; œdema present.

October 20. Blood negative as well as cerebrospinal fluid. Given last injection.

October 31. Blood negative; severe laminitis observed; œdema disappeared.

November 8. Blood negative; laminitis slightly improved.

November 13. Blood negative; animal down, unable to stand, struggling desperately to get up. When helped to its feet, the animal manifested forced movements. In the afternoon it was killed in extremis. Two white rats were given cerebrospinal fluid but failed to develop surra. After a month susceptibility test made. Both came down with the disease and died subsequently.

Experiments 8, 9, and 10 were intended to determine the value of etharsanol-naganol treatment in experimental surra in horses that failed to respond to the intrathecal-intravenous injections.

EXPERIMENT 8. HORSE 69; WEIGHT, 140 KILOGRAMS

June 17, 1934. Relapsed as recorded in experiment 3 in spite of the intrathecal-intravenous treatment of naganol.

June 19. Blood negative. Two white rats inoculated with blood. Both developed surra after seven days and died in the course of five days. Given simultaneous intravenous injections of etharsanol and naganol in doses of 2.24 grams and 1.49 grams in 10 per cent concentration, respectively.

June 20. Blood negative. Complement-fixation test positive (++++).

June 25. Blood negative. Treatment repeated. The dose of naganol reduced to 0.745 gram, the etharsanol remaining the same as in the initial injection.

July 1. Blood negative. Given the third treatment, the same doses as immediately above.

July 8. Blood negative. Complement fixation positive (++++) in three tubes.

August 3. Blood negative. Complement fixation positive; ++++ in the first, +++ in the second, and ++ in the third tube.

August 15. Blood negative. Complement fixation positive; ++++ in the first and second tubes and +++ in the third tube. Animal was gaining in weight (159 kilograms).

September 3. Blood negative. Complement fixation negative.

September 30. Blood negative. Complement fixation negative.

October 16 and November 5. Blood negative. Complement fixation negative.

November 21. Blood negative. Cerebrospinal fluid obtained and injected into two white rats. Both failed to develop surra, hence after thirty days' observation they were inoculated with surra organisms. In five days surra organisms appeared in the tail blood; died four days later.

February 1, 1935. Blood negative. Complement fixation suspicious (±).

April 8 and September 4 and 20, 1935, and February 17, 1936. Blood negative (animal inoculation). Complement fixation negative. Animal weighed 160 kilograms.

August 1. Animal in good condition; weight 191 kilograms.

EXPERIMENT 9. HORSE 71; WEIGHT, 118 KILOGRAMS

October 2, 1934. Relapsed as recorded in experiment 5 after the second intrathecal-intravenous injection of naganol.

October 3. Blood positive (+). Complement fixation ++++ in two tubes. Given the initial treatment of etharsanol-naganol combination, the same doses as in experiment 8.

October 4. Blood negative.

October 9. Blood negative; treatment repeated.

October 16. Blood negative; treatment repeated.

October 30. Blood negative. Complement fixation positive (+).

November 16 and December 4, 1934; February 1 and March 5, 1935; and February 17, 1936. Complement fixation negative. Weight of the horse 157 kilograms; condition good. Animal inoculation negative.

EXPERIMENT 10. HORSE 72; WEIGHT, 137 KILOGRAMS

April 30, 1935. Relapsed as recorded in experiment 6 from the intrathecal-intravenous treatment of naganol. Blood obtained from the horse and injected into a white rat; the latter killed inside of ten days after the first appearance of the trypanosomes in the tail blood.

May 3. Given initial treatment.

May 9 and 16. Blood negative. Treatment repeated on both days.

July 25 and September 4. Blood negative. Complement fixation negative.

September 13. Cerebrospinal fluid obtained and injected into two white rats. Both escaped infection. Susceptibility test made. Rats developed surra and died.

February 17, 1936. Blood negative. Complement-fixation test negative. Horse in good condition.

July 30. Animal in good condition and weighed 163 kilograms. Animal inoculation negative.

For the sake of clarity some of the results of the experiments were condensed and are given in Tables 1 and 2.

TABLE 1.—*Showing some of the results obtained in experiments 1 to 7.*

Experiment No.	Animal No.	Infected.	Incubation period.	Weight of animal.			Treatment.		
				Before infection.	Before treatment.	After relapse.	Date.	Intrathecal.	Intravenous.
			Days.	*kg.*	*kg.*	*kg.*		*mg.*	*c.*
1	67	Jan. 16, 1934	4	161			Jan. 25, 1934	6.70	2.26
							Feb. 25, 1934	5.445	1.82
2	68	Feb. 7, 1934	7	154	121		Mar. 16, 1934	5.445	1.82
							Mar. 31, 1934	5.445	1.82
							Apr. 14, 1934	5.445	1.82
3	69	Apr. 8, 1934	10	166	149	149	May 1, 1934	6.71	2.24
							May 15, 1934	6.71	2.24
							May 30, 1934	6.71	2.24
4	70	Apr. 9 and 21, 1934	7	109	86		May 12, 1934	3.87	1.29
5	71	Sept. 1, 1934	7	151	118	118	Sept. 17, 1934	5.31	1.77
							Oct. 1, 1934	5.31	1.77
6	72	Dec. 20, 1934	6	164	150	137	Jan. 5, 1935	6.75	2.25
							Jan. 20, 1935	6.75	2.25
							Feb. 3, 1935	6.75	2.25
7	73	Sept. 14, 1935	6	141	131		Sept. 23, 1935	5.896	1.97
							Oct. 6, 1935	5.896	1.97
							Oct. 20, 1935	5.896	1.97

TABLE 1.—*Showing some of the results obtained in experiments 1 to 7*—Continued.

Experiment No.	Animal No.	Results.	Remarks.
1	67	Died the day following	This was a worn-out castaway calesa horse, hence very susceptible to surra organisms; cerebrospinal fluid positive as a result of animal inoculation.
2	68	Relapsed Mar. 16 and Aug. 19, 1934; died Aug. 28, 1934	Cerebrospinal fluid positive as a result of animal inoculation.
3	69	Relapsed May 25 and June 17, 1934	June 19, 1934, subjected to etharsanol-naganol treatment; cerebrospinal fluid positive (animal inoculation).
4	70	Died May 15, 1934; cerebrospinal fluid positive for surra trypanosomes.	Cerebrospinal fluid positive as a result of animal inoculation.
5	71	Relapsed Oct. 2, 1934	Oct. 2, 1934, subjected to etharsanol-naganol treatment; cerebrospinal fluid positive (animal inoculation).
6	72	Relapsed Apr. 30, 1935	Infected intraDucally; subjected to ethersanol-naganol treatment May 8, 1935; cerebrospinal fluid positive (microscopic examination).
7	73	Killed in extremis Nov. 13, 1935; surra organisms were not recovered from the cerebrospinal fluid.	Infected intrathecally; cerebrospinal fluid positive by microscopic examination.

TABLE 2.—*Showing some of the results obtained in experiments 8 to 10.*

Experiment No.	Horse No.	Date relapsed from intrathecal-intravenous injections.	Weight.		Treatment.			Duration between last injection and final observation.		Final observation.
			Before treatment.	Final observation.	Date given.	Ethanol.	Noganol.	Yrs.	Months.	
			kg.	kg.		g.	g.			
8	69	June 17, 1931	149	191	June 18, 1934	2.24	1.49	2	1.5	No relapse; complement-fixation test negative; condition good.
					June 25, 1934	2.24	0.745			
					July 1, 1934	2.24	0.745			
9	71	Oct. 2, 1934	116	157	Oct. 3, 1934	1.77	1.18	1	10	Do.
					Oct. 9, 1934	1.77	0.59			
					Oct. 16, 1934	1.77	0.59			
10	72	Apr. 30, 1935	137	165	May 3, 1935	2.06	1.37	1	9	Do.
					May 9, 1935	2.06	0.685			
					May 16, 1935	2.06	0.685			

DISCUSSION

Treatment of equine surra with intrathecal-intravenous injections of naganol.—All of the seven horses employed failed to respond to the treatment given. While horses 67 and 70 died in the course of the treatment, horse 73 was killed in extremis at the end of the post-treatment observation period covering twenty-four days. Moreover, horse 67 being a worn-out, castaway calesa animal was quite susceptible to surra organisms and evidently too weak to bear the medicament administered, hence considered a poor risk. Horse 71 received two sets of injections; horses 68, 69, and 72, each received a complete course of treatment (in fact horse 68 received four sets of simultaneous intrathecal-intravenous injections), but relapses were noted in all cases. So far as the results of the experiments went, they disagree with the findings of Edwards and Williams in their studies of surra in India, but to some extent support those of Tubangui (1930) wherein tartar emetic was used. Furthermore, interesting evidence was shown by horse 68 in which the parasites in the cerebrospinal canal were absent as determined by animal inoculation, but not to the extent of complete absence, as a relapse was likewise observed at the end of the post-treatment observation period covering one hundred twenty-seven days. A similar condition was presented by horse 73, but although it showed nervous involvement the organisms were never recovered, probably due to the fact that the animal was killed in extremis quite early after treatment. Considering that naganol has been found effective against surra without nervous complication, the above circumstance would be difficult to explain were it not for the findings of Reichenow (1921) in his work on human trypanosomiasis wherein he stated that trypanosomes decreased or even totally disappeared in the cerebrospinal fluid after intrathecal injections, but the parasites always returned—a fact explained by the assumption that medicaments introduced into the cerebrospinal canal do not diffuse evenly with the liquor cerebralis and more especially do not penetrate into the ventricles of the brain, thus some of the trypanosomes may remain unaffected and subsequently bring about a relapse.

Treatment of relapsed horses with etharsanol-naganol combination.—The three animals (horses 69, 71, and 72 in experiments 8, 9, and 10) subjected to simultaneous treatment with etharsanol and naganol all responded satisfactorily. The results here presented furnish further evidence of the efficacy of

the etharsanol-naganol treatment against equine surra. The drawback, however, is the toxicity of the combination in some natural cases of surra treated where deaths have been recorded in the course of the treatment. In declaring the cases here described cured, microscopic examination of the blood, animal inoculation, complement-fixation test, and the period of post-treatment observation ranging from one to two years were observed. Furthermore, the increased weight and the good condition of the animals used at the termination of the investigation were also considered.

The complement-fixation test made in some of the horses used furnished an invaluable aid in declaring the animal free of surra. However, the test failed to detect the occurrence of the disease in the early stages even though the blood was already teeming with the surra parasites, as in horses 70, 71, and 72.

SUMMARY AND CONCLUSIONS

Experiments to determine the value of the simultaneous intrathecal and intravenous injections of naganol and the combination of etharsanol and naganol treatment in relapsed animals were performed.

Of the seven horses employed in the intrathecal-intravenous method, four were able to stand the complete course of the treatment with the exception of one which received only two injections, but all four relapsed. Of the remaining animals two died in the course of the treatment and one was killed in extremis at the end of the post-treatment observation period covering twenty-four days. In view of the above the intrathecal-intravenous injections of naganol as a treatment of experimental surra in Philippine horses was found to be of not much value and to some extent attended with danger.

The three animals subjected to the etharsanol-naganol treatment recovered. In declaring these cases recovered, animal inoculation, complement-fixation test, duration of post-treatment observation, microscopic examination of the blood, increase in weight, and good condition of the animals were considered.

LITERATURE CITED

BUBBERMAN, C., J. B. DOUWES, and V. E. C. VAN BERGEN. Over de toepassing van "Bayer 205" bij de surra van het paard in Nederlandsch-Indië. Veeartsenijkundige Mededeeling en Depart. v. Landbouw, Nijverheid en Handel, Buitenzorg No. 50 (1925) 64. Summarized: Trop. Vet. Bull. 13 (1925) 73–76.

EDWARDS, J. T. The chemotherapy of surra of horses and cattle in India. Journ. Comp. Path. & Therap. 39 (1926) 83–112; 169–201.

REICHENOW, EDWARD. Ueber Trypanosoma gambiense im Liquor cerebrospinalis des Menschen. Ber. Klin. Wochenschrift 58 (1921) 251–253.

RODENWALDT, E., and J. B. DOUWES. Over de toepassing van Bayer 205 bij de surra van het paard in Nederlandsch-Indië. Ned. Ind. Bladen v. Diergeneesk. en Dierenteelt. 33 (1922) 1–79. Summarized: Trop. Vet. Bull. 11 (1923) 45–50.

TUBANGUI, MARCOS A. Studies on the treatment of equine surra in the Philippines, I. Philip. Agriculturist 18 (1930) 609–620.

WILLIAMS, A. J. The treatment of surra (trypanosomiasis) of equines in India by intravenous-intrathecal injections of Bayer 205. Journ. Roy. Army Vet. Corps 1 (1929) 37–42.

YUTUC, LOPE M. Experimental studies on the curative treatment of surra in native horses in the Philippines, I. Philip. Journ. Sci. 54 (1934) 9–27.

TANNIN CONTENT OF PHILIPPINE OAK BARKS

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This paper is a continuation of our work on the tannin content of Philippine barks and woods.[1]

In the Philippines the tanning of sole leather is now done mostly with kamachile bark, *Pithecolobium dulce* (Roxb.) Benth. and there is often obtained a poor quality of leather with a disagreeable odor.

Hides tanned properly with oak-bark extract give a leather that is distinguished by a light tan color, firm texture, and durability. The oak tannin combines well with hides and penetrates quickly; consequently it is one of the best materials for producing heavy leather.[2]

According to Wilson,[3] oak barks collected from different countries had a tannin content that varied from 1.5 to 29 per cent.

Formerly the species of oak commonly used for tanning were *Quercus robur* and *Q. prinus*, containing 9 to 12 per cent tannin; *Quercus densiflora*, with a tannin content of 10 to 29 per cent, was also employed when available.

Recently we analyzed several species of oak bark grown in various districts in the Philippines. The official hide-powder method, adopted by the American Leather Chemists Association, was used. The results are recorded in Table 1. As shown by the data six species of Philippine oak bark contained more than 10 per cent tannin. Pieces of hides were tanned very satisfactorily with infusions of these barks. Apparently these barks compare favorably with those in other countries.

Of the Philippine barks analyzed *Quercus prinosa*, grown at the Cebu Forest Station, gave the highest tannin content (17.76 per cent). When this species was grown near Baguio it gave the lowest tannin content (3.52 per cent).

[1] Baens, L., F. M. Yenko, and A. P. West, Philip. Journ. Sci. 55 (1934) 177.

[2] Rogers, A., Practical Tanning (1922) 265. Bennett, H. G., Animal Proteins (1921) 34.

[3] The Chemistry of Leather Manufacture 1 (1928) 401 and 407.

TABLE 1.—*Analyses of Philippine oak barks.*

Sample No.*	Scientific name.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*
1	*Quercus Robinsonii* Merr.	12.96	3.95	77.95	19.58	17.91	1.67
2	...do...	15.65	5.14	75.28	23.97	20.79	3.18
3	*Quercus Mearnsii* Merr.	11.47	4.09	73.71	16.32	15.56	0.76
4	*Quercus sourigiana* Vid.	12.81	3.61	78.49	18.17	16.52	1.65
5	*Quercus philippinensis* A. DC.	14.90	3.69	82.87	19.61	17.98	1.63
6	*Quercus Bennettii* Miq.	16.01	3.50	82.91	21.69	19.31	2.38
7	*Quercus philippinensis* A. DC.	15.79	3.30	82.33	23.98	19.18	4.80
8	*Quercus ocalia* Blco.	3.77	3.01	65.69	7.16	6.78	0.38
9	*Quercus pruinosa* Bl.	3.52	4.19	45.65	8.05	7.71	0.34
10	*Quercus Woodii* Haines	9.86	11.20	44.72	22.56	20.26	2.30
11	*Quercus Curranii* Merr.	8.78	10.50	45.78	20.15	19.18	0.97
12	*Quercus sobrina* Vid.	4.78	6.18	43.61	11.07	10.96	0.11
13	*Quercus sundaica* Bl.	8.78	11.78	42.70	20.80	20.56	0.24
14	*Quercus apoensis* Elmer.	6.08	4.71	56.35	11.68	10.79	0.89
15	*Quercus pruinosa* Bl.	17.76	8.85	66.74	27.79	26.61	1.18

* Samples 1 to 7 were collected at Los Baños, Laguna Province. Samples 8 to 13 were collected at Baguio, Mountain Province. Sample 14 was collected at Babatngon, Leyte. Sample 15 was collected at the forest station in Cebu.

Oak barks from trees grown at the Los Baños Forest Station gave a tannin content that varied from 11.47 to 16.01 per cent.

In this investigation the oak barks used were kindly presented to us by Mr. Arthur F. Fischer, director of the Bureau of Forestry.

The identification of barks 1 to 7 was made by Mr. Mamerto D. Sulit, of the Bureau of Forestry. All the other barks were identified by Dr. Eduardo Quisumbing, of the Bureau of Science.

SUMMARY

Philippine oak barks of various species were analyzed for their tannin content.

Six species contained more than 10 per cent tannin. The Philippine barks compare favorably in tannin content with oak barks grown in other countries.

The species *Quercus pruinosa*, grown at the Cebu Forest Station, gave the highest tannin content (17.76 per cent). When this species was grown near Baguio it gave the lowest tannin content (3.52 per cent).

EFFECT OF MOLDS ON SOME PHILIPPINE TANNING LIQUORS, II

By Luz Baens and F. M. Yenko
Of the Bureau of Science, Manila

FOUR TEXT FIGURES

This paper is a continuation of the work reported in our first publication[1]—the effect of molds on Philippine tanning liquors.

Several years ago we investigated the tannin content of a large number of Philippine tanbarks.[2] Some of them were found to contain a rather high percentage of tannin as shown by the data recorded in Table 1, in which there is also included the analysis of betel-nut kernel.

These particular materials (Table 1) were selected for the mold experiments recorded in this paper. Brief descriptions of the trees from which they were obtained are as follows:

Betel nut, *Areca catechu* L.[3] This tall and slender palm is found in and about towns throughout the settled areas of the Philippines. It reaches a height of 10 meters and a diameter of 10 to 15 centimeters. It has dark green pinnate leaves about 3 meters long. The reddish yellow fruits grow on the stem below the leaves. This palm is frequently spontaneous and occurs in second-growth forests, but is rarely found distant from cultivation. It has been reported from a virgin forest in only a single locality in Palawan.

In the Philippines, as in all the Indo-Malayan and Polynesian regions, the fruits of this palm are extensively utilized for chewing with lime and the leaves of the betel pepper. They are also used to some extent in dyeing red and black shades.

Black wattle, *Acacia decurrens* Willd. The bark was obtained from trees grown in Bukidnon Province, Mindanao. In the

[1] Yenko, F. M., Luz Baens, and F. B. Serrano, Philip. Journ. Sci. 60 (1936) 241.

[2] Baens, Luz, F. M. Yenko, A. P. West, and H. M. Curran, Philip. Journ. Sci. 55 (1934) 177.

[3] Brown, William H., Minor Products of Philippine Forests 1 (1920) 144.

sitio called Kaatoan these trees reached an average height of 6.29 meters in about four years. They were cultivated from seeds that were obtained from the Forest Research Institute, Buitenzorg, Java. In some districts in Bukidnon the black-wattle tree grows very well, and it is quite likely that it could be cultivated successfully on rich soil where the climate is similar to that of Bukidnon.

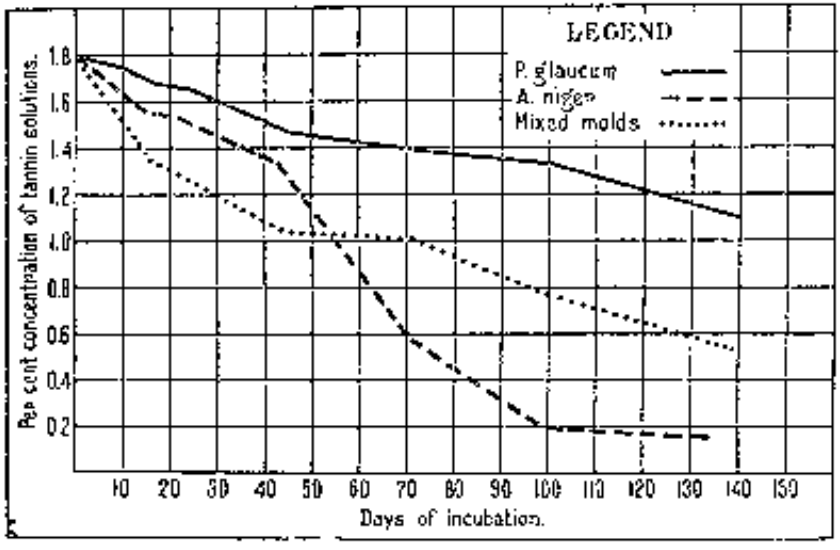

FIG. 1. Effect of molds on betel-nut solutions.

Kalumpit, *Terminalia edulis* Blco.[4] A height of about 35 meters and a diameter of about 1 meter may be attained by this tree. The fruits are about 3 centimeters wide, smooth, dark red, fleshy, and acid, and should make a good preserve.

This species is very common and widely distributed in the forests from northern Luzon to southern Mindanao, and it has been cultivated at the Lamao Experiment Station.

Kamachile, *Pithecolobium dulce* (Roxb.) Benth.[5] The tree reaches a height of 5 to 8 meters. This species is a native of tropical America but is now thoroughly naturalized in the Philippines where it is common and widely distributed. Large quantities of the bark are gathered for tanning purposes.

EXPERIMENTAL PROCEDURE

Solutions (2 per cent tannin content) were prepared from tanning extracts obtained from betel-nut kernel, and from black

[4] Brown, William H., Minor Products of Philippine Forests 2 (1920) 354.
[5] Toin. cit. 292.

wattle, kalumpit, and kamachile barks. They were heated on a steam bath for thirty minutes to pasteurize. Two-liter portions of each were separately inoculated with spores of the molds *Aspergillus niger* and *Penicillium glaucum*. Other 2-liter portions were exposed to the air and allowed to be infected with a mixture of molds existing under ordinary laboratory conditions.

The tannin content of the solutions was determined before inoculation, and periodic analyses were made afterwards.

In selecting aliquot portions of the solutions for analysis the flasks were rotated gently between the hands in order to get average samples, and care was taken to avoid disturbing the

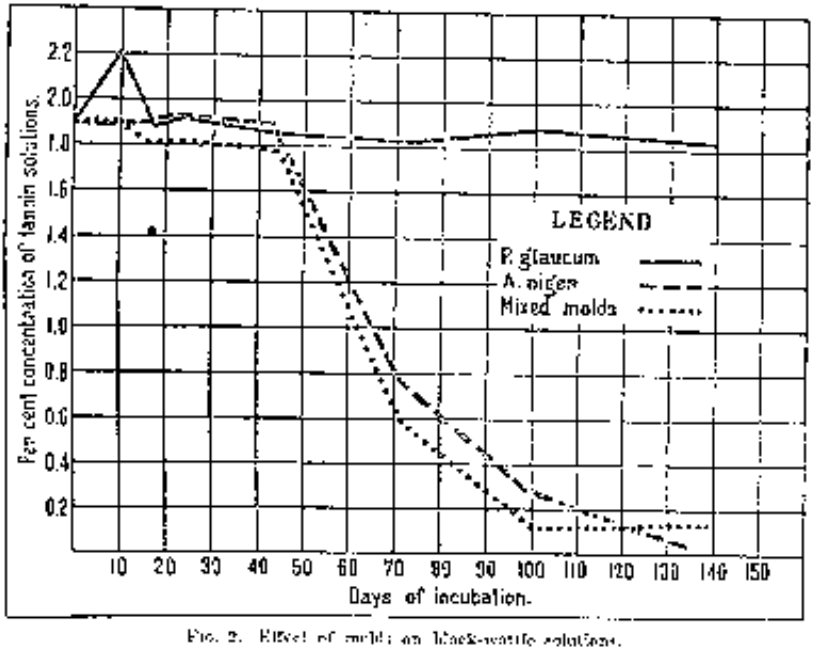

FIG. 2. Effect of molds on black-wattle solutions.

mold growth on the surface. Evaporation losses were made up with distilled water before samples were taken for analysis. The results are recorded in Tables 2 to 13.

In general the tannin content of the various extracts decreased, more or less, due to mold action. Usually the greatest decrease occurred after about forty days' exposure.

In comparing the pH values with the tannin content of the various extracts, we note certain relations.

A rise in the pH value was accompanied by a large decrease in tannin content. Acids inhibit the action of molds and the

destruction of tannins; consequently, in general, the less acid present the greater will be the decrease in tannin content. For instance, betel-nut extract inoculated with *A. niger* showed a rise in pH and a relatively high loss in tannin (Table 2). Mixed molds (Table 4) gave somewhat the same results.

When the betel-nut extract was inoculated with *P. glaucum* there was first a rise and later a decrease in pH, indicating increased acidity. There was also some loss in tannin (Table 3). The increase in acidity evidently inhibited the mold action but was not sufficient to stop it.

Treated with *A. niger* the betel-nut solution lost more tannin than treated with *P. glaucum* (Tables 2 and 3). The betel-nut extract was more resistant to *P. glaucum* than to *A. niger*.

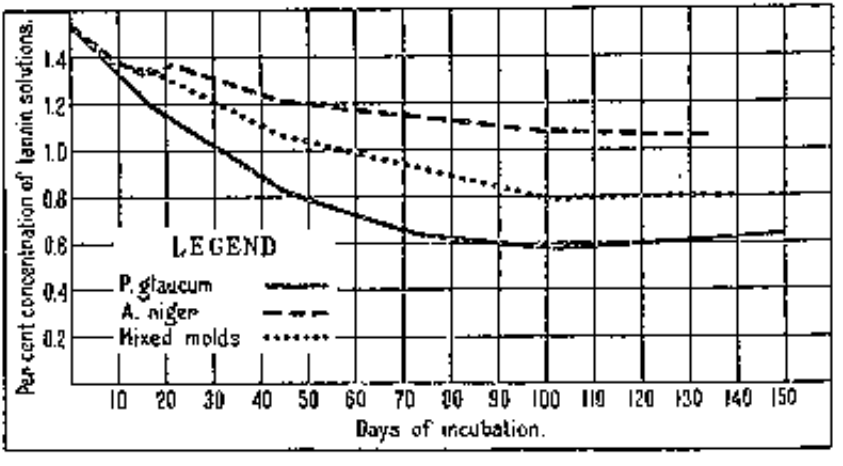

FIG. 3. Effect of molds on kalumpit solutions.

Inoculation of black-wattle extract with the mold *A. niger* gave a decrease in the pH value that was accompanied by a marked loss in tannin content (Table 5). In fact, after about four months of mold action hardly any tannin remained in the solution. In this case the increase in acidity failed to stop the mold action because the black-wattle tannin is evidently very susceptible to the action of the mold *A. niger*.

