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RETOTHEL-SARCOMA AMONG FILIPINOS IN THE TROPICS [1]

By C. M. HASSELMANN

Practicing physician and surgeon, and head, Section on Dermatology and Syphilology, Saint Luke's Hospital Dispensaries, Manila

THREE PLATES

The frequency of lymphatic tumors of the neck in the Tropics is well known. Recently Mueller has stressed this point and discussed in detail a number of these cases from the Dutch East Indies, where the pathology was of such different nature that it could be classified neither as lympho-sarcoma nor as lympho-epithelioma. He thinks that chewing of betel nuts, the custom of filing the teeth, the common occurrence of pyorrhœa and tooth infections, and other irritations are responsible as etiologic factors for these not uncommon nontuberculous tumors.

The proper classification of these tumors arising primarily in lymphoid tissues, however, often presents great difficulties. The reports on this subject by Ghon and Roman, Foot, Connor, Oberling, Richter, Roulet, and others show all the divergence of opinion and nomenclature existing heretofore. Liborio Gomez, head of the Department of Pathology, University of the Philippines, and myself have always hesitated in past years to include these "mixed tumors" in any of the usual textbook nomenclature. Our confusion was dissipated after reading Roulet's publication and his convincing proposal to classify this kind of tumor as "Retothel-Sarcoma" (Roessle) on account of its origin from reticular stellate cells.

The site of these lymphatic tumors is most frequently the neck, though mediastinal as well as mesenteric lymph nodes may

[1] This paper was read by request before the Manila Medical Society, February 13, 1934.

be primarily and only affected, or become involved, too. Connor has reported a number of cases with this form of tumor as a solitary tumor in bones. The tumors are distinct from lympho-sarcoma and lympho-epithelioma, not only in regard to their histological architecture but also biologically. They are less actively growing lesions with relatively slow development, and less expansive and tissue-destroying tendency. Metastasis occurs, but metastatic dissemination is not a tendency. Furthermore, as Lalung-Bonnaire and Bablet have pointed out, the tumors seem to be rather radio-resistant, contrary to the ordinary lymphatic new growths originating either from the follicular lymph cells or from the endothelial linings of the lymph sinus.

Arising primarily in lymphoid tissue, the tumor is composed neither of lymphocytes or their immediate precursors nor of endothelial cells. The histologic study bears out that it has no connection with ordinary vascular or sinus endothelium and is, therefore, not an "endothelioma." Its cells, furthermore, do not resemble any lymphocytes or their formative cells, and is, therefore, not a "lympho-sarcoma." The tumor, however, is derived from the stellate cells of the reticulum. In the silver-impregnation method, after Foot, a strongly marked increase in the amount of intracellular reticulum fibers becomes demonstrable.

The tumor is softer than the ordinary malignant growth; its consistency depends on the amount of reticulum fibers formed by the tumor cells. Though the connective tissue septa between the lobules of the lymph node may have been destroyed, the tissue-destroying tendency and expansiveness of the tumor are not pronounced. The capsule of the lymphatic glands is ordinarily intact, and the different lymph nodes remain well separated and discrete for a long time.

The usual architecture of the lymph node is lost early with regard to the normal distinction between follicular and medullary areas. Whereas in some parts the germinal centers with typical lymphoid cells may remain preserved, other areas are overrun more or less uniformly with tumor cells with but few lymphocytes left. In such places collections of lymphocytes may be seen only in the capillaries.

In some places round or oval areas of necrosis with round borders are pronounced; in other sections necrosis may be entirely absent, but considerable fibrosis is encountered instead.

The tumor cells are round, oval, or elongate, and several times as large as lymphocytes. The cytoplasm is moderate in amount, and slightly pink stained with hæmatoxylin eosin. Protoplasmic processes are quite conspicuous, and the formation of a lacy network by anastomosing cytoplasmic tendrils is pronounced. The nuclei are large and oval, with definite membranes. They contain scattered, densely staining, chromatin material with sometimes several prominent nucleoli. However, a nucleolus is not always distinguishable. Mitoses are numerous and occasionally the centrosome with astral rays is conspicuous. Tumor giant cells are present in our cases in various numbers, and of protean appearance. They resemble neither the Sternberg type, as characteristic for Hodgkin's disease, nor the well-known Langhans's giant-cells. They resemble, however, megakaryocytes in some instances, and in others they contain one or more rather pyknotic nuclei.