When the black-wattle tannin solution was inoculated with *P. glaucum* there was a comparatively large decrease in the pH (5.1 to 4.1). However, there was only a slight loss in tannin (Table 6). It would appear that black-wattle tannin is quite resistant to the mold *P. glaucum*.

The tannin content of the black-wattle extract decreased a great deal when the extract was exposed to the mixed molds in

the air, but there was not much change in the pH value (Table 7). Since *A. niger* is more abundant in the air than *P. glaucum* these results were to be expected in view of the data recorded in Tables 5 and 6.

In all the experiments with the kalumpit bark (Tables 8, 9, and 10) there was a large reduction in the pH. Here again, the increased acidity apparently inhibited the action of the molds. Kalumpit bark was more resistant to the action of *A. niger* than to that of *P. glaucum*. The mixed molds gave values that were about the average of the individual molds.

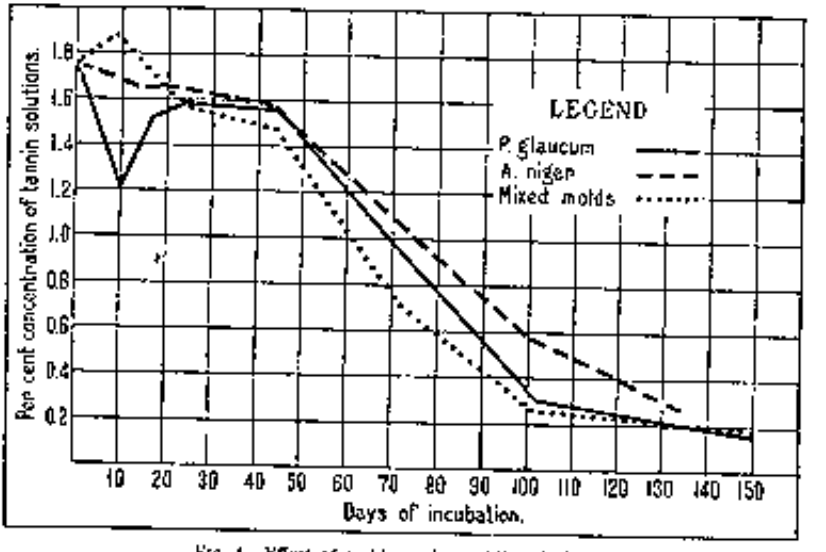

FIG. 4. Effect of molds on kamachile solutions.

The different molds gave the kamachile extract a slight increase in pH that was accompanied by an unusually large loss in tannin. This extract is very susceptible to mold action (Tables 11, 12, and 13).

The results recorded in the tables are illustrated graphically in the various charts (text figs. 1, 2, 3, and 4).

The barks used in this investigation were kindly presented to us by Mr. Arthur F. Fischer, director of the Bureau of Forestry.

SUMMARY

In this investigation a study was made of the effect of molds on some Philippine tanning liquors.

The molds used were *Aspergillus niger, Penicillium glaucum,* and mixtures consisting largely of these two.

The tannin liquors employed were extracts of betel-nut kernel and barks of black wattle, kalumpit, and kamachile.

In general the tannin content of the various extracts decreased, more or less, due to mold action.

A rise in the pH value of the extracts was accompanied by a large decrease in tannin content. Acids inhibit the action of molds and consequently the less the acid the greater the mold action.

Experiment showed that extracts of betel-nut and black wattle were very susceptible to the action of *A. niger* but were rather resistant to *P. glaucum*.

Kalumpit bark was more resistant to the action of *A. niger* than to that of *P. glaucum*.

Both molds had a deleterious effect on kamachile extract.

TABLE 1.—*Analysis of Philippine barks and betel-nut kernels.*

Sample.	Tannin.	Nontannin.	Purity.	Solids.		
				Total.	Soluble.	Insoluble.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Betel-nut kernel; *Areca catechu* [a]	20.16	9.51	67.95	32.19	29.67	2.52
Black wattle; *Acacia decurrens* [b]	45.05	10.73	80.76	56.98	55.78	0.80
Kalumpit; *Terminalia edulis* Blanco [b]	34.31	7.23	82.53	43.17	41.34	1.83
Kamachile; *Pithecolobium dulce* (Roxb.) Benth. [b]	26.32	5.58	78.27	37.41	35.65	1.76

[a] Analysis made in the tanning laboratory, Bureau of Science.
[b] Analysis made by the Philippine Dutch Corporation, Zamboanga, P. I.

TABLE 2.—*Betel-nut tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 [a]	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 10	5.1	1.67	0.75	69.59	2.58	2.40	0.18
July 17	5.4	1.56	0.58	72.90	2.35	2.14	0.21
July 24	5.4	1.53	0.53	74.27	2.30	2.06	0.24
August 14	5.2	1.34	0.21	86.45	1.86	1.55	0.30
September 11	5.2	0.53	0.75	43.61	1.75	1.36	0.42
October 9	5.0	0.20	1.02	16.39	1.63	1.22	0.41
November 13	5.6	0.17	0.89	16.04	1.57	1.06	0.51

[a] Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 3.—*Betel-nut tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	4.9	1.81	1.04	63.51	3.01	2.85	0.22
July 12	5.1	1.75	0.74	70.28	2.74	2.49	0.25
July 19	5.1	1.68	0.62	73.04	2.54	2.30	0.24
July 26	5.5	1.66	0.57	74.42	2.46	2.23	0.23
August 16	5.0	1.47	0.51	74.24	2.23	1.98	0.25
September 13	4.8	1.39	0.47	74.73	2.11	1.86	0.25
October 11	4.8	1.33	0.50	72.68	2.09	1.83	0.26
November 19	4.3	1.11	0.63	63.79	2.03	1.74	0.29

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 4.—*Betel-nut tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
July 2 *	4.9	1.81	1.04	63.51	3.07	2.85	0.22
July 11	4.9	1.54	0.68	69.37	2.52	2.22	0.30
July 18	5.5	1.35	0.54	71.43	2.26	1.89	0.36
July 25	5.7	1.26	0.46	73.56	2.05	1.74	0.31
August 15	5.5	1.01	0.44	70.27	1.59	1.48	0.11
September 13	5.1	1.00	0.39	71.94	1.62	1.39	0.43
October 10	4.9	0.77	0.60	56.20	1.85	1.37	0.48
November 18	5.9	0.54	0.78	42.52	1.70	1.27	0.43

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 5.—*Black-wattle tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 10	5.1	1.89	0.64	74.70	2.76	2.53	0.23
July 17	5.3	1.90	0.16	80.86	2.58	2.35	0.23
July 24	5.4	1.93	0.37	83.91	2.52	2.30	0.22
August 14	5.5	1.89	0.26	87.91	2.33	2.15	0.18
September 11	4.8	0.76	0.50	60.94	1.80	1.28	0.52
October 9	4.7	0.29	0.32	47.51	1.62	0.61	1.01
November 13	4.7	0.04	0.38	9.52	1.05	0.42	1.23

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 6.—*Black-wattle tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 12	4.4	2.25	0.27	89.29	2.68	2.52	0.16
July 19	4.0	1.88	0.59	76.11	2.61	2.47	0.14
July 26	4.4	1.92	0.59	76.50	2.60	2.51	0.09
August 16	4.8	1.66	0.35	84.16	2.31	2.21	0.10
September 10	4.3	1.89	0.27	87.14	2.22	2.10	0.12
October 11	4.1	1.89	0.22	89.67	2.19	2.11	0.08
November 19	4.1	1.83	0.21	89.71	2.24	2.04	0.20

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 7.—*Black-wattle tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	5.1	1.90	0.87	68.59	2.94	2.77	0.17
July 11	4.1	1.90	0.49	79.50	2.55	2.39	0.16
July 18	5.5	1.81	0.33	84.58	2.39	2.14	0.25
July 25	5.7	1.81	0.29	86.19	2.34	2.10	0.24
August 15	5.6	1.78	0.24	88.12	2.20	2.02	0.18
September 12	4.7	0.67	0.66	46.34	1.95	1.23	0.72
October 10	4.6	0.12	0.76	13.64	1.67	0.88	0.79
November 18	4.8	0.13	0.60	17.81	1.87	0.73	1.14

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 8.—*Kalumpit tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	4.4	1.54	0.51	75.12	2.26	2.05	0.23
July 10	4.0	1.40	0.47	74.87	2.16	1.87	0.29
July 17	3.9	1.32	0.41	76.30	2.04	1.73	0.31
July 24	3.7	1.35	0.40	77.14	2.02	1.75	0.27
August 14	3.7	1.22	0.37	76.73	1.90	1.59	0.31
September 11	3.5	1.15	0.37	75.66	1.84	1.52	0.32
October 9	3.2	1.09	0.37	74.66	1.72	1.46	0.26
November 13	3.3	1.06	0.33	76.26	1.63	1.39	0.24

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 9.—*Kalumpit tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 12	3.8	1.34	0.51	76.57	2.00	1.75	0.25
July 19	3.6	1.20	0.36	76.92	1.86	1.56	0.32
July 26	3.4	1.11	0.32	77.62	1.84	1.43	0.41
August 16	3.3	0.83	0.34	70.94	1.55	1.17	0.39
September 13	3.2	0.64	0.39	62.14	1.45	1.03	0.42
October 11	3.1	0.55	0.45	66.31	1.35	1.03	0.32
November 23	3.3	0.61	0.50	56.14	1.38	1.14	0.24

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 10.—*Kalumpit tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	4.4	1.54	0.51	75.12	2.28	2.05	0.23
July 11	4.4	1.37	0.43	76.11	2.05	1.80	0.25
July 18	4.3	1.35	0.43	75.84	2.05	1.78	0.27
July 26	3.9	1.29	0.34	79.14	1.90	1.63	0.27
August 15	3.4	1.07	0.28	79.20	1.65	1.35	0.30
September 12	3.3	0.93	0.28	76.80	1.67	1.21	0.46
October 10	3.2	0.79	0.28	73.83	1.55	1.07	0.48
November 18	3.1	0.80	0.30	72.73	1.50	1.10	0.40

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 11.—*Kamachile tannin solution inoculated with Aspergillus niger.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 10	5.9	1.70	0.83	67.19	2.91	2.63	0.38
July 17	6.3	1.65	0.79	67.62	2.86	2.44	0.42
July 24	6.3	1.65	0.80	67.35	2.83	2.45	0.38
August 14	6.2	1.59	0.79	66.81	2.79	2.38	0.41
September 13	5.9	1.08	1.29	45.57	2.60	2.37	0.23
October 9	5.6	0.59	1.80	24.69	2.54	2.39	0.15
November 18	5.9	0.28	2.15	11.52	2.51	2.43	0.08

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 12.—*Kamachile tannin solution inoculated with Penicillium glaucum.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 12	5.7	1.29	1.23	50.88	2.64	2.46	0.38
July 19	6.8	1.53	0.78	66.23	2.75	2.31	0.44
July 26	5.7	1.58	0.77	67.37	2.72	2.36	0.36
August 16	6.1	1.56	0.78	66.66	2.62	2.34	0.28
September 13	6.1	0.93	1.46	38.91	2.60	2.39	0.21
October 11	6.8	0.31	2.08	12.97	2.56	2.39	0.17
November 29	5.7	0.17	2.35	6.75	2.62	2.52	0.10

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

TABLE 13.—*Kamachile tannin solution inoculated with mixed molds.*

Date of analysis.	pH.	Tannin.	Nontannin.	Purity.	Solids.		
					Total.	Soluble.	Insoluble.
1935		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
July 2 *	5.7	1.76	0.88	66.67	3.04	2.64	0.40
July 11	5.9	1.89	0.51	78.75	2.70	2.40	0.30
July 18	6.4	1.93	0.77	69.20	2.64	2.50	0.14
July 25	6.1	1.68	0.70	69.30	2.51	2.26	0.25
August 15	5.8	1.47	0.75	66.22	2.48	2.22	0.26
September 12	5.8	0.71	1.56	31.28	2.44	2.27	0.17
October 10	5.5	0.27	2.07	11.54	2.48	2.34	0.14
November 29	5.8	0.18	2.25	7.41	2.64	2.43	0.21

* Analysis made before inoculation. All other analyses recorded in this table were made after inoculation.

ILLUSTRATIONS

TEXT FIGURES

PHILIPPINE ANNATTO DYE AS A COLORING AGENT

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THREE PLATES

The bulk of the dyes that are now used commercially are synthetic products.[1] There are, however, a few natural dyes[2] that are still employed. One of the most important of these is annatto, which is obtained from the seeds of the annatto tree. This tree is known botanically as *Bixa orellana* Linn. It is a native of tropical America and has been introduced into many other countries. For more than a hundred years the tree has been cultivated in India, where the dye has been used for various purposes.[3] Years ago annatto was introduced into the Philippines, where it is grown in and about towns, and is called, in Tagalog, *achuete*.[4]

The annatto tree reaches a height of 4 to 6 meters. The flowers are white to pinkish in color. The seeds are inclosed in capsules that are somewhat rounded and covered with soft bristles. The seeds are about the size of grapeseeds and are pyramidal in shape. They are covered with a soft resinous pulp that has an attractive vermilion color. This pulp surrounding the seeds contains the annatto dye.

Formerly annatto was employed to some extent for dyeing certain textiles. It is not a fast dye, and consequently, like most other natural dyes, it has been replaced by synthetic colors. However, it is still used for coloring butter and cheese.

In certain districts along the Amazon River the Indian families make ornamental pottery and drinking cups which they sell to traders and travelers. These products are often painted rather cleverly with different colors. The red tints are made with annatto dye.[4]

[1] Cain and Thorpe, Synthetic Dyestuffs. Revised by J. F. Thorpe and R. P. Linstead (1933).

[2] Perkin, A. G., and A. E. Everest, Natural Organic Coloring Matters (1918).

[3] Watt, G., Dictionary of the Economic Products of India 1 (1891) 454.

[4] Bates, H. W., The Naturalist On the River Amazons (1931) 122.

In the Philippines one can usually find annatto seeds for sale in the larger markets. The seeds are used mostly for coloring local foods.

Annatto is exported from Jamaica, Ecuador, Brazil, and neighboring regions, and also from India and Java, but not from the Philippines.

According to Thorpe: [5]

> Annatto comes into the market in the form of cakes, and among the different varieties Cayenne annatto is the most esteemed, and is considered to be the richest in colouring matter. It should contain from 10 to 12 p.c. of the pure dye, and not more than 5 p.c. of ash, whereas the amount of colouring matter in the Bengal product is frequently lower than 6 p.c.

Annatto dye contains two coloring matters. It consists mostly of bixin (cinnabar red) together with some orellin (yellow). Etti,[6] who first prepared crystallized bixin, proposed the formula $C_{25}H_{30}O_4$ for it. There has been some controversy in chemical literature as to the correctness of this formula, and some investigators have suggested somewhat different formulas.[7]

Occasionally the Bureau of Science receives letters requesting recipes in which annatto dye is one of the constituents. For this extension service we have worked out some recipes that serve to illustrate how this dye may be used.

EXPERIMENTAL PROCEDURE

Various methods have been suggested for extracting the dyestuff contained in the pulp surrounding the annatto seeds. One of the simplest methods is to place the seeds in a mortar, add some water and stir the seeds around with a pestle. The colored solution is poured off and the trituration process repeated until no more color is extracted. The combined water solutions are acidified with 4 per cent acetic acid, or vinegar. This precipitates the crude dye which is obtained by pouring off the supernatant liquid or by filtering.

Bixin is the more useful coloring matter in the crude dye and is obtained conveniently by Zwick's method.[8] The seeds are extracted for twenty-four hours with boiling chloroform. The extract is then poured off from the seeds and the excess solvent

[5] Thorpe, E., Dictionary of Applied Chemistry 1 (1927) 332.
[6] Ber. Deut. Chem. Gesell. 7 (1874) 446; 11 (1878) 864.
[7] Thorpe, E., Dictionary of Applied Chemistry 1 (1927) 333.
[8] Thorpe, E., op. cit. 332.

removed by distilling. The concentrated solution is evaporated to dryness and the residue is treated several times with petroleum ether to remove oily constituents. The red powder that remains is crystallized from chloroform giving crystals that melt at 165° C.

The red powder, or crystals, dissolved in concentrated sulphuric acid, gives a solution with a bright blue color, and on dilution with water a green precipitate is obtained (test for bixin).

Kolhaas and Koppel [9] have recently suggested another method for producing annatto paste in which the dye is extracted with dilute alkali.

COMMERCIAL PRODUCTS

Although the recipes that follow have given satisfactory results they are presented as suggestions rather than specific directions. The exact quantity of the individual ingredients in each recipe can usually be varied to some extent. Again the more costly constituents might be replaced by substitutes that are cheaper if quality is not a matter of primary importance.

FLOORWAX AND FURNITURE POLISH

Materials:	
Beeswax, g	80
Carnauba wax, g	80
Paraffin, g	80
Tallow, g	80
Hercules rosin, g	80
Turpentine (colored with annatto), cc	500

The colored turpentine is prepared by treating 250 grams of annatto seeds with 1,000 cubic centimeters of turpentine. Allow the mixture to stand overnight, then pour off the supernatant liquid from the seeds. This is the stock solution of annatto-colored turpentine that is used for coloring.

The solid materials (waxes, paraffin, tallow, and rosin) are melted together in a casserole over a small flame. The flame is then extinguished and the annatto-colored turpentine added. The mixture is stirred thoroughly and while still hot is poured into containers and cooled quickly. The stoppers of the containers should fit tightly to prevent loss of solvent.

The polish should be applied with a soft cloth and the polished surface rubbed briskly to produce a brilliant luster.

[9] Indische Mercuur 58 (1935) 525.

SHOE POLISH (FOR BROWN OR TAN SHOES)

Materials:	
Carnauba wax, g	50
Beeswax, g	100
Paraffin, g	80
Tallow, g	20
Annatto-colored turpentine, cc	300
Nitrobenzene, cc	10

The annatto-colored turpentine is prepared as in the recipe for furniture polish.

The solid materials are melted together in a casserole over a small flame. When the materials are completely melted the flame is extinguished and the annatto-colored turpentine added. The mixture is now stirred thoroughly, and when it is somewhat cool the nitrobenzene is added and the product poured into containers.

The polish should be applied with a soft cloth and the polished surface rubbed briskly to produce a brilliant luster.

NAIL GLOSS

Materials:	
Celluloid, g	50
Amyl acetate, cc	450
Acetone, cc	450
Acetone saturated with annatto, cc	1

The celluloid is first dissolved in amyl acetate. Acetone is now poured into this solution, after which there is added about 1 cubic centimeter of a solution of acetone saturated with annatto.

This gloss should be applied with a small camel's hair brush. Finger nails treated with this gloss acquire a deep red color.

Scrap photo films can be used in place of celluloid but they should first be cleaned by treating with dilute alkali solution and washed well with water.

A saturated solution of annatto dye dissolved in acetone may be prepared by treating about 0.5 gram of annatto dye with 20 cubic centimeters of acetone.

The gloss may be removed by washing with acetone.

BRASS LACQUER

Materials:	
Celluloid, g	50
Amyl acetate, cc	400
Acetone, cc	400
Acetone saturated with annatto, cc	1

The brass lacquer is made in the same manner as the nail gloss. Various shades may be obtained by varying the amount

of colored solution or the color may be omitted entirely. It may be applied with a soft brush or used as a spray.

If the liquid becomes too thick due to evaporation of the solvents (amyl acetate or acetone) it may be diluted with either of them.

When vases and other brass articles are allowed to stand around as ornaments they soon lose their brightness and luster and are no longer very attractive. If new or polished brassware is first treated with this preparation it retains its original brilliant appearance for a considerable length of time.

HAIR OIL

Macerate the annatto seeds in colorless and odorless coconut oil. Use sufficient seeds to obtain the desired color. When all the dye is dissolved remove the seeds by filtering and add a small quantity of any desired perfume.

WOOD STAIN

Annatto dye dissolved in acetone, chloroform, or ethyl acetate gives a dark red solution that can be used for staining wood. This colored solution may also be incorporated with an alcoholic solution of shellac if a colored shellac varnish is desired.

SUMMARY

The annatto tree, *Bixa orellana* Linn., is a native of tropical America and has been introduced into many other countries including the Philippines.

The seeds of the annatto tree are covered with a soft resinous pulp that contains a red dye known as annatto. Various methods have been suggested for extracting this dye.

Annatto is one of the very few natural dyes that is still used commercially. It is employed mostly for coloring butter and cheese. Local foods are often colored with it in the Philippines.

In order to illustrate how annatto dye may be used recipes for making the following products were worked out: Floorwax, furniture and shoe polish, nail gloss, brass lacquer, hair oil, and wood stain.

ILLUSTRATIONS

PLATE 1

Annatto tree (*Bixa orellana* Linn.) growing in Manila.

PLATE 2

FIG. 1. Annatto buds and flower.
2. Annatto capsules.

PLATE 3

FIG. 1. Annatto capsule opened showing immature seeds.
2. Mature annatto seeds.

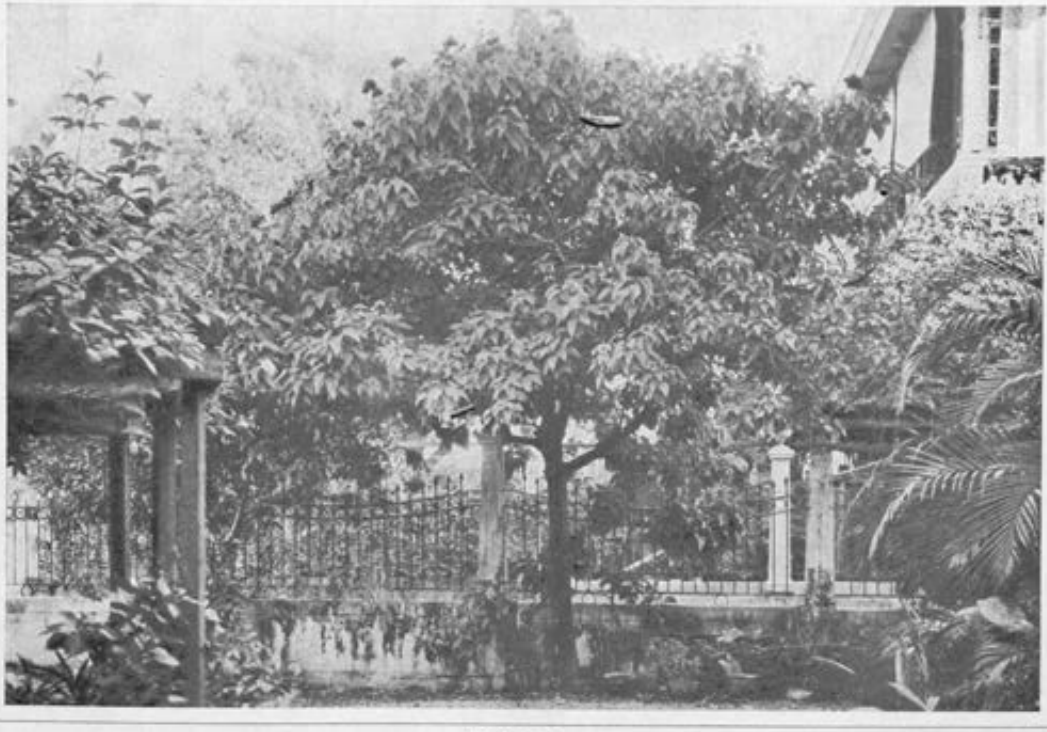

PLATE 1.

PLATE 2.

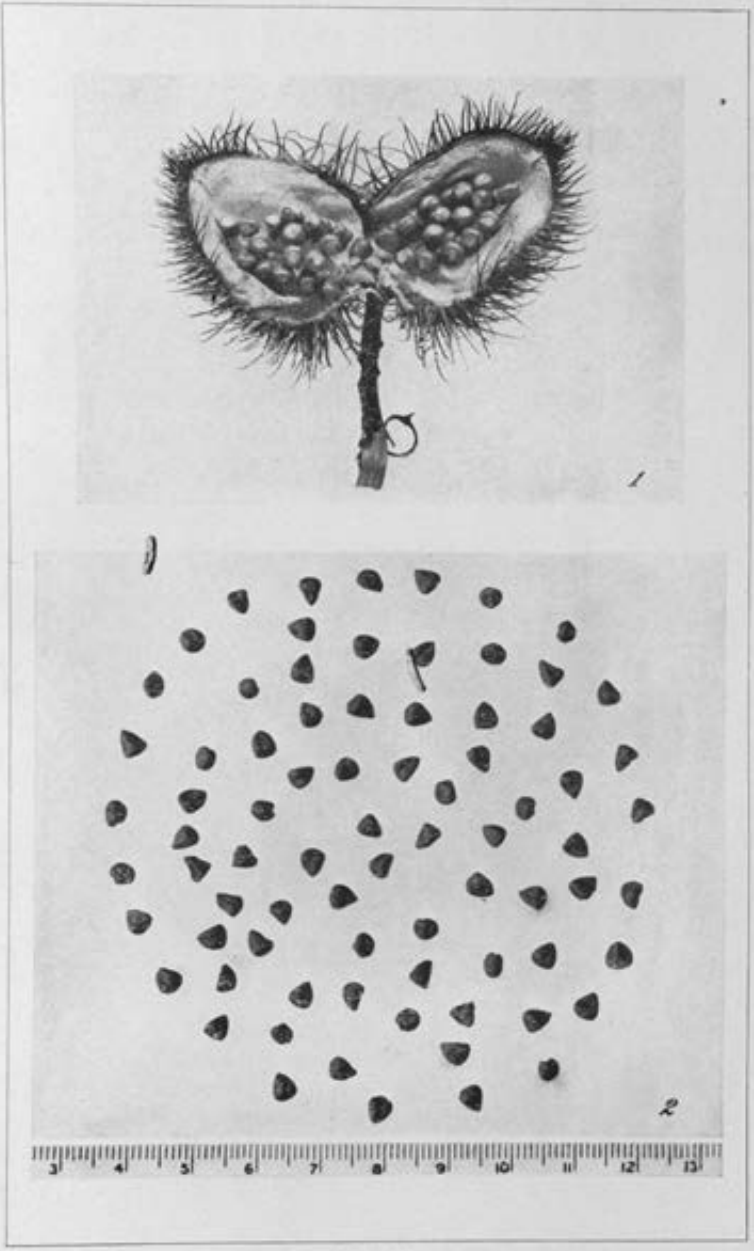

PLATE 3.

COMPOSITION OF PHILIPPINE PHYSIC-NUT OIL

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THREE PLATES

Recently the Bureau of Science received several requests for information concerning the constituents of physic-nut oil. Experiments on this oil have been carried out in various laboratories, but the results were not concordant. To determine the exact composition of physic-nut oil the present investigation was therefore undertaken.