The comparatively slow development and a glance at the tumor description will show how different it is from the usual lympho-sarcoma and lympho-epithelioma, respectively, in regard to the histologic architecture. Naturally, the question arises as to the origin and relationship of these reticulum stellate cells, making up these retothel-sarcomata. According to Aschoff, Downey, Maximow, and others, the primitive mesenchyme cell of early embryonic life is the mother cell for all of the four types of ripe cells composing a lymph node; namely, the different white blood cells, the endothelial cells, the reticular stellate cells, and the ordinary connective tissue cells and fibroblasts. Cytologic study and differing characteristics in function suggest that a strict differentiation must be made between the endothelial cell of the linings of capillaries and lymph sinus, and the reticulum cell. Nowhere in these tumors exists any conversion or transformation from one cell type into another. The endothelium linings are all intact, though tumor cells are frequently met with just outside of the lymph sinus.

Since Richter, Roulet, and others have discussed the possibility of retothel-sarcoma developing on the basis of existing chronic lymphatic leukemia, as reported in some cases, it may be likewise stressed that no transformation of lymphocytes into tumor cells is anywhere found in our cases. This lack is worth while mentioning for the further reason that lymphoid reactions and lymphatic leukemia, which itself may be considered a tumor condition, are not uncommon in the Tropics, as pointed out by Hasselmann.

Though the clinical course of the tumor conditions is rather similar, the histology and the absence of a typical porphyry spleen require, nevertheless, differentiation from Hodgkin's disease. Retothel-sarcoma does not show the mostly dominating feature of eosinophiles, Sternberg's giant cells, the dominance of young fibroblasts, and the characteristic indented areas of necrosis in the lymph nodes, which are all quite typical for Hodgkin's granuloma. The histologic picture of retothel-sarcoma gives rather the impression of a grotesque and bizarre variety, whereas the cell structure of Hodgkin's granuloma is rather monotonous. The differential diagnosis between the two may, however, be not easy if only the histopathology of a lymph node is consulted.

The clinical course of these cases is said to be less progressive than in ordinary malignancy. Though it is claimed that the condition could be controlled by repeated surgical removal of affected lymph glands combined with radium or Roentgen therapy, the tumor condition mostly recurs and eventuates in death. All of our four cases were fatal; clinically they did not show anything in particular to warrant a detailed report. We wish, however, to add that we have also observed here in the Tropics and among Filipinos typical "lympho-sarcoma" as well as "lympho-endothelioma."

After verifying our observation of four cases as identical with Roulet's "Rethotel-Sarcoma," Dr. Antonio Gabriel has collected six more cases among Filipinos.

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ILLUSTRATIONS

PLATE 1

FIG. 1. Retothel-sarcoma of neck lymph node. Loose lacy network of tumor cells; marked fibrosis.

2. Typical nestlike appearance of lympho-epithelioma in a Filipino.

PLATE 2

FIG. 1. Typical lymphosarcoma in a Filipino. Note the uniform, rather monotonous architecture consisting of lymphocytes and their immediate precursors, all of uniform appearance.

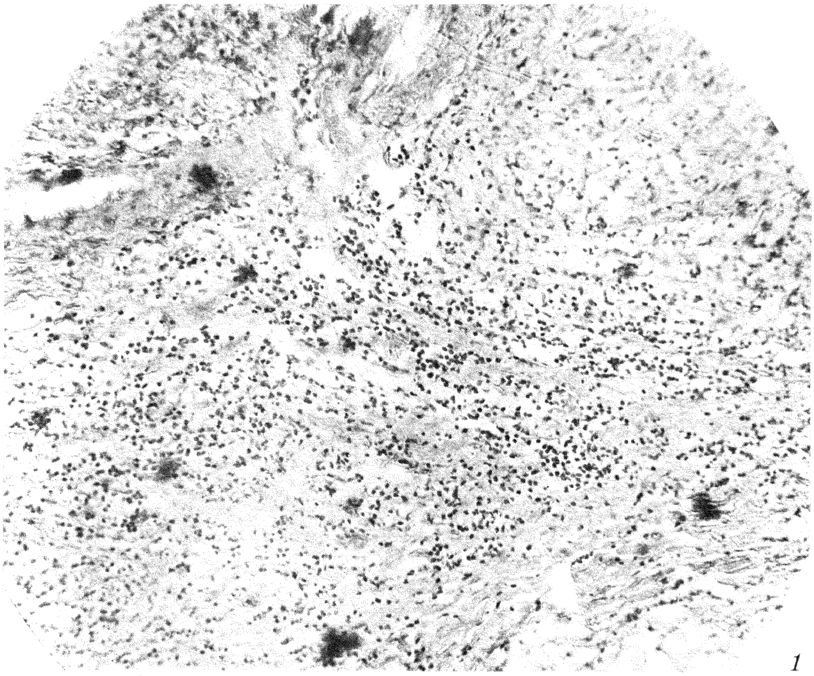
2. Retothel-sarcoma. Silver impregnation after Foot. Intracellular fibrils forming an anastomosing network.

3. Retothel-sarcoma of neck lymph node. Note the giant-cells of protean appearance; some with several pyknotic nuclei; others resembling more megakaryocytes.

PLATE 3

FIG. 1. Retothel-sarcoma of neck lymph gland. Large oval tumor cells with conspicuous protoplasmatic processes are forming a lacy network with anastomosing tendrils. The large nuclei contain scattered, densely staining, chromatin material, and sometimes several nucleoli are distinguishable. Mitoses are numerous; one showing the typical astral arrangement is present in the center of the photograph. Note the grotesque variety of cell architecture in this form of tumor.

2. Retothel-sarcoma of mesenteric lymph gland. Section from periphery shows a zone where there are still numerous typical lymphocytes present besides the large reticulum cells of the tumor.



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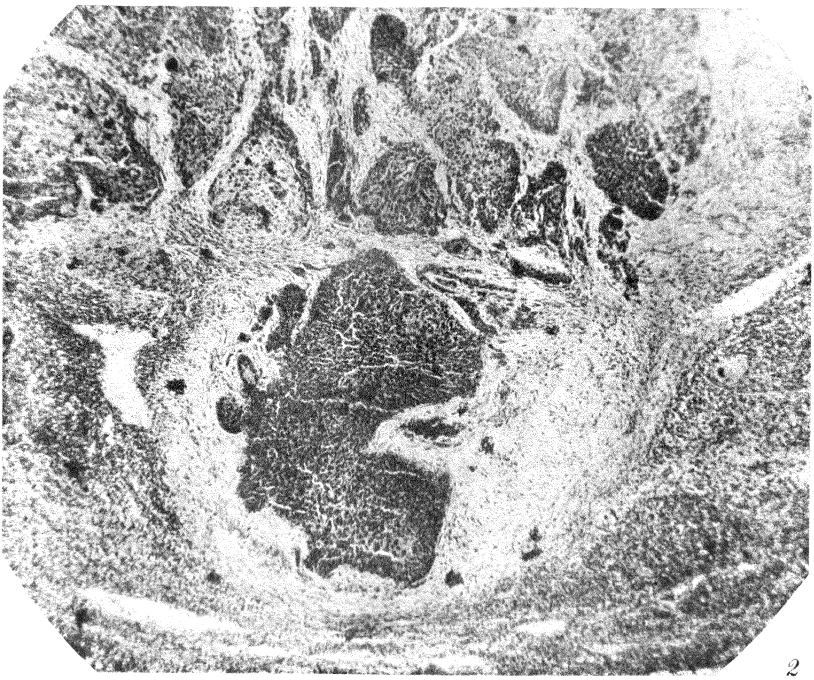

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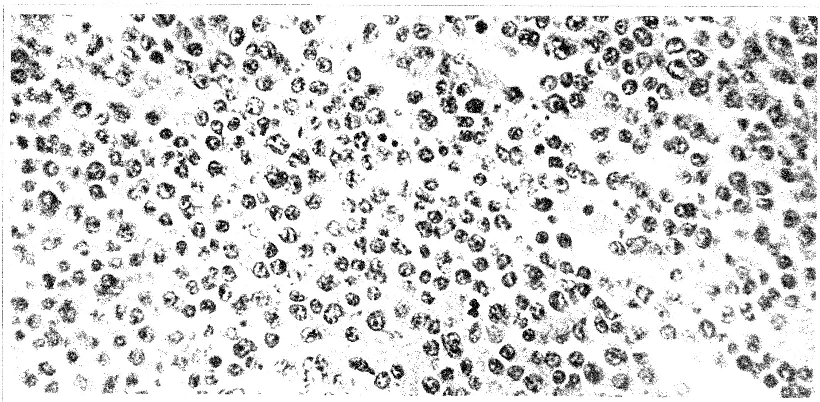