Physic-nut oil is obtained from the seeds of a small tree that grows to a height of 2 to 5 meters. This tree is a native of tropical America and is known botanically as *Jatropha curcas* Linn. For many years it has been grown in other countries, including the Philippines, where it is usually cultivated in and about towns to serve as a hedge plant. It is called in Tagalog *tubang-bakod*. *Tuba* is a name given to many plants of this family that are used for poisoning fish, and *bakod*, is the Tagalog word for "hedge" or "fence." Hence the name túbang-bakod. The seeds of this plant are inclosed in capsules that are mostly rounded.

The constants and characteristics of physic-nut oil have been determined by various investigators. The oil has strong purgative properties when taken internally, and it also contains a toxic substance.[1] It has been used medicinally in India [2] as a remedy for itch. In Portugal [3] it has been employed for soap making and as an illuminant. In the Philippines the oil is not extracted from the seeds.

[1] Anon., Bull. Imp. Inst. 17 (1919) 433. Heim, F., and J. Rullier, Bull. del'office colonial 12 (1919) 96.

[2] Watt, G., Dictionary of the Economic Products of India 4 (1890) 546.

[3] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 2141.

Samples of physic-nut oil obtained from different countries gave iodine values [4] that varied from about 94 to 106. This oil would therefore be classified as a semidrying oil.

When the glycerides of physic-nut oil are converted into acids, these mixed acids, according to Lewkowitsch,[5] have about equal amounts of the unsaturated oleic and linolic acids in addition to the saturated acids they contain. Soliven [6] reported 35.21 per cent oleic and 49.28 per cent linolic acid in the mixed acids. Kafuku, Hata, and Fujikawa [7] found that the total mixed acids contained 53.20 per cent oleic and 22.80 per cent linolic acid. Experiments performed by Francois and Droit [8] indicated that the mixed acids have about three and a half times as much oleic as linolic acid.

From the inconsistent data recorded in the literature it is evident that the exact composition of physic-nut oil is still an open question.

EXPERIMENTAL PROCEDURE

The physic-nut seeds used in this investigation were collected near Magalang, Pampanga Province, Luzon. They were found to have 34.3 per cent of hulls and 65.7 per cent of kernels. A sample of the kernels extracted with ether gave 46.5 per cent of oil, hence the oil in the whole seeds amounted to 30.6 per cent. The seeds had a moisture content of 20.0 per cent; calculated on a moisture-free basis the whole seeds contained 38.2 per cent of oil.

When tested in the Bureau of Science by the Division of Tests and Standards the hulls gave a heating value of 4,653 calories per gram. This is somewhat higher than the result obtained for common Philippine firewood which gave 4,633 calories per gram.

The physic-nut oil, obtained by cold-pressing the crushed kernels, was filtered to eliminate most of the solid material. The

[4] Grimme, L. I. C., Zeit. deut. Oel-Fett-Ind. 41 (1921) 513. Anon., Bull. Imp. Ins. 19 (1921) 288. L., Mat. grasses 14 (1922) 6099. Soliven, F. A., Philip. Agr. 16 (1928) 587. Smith, T. J., Chemist and Druggist 112 (1930) 746. Kafuku, Y. K., C. Hata, and M. Fujikawa, Journ. Chem. Soc. Japan 53 (1932) 1115. Droit, S., Bull. mat. grasses inst. colonial Marseille 16 (1932) 270. Francois, M. T., and S. Droit, Bull. Soc. Chim. 53 (1933) 728; 1564. Adriaens, L., Mat. grasses 28 (1936) 10786; 10813.

[5] Chemical Technology and Analysis of Oils, Fats, and Waxes 2 (1922) 241.

[6] Philip. Agr. 16 (1928) 593.

[7] Journ. Chem. Soc. Japan 53 (1932) 1115.

[8] Bull. Soc. Chim. 53 (1933) 728.

oil was then purified by treating successively with 2 per cent kieselguhr, suchar, and talcum powder. This treatment removes vegetable fibers and colloidal matter and produces a brilliantly clear oil that is only slightly yellow.

The oil cake that remains after expelling the oil cannot be used as cattle food because it contains a purgative substance that is toxic. Analysis [9] gave the following results (Table 1).

TABLE 1.—*Composition of physic-nut oil cake.*

Constituent.	Per cent.
Moisture	6.63
Ash	8.87
Oil	14.14
Protein	49.39
Crude fiber	3.45
Carbohydrates (by difference)	17.01

In Table 2 is given the fertilizer value [10] of physic-nut oil cake. It has a high value as a fertilizer and is about as rich in nitrogen and phosphorus as castor-seed cake.

TABLE 2.—*Fertilizer constituents in physic-nut oil cake.*

Constituent.	Per cent.
Nitrogen (N_2)	8.23
Phosphoric anhydride (P_2O_5)	4.71
Potash (K_2O)	0.25
Moisture	8.05

The physical and chemical constants of physic-nut oil are given in Table 3.

TABLE 3.—*Physical and chemical constants of physic-nut oil.*

Specific gravity at 30°/4° C.	0.9082
Refractive index at 20° C.	1.4665
Iodine number (Hanus)	94.8
Saponification value	192.4
Unsaponifiable matter (per cent)	0.45
Acid value	5.1
Saturated acids, determined (per cent)[a]	17.37
Unsaturated acids plus unsaponifiable matter, determined (per cent)	77.90
Saturated acids, corrected (per cent)	16.82
Unsaturated acids, corrected (per cent)[b]	78.09
Iodine number of unsaturated acids	111.00

[a] Due to the incomplete separation by the lead-salt-ether method the saturated acids, as determined, contain 1.05 per cent unsaturated acids.

[b] Corrected for unsaponifiable matter and also for the percentage of unsaturated acids contained in the saturated acids.

[9] Analysis was made by Miss Gloria Cortes of the Bureau of Science.

[10] Analysis was made by Mr. R. Isidro of the Philippine Soil Surveys.

The saturated and unsaturated acids that occur as glycerides in Philippine physic-nut oil were separated by the lead-salt-ether method [11] in accordance with the suggestions of Baughman and Jamieson.[12] The results are recorded in Table 4.

TABLE 4.—*Separation of saturated acids from the unsaturated acids in Philippine physic-nut oil by the lead-salt-ether method.*

Experiment No.	Oil used.	Unsaturated acids.	Saturated acids.	Unsaturated acids (directly determined).	Saturated acids (directly determined).	Unsaturated acids (corrected).	Saturated acids (corrected).
	g.	*g.*	*g.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	18.0477	14.1066	3.1020	78.16	17.18	78.20	16.62
2	17.1276	13.2535	3.0067	77.64	17.55	77.75	16.93
Mean				77.90	17.37	78.00	16.82

[a] Unsaturated acids (unsaponifiable matter) removed; iodine number (Hanus) 111.6.
[b] Iodine number (Hanus) 3.2.
[c] Iodine number (Hanus) 4.8.

Unsaturated acids.—The unsaturated acids separated from physic-nut oil by the lead-salt-ether method were treated with bromine and converted into their bromo-derivatives.[13]

No ether-insoluble hexabromide was obtained, thus showing the absence of linolenic acid. The composition of the mixed unsaturated acids, which occur as glycerides in physic-nut oil, was calculated from the iodine number of the unsaturated acids. The results are recorded in Table 5. There are also included the calculated percentages of glycerides corresponding to these individual unsaturated acids.

TABLE 5.—*Composition of the unsaturated acids of physic-nut oil and the glycerides corresponding to these acids.*

Acid.	Mixture of unsaturated acids.	Original oil.	Glycerides in original oil.
	Per cent.	*Per cent.*	*Per cent.*
Linolic	22.39	17.85	18.65
Oleic	77.61	60.15	62.86
Total	100.00	78.00	81.51

[11] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.

[12] Cotton Oil Press 6 No. 1 (1922) 41. Journ. Am. Chem. Soc. 42 (1920) 2398.

[13] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 685.

Saturated acids.—The saturated acids were separated from physic-nut oil by the lead-salt-ether method and esterified with methyl alcohol. The mixed acids were dissolved in methyl alcohol and saturated with dry hydrogen chloride gas. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution washed with sodium carbonate solution and afterwards with water. The ethereal solution was dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters which were yellow, were distilled under diminished pressure. A preliminary distillation at 5 millimeters pressure was made. The esters were redistilled at 4 millimeters pressure. Data on the distillation of the esters are given in Tables 6 and 7.

TABLE 6.—*First distillation of the methyl esters of the saturated acids; pressure 5 millimeters; 96.9878 grams of esters distilled.*

Fraction.	Temperature.	Weight.
	°C.	g.
A	174–177	15.1491
B	177–180	30.5863
C	180–183	15.2811
D	183–186	11.0556
E	186–194	9.5761
F	194–204	6.3588
Residue		1.7707
Total		96.7893

TABLE 7.—*Second distillation of the methyl esters of the saturated acids; pressure 4.0 millimeters; 96.7893 grams of esters redistilled.*

Fraction.				
From first distillation.	Second distillation.	Temperature	Weight.	
		°C.	g.	
A and B	1	170–173	19.0076	
C	2	173–176	20.5963	
D	3	176–179	16.6203	
E	4	179–182	10.4567	
F and residue	5	182–185	15.6619	
	6	185–188	7.9859	
	7	188–204	5.2420	
	Residue		0.6512	
Total			96.2270	

In Table 8 are given the analyses of fractions obtained in the second distillation of methyl esters. From these data there were calculated the amounts of the individual acids corresponding to the methyl esters contained in the various fractions. The results are recorded in Table 9 and were computed in accordance with the procedure used by Baughman and Jamieson [1] in their investigations of vegetable oils.

TABLE 8.—*Analyses of fractions obtained in the second distillation of the mixed methyl esters.*[a]

Fraction.	Iodine number.	Saponification value.	Mean molecular weight of mixed esters.	Composition of mixed esters.		Mean molecular weight of saturated esters.
				Saturated.	Unsaturated.	
				Per cent.	*Per cent.*	
1	2.0	209.5	267.8	98.11	1.89	267.3
2	2.9	207.1	270.5	97.26	2.74	269.8
3	5.0	202.4	277.2	95.27	4.73	276.4
4	7.3	199.8	280.8	93.09	6.91	279.7
5	9.5	194.9	289.3	91.03	8.99	288.7
6	10.2	191.8	293.7	90.35	9.65	293.6
7	9.7	185.9	301.8	90.82	9.18	302.4

[a] Calculated iodine number of unsaturated methyl esters 106.7; calculated saponification value of unsaturated methyl esters 189.8.

TABLE 9.—*Saturated acids corresponding to methyl esters in each fraction.*

Fraction.	Acid.							
	Myristic.		Palmitic.		Stearic.		Arachidic.	
	Per cent.	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*	*Per cent.*	*g.*
1	9.89	1.8880	83.07	15.7896				
2	1.63	0.3357	90.58	18.6561				
3			70.65	11.7426	19.79	3.2893		
4			68.64	6.1318	29.76	3.1140		
5			29.59	4.6844	57.60	8.9273		
6			14.38	1.1489	71.65	5.7246		
Tar					73.88	3.8793	12.73	0.6671
Residue[a]								0.6253
Total		2.2237		58.1034		24.9266		1.2907

[a] Residue assumed to be methyl arachidate.

[1] Journ. Am. Chem. Soc. 42 (1920) 156; 1197.

Table 10 gives the composition of the mixed saturated acids and the glycerides in the original oil corresponding to these acids.

TABLE 10.—*Saturated acids.*

Acid.	Mixture of saturated acids *			Glycerides in original oil.
	Weight.	Composition.	Proportion in original oil.	
	Gm.	*Per cent.*	*Per cent.*	*Per cent.*
Myristic	2.3157	2.56	0.43	0.45
Palmatic	58.1034	67.14	11.29	11.84
Stearic	24.9289	28.81	4.85	5.07
Arachidic	1.2997	1.49	0.25	0.26
Total	86.5984	100.00	16.82	17.62

* When separated from physic-nut oil the corrected percentage of saturated acids was 16.82.

The composition of Philippine physic-nut oil is recorded in Table 11. As shown by the data the oil consists principally of oleic, linolic, and palmitic glycerides. The amount of oleic glyceride is remarkably large. This oil is suitable chiefly for making soap.

The theoretical saponification value of physic-nut oil, calculated from our results, is 191.2. The saponification value as determined by experiment was found to be 192.4. The calculated value checks very well with the experimental result.

TABLE 11.—*Composition of Philippine physic-nut oil.*

Constituent.	Per cent.
Glycerides of:	
Unsaturated acids—	
Oleic	62.86
Linolic	18.65
Saturated acids—	
Myristic	0.45
Palmitic	11.84
Stearic	5.07
Arachidic	0.26
Unsaponifiable matter	0.45
Total	99.58

SUMMARY

Jatropha curcas is a small tree that is grown in the Philippines and usually cultivated in and about towns to serve as a hedge plant.

The oil obtained from the seeds of this tree is known as physic-nut oil. When taken internally it has strong purgative properties and in some countries it has been used medicinally. It has also been employed for making soap and as an illuminant.

Physic-nut oil consists principally of glycerides of oleic, linolic, and palmitic acids. The amount of oleic glyceride contained in the oil is remarkably large.

ILLUSTRATIONS

PLATE 1

Physic-nut tree (*Jatropha curcas* Linn.), growing near Manila.

PLATE 2

Physic-nut capsules.

PLATE 3

FIG. 1. Physic-nut flowers.
2. Mature physic-nut seeds (natural size).
3. Physic-nut capsule opened showing seeds.

PLATE 1.

PLATE 2.

PLATE 3.

AN IMPROVED JONES REDUCTOR

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ONE PLATE

The recent use of fretted glass instead of asbestos for filtration, as for example in the Gooch crucible, suggested the idea of applying it to the Jones reductor for iron determinations.

Whether the ordinary form of the Jones reductor is used, or, better, the design favored by Hillebrand and Lundell,[1] some pad near the bottom of the tube must be provided; for it is necessary to hold the column of 20-mesh zinc securely in the reductor and prevent any of the metal from being carried into the suction flask. Filter plates do not always fit securely, and usually the construction of this pad requires some little time. To avoid these objectionable features there is substituted an integrated, fretted-glass filter pad. The pad should be of sufficient compactness to retain the zinc particles but not too dense to retard the passage of the solutions through the reductor.

The design of the reductor (Plate 1) shows the position of the fretted-glass filter pad, and is similar in general features to that favored by Hillebrand and Lundell, but differs in that the main stopcock is placed at the left instead of the right. This change it is believed facilitates the manipulation by permitting an easier use of both hands when the main and lateral stopcocks are used at the same time. The dimensions given in the drawings are tentative.

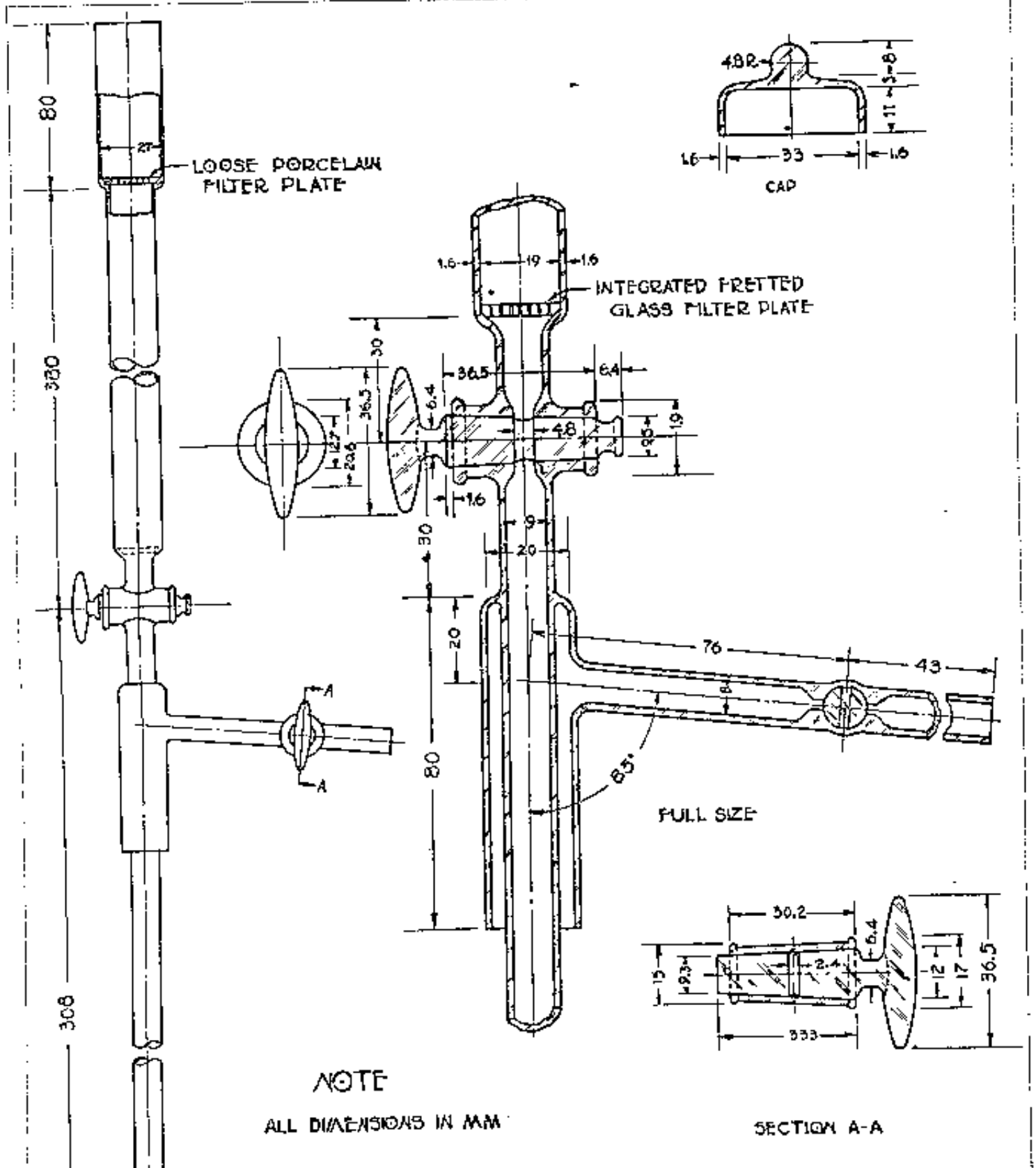
[1] Applied Inorganic Analysis (1934) 100.

ILLUSTRATION

PLATE 1

FIG. 1. Jones reductor with Meyers modification of integrated fretted-glass filter plate. About 0.4 actual size.

2. Detailed view of the fretted-glass filter and stopcocks. About 0.8 actual size. Dimensions are in millimeters on both figures.


LOOSE PORCELAIN FILTER PLATE
INTEGRATED FRETTED GLASS FILTER PLATE
CAP
FULL SIZE
SECTION A-A
NOTE
ALL DIMENSIONS IN MM
80
330
308
27
30
36.5
6.4
12.7
23.6
1.6
19
4.8
9.5
20
76
43
65°
A
A
4.82
5.6
11
33
30.2
2.4
9.3
15
17

FLORAL MECHANISM IN STERCULIA APETALA (JACQUIN) KARSTEN [1]

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FOUR PLATES

One of the most interesting and fascinating problems in botany is the peculiar biological behavior of floral organs of many angiosperms. Some of these flowers possess structures well adapted to insure pollination, while others almost lack the structural and peculiar organization essential to reproduction. Several imported shade trees, *Sterculia apetala* (Jacq.) Karsten (*S. carthaginensis* Cav.), now growing at the College of Agriculture, University of the Philippines, Los Baños, Laguna, have been producing an abundance of flowers each year for several years, and surprisingly enough few fruits or none have developed from them after any blooming period. Because of this apparent paucity of the fruits any observation on the floral behavior is of interest and worthy of record.

This large, graceful, and stately tree (Plate 2) is a native of Panama (4) and is found from southern Mexico to the West Indies and northern South America.[2] It is known there as *panama;* in Guatemala, Salvador, and Honduras, *castaño;* in Tabasco, *bellota;* in Columbia, *camajon;* and in Cuba, *camaruca.*

Its leaves are large, deciduous, digitately 3- to 5-lobed, more or less peltate, coriaceous, shining green above and soft stellate-tomentose below. Shedding of its leaves usually takes place in the middle or even as late as the later part of January and lasts for a month or so. Simultaneous with the shedding of its leaves, new leaf initials are formed at the apices of the branches. At

[1] Experiment station contribution, No. 1145. Read before the Los Baños Biological Club, September 24, 1936.

[2] The writers have failed to determine the exact date of introduction of these trees on the campus from the records of the Department of Agronomy, College of Agriculture.

the axils of the juvenile leaves, inflorescence initials are differentiated at the four to five basal young leaves. Active growth of the leaf and inflorescence initials takes place only when all of its leaves are nearly shed (Plate 3), this lasting for about a week or so, whence the tree regains its former verdure and the inflorescences become well developed (Plate 4).

The inflorescence, which is axillary, is a large, spreading panicle, bearing numerous pedicellate, bell-shaped, polygamous (andromonoecious) flowers. The hermaphrodite, or perfect, flowers (Plate 1, fig. 8), are less in number than the males (Plate 1, fig. 9) and are the first to mature. Neither flower possesses distinct petals or sepals, and instead each is provided with a 5-lobed, bell-shaped perianth, studded with pinkish to reddish woolly shaggy hairs on the outside, and villous within. Sometimes the perianth may be reddish and woolly inside, dark red and greenish yellow without. Each flower usually measures from 1.8 to 2.5 centimeters in diameter, and is provided with a terete pedicel about 0.8 to 1.2 centimeters in length. At the central inner portion of the perianth surrounding the stalk, which bears either the pistil and stamens or stamens alone, is a yellowish circular disc whereon deposits of droplets of nectar can be detected before anthesis, and these attract insects during the early forenoon.

In the hermaphrodite flower the stipitate pistil is hairy, 4- or 5-carpelled, 4- or 5-celled; style connate; stigma radiate. The anthers are borne in groups of two or three on a ring around the base of the ovary (Plate 1, figs. 10–12) and are more or less provided with very short stubby filaments. The anthers are bilobed, and dehiscence is longitudinal.

The staminate flower, which develops much later than the hermaphrodite, is provided with a terete hairy stalk borne at the center of the perianth and is enlarged at its apex, whereon the anthers are borne on a common disc (Plate 1, fig. 9). Surrounded by the anthers and usually inconspicuous is a rudimentary pistil.

The fruit, which seldom sets, is borne in a cluster of five podlike carpels, about 10 centimeters long and contains large brown chestnutlike seeds. Its interior is covered with stiff brown bristles that may penetrate the flesh and may cause irritation.

The trees on the College of Agriculture campus were first observed by the writers to bloom in March, 1924. Earlier blooming might have taken place, as a herbarium collection deposited in the National Museum Division, Bureau of Science, shows that

Mr. J. E. Higgins, formerly a professor of agronomy of the College of Agriculture, collected specimens of this species with mature inflorescence March 4, 1922. As far as the writers are aware this is the earliest record of the blooming of this species on the campus. Opportunities for observing the floral behavior of this species offered themselves during 1925, 1926, and 1931.

Anthesis.—March 25 and 26, 1925, and March 1 and 2, 1926, hourly observations were made on the opening of the male and perfect flowers for a period of twenty-four hours. During each observation eighty flowers of each kind were studied.

The mode of opening and separation of the perianth lobes in both flowers is perfectly identical. Long before anthesis, the perianth lobes are intact (Plate 1, fig. 7) at their margins and seem to be so well fitted together as to be nearly air-tight. This is indicated by the slight puffing action when a slight pressure is applied on the perianth. Separation of the perianth lobes usually begins at about 10.45 to 11 p. m. Small slits between the lobe margins are formed (Plate 1, fig. 1) simultaneously, usually starting at the middle where the opening is the widest. Sometimes slit formation takes place between two opposing margins of the lobes (Plate 1, fig. 2), so that the lobes become separated into one group of two lobes and another with three lobes. Between 1.07 and 1.25 a. m. the third slit is formed (Plate 1, fig. 4) separating one of the lobes from the group of three. Sometimes, a fourth slit is simultaneously formed so that three lobes become distinctly separated, while the two still remain intact (Plate 1, fig. 5). When slits are formed simultaneously between the lobes (Plate 1, fig. 1) early at night (10.45 to 11 p. m.), we obtain a condition similar to that shown in Plate 1, fig. 3, where three of the lobes remain intact only at their apices, while the other two touch each other only at their apices. These conditions remain throughout the early morning, and at about 4 to 4.15 a. m. all of the lobes separate from one another completely (Plate 1, fig. 6) and begin to curve outward very slowly until the perianth segments are actually distended and curved outward, thus exposing the sexual organs at 5 a. m. or at dawn. Anthesis is accompanied by an exhalation of a characteristic odor, which attracts insects and lasts practically the whole day. In other words, the perianth lobes begin to separate at about 11 p. m. and are completely distended at 5 a. m., a period covering practically six hours. In no case did the writers observe a single flower remaining closed; all of them (male and hermaphrodite) opened.

Movement of the pistil.—Movement is essentially confined to the stalk bearing the pistil and the stamens or the stamens and the rudimentary pistil, and to the style of the pistil in the hermaphrodite flower.

When the hermaphrodite flower has attained a diameter of about 7 to 8 millimeters, its pistil and stamens inclosed by the perianth segments (Plate 1, fig. 7) are very well differentiated and developed. Its pistil is borne on a very short, stubby, terete stalk arising from the center of the perianth. As the flower develops and enlarges, this stalk elongates (Plate 1, fig. 8) vertically, thus pushing the stigmas way down against the apices of the perianth lobes. This elongation is accompanied by an unequal growth or elongation of the cells of the stalk on one side, which results in the bending of the same stalk. This combined elongation and bending of the stalk is completed prior to 9 p. m., the night before anthesis. On the other hand, the style begins to elongate and bend early in the morning (8 a. m.), the day prior to anthesis, and continues to do so until 3 p. m. of the same day, at which time the style assumes a nearly horizontal position (Plate 1, fig. 11). Bending of the style and the stalk, therefore, must have started more than fifteen hours before anthesis when the sexual organs are fully exposed. The pistil retains this position through the night until about 4 a. m. the next day, when another active bending takes place in the style alone. This further growth of the style keeps it nearly touching the carpel wall of the ovary (Plate 1, fig. 12) and the stigmas directed towards the pedicel. The style, therefore, has two periodic movements; during and after the first movement the stigmas may be placed in such a position that a slight chance for self-pollination, or autogamy, may be attained, although, as is noted below, this seems to be improbable.

The movement of the stalk of the male flower is very similar to that described for the hermaphrodite flower. In this the elongation and curvature of this stalk is much more pronounced (Plate 1, fig. 9) so that at anthesis the anthers are placed in a nearly oblique position facing the perianth. No movement of the rudimentary pistil has been noted.