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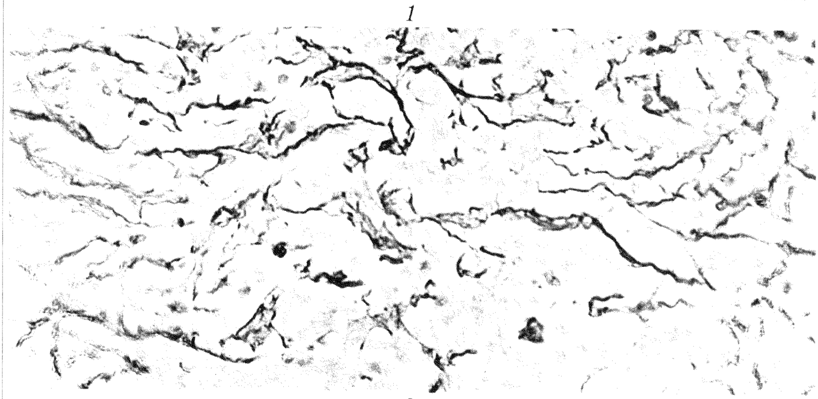

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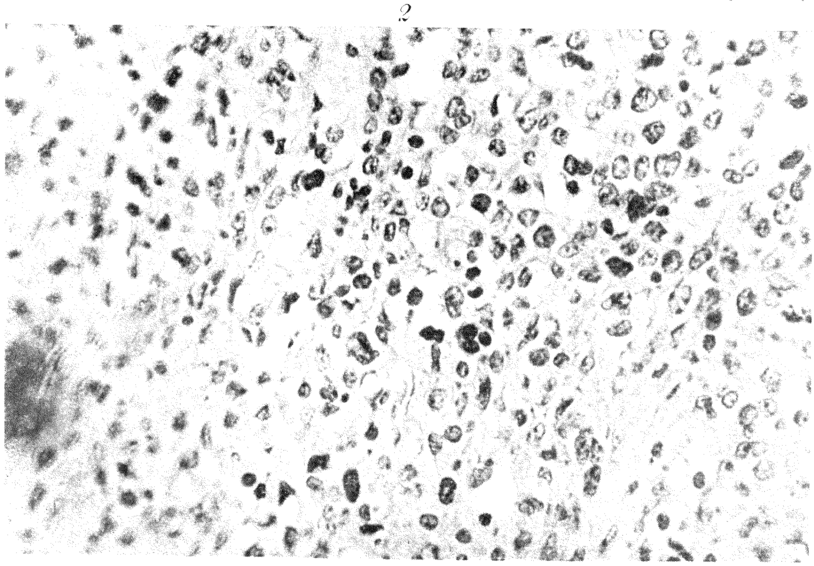

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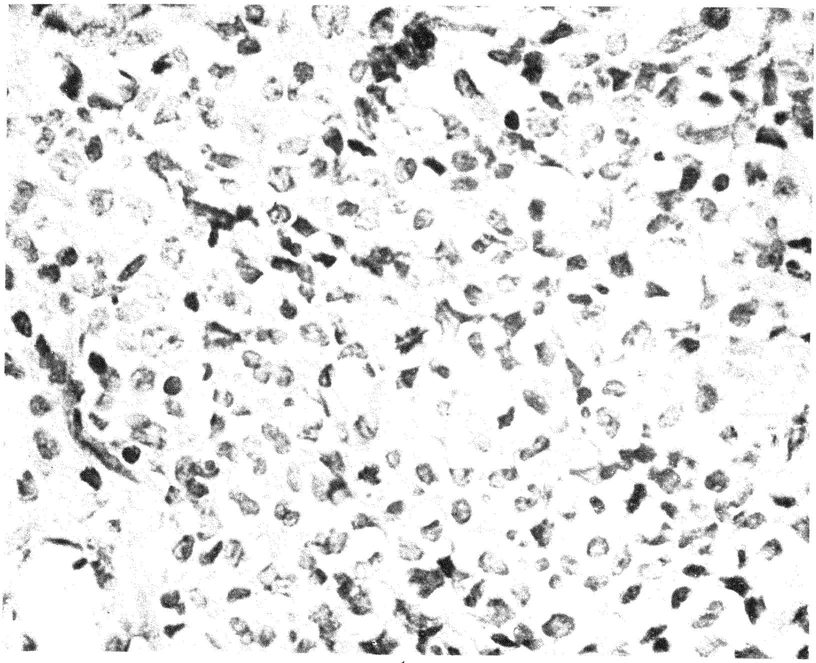
PLATE 2.



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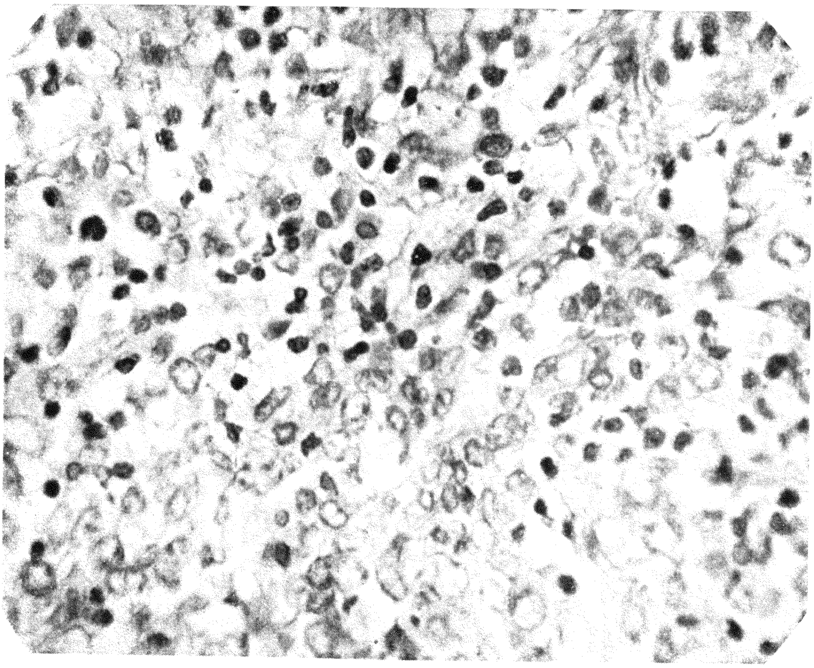

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PLATE 3.

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

By LOPE M. YUTUC

Of the College of Veterinary Science, University of the Philippines, Manila

More than half a century has elapsed since Griffith Evans (1880) discovered the causative agent of surra, *Trypanosoma evansi*, but in spite of about thirty-four years of intensive investigation into its chemotherapy, the precise method of curative treatment of the disease in horses has not gone far beyond experimentation. Whether an effective method of control of surra infection by means of a single drug, in the sense that quinine is used to control malaria, will eventually be discovered, is problematical. However, with the advent of naganol in the chemotherapy of the trypanosomiases, a more-decided advance in its treatment has been attained. To Baermann (1922) belongs the credit of being the first to use the drug against surra in horses. The literature discloses the fact that naganol has been employed as a curative remedy against equine surra either alone or in combination with other trypanocides.

Among the ardent adherents of the single-drug treatment during the last decade were Edwards (1926), Jacotot (1931), Williams (1931–1932), and Sen (1933), who employed naganol alone against surra in equines with satisfactory results. Moreover, Edwards has advocated the intrathecal injection in conjunction with the intravenous administration of the drug in order to control cerebrospinal along with circulatory infection, although Sen considers it not superior to the intravenous administration alone, especially so in early cases. On the other hand, the most-striking results obtained by the combined therapy are recorded in the experiments and observations of Bubberman, Douwes, and van Bergen (1925), Howard (1926), Kahan Singh (1927–1928), Zijp (1929), Bubberman (1930), Nieschulz (1931), and Bakker (1925, 32), who used naganol in combination with tartar emetic or atoxyl, or with other arsenic derivatives, against equine surra. Similar findings with the use of trypanocides other than naganol, supporting the combined therapy, have been obtained by Broudin, Le Louet, and Romary (1928), Romary (1929), and Jacotot (1929) with the combined use of Fourneau 309 with either sulfarsenol or neotrepol. Promising results have also been recorded on the combination of tartar emetic with mercuric iodide and etharsanol by Tubangui (1930), and by Reynolds, Simmons, and St. John (1930), respectively. In addition, Tubangui has suggested intrathecal puncture and the use of an anthelmintic as adjuvant treatments.