Dehiscence.—Dehiscence of the pollen grains was observed for three years (1925, 1926, and 1931) and was found to take place between 1 and 2 a. m. The anthers never dehisce their contents all at one time; they open one after another in no regular succession for a period of an hour. It is very interesting to note that dehiscence takes place at the time when the stigmas are

held nearly horizontal (Plate 1, fig. 11), so that pollination, or autogamy, even by gravity, is rather difficult, if not impossible. The direct line of fall of the pollen grains does not coincide with the position of the stigmas so that pollen grains would rarely lodge on the stigmas. Protrandry is the rule in this species as dehiscence takes place long before complete anthesis is attained.

Emasculation.—To ascertain whether the bending of the style and the stalk is influenced by the presence of the stamens at the base of the ovary in the perfect flower, one hundred hermaphrodite flowers were emasculated in March, 1926, and 1931, at 8 a. m., before the styles had a chance to show any sign of movement. For emasculation flowers that were expected to open the next morning were selected. With a slight pressure applied on the perianth, the lobes were mechanically separated from one another, and a pair of fine forceps was inserted into the perianth. The anthers were removed carefully, one by one, care being taken to dip the forceps in ethyl alcohol (95 per cent) every time a stamen was removed from a flower. Beginning at 9 o'clock that night, hourly observations were made on the behavior of the styles and stalks of the emasculated flowers; the results are interesting. The stalks bearing the pistils elongated and bent as described above, but their styles never changed their positions for twenty-four hours from 9 p. m., these remaining perpendicular to the axis of the ovary. None of the emasculated flowers produced fruits; they shriveled and dried, remaining on the floral cluster for some time until the whole inflorescence abscinded from the tree. It seems very likely that some direct relation really exists between the bending of the styles and the presence of stamens at the bases of the ovaries, but not with the elongation and bending of the stalks bearing the pistils. The presence of stamens serves perhaps as a stimulus for such movement of the style.

The writers believed that gravity might play a part in the bending of the style in this species. March 1, 1931, two large branches bearing numerous flowers or floral clusters were tied to a long wooden pole so as to change the normal position of the individual flowers. This was done at 8 a. m. The relative positions of one hundred perfect flowers were noted and recorded; some were held in an inverted position, while others were held laterally. Hourly observations were made on these flowers for a period of twenty-four hours. The young flower buds (mostly males) that did not open the next morning were decapitated, while fifteen were allowed to remain as controls.

Only five of the hermaphrodite flowers held laterally showed bending of their styles; the styles of those that were turned upside down exhibited no movement at all, but remained vertical with the stigmas directed upward as before. The young male flowers used as control were able to change their position and assumed the normal pendant position the next morning. Although the data herein presented on the influence of change of position on the movement of the styles seem insufficient, there are indications to show that gravity has little or nothing to do with the bending of the styles.

It is clearly evident that self-pollination here may be inadequate because of the nonsynchronous movements of the style and stalk with the time of dehiscence. Cross-pollination may be possible though, because of the possibility of pollen transfer by insects during the early morning when the stigmas are still receptive. In many species of angiosperms movements of the style or stigma and stamens bring about autogamy and pollination very successfully. Knuth,(2) for example, cites *Epilobium angustifolium* Linn. as having flowers with styles short at first; later, after twenty-four hours from anthesis, these elongate, and the widely divergent stigmas finally recurve so as to touch the pollen-covered anthers. In *Oenothera biennis* Linn. the style straightens half an hour after anthesis, and the stigmas spread out, so that crossing may be effected by insects already dusted with pollen. As the four stigmas roll back they ultimately touch the anthers before these have lost their pollen. In *Stachys sylvatica*(3) the style, at first with almost apposed branches, is situated behind the anthers, which have dehisced downward. Later the style bends downward under the anthers and, at the same time, opens its branches widely. If insects fail to visit the flower, autogamy is effected by the stigmatic branches, which slide gradually between the anthers that are still covered with pollen, or the stigmatic branches bend downward until they touch the anthers. Similar movements of the styles in *Valerianella olitoria* Pollich., *Morina elegans* Fisch. and Avé-Lall., and *Tricyrtis pilosa* Wall. also effect autogamy.

Hildebrand(1) observed that the movement of the floral organs in *Cleome spinosa* and *C. gigantea* was due to gravitation. He further states that as the position of the floral organs in this respect is altered, the stigmas and the anthers always assume such positions that they do not come in contact with one another, and cross-pollination is promoted.

Knuth(3) also mentions that the movements of the stamens of *Berberis vulgaris* Linn. are caused by the flow of water in the stimulated part. The stamens bend inward towards the stigma due to the presence of a special tissue, consisting of elongated narrow cells which are almost fused together and provided with small intercellular spaces, especially at their ends. The transverse walls of these cells are thin, and their longitudinal walls, on the contrary, are thick with numerous scattered pits which render possible both a very rapid interchange between cells and also a quick bending of this elastic tissue. On stimulation, the stamen becomes lax, spreads out, curves like a bow, while its edges pull upon the transverse walls, and its convex central part presses against the outer wall, which becomes strongly arched. Hence, the cells become shorter and thicker. This change in the motile tissue causes the filaments to bend inward.

Artificial pollination.—In March, 1926, artificial pollination of one hundred hermaphrodite flowers was performed by the writers. The pollen was collected between 1 and 2 a. m. from normal male flowers with the use of a camel's hair brush. The pollen grains were gently brushed against the stigmas of the perfect flowers that were to open that same morning. This was repeated in March, 1931. Of the one hundred flowers thus artificially pollinated, only two developed fruits in 1926, and only one in 1931. These results clearly indicate two possibilities; namely, that the nonsetting of fruits may be due to lack of proper pollination or to the presence of defective pollen, defective ovular contents, or similar conditions inherent in the plant. The writers have no information to offer on this matter.

Insect visitors.—As fruit setting is rather rare, it seemed in order to find out what kind of insects usually visit the flowers. March 1, 1926, several insects were observed flying from flower to flower. Some of the insects that were found between 8 to 10 a. m. were *Erassa penanga*e Moore (a moth), *Trigona biroi* Fabr., *Monolepta bifasciata* Hornst. (a beetle), and *Cantharis granulipennis* Blanchard (a beetle).[2] During the afternoon, from 3 to 5 p. m., the following insects were the frequent visitors: *Erassa penanga*e Moore, *Trigona biroi* Fabr., and *Lucilia dux* Linn. (a fly). In the evening only moths and flies visited

[2] The identification of these insects was made by Dr. Leopoldo B. Uichanco, of the College of Agriculture, to whom the writers are greatly indebted.

the flowers, and their activities seemed to stop after 8 p. m. Throughout the whole night practically no other insects visited the flowers.

March 10, 1931, another observation on insect visitors was made by the writers. The day was bright and clear, and the plant was in full bloom. The insects observed are listed in Table 1.

TABLE 1.—*Insects that visited flowers of Sterculia apetala March 10, 1931, from 7 a. m. to 12 noon and from noon to 6.15 p. m.*

	7 a.m. to 12 noon	12 noon to 6.15 p. m.
Apis indica Fabr., race *nigrocincta* Smith (Apidæ, Hymenoptera)	−	+
Chalcididæ, Hymenoptera (parasitic wasp)	+	+
Cantharis flavifemoralis Blanchard (Coleoptera)	+	−
Chilomenes 6-maculata Fabr. (Coccinelidæ, Coleoptera)	+	+
Chalcididæ, Hymenoptera (wasp)	+	+
Ceratia similis Oliver (Chrysomelidæ, Coleoptera)	−	+
Dasyproctus philippinensis Ashmead (Crabronidæ, Hymenoptera)	+	−
Diacamma sp. (Formicidæ, Hymenoptera)	+	−
Dysdercus megalopygus Breddin (Pyrrhocoridæ, Hemiptera)	+	−
Dysdercus poecilus H. S. (Pyrrhocoridæ, Hemiptera)	+	+
Mycetophilidæ, Diptera	+	· ·
Muscoidea, Diptera	+	+
Musca sp. (Muscidæ, Diptera)	−	+
Plecoptera	+	−
Polyrhachis dives Sm. (Formicidæ, Hymenoptera)	+	+
Phyllodromia sp. (Blattidæ, Orthoptera)	+	−
Odynerus hæmorrhoidalis var. *ater* Sauss. (Eumenidæ, Hymenoptera)	−	+
Reduviidæ, Hemiptera	−	+
Syrphidæ, Diptera	+	+
Tabanus striatus Fabr. (Tabanidæ, Diptera)	−	+
Tachinidæ, Diptera	+	+

At night, from 8 to 6 o'clock the next morning, no insect other than mosquitoes were observed to visit the flowers.

Of the insects enumerated above, the following are the only possible flower pollinators: *Apis indica* Fabr. race *nigrocincta* Smith., *Dasyproctus philippinensis* Ashmead, *Odynerus hæmorrhoidalis* var. *ater* Sauss., and possibly the Muscoidea (Diptera), *Musca* sp. and Syrphidæ (Diptera). These are mostly present during the early forenoon, while others may continue to visit the flowers even in the afternoon.

From the above observations it is apparent that insect visitors are rather numerous in the early morning and afternoon, and practically absent at night. As dehiscence takes place at the time when insect visitors are absent, this species is dependent largely, if not entirely, on autogamy for pollination. During the day when insects are numerous, the anthers are wholly, if not entirely, devoid of their contents, as their pollen grains have been dehisced by them. Of course, during the early morning hours when the stigmas are still receptive, a certain amount of cross-pollination may occur.

SUMMARY

Macroscopical observations on the floral behavior of *Sterculia apetala* (Jacq.) Karsten (*Sterculia carthaginensis* Cav.) are herein reported. The flowers (hermaphrodite and male) start to open at about 11 p. m. and are completely opened by 5 o'clock the next morning. Simultaneous elongation and bending of the stalk bearing the pistils and stamens as well as stamens alone have been noted. These movements may bring the stigma in the line of fall of the pollen grains, but since anthesis takes place at the time the stigmas have already passed this line, autogamy hardly occurs.

Insects visiting the flowers are abundant during the day and are practically absent at night, during which time anthesis takes place. Scarcity of fruits that are set during each blooming period may be attributed to the poor device for bringing about self-pollination in this species.

The presence of stamens on the ovary is believed to be the stimulus necessary for the movement of the style but not the stalk bearing the pistil. Gravity has very little, if any, influence on the movements of the style and stalk bearing the pistil.

Artificial pollinations disclosed the fact that the nonsetting of fruits may be due either to the lack of proper pollination or to the presence of defective pollen, defective ovular contents, and the like.

BIBLIOGRAPHY

1. Hildebrand, F. Die Beeinflussung durch die Lage zum Horizont bei den Blütentheilen einiger Cleome-Arten. Ber. d. Deutsch. bot. Gesells. 4 (1886) 329–337.
2. Knuth, P. Handbook of Flower Pollination. Oxford 1 (1906) 382.
3. Knuth, P. Handbook of Flower Pollination. Oxford 2 and 3 (1908–1909) 1347.
4. Standley, P. C. Trees and shrubs of Mexico. U. S. Nat. Museum Contrib. 23 [1] (1923) 517–848.

ILLUSTRATIONS

[The drawings were retraced by Mr. V. V. Bienvenue, of the National Museum, Bureau of Science, from the original drawings of the senior author. The photographs were taken by the photographic division of the College of Agriculture.]

PLATE 1. STERCULIA APETALA (JACQ.) KARSTEN

FIG. 1. Front view of the hermaphrodite flower showing early formation of slits between the perianth lobes, collected at 10.45 p. m.; × 1.

2. The same as fig. 1, collected at 10.50 p. m.; × 1.

3. The same, collected at 1 a. m.; × 1.

4. The same, collected at 1.25 a. m.; × 1.

5. The same, collected at 1.30 a. m.; × 1.

6. Another flower showing all its lobes fully separated from one another, collected at 4 a. m.; × 1.

7. Young hermaphrodite flower with portion of its perianth removed to show the short stalk bearing the pistil, the ovary of which bears at its base the stamens; × 3.

8. Showing elongation of the stalk bearing the pistil and stamens in hermaphrodite flower; *pe*, perianth; × 3.

9. A mature male flower with a portion of its perianth, *pe*, removed to show the long, curved stalk bearing the anthers at its apex (rudimentary pistil not seen); × 3.

10. Showing the bending of the stalk bearing the pistil and stamens in the hermaphrodite flower; × 3.

11. Showing the anthers already dehiscing, while the style is held horizontally; *ov*, ovary; × 3.

12. At anthesis, showing the style, *st*, completely bent and the stalk fully bent and elongated; *pi*, pedicel; *sa*, stigmas. Note the wide dehiscence of the anthers, *st*; × 3.

PLATE 2. STERCULIA APETALA (JACQ.) KARSTEN

The plant in full foliage and in full bloom. Photographed March 17, 1926.

PLATE 3. STERCULIA APETALA (JACQ.) KARSTEN

The same tree nearly defoliated. Shows active growth of new leaf buds at the axils of which are formed the inflorescence initials at nearly the same time. A few old dry leaves still persist on the terminal branches. Photographed February 9, 1931. This tree was uprooted by a typhoon in 1935.

PLATE 4. STERCULIA APETALA (JACQ.) KARSTEN

Another tree of the same species growing near the administration building (north side) in full bloom and in full foliage. Abundant dried leaves on the ground. On the right is a stem of a young royal palm, and *Phytolacca dioica* Linn. on its extreme right. *Averrhoa bilimbi* Linn. is in the background between the *Sterculia* and the royal palm. Photographed March 30, 1926.

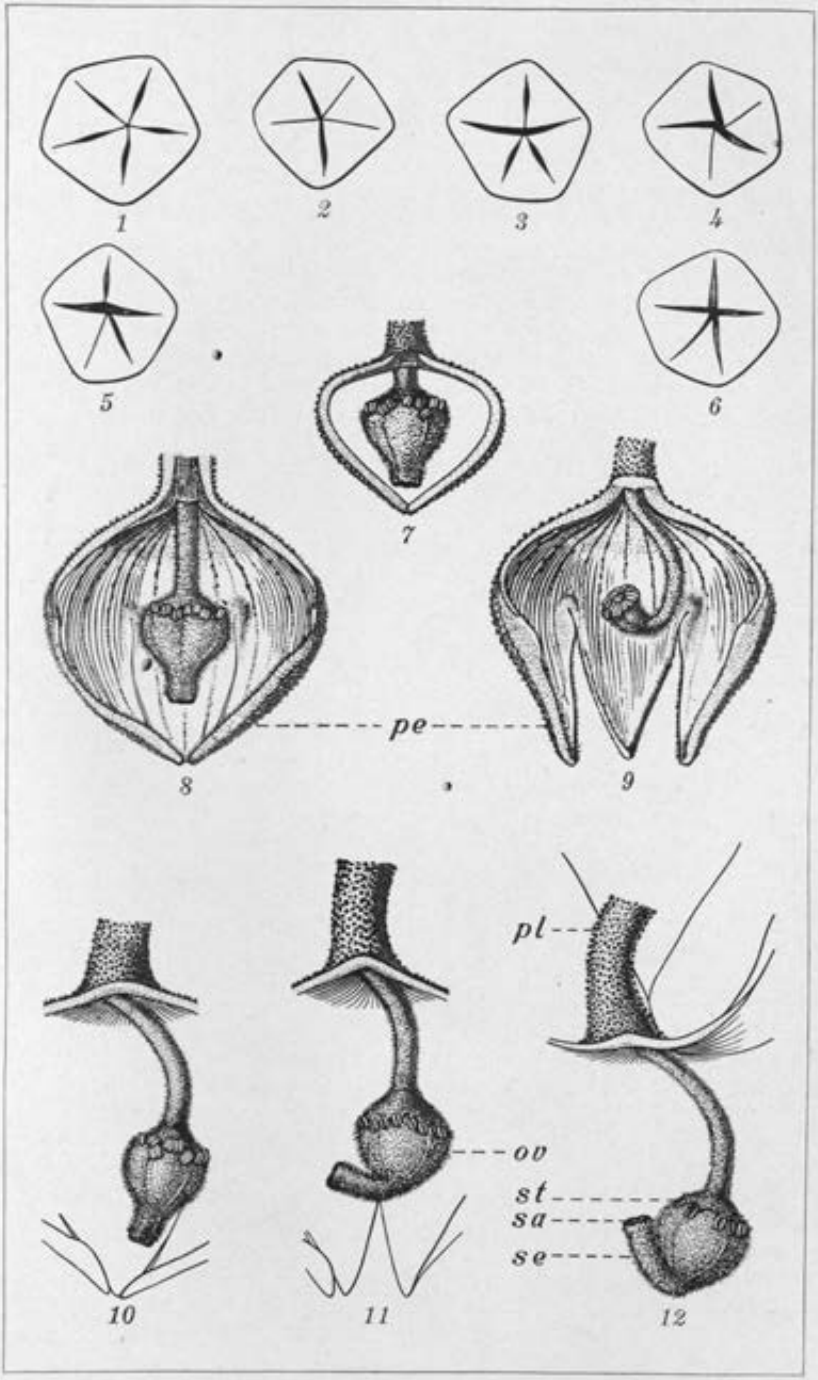

PLATE 1.

PLATE 2.

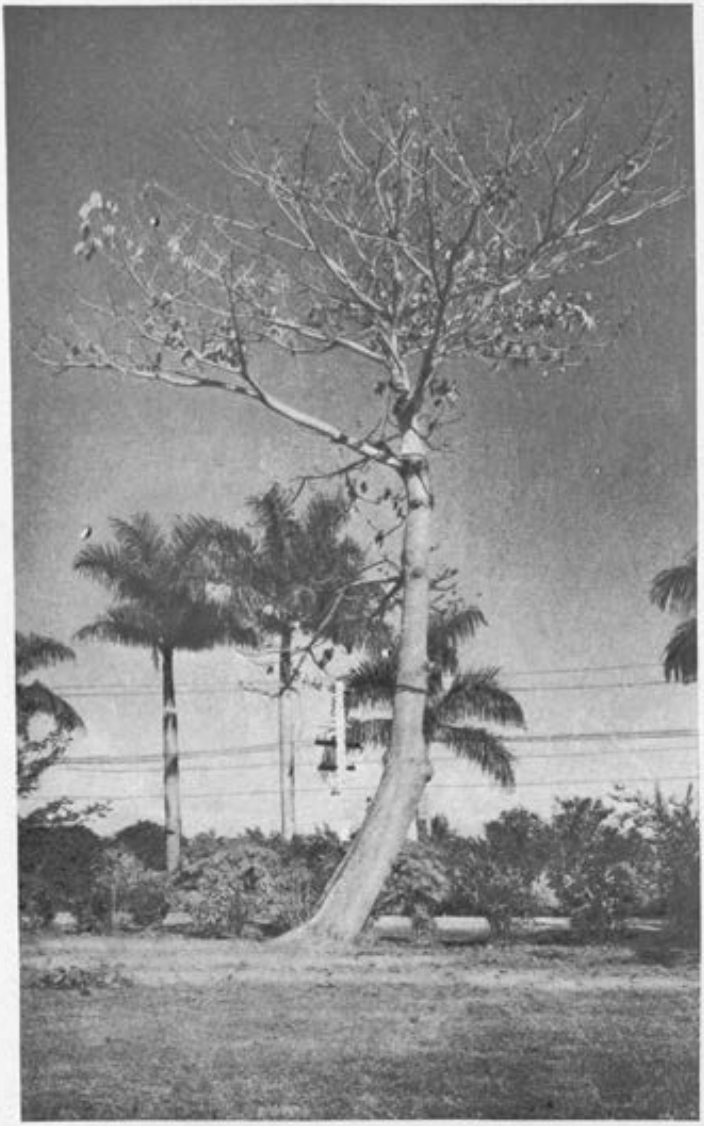

PLATE 3.

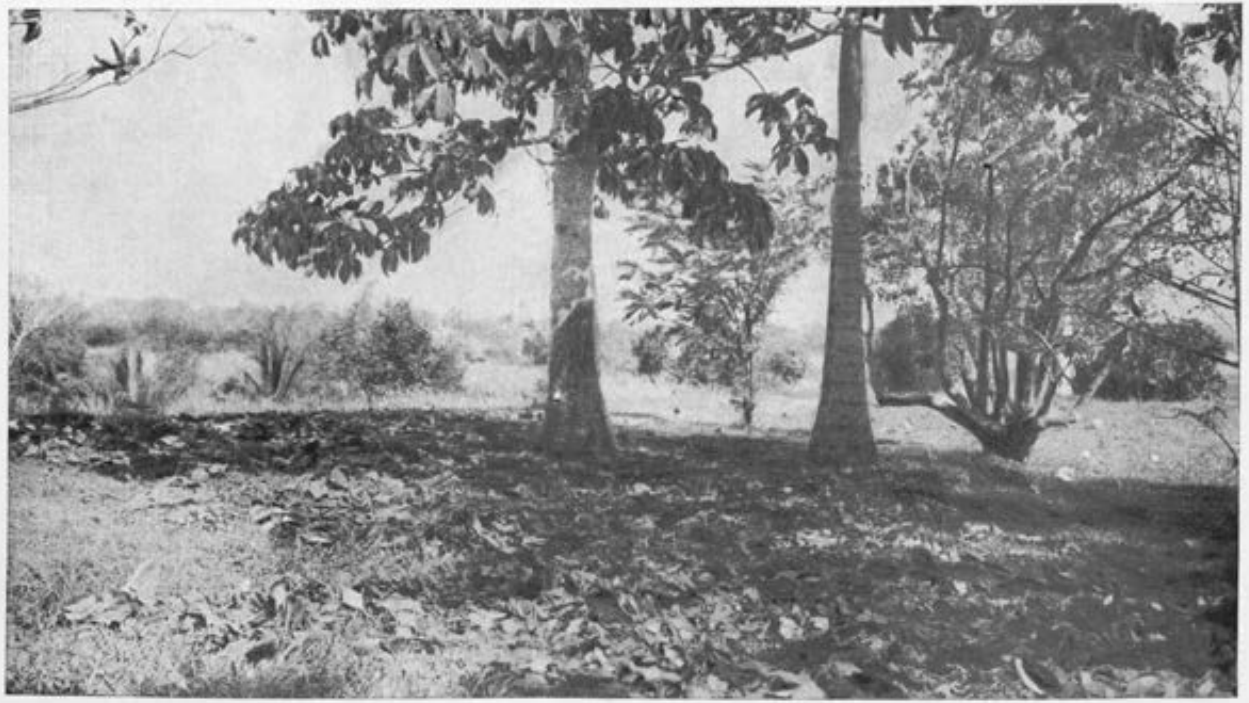

PLATE 4.

PHILIPPINE RUSTS IN THE CLEMENS COLLECTION 1923–1926, II[1]

By J. C. ARTHUR and GEORGE B. CUMMINS

Of the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana

FOUR PLATES

ON MORACEÆ

52. CEROTELIUM ALLAEANTHI Syd.

On *Allaeanthus luzonicus* (Blco.) F. Vill. var. *glaber* (Warb.) Merr., LUZON, Isabela Province, Cabagan, January 16, 1924, *Clemens 1697*.

53. CROSSOPSORA FICI sp. nov. Plate 2, fig. 3.

Urediis hypophyllis, subepidermalibus, minutis, brunneis, paraphysibus periphericis, hyphoideis; urediosporis irregularis, ellipsoideis, obovoideis vel triangularis, 16–19 x 19–30 μ; membrana 1.5 μ cr., cinnamomea, echinulata, poris germ. 3, aequatorialibus. Teliis hypophyllis, filiformis, brunneis, 2–5 mm longis; teliosporis oblongis, 7–10 x 23–30 μ; membrana 1 μ cr., pallide brunnea.

On *Ficus variegatus* Bl., LUZON, Zambales Province, Castillejos to Subic, March, 1924, *Clemens 1727*.

54. PHYSOPELLA FICI (Cast.) Arth.

On *Ficus Cumingii* Miq., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5123*. On *Ficus hauili* Blco., LUZON, Bulacan Province, Sibul Springs, December, 1924, *Clemens 4947;* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 5021;* Baguio highway, February, 1925, *Clemens 5812*. On *Ficus religiosa* L., LUZON, Manila, February 5, 1924, *Clemens s. n.* On *Ficus subulata* Bl., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2031*. On *Ficus* sp., LUZON, Isabela Province, Ilagan, December 24, 1924, *Clemens 1812*. CEBU, Cebu, May 16, 1924, *Clemens 1921*. On *Malaisia scandens* (Lour.) Planch., LUZON, Isabela Province, Echague, December 19, 1923, *Clemens 1785*.

[1] Contribution from the Department of Botany, Purdue University Agricultural Experiment Station, Lafayette, Indiana.

55. UREDO ARTOCARPI B. and Br.

On *Artocarpus communis* Forst., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 1979*.

ON URTICACEÆ

56. PUCCINIASTRUM PIPTURI Syd.

On *Pipturus arborescens* (Link) C. B. Rob., LUZON, Cagayan Province, Callao Caves, January 14, 1924, *Clemens 1721*; Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5166*. On *Pipturus repandus* Wedd., LUZON, Nueva Vizcaya Province, south of Santa Fe, January 25, 1924, *Clemens 1691*.

It is doubtful whether this species can belong in the genus *Pucciniastrum*. The uredia have hyphoid, hyaline, peripheral paraphyses surmounting a very short and indistinct peridium. Such characters would indicate a relationship with *Cerotelium* rather than *Pucciniastrum*. In the absence of telia there can be no advantage in shifting the species about, however.

57. PUCCINIASTRUM BOEHMERIAE (Dict.) Syd.

On *Boehmeria multiflora* C. B. Rob., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5810*. On *Cypholophus brunneolus* Elm., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5809*.

58. UREDO sp.

On Urticaceæ (*Pilea?*), LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 4986*.

Apparently this rust has not been described, but because of the uncertainty regarding the identity of the host and the fragmentary character of the specimen we are listing it as above. The uredia are amphigenous, erumpent, cinnamon-brown, with a few peripheral, brownish, thin-walled paraphyses; urediospores ellipsoid or globoid, 18 to 23 by 24 to 29 μ; wall 2 to 3 μ thick, cinnamon-brown, sharply echinulate, pores 2 and equatorial. The rust is probably a species of *Puccinia*.

ON POLYGONACEÆ

59. PUCCINIA CONGESTA B. and Br.

On *Polygonum chinense* L., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5012*. On *Polygonum tomentosum* Willd., LUZON, Tarlac Province, Gerona, January, 1925, *Clemens 4951*.

60. PUCCINIA POLYGONI-AMPHIBII Pers.

On *Polygonum chinense* L., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5125;* Baguio, February, 1925, *Clemens 5819, 5819a.*

Only uredia are represented in these collections. The spores have two or three pores near the hilum, as in the North American form on *Polygonum virginianum.*

ON ANONACEÆ

61. AECIDIUM UVARIAE-RUFAE P. Henn.

On *Uvaria rufa* Bl., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4856.*

ON AMARANTHACEÆ

62. UROMYCES DEERINGIAE Syd.

On *Deeringia baccata* (Retz.) Moq., LUZON, Benguet Subprovince, Mount Pulog, below Camp 42, February 24, 1925, *Clemens 5030.*

ON RANUNCULACEÆ

63. COLEOSPORIUM CLEMATIDIS Barcl.

On *Clematis gouriana* Roxb., LUZON, Benguet Subprovince, between Camp 42 and Adouay, February 27, 1925, *Clemens 4988.*

64. PUCCINIA EXHAUSTA Diet.

On *Clematis gouriana* Roxb., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 2002.* LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5814.*

ON BERBERIDACEÆ

65. PUCCINIOSIRA CLEMENSIAE sp. nov. Plate 2, fig. 2.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, in greges maculis laxe dispositis, albido-flavis; cellulis peridii irregularis, oblongis, verrucosis, laxi conjunctis; teliosporis oblongis, 14–19 x 26–32 μ, utrinque rotundatis, medio leviter constrictis, levibus, facillime in loculos secedentibus, episporio 1–2 μ cr.; cellulis intercalaribus conspicuis.

On *Berberis barandana* Vid., LUZON, Benguet Subprovince, Mount Pulog, February 25 to 26, 1925, *Clemens 4974.*

We take great pleasure in naming this species in honor of Mrs. Clemens, whose botanical work in the Philippine Islands has resulted in many important discoveries.

ON LAURACEÆ

66. AECIDIUM MACHILI P. Henn.

On *Machilus philippinensis* Merr., LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 5815*.

ON SAXIFRAGACEÆ

67. PUCCINIOSTELE CLARKIANA (Barcl.) Diet.

On *Astilbe philippinensis* Henry, LUZON, Benguet Subprovince, near Camp 42, en route to Mount Pulog, February 24, 1925, *Clemens 5028;* Mount Santo Tomas, February 19, 1925, *Clemens 5811a*.

ON ROSACEÆ

68. HAMASPORA ACUTISSIMA Syd.

On *Rubus moluccanus* L., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2029*. On *Rubus niveus* Thunb., LUZON, Benguet Subprovince, Mount Pulog region, February 27, 1925, *Clemens 5130, 5131*. On *Rubus pyrifolius* Sm., MINDANAO, Thermal Springs, Mount Apo, May 30, 1924, *Clemens 2024*. On *Rubus Rolfei* Vid., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 5135, 5136*.

69. KUEHNEOLA JAPONICI Diet.

On *Rosa philippinensis* Merr., LUZON, Benguet Subprovince, Adotuay, February 24, 1925, *Clemens 4989*.

70. GERWASIA FASCICULATA sp. nov. Plate 2, fig. 1.

Pycniis et aeciis ignotis. Urediis epiphyllis, minutis, intraepidermalibus; urediosporis globosis vel ellipsoideis, 18–23 x 25–30 μ; membrana 2 μ crassa, hyalina, aculeata, poris germ. obscuris (3 aequatorialibus?). Teliis hypophyllis, minutis, pallidis, subepidermalibus, per stomata erumpentes; paraphysibus peripheriicis, hyalinis, valde curvatis, membrana crassa; teliosporis et paraphysibus in apice hypharum erumpentium ortis, teliosporis globosis vel ellipsoideis, 19–22 x 26–34 μ; membrana 1 μ crassa, ad apice 3 μ, hyalina, levis; pedicello brevi.

On *Rubus* sp., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 5134*.

The telia of this rust are similar to those described for the genus *Gerwasia* in their mode of formation but differ in the curiously contorted nearly solid paraphyses. Because of the small size of the telia it is difficult to gain a clear conception of the base of the sorus, but it apparently originates beneath the epidermis and develops a slender stalk which passes through a stoma. Above the epidermis and at the apex of this stalk a

tangle of paraphyses is formed and among them the teliospores. Apparently the paraphyses and the teliospores are developed from the same stalk cell. The pedicels of the teliospores consist of one short cell. The uredia are formed in cavities in the hypertrophied epidermal cells.

Our attempts to obtain a specimen of *Gerwasia rubi* Racib. have proved futile. Nevertheless, we assign this new species to the genus *Gerwasia* rather than to *Muinsia* in the belief that the latter genus will prove to be synonymous with *Gerwasia*. A solution to the relationship of these peculiar rusts of *Rubus* will require a study of Raciborski's type, presumably to be found at the Botanical Institute, Jagellonian University, Krakow, Poland, or the rediscovery of the species.

71. UREDO sp.

On *Rubus Copelandi* Merr., LUZON, Benguet Subprovince, Mount Pulog, February, 1925, *Clemens 5132*. On *Rubus fraxinifolius* Poir., LUZON, Benguet Subprovince, between Adouay and Camp 42, February, 1925, *Clemens 5129;* Mount Pulog, February 24 to 27, 1925, *Clemens 5129a, 5129b;* Mount Santo Tomas, February 19, 1925, *Clemens 5825*.

Only uredia are present on these collections. The sori are subepidermal, small, yellowish, with abundant discal, incurved, thin-walled, hyaline paraphyses; urediospores ellipsoid, 13 to 17 by 17 to 22 μ, the wall 1 to 1.5 μ thick, colorless, very finely echinulate, with several scattered pores.

It has been impossible to place this *Uredo* with certainty. The uredia are much like those of *Phragmidium* or *Humaspora*.

ON LEGUMINOSÆ

72. PUCCINIA PERIODICA Racib.

On *Derris heptaphylla* (L.) Merr., LUZON, Zambales Province, Olongapo, March, 1924, *Clemens 1729*. On *Derris polyantha* Perk., LUZON, Tarlac Province, La Paz, December 10, 1924, *Clemens 4885*.

73. UROMYCES MUCUNAE Rabh.

On *Mucuna sericophylla* Perk., LUZON, Isabela Province, ferry below Tumauini, December 25, 1923, *Clemens 1740*. On *Mucuna* sp., MINDANAO, Todaya, Mount Apo, May, 1924, *Clemens 2023;* June 15, 1924, *Clemens 2134*. On ? *Mucuna* sp., LUZON, Cagayan Province, Callao Caves, January 14, 1924, *Clemens s. n.*

74. UROMYCES ORIENTALIS Syd.

On *Indigofera trifoliata* L., LUZON, Tarlac Province, Tarlac, November, 1923, *Clemens 4889*.

75. MARAVALIA ACHROA (Syd.) comb. nov. Plate 2, fig. 5.

Uromyces achrous Syd., Ann. Myc. 5 (1907) 491.

On ? *Dalbergia* sp., LUZON, Rizal Province, Bosoboso, February 11, 1924, *Clemens 1701*.

This interesting rust is undoubtedly a representative of the genus *Maravalia* and although we have not seen Sydow's species of *Uromyces* yet we feel certain that it is the same. Only a few urediospores, measuring 11 to 15 μ in diameter, were seen. The telia are amphigenous and, on the petioles, pulvinate and nearly colorless. The teliospores are 11 to 15 by 22 to 29 μ, delicate, and have a thin, hyaline, smooth wall. There apparently is no differentiated germ pore, the apex continues to grow during germination, to produce the 4-celled basidium.

76. SPHAEROPHRAGMIUM DALBERGIAE Diet.

On *Dalbergia polyphylla* Benth., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5905*.

This collection is assigned to the above species with some question. No uredia are present but paraphyses are present in the telia and some few show the septation which characterizes the uredial paraphyses of *S. dalbergiae*. We have not[1] had telial material available for comparison. The teliospores in this collection are 4-celled and closely sculptured with spines which are simple or have a stellate base. The apex of the spines is not forked. The species seems to be closely related, morphologically, to *S. debile* Syd.

77. SPHAEROPHRAGMIUM LUZONICUM Yates.

On *Albizzia saponaria* Blume, LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1738*.

This collection was identified by comparison with another of Mrs. Clemens's collections (*5907*) published by Sydow.[2] While we have not had Yates's material available it should be noted that he describes the urediospores as having a single pore. The above collection, as well as *5907*, has urediospores with four pores.

78. SPHAEROPHRAGMIUM CLEMENSIAE Syd.

On *Albizzia lebbekoides* (DC.) Benth., LUZON, Bulacan Province, Angat, November, 1924, *Clemens 4859*.

In addition to this collection we also have two numbers (*5904, 5904a*) on the same host but collected at Rosales, Pangasinan Province, Luzon, February 1 to 14, 1925, which differ in having

[1] Ann. Myc. 29 (1931) 160.

urediospores measuring 13 to 18 by 23 to 34 μ. This is perhaps the same form as mentioned by Sydow.[3]

It has not been possible with our material to decide what disposition should be made of these specimens of *Sphaerophragmium* on *Albizzia*. If *S. luzonicum* has 1-pored urediospores it is distinct from *S. Clemensiae*, otherwise it seems to us doubtful that two species are justified. The third form with larger 4-pored urediospores, mentioned above, appears at present to be distinct. However, in view of the existing confusion regarding specific limits in this group it is inadvisable to further complicate the situation. Clarification of the problem can only be attained by a comparison of type specimens.

19. SPHAEROPHRAGMIUM IRREGULARE sp. nov. Plate 1, fig. 5.

Uredíis hypophyllis, subepidermalibus, minutis, 0.1–0.3 mm diam.; paraphysibus peripheriéis, brunneis, 5–7 μ diam., membrana crassa; urediosporis obovoideis vel reniformis, 19–26 x 35–55 μ, membrana 1.5–2 μ cr. vel ad apice 3–5 μ, cinnamoneo-brunneis, echinulatis, poris germ. 4, aequatorialibus. Teliis non visis; teliosporis ex cellulis 4 compositis, oblongis vel variabilis, 24–30 x 38–52 μ; membrana 1.5 μ cr., castaneo-brunnea, aculeis subhyalinis usque 6 μ longis obsitis; pedicello hyalino, sporam aequante vel breviore.

On *Strongylodon pulcher* C. B. Rob., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2082*.

Aside from inhabiting another genus of hosts this species differs markedly from any previously described in this genus in the arrangement of the cells in the teliospores, the simplicity of the spines, and the large urediospores. The urediospores are characteristic of the genus in that they are radially asymetrical, being reniform or "mitten-shaped" in one plane and obovoid in the other.

The species is further interesting in that the teliospores approach more nearly those of *Hapalophragmium* in the arrangement of the cells and the simple nature of the spines than any previously known.

20. UREDO DERRIDICOLA sp. nov. Plate 2, fig. 6.

Uredíis hypophyllis, minutis, 100–150 μ diam., brunneis; paraphysibus peripheriéis, compactiusculis, hyalinis, ubique tenue tunicatis; urediosporis reniformis vel obovoideis, 15–23 x 23–26 μ; membrana 1.5 μ cr., cinnamomea, echinulata, poris germ. 1, super-aequatorialibus.

[3] Op. cit. 162.

On *Derris* sp., MINDANAO, Davao Province, Todaya, Mount Apo, June 16, 1924, *Clemens 1915* (type); June 18, 1924, *Clemens 2033*. LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5137*.

This species differs from other rusts on *Derris* in having urediospores with only one germ pore. The pore is located on the concave side near the apex at the widest part of the spore. The spores are radially asymetrical, obovoid with the pore in face view but "mitten-shaped" with the pore in side view.

From the peculiar shape of the spores it seems probable that the species belongs to *Sphaerophragmium* or possibly *Hapalophragmium*.

81. RAVENELIA CLEMENSAE Syd. Plate 1, fig. 1.

On *Albizzia procera* (Roxb.) Benth., MINDANAO, Cotabato Province, near Saub, June 22, 1924, *Clemens 1965*. LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5006*: Abra Province, near Bangued, February 3, 1923, *Clemens s. n.* On *Albizzia saponaria* (Lour.) Bl., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens s. n.*

82. RAVENELIA LAEVIOIDES sp. nov. Plate 1, fig. 4.

Urediis amphigenis vel caulicolis, subepidermalibus; paraphysibus clavatis, 15–20 x 40–50 μ, membrana 3–5 μ cr., aureobrunnea; urediosporis globosis vel ellipsoideis, 15–18 x 18–20 μ; membrana 1.5 μ cr., pallide flavida, echinulata, poris germ. obscuris, 10–12, sparsis. Teliis caulicolis, 2–7 mm longis, atrobrunneis; capitulis teliosporarum leviter convexis, obscure castaneo-brunneis, levibus, 60–100 μ diam., ex sporis 3–7 in omni directione compositis, sporis singulis uniellularibus; membrana 2–2.5 μ cr., ad apicem 3–5 μ; cystidiis capitulo adpressis, eodem numero quo sporis singulis; pedicello hyalino, crasso.

On *Indigofera nigrescens* Kurz, LUZON, Benguet Subprovince, below Camp 42, February 27, 1925, *Clemens 4972*.

This species is similar to *R. laevis* D. and H., but differs in the caulicolous habit of the telia, in having 1-celled teliospores, and in the smaller size of both the urediospores and the paraphyses.

83. RAVENELIA INDIGOFERAE Trans.

On *Indigofera zollingeriana* Miq., LUZON, Benguet Subprovince, below Camp 42, February 24 to 27, 1925, *Clemens 4978*.

84. RAVENELIA VENUSTULA Syd. Plate 1, fig. 2.

On *Acacia pennata* (L.) Willd., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4854, 4854a.*

85. RAVENELIA ORNATA Syd. Plate 1, fig. 6.

On *Abrus precatorius* L., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4929.* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5910.*

86. SPUMULA CLEMENSIAE sp. nov. Plate 1, fig. 3.

Uredlis amphigenis, subepidermalibus, minutis, castaneo-brunneis; paraphysibus periphericis, clavatis, introrsum curvatis, 10–12 μ diam., membrana 3 μ cr., ad apicem 8–10 μ, castaneo-brunnea; urediosporis oblongis, 10–16 x 24–30 μ; membrana 2 μ cr., ad apicem 3–5 μ, cinnamomeo-brunnea, echinulata, poris germ. 4, aequatorialibus. Teliis amphigenis, subepidermalibus, sine paraphyses, capitulis teliosporarum ex sporis 3–5, plerumque 4, compositis; membrana 2 μ cr., ad apicem 3–4 μ, flavida vel pallide cinnamomea, levibus; cystidiis pendulis, globosis, plerumque 2, rarius 3; pedicello, hyalino, brevi.

On *Acacia philippinarum* Benth., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1737.*

This species is especially interesting because of the simplicity of the teliospore heads. These heads are usually composed of four cells with only two cysts borne on a simple pedicel. None were seen in which the number of cysts equaled the number of spores. *Spumula quadrifida* Mains is the only other species in the genus.

87. PHAKOPSORA CROTALARIAE (Diet.) Arth.

On *Crotalaria albida* Heyne, LUZON, Pangasinan Province, Lingayen, November 23, 1923, *Clemens 1850.*

88. PHAKOPSORA PACHYRHIZI Syd.

On *Pachyrhizus erosus* (L.) Urban, Luzon. Manila, Cementerio del Norte, September 18, 1923, *Clemens s. n.*

89. PHAKOPSORA MEIBOMIAE Arth.

On *Desmodium dasylobum* Miq., MINDANAO, Davao Province, Todaya, Mount Apo, June 12, 1924, *Clemens 1974.* On *Desmodium laxiflorum* DC., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1707.*

There appears to be little justification for considering that *Uredo desmodii-pulchelli* Syd. is distinct from this species.

90. PHAKOPSORA VIGNAE (Bres.) Arth.

On *Pueraria pulcherrima* Merr., MINDANAO, Davao Province, Todaya, Mount Apo, May, 1924, *Clemens 2022*.

91. UREDO DUNBARIAE sp. nov.

Uredíis hypophyllis, minutis, subepidermalibus; paraphysibus peripheríeis, hyphoideis, hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 18–23 x 25–31 μ; membrana 1.5 μ cr., echinulata, pallide flavida, poris germ. obscuris (3, aequatorialibus?).

On *Dunbaria ? rotundifolia* (Lour.) Merr., LUZON, Cagayan Province, near Aparri, January 9, 1924, *Clemens 1833*.

92. UREDO SUBNIGRA sp. nov. Plate 2, fig. 4.

Uredíis hypophyllis, subepidermalibus, singulis in maculis atrobrunneis; paraphysibus peripheríeis, copiosissimis, hyphoideis, 4–9 μ diam., hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 16–20 x 26–32 μ; membrana 1.5–2 μ cr., echinulata, flavida, poris germ. obscuris (4, aequatorialibus?).

On *Bauhinia Cumingiana* (Benth.) F. Vill., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4928*.

The sori are deep-seated with abundant, thin-walled paraphyses directed towards a central porelike orifice. We have found no other rust on *Bauhinia* with such paraphyses.

93. UREDO TERAMNICOLA sp. nov.

Uredíis hypophyllis, subepidermalibus; paraphysibus peripheríeis paucis praeditis, hyalinis, ubique tenue tunicatis; urediosporis ellipsoideis, 18–22 x 26–32 μ; membrana 1.5 μ cr., minute echinulata, pallide flavida; poris germ. obscuris (aequatorialibus?)

On *Teramnus labialis* (L.f.) Spreng., LUZON, Tarlac Province, Gerona, January, 1925, *Clemens 4952*: Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4991*.

This species differs from *U. teramni* Mayor in having paraphyses and larger spores.

94. UREDO SOCOTRAE Syd.

On *Cassia occidentalis* L., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1749*.

ON SIMARUBACEÆ

95. RUEHNEOLA HARRISONIAE (Syd.) comb. nov. Plate 3, fig. 2.

Uredo harrisoniae SYD., Ann. Myc. 26 (1928) 428.

On *Harrisonia perforata* (Blco.) Merr., LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4891*: Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5911*.

Telia hypophyllous, small; teliospores produced in chains of five to ten cells, the individual spores cuboidal, 10 to 15 μ; wall colorless, 1 to 1.5 μ thick, smooth.

The characteristically irregular or lobed urediospores have been pointed out by Sydow [4] as distinctive of the species.

Confusion exists relative to the species which should be included in *Kuehneola*. Dietel [5] has included only those species which inhabit the rosaceous genera *Rubus* and *Rosa* and has placed other similar species in *Cerotelium*.[6] Although judgment can be only tentative until a thorough study has been made of the two genera, it seems to the writers that Dietel's treatment obscures relationships.

In typical species of *Cerotelium* the urediospores are unpigmented or nearly so and have ill-defined, scattered pores. The urediospores of *Kuehneola*, on the other hand, are pigmented and have a few equatorial pores. A more complete knowledge of life cycles will be necessary to a solution of the problem.

ON GUTTIFERÆ

96. UREDO ZANTHOXYLONIS sp. nov.

Urediis subepidermalibus, hypophyllis, minutis, brunneis; urediosporis globoideis vel ellipsoideis, 16–20 x 20–26 μ; membrana 1.5 μ cr., ad apicem 2–3 μ cr., cinnamomeo-brunnea, echinulata, poris germ. 4, aequatorialibus.

On *Cratoxylon cochinchinense* (Lour.) Bl., LUZON, Cagayan Province, near Aparri, January 9, 1924, *Clemens s. n.*

ON BURSERACEÆ

97. SKIENKA CANARII Racib.

On *Canarium luzonicum* A. Gray, LUZON, Nueva Vizcaya Province, Bambang, January, 1924, *Clemens 1720*. On *Canarium villosum*?, LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5912*.

ON EUPHORBIACEÆ

98. CROSSOPSORA SAWADAE (Syd.) comb. nov. Plate 4, fig. 1.

Cronartium sawadae SYD., Ann. Myc. 12 (1914) 109.

On *Glochidion Merrillii* C. B. Rob., LUZON, Benguet Subprovince, Mount Santo Tomas, February, 1925, *Clemens 5321*. On

[4] Loc. cit.
[5] Engler and Prantl, Nat. Pfl. 6 (1928) 60.
[6] Op. cit. 56.

Glochidion sp., LUZON, Zambales Province, Olongapo, March, 1924, *Clemens 1730*.

Pycnia and aecia are present on both collections and telia also on *1730*. The telia may arise alone or from old aecial infections. A description of the pycnia and aecia follows.

Pycnia epiphyllous, subcuticular, crustlike. Aecia mainly hypophyllous, on hypertrophied spots 3 to 10 mm in diameter, located deep within the tissue of the host, without peridium, opening irregularly; aeciospores ellipsoid or oval, often narrowed above, 15 to 21 by 24 to 30 μ; wall 1.5 μ thick or slightly thicker above, colorless, echinulate, pores obscure but seemingly equatorial.

We transfer this species to *Crossopsora* in the belief that its relationship is with that genus rather than with *Cronartium*. Aecia have not previously been reported for the genus and this species is unique in lacking uredia. The echinulate aeciospores are distinctive and decidedly different from the known aeciospores of *Cronartium*.

99. CROSSOPSORA ANTIDESMAE-DIOICAE (Rac.) comb. nov.

Uredo antidesmae-dioicae RAC., Paras. Algen und Pilze Javas 2 (1900) 33.

Cronartium antidesmae-dioicae SYD., Ann. Myc. 14 (1916) 259.

On *Antidesma ghesaembella* Gaertn., LUZON, June 1923, *Clemens s. n.*; Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5916a*.

The peripheral paraphyses present in the uredia in this species are typical of those found in other species of the genus. The urediospores are also pigmented and the pores indistinct but apparently equatorial.

100. PHAKOPSORA PHYLLANTHI Diet.

On *Phyllanthus benguetensis* C. B. Rob., LUZON, Benguet Subprovince, Baguio, February, 1925, *Clemens 5823*. On *Phyllanthus niruri* L., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 1746*; Bulacan Province, Santa Maria, November, 1924, *Clemens 4868*.

101. BUBAKIA BRIDELIAE (Koord.) Diet.

On *Bridelia glabrifolia* (Muell.-Arg.) Merr., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5915, 5915a*.

102. BUBAKIA GLOCHIDII (Syd.) Diet.

On *Glochidion psidioides* C. B. Rob., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1711*. On *Glo-*

chidion sp., LUZON. Cagayan Province, near Callao Caves, December 31, 1923, *Clemens 1745*.

103. RAVENELIA BREYNIAE Syd.

On *Breynia rhamnoides* (Retz.) Muell.-Arg., LUZON, Rizal Province, Bosoboso, February 11, 1924, *Clemens 1701a:* Bulacan Province, Santa Maria, November, 1924, *Clemens 4862:* Tarlac Province, Gerona, January, 1925, *Clemens 4953*.

104. MASSEELLA FLUEGGEAE Syd. Plate 4, figs. 1 and 2.

On *Fluggea virosa* (Roxb.) Baill., LUZON, Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4992, 5027*.

As published by Sydow[1] the teliospores of this species are smooth. Careful study, however, proves that they are finely and longitudinally striate (see Plate 4, fig. 2).

105. ENDOPHYLLUM EMASCULATUM sp. nov.

Pycniis nullis. Teliis aecidioideis, hypophyllis, gregariis, maculis orbicularibus usque 4 mm diam. insidentia; cellulis peridii laxi conjunctis, oblongis vel cuboideis, 12–15 x 15–20 μ, pariete exteriore 3–5 μ cr., leve, interiore 2 μ cr., verrucoso; teliosporis unicellularis, globosis, 13–15 x 15–18 μ; episporio 1.5 μ cr., hyalino, minute verruculoso sed apparenter levibus.

On *Breynia rhamnoides* (Retz.) Muell.-Arg., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4916*.

The absence of pycnia and the smooth or perhaps minutely verrucose spores characterize this species, which seems closely related to *Aecidium alchorneae* Sacc. We have not seen germinating spores and therefore the assignment of the species to *Endophyllum* can be only tentative.

ON ANACARDIACEÆ

106. CEROTELIUM ALIENNUM (Syd. and Butl.) Arth.

On *Spondias pinnata* (L.) Kurz., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens s. n.*

ON CORIARIACEÆ

107. PUCCINIASTRUM CORIARIAE Diet.

On *Coriaria intermedia* Mats., LUZON, Benguet Subprovince, Baguio, Mount Santo Tomas, February 19, 1925, *Clemens 4968;* Mount Pulog, below Camp 42, February 24, 1925, *Clemens 5031*.

[1] Ann. Myc. 25 (1923) 424.

ON CELASTRACEÆ

108. UREDO CELASTRI sp. nov.

Urediis hypophyllis vel rarius amphigenis, subepidermalibus, brunneis; urediosporis obovoideis vel ellipsoideis, 22–27 x 28–34 μ; membrana 1.5–2.5 μ cr., cinnamomeo-brunnea, valde echinulata; poris germ. 5–7, sparsis.

On *Celastrus paniculatus* Willd., LUZON, Nueva Vizcaya Province, Bambang, January 21 to 23, 1924, *Clemens 1692*.

ON HIPPOCRATACEÆ

109. CAROMA DIVINUM Syd.

On *Salacia philippinensis* Merr., LUZON, Tarlac Province, La Paz, December, 1924, *Clemens 4894*. On *Salacia prinoides* DC., LUZON, Zambales Province, Iba, February 27, 1924, *Clemens 1723*.

ON BALSAMINACEÆ

110. PUCCINIA ARGENTATA (Schultz) Wint.

On *Impatiens Barnesii* Hk. f., LUZON, Benguet Subprovince, Camps 30 to 42, February, 1925, *Clemens 5141*. On *Impatiens Burkei* Hk. f., MINDANAO, Todaya, Mount Apo, May 27, 1924, *Clemens 1981*.

ON SABIACEÆ

111. PHAKOPSORA MELIOSMAE Kusano.

On *Meliosma multiflora* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 1925, *Clemens s. n.*

ON RHAMNACEÆ

112. PUCCINIA GOUANIAE-TILIAEFOLIAE Syd.

On *Gouania tiliaefolia* Lam., LUZON, Bulacan Province, Santa Maria, November, 1924, *Clemens 4857*.

ON VITACEÆ

113. PHYSOPELLA VITIS (Thüm.) Arth.

On *Cissus simplex* Blco., LUZON, Pangasinan Province, Mount Bulangao, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5917*.

114. PHAKOPSORA AMPELOPSIDIS Diet. and Syd.

On *Ampelopsis heterophylla* (Thun.) Zieb. and Zucc., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.*

ON MALVACEÆ

115. CERATELIUM DESMIUM (B. and Br.) Arth.

On *Gossypium ? brasiliensis*, MINDANAO, Davao Province, Todaya, Mount Apo, May, 1924, *Clemens 5648*.

ON TILIACEÆ

116. RAVENELIA ATRIBIS Syd.

On *Grewia eriocarpa* Juss., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.* On *Grewia multiflora* Juss., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 4415.*

117. UREDO COLUMBIAE sp. nov. Plate 3, fig. 5.

Uredíis hypophyllis, subepidermalibus; paraphysibus periphericis, 5–8 μ diam., ad apicem attenuatis, membrana 1 μ cr., hyalina; urediosporis ellipsoideis, 16–20 x 22–29 μ; membrana 1–1.5 μ cr., pallide flavida vel hyalina, minute echinulata, poris germ. obscuris.

On *Columbia serratifolia* (Cav.) DC., LUZON, Tarlac Province, La Paz, December 10, 1924, *Clemens 4892.*

The sori in this species are rather deep-seated and in gross appearance are much like those of *Uredo lucheae* Speg., but differ in having pointed paraphyses and smaller spores.

ON ERICACEÆ

118. CHRYSOMYXA DIETELII Syd.

On *Rhododendron subsessile* Rendle, LUZON, Benguet Subprovince, Mount Santo Tomas, February 19, 1925, *Clemens 4966, 4968;* Mount Pulog, February 25, 1925, *Clemens 5022.*

ON OLEACEÆ

119. UROMYCES HOBSONI Vize.

On *Jasminum aculeatum* (Blco.) Walp., LUZON, Benguet Subprovince, Adouay, February 24 to 27, 1925, *Clemens 4997, 5023a.* On *Jasminum populifolium* Blume, LUZON, Benguet Subprovince, Adouay, February 27, 1925, *Clemens 5023.*

ON THYMELEACEÆ

120. MELAMPSORA YOSHINAGAI P. Henn.

On *Wikstroemia ovata* Mey., MINDANAO, Todaya, Mount Apo, June 18, 1924, *Clemens 2065;* LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4897.* (See also *Phaleria* under 121, next following.)

ON APOCYNACEÆ

121. ACROTELIUM ICHNOCARPI Syd. Plate 3, fig. 1.

On *Ichnocarpus ovalifolius* A. DC., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens 1828;* Tarlac Province, Paniqui, January, 1925, *Clemens 4963.* MINDANAO, Davao Province, Mount Apo, Todaya, June 18, 1924, *Clemens 2058;* May 26,

1924, *Clemens 2059*. On *Phaleria* sp. (Thymelaeaceæ) LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5020*. On *Trachelospermum Vanoverberghii* Merr., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens 1708*. On ? *Gymnema* sp. (Asclepiadaceæ), LUZON, Isabela Province, Echague, December 20, 1923, *Clemens 1733*.

The hosts are listed here as they appear on the labels, but it is not improbable that all are *Ichnocarpus*. There is no cause for questioning the identity of the rust, whether or not the hosts are all of a single genus.

Superficially the telia of this genus are strikingly like those of *Maravalia*, but the manner of germination by an internal basidium distinguishes the genus sharply from *Maravalia*. Except for the absence of a gelatinous matrix the telia also resemble somewhat those of the genus *Goplana*, which likewise develops an internal basidium. Urediospores may occur in individual sori or intermingled with the teliospores.

The genus is interesting but certainly has no relationship with *Coleosporium*, although Sydow [5] named it as a genus of the Coleosporiaceæ. The development of an internal basidium has evidently occurred at several widely separated places in the order Uredinales and can no longer be given major importance as a family characteristic.

122. CROSSOPSORA AGANOSMAE Syd.

On *Aganosma velutina* A. DC., LUZON, Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens s. n.*

123. HEMILEIA WRIGHTIAE Rac.

On *Wrightia laniti* (Blco.) Merr., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4917*; LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5920*.

124. PUCCINIA ENGLERIANA P. Henn.

On *Tabernaemontana pandacaqui* Poir., LUZON, Tarlac Province, Tarlac, December, 1924, *Clemens 4898*; Paniqui, January 1925, *Clemens 4962*; Gerona, January, 1925, *Clemens 4962a*. On *Tabernaemontana* sp., LUZON, Pangasinan Province, Mount Balungao, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5918*.

Aecia are present in *4898* and *4962* and probably represent the aecial stage of this species. A description follows.

[5] Ann. Myc. 26 (1928) 425.

Pycnia not seen, perhaps not formed. Aecia amphigenous and caulicolous, causing extensive hypertrophy and distortion, deep-seated, large, orange-yellow when fresh, with no peridium but with a dense layer of hyphæ and collapsed host-tissue; aeciospores globoid, ellipsoid or oblong, 21 to 27 by 28 to 40 μ; wall 3 to 5 μ thick, hyaline or pale yellowish, closely and coarsely verrucose.

125. AECIDIUM LAGUNENSE Syd.

On *Tabernaemontana* sp., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens s. n.*

This collection is fragmentary, but the rust is apparently this species, judging from the apical thickening of the walls of the aeciospores.

ON GENTIANACEÆ

126. COLEOSPORIUM EXACI Syd.

On *Exacum chironioides* Griseb., LUZON, Cagayan Province, Tuguegarao, January 14, 1924, *Clemens s. n.*

ON CONVOLVULACEÆ

127. AECIDIUM KAERNBACHII P. Henn.

On *Ipomoea* sp., MINDANAO, Davao Province, Daron, June 21, 1924, *Clemens 2061.* On *Lepistemon obscurum* (Blco.) Merr., LUZON, Cagayan Province, Tuguegarao, December 29, 1923, *Clemens 1820.* On *Merremia umbellata* Hall. f., MINDANAO, Davao Province, Daron, May, 1924, *Clemens 4931.* On *Merremia* sp. (or *Ipomoea* sp.), LUZON, Manila, September, 1923, *Clemens s. n.*

ON VERBENACEÆ

128. PUCCINIA EREBIA Syd.

On *Clerodendron minahassae* T. and B., LUZON, Manila, near San Francisco Church, October 9, 1923, *Clemens 1603.*

129. PUCCINIASTRUM CLEMENSIAE sp. nov. Plate 3, fig. 6.

Uredinis hypophyllis, minutis; cellulis peridii cuboideis, membrana 3 μ cr., hyalina; urediosporis ellipsoideis, 13–16 x 18–21 μ; membrana 1–1.5 μ cr., hyalina, minute echinulata, poris germ. obscuris. Teliis ignotis.

On *Vitex negundo* L., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5924* (type), *5925*; Nueva Vizcaya Province, Bambang, January 21, 1924, *Clemens 1709.*

This species is dedicated to Mrs. Mary Strong Clemens, a discriminating collector, whose name cannot be too often associated with the Uredinales of the Philippine Islands.

130. CROSSOPSORA PREMNAE (Pelch) Syd.

On *Premna nauseosa* Blco., LUZON, Manila, Cementerio del Norte, October 9, 1923, *Clemens 1604*. On *Premna* sp., LUZON, Isabela Province, Tumauini, December 25, 1923, *Clemens 1830*: Cagayan Province, Callao Caves, January 14, 1924, *Clemens s. n.*

131. UREDO CALLICARPAE Pelch.

On *Callicarpa formosana* Rolfe, LUZON, Isabela to Nueva Vizcaya Province, Iligan, January 18 to 19, 1923?, *Clemens s. n.*: Tarlac Province, Gerona, January, 1925, *Clemens 4955, 4955a*. On *Callicarpa* sp., LUZON, Benguet Subprovince, below Camp 42, February 24, 1925, *Clemens 5029*.

This interesting species probably belongs in the genus *Crossopsora* near *C. premnae* which also has similar urediospores and septate paraphyses differing only in minor details.

ON LABIATÆ

132. COLEOSPORIUM PLECTRANTHI Barcl.

On *Plectranthus diffusus* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 24, 1925, *Clemens 5142*; Mount Santo Tomas, February 19, 1925, *Clemens 5829*; Baguio, February, 1925, *Clemens 5829a*.

133. PUCCINIA PLECTRANTHELLA sp. nov. Plate 3, fig. 7.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, in maculis deformantibus profunde immersis; teliosporis oblongis vel clavatis, 14–17 x 33–50 μ; membrana 1.5 μ cr., ad apicem 2–3 μ, hyalina vel pallide flavida, levibus, statim germinantes, pedicello hyalino, brevi, fragili.

On *Plectranthus* or *Coleus* sp., MINDANAO, Thermal Springs, Mount Apo, May 31, 1924, *Clemens 2030*.

This species is similar to *P. plectranthi* Thüm, but differs in being microcyclic and having teliospores with a much thinner apical wall and an almost total absence of color. The telia occur on small hypertrophied spots and are sunken in small pockets of the host tissue.

134. PUCCINIA HYPTIDIS (M. A. Curt.) Tr. and Earle.

On *Hyptis spicigera* Lam., MINDANAO, Davao Province, Daron, May, 1924, *Clemens 4932*.

135. PUCCINIA DILECTA Syd.

On *Gomphostema philippinarum* Benth., MINDANAO, Mount Apo, Thermal Springs, May 31, 1924, *Clemens 2028*.

ON ACANTHACEÆ

136. PUCCINIA RUELLIAE (B. and Br.) Lagerh.

On *Ruellia repens* L., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5027a*.

137. PUCCINIA THWAITESII B. and Br.

On *Justicia gendarussa* Burm. f., MINDANAO, Zamboanga, May 20, 1924, *Clemens 4939*.

138. PUCCINIA HEMIGRAPHIDIS sp. nov. Plate 2, fig. 4.

Pycniis ignotis. Aeciis et urediis nullis. Teliis hypophyllis, subepidermalibus, minutis, in macula 2–8 mm diam. insidentibus; teliosporis oblongis, medio constrictis, 18–23 x 32–50 μ; membrana 2 μ cr., ad apicem 3–5 μ, pallide castaneo-brunnea, levibus, statim germinantes; pedicello hyalino, persistenti, sporam aequante.

On *Hemigraphis* sp., MINDANAO, Mount Apo, below Todaya, May 26, 1924, *Clemens 1978*.

139. UREDO RYGROPHILAE Syd.

On *Hygrophila phlomoides* Nees, LUZON, Manila, Cementerio del Norte, February 14, 1924, *Clemens 1704*.

140. AECIDIUM THUNBERGIAE-FRAGRANTIS Syd.

On *Thunbergia fragrans* Roxb., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4918*.

141. AECIDIUM MANILENSE sp. nov.

Pycniis hypophyllis, subepidermalibus. Aeciis hypophyllis, per totam folii superficiem occupantibus; cellulis peridiis firme conjunctis, 15–18 x 28–35 μ, pariete interiore verrucoso, 4–6 μ cr., exteriore levi, 2–2.5 μ cr.; aeciosporis oblongis vel ellipsoideis, 18–26 x 24–31 μ; membrana 2–2.5 μ cr., hyalina, dense minuteque verruculosa.

On *Hygrophila phlomoides* Nees, LUZON, Manila, Cementerio del Norte, February 14, 1924, *Clemens 1597a*. On *Hygrophila* sp. (*phlomoides?*), LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5027* (type).

Pycnia do not seem always to accompany the aecia or the aecia completely displace them. Pycnia likewise occur on leaves where there are no aecia. Even in the normal appearing pycnia no pycniospores were seen.

ON RUBIACEÆ

142. COLEOSPORIUM KNOXIAE Syd.

On *Knoxia corymbosa* Willd., LUZON, Pangasinan Province, Lingayen, November, 1923, *Clemens 1800.*

143. HEMILEIA CANTHII B. and Br.

On *Plectronia peduncularis* (Cav.) Vid., LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5928.*

144. HEMILEIA VASTATRIX B. and Br.

On *Coffea arabica* L., MINDANAO, Zamboanga Province, Zamboanga, May 20, 1924, *Clemens 4938.*

145. PUCCINIA GEOPHILAE Raeib.

On *Geophila herbacea* (Jacq.) Kuntze, MINDANAO, Davao Province, Mount Apo, Todaya, 1924, *Clemens 2063.*

146. UREDO PSYCHOTRICOLA P. Henn.

On *Psychotria luzoniensis* (Cham. and Schlect.) F. Vill., LUZON, Cagayan Province, Aparri, January 9, 1924, *Clemens 1892.*

147. UREDO LASIANTHI Syd.

On *Lasianthus tashiroi* Mats., MINDANAO, Davao Province, below Mount Apo, Todaya, May, 1924, *Clemens 2017.*

148. AECIDIUM PAEDERIAE Diet.

On *Paederia foetida* L., LUZON, Cagayan Province, Callao Caves, December 31, 1923, *Clemens 1825:* Benguet Subprovince, Adouay, February 24, 1925, *Clemens 4996.*

149. AECIDIUM PLAVIDUM B. and Br.

On *Paretta indica* L., MINDANAO, Davao Province, Mount Apo, below Todaya, May 26 to 27, 1924, *Clemens 1975.*

150. AECIDIUM DAPSILE sp. nov.

Pycniis ramicolis vel foliicolis, subcuticularibus, lenticularis, rufo-brunneis, sine paraphysibus. Aeciis ramicolis vel foliicolis, matricem deformantibus, densiuscule dispersis, profunde immersis; cellulis peridii laxiuscule conjunctis, 10–14 x 16–24 μ, pariete exteriore levi, 2 μ cr., interiore verrucoso, 3–4 μ cr.; aeciosporis globosis, 15–18 x 17–19 μ, membrana 1–1.5 μ cr., pallide flavida vel subhyalina, minutissime verrucoso-echinulata.

On *Plectronia Mabesae* Elm., LUZON, Bulacan Province, Angat, November 3, 1924, *Clemens 4855.*

This species has much the habit of *Aecidium prolizum* Syd. on *Wrightia* and also agrees quite closely with the description of *A. hedyotidis* Syd. on *Hedyotis*, a rubinceous genus. The

position of the pycnia is not given for the latter species. It is interesting that both *Wrightia* and *Plectronia* also serve as hosts for species of *Hemileia*, but there is no other evidence to indicate that these aecia belong in the life cycle of those species.

ON CAMPANULACEÆ

151. COLEOSPORIUM CAMPANULAE (Pers.) Lév.

On *Wahlenbergia bivalvis* Merr., LUZON, Benguet Subprovince, Mount Pulog, February 25, 1925, *Clemens 4998*.

ON CUCURBITACEÆ

152. PUCCINIA MELOTHRICOLA Syd.

On *Melothria mucronata* (Bl.) Cogn., LUZON, Benguet Subprovince, between Camp 30 and Baguio, February, 1925, *Clemens 5144;* Mount Santo Tomas, February 19, 1925, *Clemens 5832*.

Pycnia and uredinoid aecia are present on both specimens, in addition to uredia and telia. A description follows.

Pycnia amphigenous, subepidermal. Aecia amphigenous, subepidermal, in a small circle about the pycnia, uredinoid, cinnamon-brown; aeciospores resembling urediospores, ellipsoid or globoid, 24 to 31 by 29 to 37 μ; wall 1.5 μ thick, cinnamon-brown, sharply echinulate, pores 2, opposite and superequatorial.

ON COMPOSITÆ

153. UROMYCES BIDENTICOLA (P. Henn.) Arth.

On *Bidens pilosa* L., MINDANAO, Mount Apo, Todaya, May 30, 1924, *Clemens 2019*. LUZON, Benguet Subprovince, Adouay, February, 1925, *Clemens 5019, 5156;* Mount Santo Tomas, February 19, 1925, *Clemens 5839*.

154. UROMYCES WEDELIAE P. Henn.

On *Wedelia biflora* (L.) DC., MINDANAO, Cotabato Province, Petagos, June 22 and 23, 1924, *Clemens 1964;* Davao Province, below Todaya, June 18 to 20, 1924, *Clemens 2060*.

Only pycnia and uredinoid aecia are present on these specimens. Sydow[9] pointed out that these uredinoid aecia are the form described as *Uredo nerviseda* Syd., characterized by spores which have a single germ pore.

155. PUCCINIA MILLEFOLII Fckl.

On *Artemisia capillaris* Thunb., LUZON, Benguet Subprovince, below Adouay, February 24 to 27, 1925, *Clemens 4999*.

Uredo artemisiae-japonici Diet. is also present on this specimen.

[9] Ann. Myc. 15 (1917) 172.

156. PUCCINIA CIRSII Lasch.

On *Cirsium luzonicense* Merr., LUZON, Benguet Subprovince, Mount Pulog and vicinity, February 24 to 27, 1925, *Clemens 5142, 5147a;* Mount Santo Tomas, February 19, 1925, *Clemens 5835.*

157. UREDO MICROGLOSSAE Pelch.

On *Microglossa volubilis* (Wall.) DC., MINDANAO, Mount Apo, Todaya, May, 1924, *Clemens 2020.*

158. UREDO VERNONICOLA Pelch.

On *Vernonia patula* (Dry.) Merr., LUZON, Cagayan Province, Solana, January 2, 1924, *Clemens s. n.;* Rizal Province, Antipolo, February 11, 1924, *Clemens 1700.*

159. UREDO ELEPHANTOPODIS Pelch.

On *Elephantopus scaber* L., LUZON, Nueva Vizcaya Province, Bambang, January 19, 1924, *Clemens s. n.*

Uredo elephantopodis and *U. vernonicola* are probably the same species, but without telia there can be no advantage in uniting them. The septate paraphyses are similar to those found in some species of *Crossopsora*, as *C. premnae*, and it is probable that the species will be found to belong in that genus.

160. UREDO ERIGERONTIS sp. nov. Plate 3, fig. 3.

Urediis amphigenis, minutis, sparsis, subepidermalibus; urediosporis obovoideis, 15–19 x 23–33 μ; membrana 1 μ cr., pallide flavida, minute echinulata, poris germ. obscuris, 4, aequatorialibus.

On *Erigeron sumatrensis* Retz., LUZON, Nueva Vizcaya Province, Santa Fe, January 25, 1924, *Clemens 1690* (type); Benguet Subprovince, Adoutay, February 24 to 27, 1925, *Clemens 5001;* Mount Pulog and vicinity, February, 1925, *Clemens 5145.*

161. AECIDIUM FORMOSANUM Syd.

On *Emilia sonchifolia* (L.) DC., LUZON, Nueva Vizcaya Province, Bambang, January 23, 1924, *Clemens 1705.*

162. AECIDIUM BLUMEAE P. Henn.

On *Blumea balsamifera* (L.) DC., MINDANAO, Zamboanga Province, May 20, 1924, *Clemens 4930.* LUZON, Pangasinan Province, Rosales and vicinity, February 1 to 14, 1925, *Clemens 5029.*

163. AECIDIUM BANOSENSIS Syd.

On *Vernonia arborea* Ham., MINDANAO, Davao Province, Mount Apo, below Todaya, May 26, 1924. *Clemens 1977.* On *Vernonia*

vidalii Merr., LUZON, Nueva Vizcaya Province, Bambang, January 21 and 23, 1924, *Clemens 1095*.

151. PUCCINIA LACTUCAE Pirt.

On *Lactuca dentata* (Thunb.) C. B. Rob., LUZON, Benguet Subprovince, above Adonay, February 24 to 27, 1925, *Clemens 5000;* Mount Santo Tomas, February 19, 1925, *Clemens 5837*.

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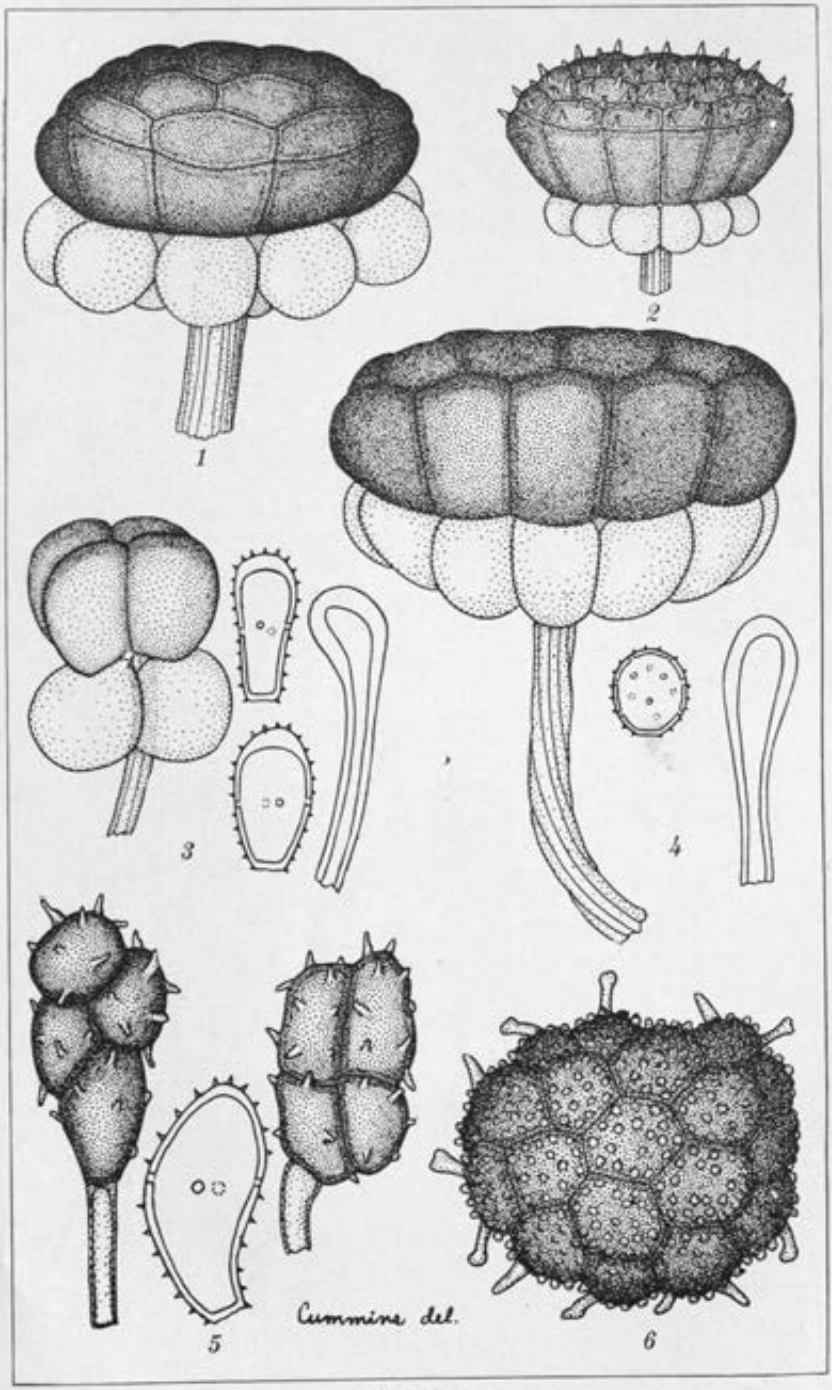

PLATE 1.

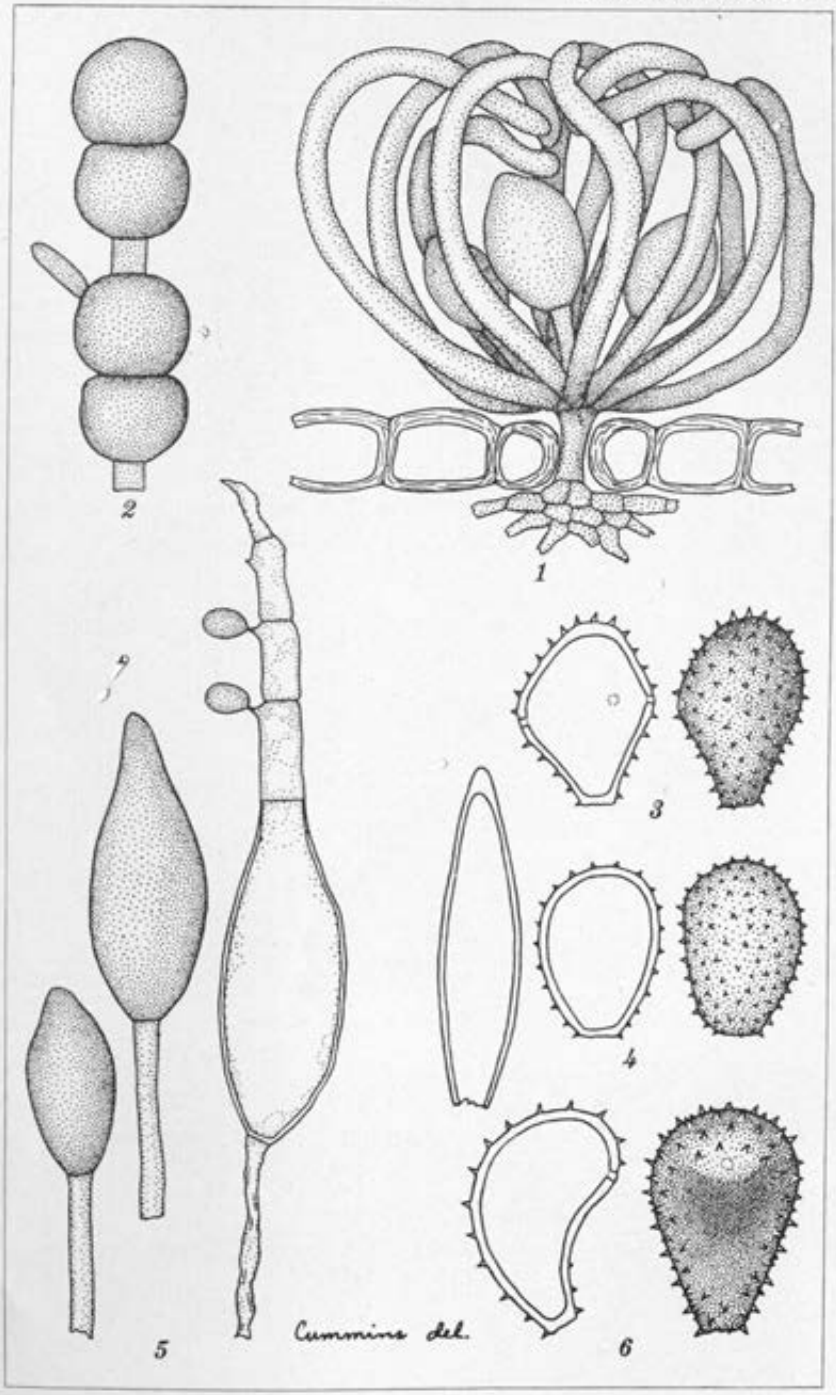

PLATE 2.

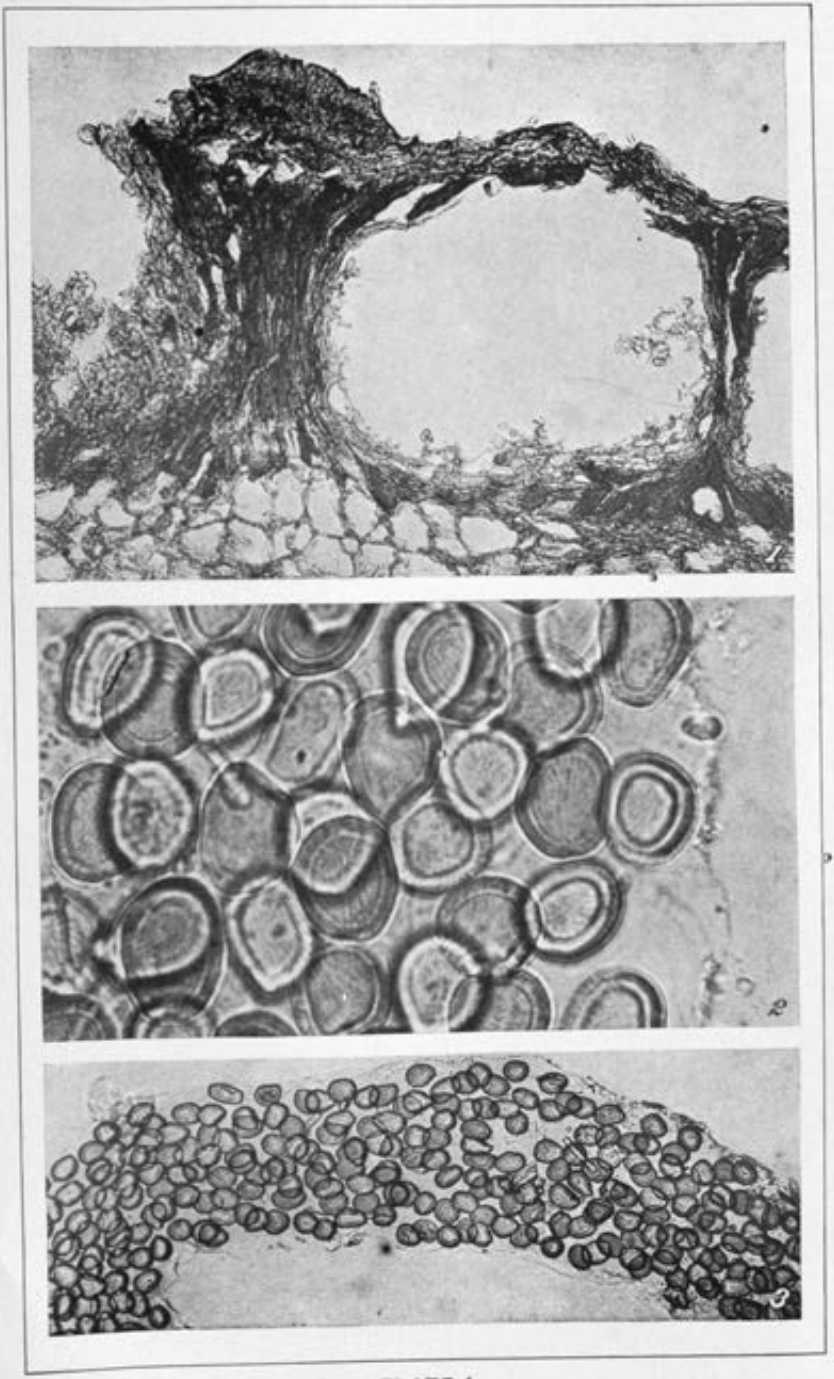

PLATE 4.

PHILIPPINE RECENT SHELLS, I

By GODOFREDO L. ALCASID

Of the National Museum Division, Bureau of Science, Manila

TWO PLATES

In the present paper all species of the family Doliidæ known or reported to occur in the Philippine Archipelago are considered.

Family DOLIIDÆ Adams

Shell thin, ventricose, ovate or subglobular, spire short, body whorl large, transversely ribbed or decussated; devoid of operculum in the adult.

Key to Philippine Doliidæ.

a^1. Shell globosely swollen, ventricose, transversely ribbed..... *Dolium.*
b^1. Shell thin, lip simple or very slightly thickened.
c^1. Interstices between ribs narrow and shallow.
d^1. Shell fulvous-brown with whitish lunate spots..... *perdix.*
d^2. Shell fulvous-chestnut, maculated with white..... *olearia.*
d^3. Shell with spiral, longitudinally lineated bands..... *cumingii.*
d^4. Shell with bands of white and brown spots..... *deshayesii.*
c^2. Interstices between ribs wide.
c^1. Shell provided with small ribs between the large principal ribs. *zonatum.*
c^2. Shell 5 banded with chestnut..... *sulcosum.*
c^3. Shell with pale brown ribs..... *ullieni.*
c^4. Shell with brown spots on the ribs..... *fimbriatum.*
b^2. Shell solid, lip thickened, somewhat reflected..... *pomu.*
a^2. Shell elongately pyriform, ventricose, canaliculated at the base. *Pyrula.*
f^1. Shell reticulately cancellated throughout..... *reticulata.*
f^2. Shell elongated, slender, transversely ridged, cancellated. *dussumieri.*
f^3. Shell short, surface rather smooth..... *ficus.*

Genus DOLIUM Brown

Shell thin, globular, ventricose, spire short, body whorl very large, transversely ribbed, aperture large, lip simple or slightly crenulated, columella rather twisted, umbilicated.

Dolium Lamarck 1801[1] had long been in use and generally accepted when it was found necessary to use *Tonna* Brunnich

[1] Lamarck, Anim. sans Vert. (1801) 79.

1772[2] for priority. On further investigation it has been noted that *Dolium* Brown 1756[3] has more claim and therefore it is being used here. Tryon used *Dolium* Linnæus,[4] and as synonyms gave *Perdix* Montfort and *Doliopsis* Conrad, but in his Manual[5] he used *Dolium* Lamarck.

DOLIUM PERDIX (Linnæus). Plate 1, fig. 1.

Buccinum perdix LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1197; DILLWYN, Cat. Recent Shells 2 (1817) 583.

Dolium perdix Linnæus, LAMARCK, Anim. sans Vert. 7 (1822) 261; KIENER, Icon. Coq. Viv. *Dolium* p. 4, pl. 3, fig. 9; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 6, fig. 9; HANLEY, Proc. Zool. Soc. (1859) 492; TRYON, Man. Conchol. 7 (1885) 264, pl. 3, fig. 15; pl. 4, figs. 23–25; HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna perdix Linnæus, HEDLEY, Rec. Aust. Mus. 12 (1919) 335; FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell oblong-ovate, thin, spire exserted; base somewhat obliquely effused, umbilicated; whorls six, transversely ribbed, ribs about twenty, broad, smooth, rather flattened; grooves between ribs narrow and shallow; fulvous-brown marked with whitish lunate spots; interior of aperture brownish, washed with white towards the outer lip; lip simple; columella arched.

Height, 144 mm; thickness, 76; height of spire, 37; height of body whorl, 92.

Philippines, *Bur. Sci. 18205, Fulton.* BOHOL, *Bur. Sci. 14164 Kelly.* CEBU, *Bur. Sci. 14219 Lopez.* MINDORO, Calapan, *Bur. Sci. 12938 Labsan.* MARINDUQUE, *Hidalgo.* MINDANAO, Dapitan and Zamboanga, *Hidalgo.* JOLO, *Hidalgo.*

Distribution.—Coasts of America, *Linnæus;* Jamaica, *Lister;* Amboina, *Rumphius;* coast of Senegal, *Adanson;* West Indies, China, and South Seas, *Humphreys;* Indian, African, and American equatorial seas, *Lamarck;* Indian Ocean, Mauritius, Polynesia, West Africa, West Indies, and Brazil, *Tryon.*

The spire of this species is rather exserted, making the general form more elongate as compared with other members of this genus. The lip is simple with a slight thickening of white nacreous deposit, which gradually diminishes towards the interior. The lunate spots which characterize this species are not well marked in young specimens, the painting being diffused rectangular and linear spots.

[2] Morch, Malak. Blatt. 18 (1871) 16; Hedley, Rec. Aust. Mus. 12 (1919) 329; Faustino, Bur. Sci. Monog. 25 (1928) 225.

[3] Sowerby, Conchol. Man. (1852) 146.

[4] Tryon, Struct. Syst. Conchol. 2 (1883) 202.

[5] Tryon, Man. Conchol. 7 (1885) 261.

DOLIUM OLEARIUM (Bruguière) non Linnaeus. Plate 1, fig. 2.

Dolium olearium Bruguière, LAMARCK, Anim. sans Vert. 7 (1822) 259; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, fig. 14; TRYON, Man. Conchol. 7 (1885) 262, pl. 2, figs. 8–11; HIDALGO, Cat. Marine Moll. (1904) 153.

Dolium olearium Lamarck var. KIENER, Icon. Coq. Viv. *Dolium* p. 6, pl. 1, fig. 1*a*.

Tonna olearia Bruguière, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell globosely ovate, ventricose, umbilicated; spire but a little exserted; sutures channeled; whorls six to seven, transversely ribbed, ribs broad, close-set, flatly depressed, grooves between ribs narrow and shallow; fulvous-chestnut, maculated with white; interior of aperture dark fulvous brown, whitish towards the lip; lip simple; columella arched, splashed with white nacreous material.

Height, 85 mm; thickness, 66; height of spire, 20; height of body whorl, 71.

Philippines, *Bur. Sci. 1355, 2676 Quadras.* MINDORO, Puerto Galera, *Bur. Sci. 14678 Seale.* MARINDUQUE, *Elera.* CEBU, *Bur. Sci. 14218 Quadras.* BOHOL, *Bur. Sci. 14167 Kelly.* MINDANAO, *Bur. Sci. 1371 Quadras;* Surigao, *Elera.* LEYTE, NEGROS, and JOLO, *Hidalgo.*

Distribution.—Indian Ocean, *Lamarck.*

This species is characterized by white longitudinal markings each paired with chestnut similar to those of *D. deshayesii,* but rather of a different pattern and mode of distribution. The suture is very deeply channeled.

DOLIUM CUMINGII Hanley. Plate 1, fig. 4.

Dolium cumingii HANLEY, Proc. Zool. Soc. (1859) 491; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, figs. 13*b*, *c*; HIDALGO, Cat. Marine Moll. (1904) 152.

Dolium olearium var. *cumingii* Hanley, TRYON, Man. Conchol. 7 (1885) 262, pl. 2, fig. 9.

Tonna cumingii Hanley, HEDLEY, Rec. Aust. Mus. 12 (1919) 331; FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell globosely ovate, ventricose, umbilicated; spire rather short; sutures deep; whorls six to seven, transversely ribbed, ribs nineteen, rather flattened, a little rounded, close-set; grooves distinct; fulvous-chestnut with spiral longitudinally lineated brown and white bands; interior fulvous-brown; columella slightly twisted; lip simple with a slight thickening of white porcelaneous deposit within, somewhat denticulated.

Height, 58 mm; thickness, 48; height of spire, 17; height of body whorl, 50.

Philippines, *Cuming*. POLILLO, *Bur. Sci. 12944 Robinson*. *Distribution*.—Australia, *Hedley*.

Tryon, in his Manual of Conchology, placed this species with *D. deshayesii* as varieties of *D. olearium*. However, there seems to be enough difference to warrant the separation of this as an independent species. *Dolium cumingii* is smaller, a bit more globose, the sutures not channeled, and the type or pattern of markings is not similar to that of *D. olearium*.

DOLIUM DESHAYESII Reeve. Plate 1, fig. 4.

Dolium deshayesii REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 8, fig. 13*a*; HANLEY, Proc. Zool. Soc. (1859) 490; HIDALGO, Cat. Marine Moll. (1904) 152.

Dolium olearium var. *deshayesii* Reeve, TRYON, Man. Conchol. 7 (1885) 262, pl. 2, fig. 10.

Tonna olearia Reeve, FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell thin, ovate, rather globose, ventricose, umbilicated; spire short; sutures distinct; whorls six, transversely ribbed, ribs twenty-three, somewhat flattened, a little rounded, close-set; grooves distinct; whitish or pale fulvous-brown, painted with bands of white and brown spots; interior of aperture whitish or very light brown; columella slightly twisted; lip simple with a slight thickening of white porcelaneous deposit within, somewhat denticulated.

Height, 59 mm; thickness, 40; height of spire, 19; height of body whorl, 42.

Philippines, *Bur. Sci. 13207 Fulton*.

This species seems to be limited to the waters of the Philippine Islands, where the type specimen was collected by Cuming.

The affinity of this species is more with *D. cumingii* than with *D. olearium;* the general form and character of the ribs are the same, differing only in the distribution and design of the spots, and in the extent of the excavation of the sutures.

DOLIUM ZONATUM Green. Plate 1, fig. 5.

Dolium zonatum GREEN, Trans. Albany Inst. 1: 131; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 7, figs. 12*a*, *b*; TRYON, Man. Conchol. 7 (1885) 263, pl. 3, fig. 17; HIDALGO, Cat. Marine Moll. (1904) 153.

Shell thin, ovately globose, umbilicated, spire a little exserted; sutures channeled; whorls six, transversely ribbed, ribs sixteen, rather convex; grooves broad, those at the anterior portion each decorated with a small rib, those at the upper part with two or three; dark reddish chestnut, spire somewhat lighter, apex

black; interior dark chestnut glazed with a uniform grayish color; columella twisted; lip simple.

Height, 168 mm; thickness, 129; height of spire, 42; height of body whorl, 147.

LUZON, Manila Bay, *Bur. Sci. 14674 Lopez.* Obtained with beam-trawl nets at a depth of 20 to 23 fathoms.

Distribution.—China, *Cuming;* Japan, *Tryon;* Philippines (?) *Elera.*

Reeve noted that "this is the only species of the genus in which there is an isolated raised line between the interstices of the lower ribs of the shell." These are very well marked in the specimens under consideration. In the three spaces at the upper part of the body whorl there are three of these raised lines, a characteristic present only in the young of *D. galea.* This is the largest specimen in the Bureau of Science collection, of a uniform dark reddish chestnut except near the apex. Others are a little more elongated, narrower, and yellowish chestnut.

DOLIUM SULCOSUM (Born). Plate 2, fig. 2.

Buccinum sulcosum Born, DILLWYN, Cat. Recent Shells 2 (1817) 584.
Dolium fasciatum Bruguière, LAMARCK, Anim. sans Vert. 7 (1822) 260; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 7, figs. 11*a*, *b*; TRYON, Man. Conchol. 7 (1885) 262, pl. 3, fig. 16; HIDALGO, Cat. Marine Moll. (1904) 153.
Tonna sulcosa Born, HEDLEY, Rec. Aust. Mus. 12 (1919) 315.
Tonna fasciata Bruguière, FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Shell globosely ovate, scarcely umbilicated, spire a little exserted; sutures rather channeled; whorls six to seven, transversely ribbed, ribs nineteen, flatly convex, sharp-edged, rather distant; creamy white, encircled with five broad brownish bands, which fade towards the outer lip; apex dark chestnut; interior whitish, outer lip reflected, fimbriately denticulated; columella a little twisted.

Height, 83 mm; thickness, 63; height of spire, 18; height of body whorl, 67.

LUZON, *Elera:* Manila Bay, *Lopez collection.* MINDORO, *Lopez collection.* CEBU, *Hidalgo.*

Distribution.—Indian Ocean, *Lamarck;* Chinese Seas, *Humphreys;* China and Japan, *Tryon;* coasts of Coromandel, *Martini;* Australia, *Hedley.*

This species very closely resembles *D. allium* and may be very easily confused with it except for the five broad chestnut bands, and the finer and closer-set ribs of this species.

DOLIUM ALLIUM (Dillwyn). Plate 2, fig. 4.

Buccinum dolium var. *B. Buccinum allium* from Solander's MSS, DILLWYN, Cat. Recent Shells 2 (1817) 585.

Dolium costatum Deshayes, REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 5, fig. 8.

Dolium fasciatum var. KIENER, Icon. Coq. Viv. *Dolium* p. 11, pl. 4, fig. 6.

Dolium laqueatum Martini, HANLEY, Proc. Zool. Soc. (1859) 489.

Dolium costatum Menke, TRYON, Man. Conchol. 7 (1885) 263, pl. 4, fig. 19; HIDALGO, Cat. Marine Moll. (1904) 152.

Tonna costata Menke, SHIRLEY, Proc. Roy. Soc. Queensland 22 (1911) 98; HEDLEY, Rec. Aust. Mus. 12 (1919) 334; FAUSTINO, Bur. Sci. Monog. 25 (1928) 225.

Tonna allium Dillwyn, IREDALE, Rec. Aust. Mus. 18 (1931) 215.

Shell oblong-ovate, ventricose, slightly umbilicated; spire rather exserted, sutures very slightly channeled; whorls seven, transversely ribbed, ribs thirteen, prominent, somewhat rounded; interstices broad, concave, smooth; creamy white; ribs slightly brownish, apex black; interior white, lip fimbriated, inner border denticulated; columella twisted.

Height, 100 mm; thickness, 71; height of spire, 35; height of body whorl, 82.

Philippines, *Bur. Sci. 13217 Fulton, Bur. Sci. 2687 Quadras.* CEBU, *Bur. Sci. 1343, 11907 Quadras.* BANTAYAN, *Bur. Sci. 13744 Lopez.* MARINDUQUE, *Hidalgo.* MINDANAO, Zamboanga, *Hidalgo.* BASILAN, *Hidalgo.*

Distribution.—Australia, *Hedley.* Dillwyn listed Sicily and Barbary, *Bonnani;* Amboina, *Rumphius;* Philippine Islands, *Peti-ver;* Senegal, *Adanson;* Tranquebar, *Martini;* very common about Tarentum, *Ulysses.* The writer could not ascertain which of these localities refer to *B. dolium* and which to *B. allium.*

This species with its prominent distant ribs may be distinguished from *D. fimbriatum* by the absence of the brown spots on the ribs, and from *D. sulcosum* by the absence of the five broad brownish bands.

DOLIUM FIMBRIATUM Sowerby. Plate 2, fig. 1.

Dolium fimbriatum SOWERBY, Genera Rec. Foss. Shells 2 (1827) pl. 242, fig. 2; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 3, fig. 3*b* (not 3*a*); HANLEY, Proc. Zool. Soc. (1859) 491; HIDALGO, Cat. Marine Moll. (1904) 153.

Dolium lischkeanum Küster, DUNKER, Index Molluscorum Maris Japonici (1882) 57.

Dolium costatum var. *fimbriatum* Sowerby, TRYON, Man. Conchol. 7 (1885) 264, pl. 4, fig. 22; pl. 3, fig. 18.

Tonna fimbriata Sowerby, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell globosely ovate, ventricose, slightly umbilicated; spire but a little exserted; sutures distinct; whorls six, transversely ribbed, ribs fourteen, prominent, somewhat rounded; interstices broad, concave, smooth; creamy white, ribs spotted with fawn-brown; apex dark chestnut, interior of aperture brown; lip fimbriated, a little exserted, denticulated within, columella a little twisted, callous anteriorly.

Height, 92 mm; thickness, 69; height of spire, 22; height of body whorl, 78.

LUZON, Manila Bay, *Lopez collection*. MINDORO, Naujan, *Bur. Sci. 1350 Quadras*. BOHOL, *Elera*. PALAWAN, Banga, *Bur. Sci. 14217 Quadras*. CEBU and NEGROS, *Hidalgo*. MINDANAO, Dapitan, *Bur. Sci. 1351 Quadras*. Davao and Zamboanga, *Hidalgo*.

Distribution.—Senegal and Japan, *Tryon*.

This species and *D. maculatum* have been placed by Tryon as varieties of *D. allium*. The shell of the first is more globose, the spire shorter, and the ribs spotted with brown. Reeve, however, noted the difference in the number and character of the ribs among these three closely related species.

Subgenus MALEA Valenciennes

Shell solid, lip thickened, somewhat reflected, denticulated within.

DOLIUM (MALEA) POMUM (Linnæus). Plate 2, fig. 3.

Buccinum pomum LINNÆUS, Syst. Nat. ed. 12 1ª (1767) 1197; DILLWYN, Cat. Recent Shells 2 (1817) 583.

Dolium pomum Linnæus, LAMARCK, Anim. sans Vert. 7 (1822) 261; REEVE, Conchol. Icon. 5 (1849) *Dolium* pl. 4, spc. 6*a*, *b*; TRYON, Man. Conchol. 7 (1885) 205, pl. 5, fig. 26; KIENER, Icon. Coq. Viv. *Dolium* p. 12, pl. 5, fig. 8.

Malea pomum Linnæus, HIDALGO, Cat. Marine Moll. (1904) 153.

Tonna (*Malea*) *pomum* Linnæus, FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell elongately ovate, solid, very slightly umbilicated; spire short; sutures deep; whorls six, transversely ribbed, ribs thirteen to fourteen, prominent, rounded, those at the middle rather flattened; whitish to light fulvous-bay, sprinkled with white and yellowish spots; interior dark orange, aperture somewhat contracted; lip thickened, flatly reflected, denticulated within; columella rudely ribbed, callous, excavated towards the base.

Height, 62 mm; thickness, 45; height of spire, 10; height of body whorl, 58.

Philippines, *Bur. Sci. 13208 Fulton*. LUZON, Bataan Province, Moron, *Hidalgo*. MINDORO, Naujan, *Hidalgo*. MARINDU-

QUE and CEBU, *Hidalgo*. MINDANAO, Zamboanga, *Bur. Sci. 1348, Quadras*.

Distribution.—Java, *Linnæus;* coasts of Spanish America, *Bonanni;* Amboina, *Rumphius;* China, *Humphreys;* Red Sea and Indian Ocean, *Tryon;* Indian Ocean, *Kiener;* Society Islands, *Cuming*.

This species is of the *Cassis* form, being solid with the lip thickened, toothed and reflected, and the columella covered with a callosity of white enamel. The excavation at the base of the columella as noted by Reeve is but slight.

Genus PYRULA Lamarck (restricted)

(*Ficula* Swainson)

Shell thin, pyriform, ventricose; spire short; body whorl broad, canaliculated at the base, canal prolonged; aperture elongated, columella thin; lip simple.

Of the nine species of *Pyrula*[6] listed by Faustino six belong to other genera; *colossea* Lam., *lactea* Reeve, and *ternatana* Lam. belong to *Hemifusus; galeodes* Lam. belongs to *Melongena; morus* Gray to *Rapana;* and *rapa* Linn. to *Rapa*. Of the three remaining, *ficus* Linn. and *lævigata* Reeve are synonimous, leaving only two species. To these two *dussumieri*[7] was added, giving a total of three valid Philippine species. In Hidalgo's work[8] two species, *ficus* Linn. and *reticulata* Lam., and one variety, *ficoides* Lam., are listed.

PYRULA RETICULATA Lamarck. Plate 2, fig. 5.

Pyrula reticulata LAMARCK, Anim. sans Vert. 7 (1822) 141; KIENER, Icon. Coq. Viv. *Pyrula* p. 28, pl. 12, fig. 1; TRYON, Man. Conchol. 7 (1885) 265, pl. 5, fig. 28; pl. 6, fig. 33; HIDALGO, Cat. Marine Moll. (1904) 154; FAUSTINO, Bur. Sci. Monog. 25 (1928) 227.

Pyrula ficoides LAMARCK, Anim. sans Vert. 7 (1822) 142.

Ficula reticulata LAMARCK, Reeve, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 1.

Pyrula clathrata ROUSSEAU, Proc. Zool. Soc. (1852) 185.

Shell thin, pyriform, ventricose; spire flatly depressed; sutures shallow; reticulately cancellated with sharp longitudinal and spiral ridges, the latter generally alternating large and small; pale yellowish brown encircled with five obscure whitish transverse bands, maculated with reddish brown; interior pale violet; lip simple, columella thin.

[6] Faustino, Bur. Sci. Monog. 25 (1928) 226.
[7] Alcasid, Philip. Journ. Sci. 60 (1936) 423.
[8] Hidalgo, Cat. Marine Moll. (1904) 154.

Height, 70 mm; thickness, 38; height of spire, 5; height of body whorl, 65.

LUZON, Manila Bay, *Lopez collection:* Batangas Province, Taal, *Bur. Sci. 2639 Quadras.* SULU, *Adams;* Jolo, *Elera.*

Distribution.—Indian Ocean, *Lamarck;* East Indies and Japan, *Tryon.*

This species has been erroneously figured by Sowerby [9] as *P. decussata* Wood, while the figure for the true *P. decussata* was described as *P. reticulata.* The specimens figured here show very clearly the reticulately decussated surface of the entire shell; the transverse ridges being alternate coarse and fine striæ; marked with five faint whitish narrow bands and spotted with reddish brown throughout. It approaches *P. ficus* in shape but differs from it by the decussated surface.

PYRULA DUSSUMIERI Valenciennes. Plate 2, fig. 6.

Pyrula dussumieri Valenciennes, KIENER, Icon. Coq. Viv. *Pyrula* p. 25, pl. 11; TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 30; ARCASID, Philip. Journ. Sci. 60 (1936) 423.

Ficula dussumieri Valenciennes, REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 2; SOWERBY, Thes. Conchyl. 4 (1880) 110 *Ficula* pl. 423, fig. 5.

Shell thin, elongately pyriform, slender, spire short, sutures shallow; transversely ridged, ridges coarse, smooth, rather depressed; grooves distinct, cancellated with fine longitudinal striæ; pale fawn, painted with longitudinal wavy light brown streaks; interior fawn-brown, whitish towards the lip, lip simple.

Height, 97 mm; thickness, 45; height of spire, 8; height of body whorl, 91.

LUZON, Manila Bay, *Bur. Sci. 14660 Lopez.* Collected with beam-trawl nets at a depth of 15 to 20 fathoms.

Distribution.—China, *Cuming.*

A very fine species characterized by its slender form and by the wavy longitudinal light brown streaks. The sculpture of the surface is similar to *P. reticulata* but differs from it by its more elongated form. Hidalgo [10] listed this species as one cited from the Philippines, but decided in the meantime to place it as a Chinese species.

PYRULA FICUS (Linnæus). Plate 2, fig. 7.

Bulla ficus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1184; DILLWYN, Cat. Recent Shells 1 (1817) 484.

[9] Sowerby, Thos. Conchyl. 4 (1880) 110, pl. 423, figs. 1, 2, 3.
[10] Hidalgo, Cat. Marine Moll. (1904) 154.

Pyrula ficus LAMARCK, Anim. sans Vert. (1801) 82; KIENER, Icon. Coq. Viv. *Pyrula* p. 30, pl. 13, fig. 1.

Ficula lævigata REEVE, Conchol. Icon. 4 (1847) *Ficula* pl. 1, fig. 4.

Ficula ficus LINNÆUS, SOWERBY, Thes. Conchyl. 4 (1880) 109 *Ficula* pl. 423, fig. 4.

Pyrula ficus Linnæus, TRYON, Man. Conchol. 7 (1885) 266, pl. 5, fig. 29; pl. 6, fig. 36 (not 37); HIDALGO, Cat. Marine Moll. (1904) 154; FAUSTINO, Bur. Sci. Monog. 25 (1928) 226.

Shell thin, abbreviately pyriform, ventricose; spire short; sutures shallow; transversely lightly ridged, ridges flat, smooth, spotted with reddish brown, cancellated with fine, scarcely visible, longitudinal striæ; pale fawn encircled with five transverse obscure whitish bands, maculated throughout with broad patches of dark chestnut; interior pale violet; lip simple.

Height, 70 mm; thickness, 44; height of spire, 7; height of body whorl, 65.

Philippines, *Bur. Sci. 13219 Fulton.*

Distribution.—Amboina, *Linnæus;* Red Sea, Indian Ocean, and Singapore, *Tryon;* Moluccas, *Lamarck;* Eastern Seas, *Cuming.*

This species is shorter and more ventricose than the other members of the genus; the surface is so slightly sculptured as to render it rather smooth. The original Linnæan *Bulla ficus* contained two distinct species. Lamarck separated one of them and named it *Pyrula reticulata*, retaining *ficus* for the other. Reeve later "to avoid tautology" changed the name *ficus* to *laevigata*.

ILLUSTRATIONS

Plate 1

Fig. 1. *Dolium perdix* (Linnæus).
2. *Dolium olearium* (Bruguière).
3. *Dolium zonatum* Gray.
4. *Dolium cumingii* Hanley.
5. *Dolium deshayesii* Reeve.

Plate 2

Fig. 1. *Dolium fimbriatum* Sowerby.
2. *Dolium sulcosum* Born.
3. *Dolium (Malea) pomum* (Linnæus).
4. *Dolium allium* (Dillwyn).
5. *Pyrula reticulata* Lamarck.
6. *Pyrula dussumieri* Valenciennes.
7. *Pyrula ficus* (Linnæus).

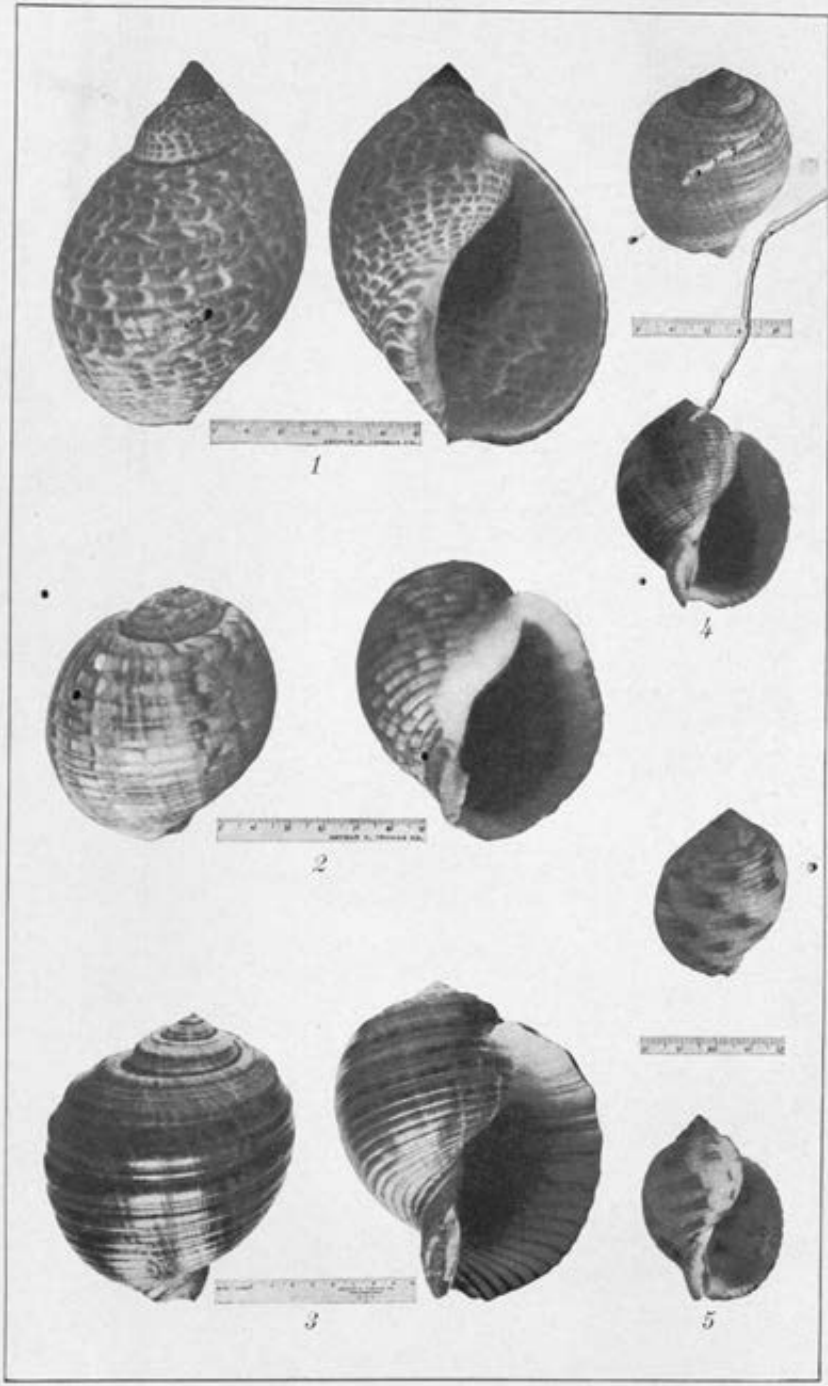

PLATE 1.

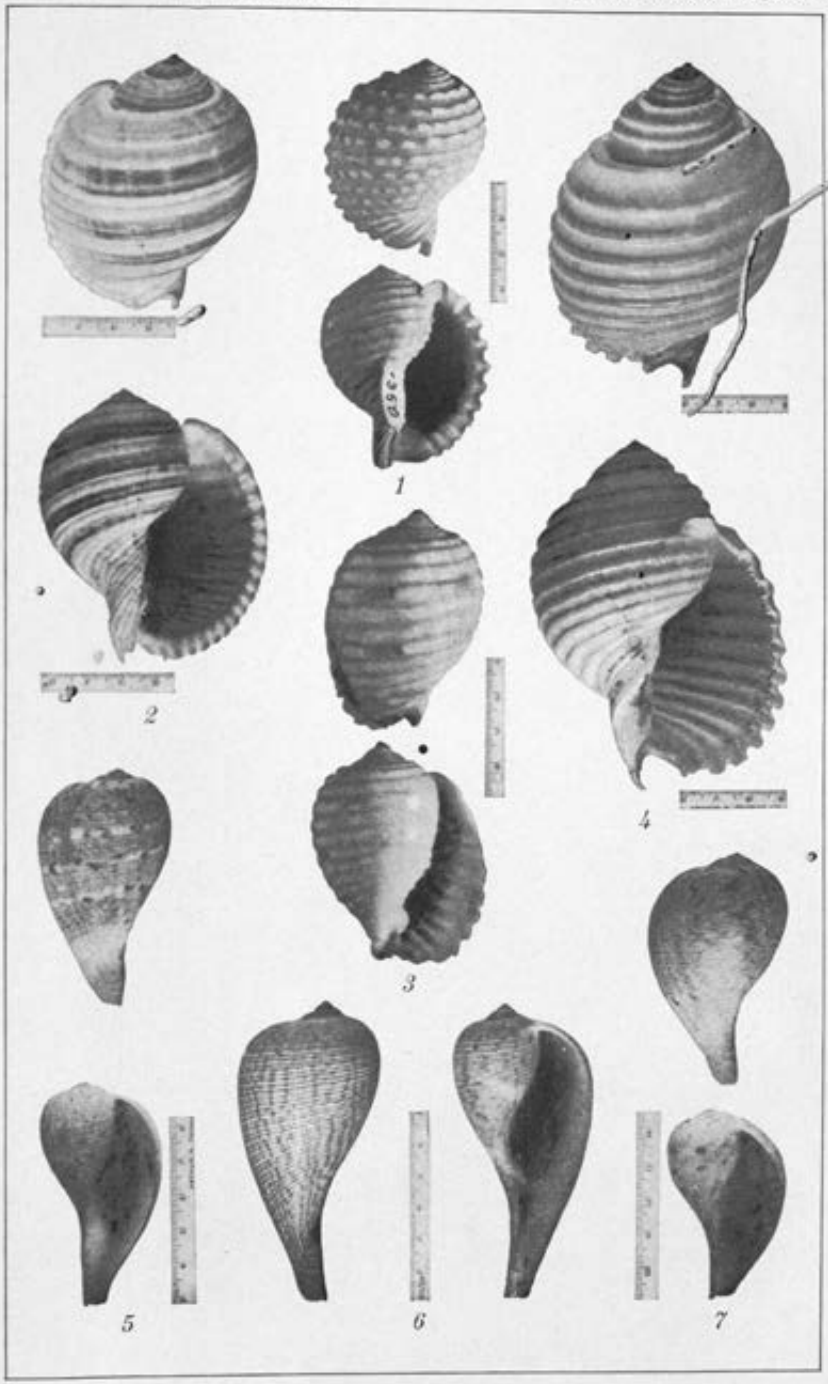

PLATE 2.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

American society for testing materials. Symposium on spectrographic analysis. Philadelphia, The Society. 1935. 51 pp., tables, diagrs. Price, $0.65.

American society for testing materials. Cleveland district committee. Symposium on pearlitic malleable cast iron. Philadelphia, The Society, 1936. 22 pp., illus., diagr. Price, $0.60.

BLANCK, A. P. Foods and the law; a manual for the business man and the laws of the United States with reference to foods and food products. N. Y., Peter Smith, 1935. ix + 246 pp. Price, $2.50.

COLLINGS, G. H. Commercial fertilizers; their sources and use. Philadelphia, P. Blakiston's son & co. [c. 1934.] xiv + 525 pp. illus. tables. Price, $3.25.

COOPER, L. F., E. M. BARBER, and H. S. MITCHELL. Nutrition in health and disease for nurses. 6th ed., rev. and reset, Philadelphia, J. B. Lippincott co. [c. 1933.] xiv + 711 pp., illus., tables, folds. diagrs., col. plates. Price, $3.

DOWELL, A. A., and O. B. JESNESS. The American farmer and the export market. Minneapolis, University of Minnesota press. [c. 1934.] v + 289 pp., maps, tables, diagrs. Price, $2.

FARRINGTON, BENJAMIN. Science in antiquity. (Home university library of modern knowledge.) London, Thornton Butterworth, 1936. 275 pp. Price, $0.75.

GIFFORD, J. C. The tropical subsistence homestead; diversified tree crops in forest formation for the Antillean area. N. Y., Books inc. [c. 1934.] 158 pp. Price, $0.50.

GLASSTONE, SAMUEL, and A. HICKLING. Electrolysis oxidation and reduction: inorganic and organic. New York, D. Van Nostrand co., inc., 1936. ix + 420 pp., tables, diagrs. Price, $9.

HAIRE, NORMAN. Birth-control methods (contraception, abortion, sterilization). London, George Allen & Unwin, 1935. 192 pp., illus., plates. Price, $1.75.

HATHAWAY, K. A. Modern radio essentials. Chicago, American technical society, 1936. 200 pp., illus., tables, diagrs. Price, $2.

HAVEN, G. B. Industrial fabrics; a handbook for engineers, purchasing agents, and salesmen. 1st ed. New York, Wellington Sears co., 1934. x + 538 pp., illus., fold. plates, tables, diagrs. Price, $3.

HAVENS, L. C. The bacteriology of typhoid, salmonella, and dysentery infections and carrier states. N. Y., The Commonwealth fund, 1935. xii + 158 pp., illus., diagrs. Price, $1.75.

Imperial agricultural bureaux. Vernalization and phasic development of plants. Aberystwyth and Cambridge, Imperial bureaux of plant genetics, 1935. 151 pp., tables. Price, $2.50.

Imperial college of tropical agriculture. Cacao research. 4th annual report, 1934. Trinidad, Govt. print. off., 1935. Price, $2.50.

KARPMAN, BEN. The individual criminal; studies in the psychogenetics of crime. Washington, D. C., Nervous and mental diseases pub. co. [c. 1935.] x + 317 pp. Price, $4.50.

KIRK, G. L. Philippine independence, motives, problems and prospects. N. Y., Farrar & Rinehart, 1936. 278 pp. Price, $2.50.

KOFOID, C. A., and others, ed. Termites and termite control. Berkeley, University of California press, 1934. xxvii + 795 pp., front., illus., tables, diagrs. Price, $5.

LEFENETRE, H., and P. DEPIEU. Technique systématique de l'inspection des viandes de boucherie. Paris, Vigot Frères, 1936. viii + 408 + xxix pp., illus.

LULL, R. S. Fossils; what they tell us of plants and animals of the past. N. Y., The University society. [c. 1931.] iv + 114 pp., illus. Price, $0.65.

MAINGOT, GEORGES, RAYMOND SARASIN, and HENRI DUCLOS. Exploration radiologique des colons et de l'appendice au moyen des solutions floculantes images de muqueuses; technique-séméiologie-syndromes. Paris, Masson et cie, 1935. 229 pp., illus. Price, 200 fr.

NODLE, R. J. Latex in industry. N. Y., The Rubber age, 1936. 384 pp., illus. Price, $7.

OCHSNER, E. H. Social security. Wisconsin, New era library, inc., 1935. xx + 231 pp. Price, $0.50.

PATTEE, A. F. Practical dietetics, with reference to diet in health and disease. 12th ed. rewritten and reset. Mount Vernon, N. Y., 1935. xv + 880 pp., illus., tables. Price, $8.

SEYMOUR, E. L. D., ed. The garden encyclopedia; a complete practical and convenient guide to every detail of gardening. New York, Wm. H. Wise & co., 1936. x + 1300 pp., illus., plates. Price, $5.

SNYDER, T. E. Our enemy the termite. Ithaca, N. Y., Comstock pub. co., 1935. xii + 196 pp., illus. Price, $3.

Success Publishing co. Success; 1500 new economy cookery and household recipes. London, The Author. [n. d.] 256 pp., col. illus. Price, $1.25.

THURSTAN, VIOLETTA. The use of vegetable dyes for beginners. rev. ed., Leicester, The Dryad press, 1936. 51 pp. Price, $0.70.

VAN UVEN, M. J. Mathematical treatment of the results of agricultural and other experiments. Groningen, Batavia, P. Noordhoff, 1935. vi + 309 pp. Price, $3.75 unbound; $4 bound.

WHITBY, L. E. H. Disorders of the blood; diagnosis, pathology, treatment and technique. Philadelphia, P. Blakiston's son & co., 1935. viii + 545 pp., illus., col. plates, diagrs., tables. Price, $7.

WIESNER, B. P. Sex. London, Thornton Butterworth, 1936. 251 pp., illus. Price, $0.75.

WILLIAMS, F. H. Radium treatment of skin diseases; new growths, diseases of the eyes and tonsils. Boston, The Stratford co. [c. 1935.] iii + 118 pp. plates. Price, $2.

WILSON, G. S. The bacteriological grading of milk. London, H. M. Stationery off., 1935. 392 pp., tables, diagrs. Price, $2.

WOLF, F. A. Tobacco diseases and decays. Durham, North Carolina, Duke university press, 1935. xix + 454 pp., illus. Price, $6.

WOLLENWEBER, H. W., and O. A. REINKING. Die fusarien; ihre beschreibung, schadwirkung und bekämpfung. Berlin, Paul Parey, 1935. viii + 355 pp., illus. Price, in Germany, Rm. 18, unbound; Rm. 20, bound; foreign, Rm. 13.50, unbound; Rm. 15, bound.

ZIMMER, FRITZ. Nitrocellulose ester lacquers; their composition, application and uses. N. Y., D. Van Nostrand co., 1934. xv + 246 pp., illus., plates, tables. Price, $7.

REVIEWS

The Chemical Control of Conception. By John R. Baker. With a chapter by H. M. Carleton. Chapman and Hall, Ltd., London, 1935. 173 pp. Price, $3.75.

This book gives a resumé of the results of the author's series of experimental investigations on the action of some chemical substances as spermicides. The author describes the technic, which he has standardized for grading contraceptive agents, and gives the results of the same scientific tests when applied to other substances that may be used for this purpose.

Judging from the net result of his experiments, however, it would seem that the perfect spermicide has yet to be discovered, inasmuch as the really potent contraceptive agent that is devoid of pathological effect has not yet been found.

The author has found that certain substances that reduce surface tension, such as soap, have high spermicidal effect. Thus Castile soap (sodium oleate) has been found as spermicidal as quinine bisulphate, which is twenty-seven times as expensive.

This book enables one to become acquainted with contraceptive materials better than those now available, but less known or only imperfectly understood. This book will be found a valuable addition to existing literature on conception by the physician, the chemist, the pharmacologist, the physiologist, and the biologist.—A. P. W.

A Text Book on Forest Management. By M. R. K. Jerram. Chapman and Hall, Ltd., London, 1935. 156 pp., 17 figs. Price, $2.25.

Written to meet the requirements of forest students, this book brings together, in as brief and simple a manner as possible, all matters of primary importance relating to the subjects which are commonly dealt with under the term "forest management." The author claims that "it is not intended to displace the study

of those authors who deal with these subjects individually at much greater length; but it does represent an endeavor to introduce the students to all the more important problems involved and to explain the elementary principles on which their solutions are based." At most, therefore, the book provides a framework on which fuller knowledge of forest management can be built up by the teacher.

The book is divided into three parts. Part I deals with the foundations of forest management; part II, with the preparation and control of a working plan; part III, with forest finance. In appendix I are found the terms used in forest management as approved by the Empire Forestry Conference in 1928. The values of I_1 op^n are also found in appendix II.—C. S.

American Conservation in Picture and Story. Compiled and edited by Ovid Butler. The American Forestry Association, Washington, D. C., 1935. 144 pp., 216 illus. Price, $2.50.

This book, which was issued by the American Forestry Association to commemorate the completion of its sixty years of public service in behalf of American forestry, gives a comprehensive and graphic picture of the history of conservation in the United States. The movement to awaken public sentiment in conservation work dates from 1875, the year in which the association was organized, and this volume records the accomplishments largely to be credited to its efforts.

The book was prepared with the coöperation of authorities on the various phases of conservation in the United States and includes such topics as the beginning of forest exploitation, the public domain, the age of wood, the story of lumbering, the National forests, the National parks, the conservation of wild life, the spread of forest education, forest research, and conservation of the soil. The more recent activities under the New Deal, such as the Civilian Conservation Corps and the Lumber Code, are also discussed. A selected reading list of references is given at the end.—C. S.

Wanderings Among South Sea Savages and in Borneo and the Philippines. By H. Wilfrid Walker. H. F. and G. Witherby, Ltd., London, 1935. 254 pp., illus. Price, 7s. 6d.

The favorable reception accorded this book since its original publication in 1909 seems to be the excuse for this second reissue.

The book is a remarkable record of adventure and gives interesting accounts of the author's wanderings among primitive

inhabitants of the South Sea Islands before the World War. Its interest lies in the fact that in giving a general impression of his experiences the author affords an insight into the life of the people visited. As realized by himself, however, in his attempt to be as concise as possible, the author has left out much that might have been interesting. Having no pretension to be "scientific" in his accounts, as he claims, he has therefore touched but lightly on the general customs of the people and has made no special study of their languages. Even such superficial treatment of these two cultural phases of primitive life, however, makes the book a valuable reading material for students of ethnology, besides being an interesting book of travel to others.—R. E. G.

Head, Heart and Hands in Human Evolution. By R. R. Marett. Henry Holt and Co., New York, 1935. 203 pp. Price, $3.50.

A book that affords interesting reading on sociological inquiry is this study by Doctor Marett, rector of Exeter College, Oxford, and one of the leading students of social anthropology and primitive religion. Marett discusses the three fundamental ways of organizing human experience; namely, by means of the head, the heart, and the hands. In part I he brings attention to the question of how to use and to keep one's head in tackling the theoretical problems involved in sociological inquiry; in parts II and III he deals with pretheologic religion, giving illustrations; and in part IV he considers primitive technology or the arts and crafts of prehistoric and primitive man.—R. E. G.

The Duke Forest, a Demonstration and Research Laboratory. By Clarence F. Korstian and William Maughan. Duke University, Forestry Bulletin No. 1. Durham, N. C., 1935. 74 pp., illus., maps.

This publication describes the Duke Forest of Duke University in Durham, North Carolina, the administration and policies controlling its operation, and the progress already achieved. The forest is somewhat similar to the Makiling National Park at Los Baños, Laguna, in that it serves the threefold purpose of demonstration, research, and outdoor laboratory in forestry. The area contains 4,696.1 acres (1,878.4 hectares) 3,411.3 acres of which are covered with forests of various types, stands, and soils. The forest is divided into three divisions containing 114 compartments, with natural or artificial boundaries, ranging in size from 5.6 to 84.5 acres with an average of 40.1 acres.

The management policy aims to make the forest serve as an area for the development and demonstration of forestry prac-

tices, as an experiment forest for research in the problems of timber growing and in the sciences basic thereto, and as an outdoor laboratory where field work can be carried on by forestry students. There are 48 permanent sample plots, ranging in size from 0.1 to 1 acre, for the purpose of studying various problems and to serve as centers of demonstration activities. In managing the forest the aim is to limit the cut within the annual growth, giving due consideration, however, to needed sanitation and silvicultural operations such as pruning, thinning, planting, and removal of defective trees. A very interesting part of the publication is the chapter dealing with the various forms used and the system of keeping forest records. Although the forest is primarily established for demonstration and research, it is also managed as a business, and complete financial record is maintained.

A description of the progress already accomplished in regard to land classification, forest protection, regulation of the cut, and silvicultural operations is given.

This is a handy, well-written bulletin, profusely illustrated with photographs and maps, giving a good idea of the Duke Forest, its present condition, and its possibilities.—C. S.

Kleines Handbuch des Hoch-, Ingenieur- und Machinenbaus. Vd. Dr. Phil. H. H. Schwanecke. Newmann-Neudamm, Berlin, 1934. Vol. I, cloth, 855 pp., illus., diagram, charts, tables. Price, 25 RM.

The author has successfully achieved the promise implied in the title by this very concise but complete presentation of two major branches of engineering. The book is richly illustrated with figures, diagrams, and charts.

Each subject—mathematics, chemistry and physics, technical mechanics, thermodynamics, and design—is remarkable in its brevity, scope, and clearness. The subject of mathematics is especially notable for the clearness of presentation in no more than one hundred sixty-three pages. It includes forty-one pages of mathematical tables, ten pages of fundamental formulas of algebra and trigonometry, besides a thorough discussion on analytic geometry and differential and integral calculus. Chemistry and physics are very lightly treated, giving only principal information for general use to the engineer. Technical mechanics covers the various technical notations, equivalents, and measuring units, dynamics and statics of rigid bodies, as well as of fluids. Under the general heading of thermodynamics is included a brief discussion of wind pressure. The design of structures is adequately covered.

It is not only a valuable book for the practicing engineer in his everyday work but is also an excellent text when he wishes to review subjects which have become dim in his memory. It is true that there are many excellent American and English texts dealing with the subjects covered by this book, but it always aids greatly in the perspective of an engineer to be also familiar with the German methods and points of view on the subjects covered by this handbook. In many of the engineering fields Germany has pioneered and has remained a foremost authority.—A. A.

Why the Weather? By Charles F. Brooks. With the collaboration of Eleanor Stabler Brooks and John Nelson. Revised and enlarged. Harcourt Brace and Co., New York, 1935. 295 pp., illus. $2.50.

This book is a veritable mine of information for those who are curious about the why and wherefore of the weather. It is purposely written for the popular mind and is attractively presented; it presents just those things which the general public would like to know. It has the further advantage of being thoroughly up-to-date, the revision having been carefully and conscientiously made. Even though it is an American book evidently compiled for an American public, and treats of many things beyond the experience of the average Filipino, such as sleet, snow, ice-storms, autumn and winter storms in general, still even residents of these Tropical Isles can find these topics interesting, entertaining, and instructive.

One might be inclined to judge hastily that the book deals too much with climatological explanations and not enough with weather forecasting, but this is really an error, for if the manifold hints about forecasting scattered here and there throughout the book were collected they would form quite a comprehensive chapter or two. However, Philippine readers should be careful to remember that the forecasting rules are for the United States or for the temperate zones in general and not for the Philippines. We are in an almost entirely different clime, as weather men trained in the former zones sometimes find to their sorrow.

As far as can be judged from a first perusal, facts are accurately stated, with possibly a few minor exceptions. The writer hardly thinks that a definite correlation has been proved between earthquakes and intense cyclones, nor does he think that such a theory meets with the approval of a majority of seismologists. On page 154, at the top, the statement is made that a typhoon commenced at Yokohama, just before the great earthquake and affected Tokyo soon after. As a matter of fact

the storms was already definitely a typhoon August 28 (the earthquake occurred September 1, 1923) in the Eastern Sea, and most probably started some days earlier south of the Loochoo (Nansei) Islands as a secondary to an occluded typhoon which passed near to the east of Shanghai, August 24. It was a typhoon of moderate intensity, and many more intense ones have passed over Japan with no earthquakes resulting. In the light of recent investigations of the Manila Observatory, it is also almost certain that the author's explanation of the origin of typhoons and hurricanes will have to be modified; surges of air on the front between different wind systems seem the essential factors rather than doldrum conditions which of themselves seem capable only of causing local overturning of the air.—C. E. D.

Scientific Results of the World Cruise of the Yacht "Alva," 1931, William K. Vanderbilt, Commanding. Crustacea: Anomura, Macrura, Euphausiacea, Isopoda, Amphipoda, and Echinodermata: Asteroidea and Echinoidea. By Lee Boone. Bulletin of the Vanderbilt Marine Museum, Volume VI. Huntington, L. I., New York, privately printed, November 30, 1935. 263 pp., 90 pls.

This bulletin, the sixth in the scientific series of the Vanderbilt Marine Museum, deals with the systematics of the collection secured by William K. Vanderbilt during a world cruise of his yacht "Alva" in 1931. It is divided into two parts, the first being a report on the Crustacea; the second treating of the Echinodermata. As the group of animals described include many forms that are Philippine, this book will be useful to students of Crustacea and Echinodermata in the identification of Philippine material. This is specially so because of the numerous splendid drawings and pictures of the animals described. By using this text in combination with the work of Roxas and Estampador on the Stomatopoda of the Philippines, with Yapchiongco's on pagurids, and with Roxas's on Echinoidea, one will obtain a comprehensive idea of the extent and classification of the Philippine crustaceans and echinoderms.—H. A. R.

International Bibliography on the Problems of Blood Transfusion and the Theory of Blood Groups, 1900–1933. By Dr. E. Koenig. The Scientific Research Institute for Blood Transfusion, Leningrad, 1935. 226 pp.

There are 4,423 articles included in this bibliography, which have been grouped into 22 main sections and 77 subsections. It claims to comprise the articles which were published throughout the world on the problems of blood transfusion and the theory of blood groups during the period 1900–1933. Only the titles in Russian, German, English, French, and Italian are

printed in the original. Titles in other languages, such as Spanish, Dutch, and Portuguese, are translated into German. Those in Russian have also, in addition, their German equivalents. The material is arranged according to an apt scheme. However, the compiler has taken considerable liberty in abbreviating the names of the periodicals, without having provided a handy means for identifying their full titles. It is doubted that the "Periodica Medica" from which the abbreviations have been adopted, will be available to many readers.

The translation of several titles from their original languages into German makes the latter the predominant language of the bibliography. This makes the compilation of distinct advantage to those who are at home in this language, but not to many who read only English or Spanish.—M. G.

INDEX

[New names and new combinations are printed in boldface.]

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