In this series of experiments were tested the value of naganol and etharsanol, alone and in combination, as curative agents against surra in native horses as it occurs in the Philippines. The results here presented are too inadequate to warrant final conclusions, but the lines of treatment followed in some of the experiments may fill some place in the chemotherapy of the disease.

MATERIALS AND METHODS

Animals used.—Native horses, white rats, and guinea pigs were employed in this investigation. Ten of the horses were naturally infected, and the rest were artificially inoculated with virulent surra trypanosomes. The causal organism, *Trypanosoma evansi* (Steel, 1885), used was recovered by subinoculation from a horse suffering from surra and brought for treatment to the ambulatory clinic of the College of Veterinary Science, Calamba, Laguna. The trypanosomes were kept alive and maintained under laboratory conditions by continued passing through guinea pigs at various intervals.

Drugs used.—Etharsanol is an arsenic derivative, prepared for the first time by C. S. Hamilton in the laboratory of Doctor Loevenhart, of the University of Wisconsin. It is also called arsenical 73 and chemically known as monosodium salt of *p*-B-hydroxy-ethylamino-phenyl arsinic acid. Two lots of the drug were used. Doctor Tatum, professor of pharmacology at the same university, furnished me the first batch (lot 4) in the form of monosodium salt, a more or less opaque white powder, odorless and tasteless, and readily soluble in water. The other lot was secured from Abbott Laboratories, Chicago. It is a free-acid preparation, a white, crystalline, odorless, and practically tasteless substance, sparingly soluble in water but readily dissolved in sodium hydroxide solution. The arsenic content of etharsanol is 20.32 per cent (Stratman-Thomas and Loevenhart, 1928).

Bayer 205, or naganol, as it has been termed in veterinary medicine, is chemically a carbamide from meta-amino-benzoyl-meta-amino-para-methyl-benzoyl-1-naphthylamine-4,6,8-tri sul-phonic-acid.[1] The preparation intended for human use is known as germanin. Naganol is manufactured by Leverkusen Works, Germany, whence the samples used in this experiment were obtained. This nonmetalliferous drug is free from arsenic, antimony, mercury, or bismuth compounds. Germanin is a white, fine, flaky, odorless powder, and to differentiate it from the preparation intended for animal use, the latter is colored pink. It is readily soluble in water, of a slightly bitter taste, and neutral in reaction.

Procedure employed.—Both naganol and etharsanol were weighed carefully in a sensitive balance and prepared freshly in 10 per cent sterile aqueous solution immediately before administration. All the injections given the animals in these experiments were administered intravenously. Some of the horses artificially infected were not treated until the disease was fairly well established.

The horses infected artificially were weighed in a pit-stock scale just before treatment. The weights of the field cases were approximately determined. The horses were kept in a screened isolation ward and not released until there was no more danger of relapse. Microscopic examination of the blood obtained from the ear vein was made daily from the time of infection to about four months, and then at irregular intervals for a variable length of time. Since the naturally infected animals were distributed in the different towns of Laguna Province, precautionary measures, such as isolation, were not properly carried out. The microscopic examination of the blood of these cases was made at irregular intervals, at most once a week. Blood inoculations to susceptible laboratory animals were also made.

Intrathecal puncture of the horses artificially infected was performed with the main object of determining the presence of trypanosomes in the cerebrospinal fluid. The technic consisted briefly in securing the animal in a recumbent position after the mane at the occipitoatlantal articulation had been clipped close

[1] From the pamphlet inclosed with the drug.

and disinfected with tincture of iodine. The head was then secured firmly by an assistant in a flexed position in such a manner as to expose the region. A sterile gauge 17 needle, 9 cm long, was inserted slowly through the tissues beneath and directed obliquely backward and downward with the wing of the atlas as a guide. As soon as the meninges were punctured, a clear fluid dribbled out in a stream. In some instances, to prevent the cerebrospinal fluid from being contaminated with the trypanosomes in the blood at the time of the operation, about 4 to 5 cc was allowed to flow before collecting the fluid in sterile containers. The fluid collected was injected immediately into normal white rats. For the detailed description of the procedure the original paper of Edwards should be consulted.

EXPERIMENTS AND RESULTS

TREATMENT OF EXPERIMENTAL SURRA IN HORSES WITH ETHARSANOL

Experiment 1.—Each horse was infected subcutaneously with surra trypanosomes. Blood smears were taken daily for microscopic examination. On the fifth to the eighth day after inoculation, the trypanosomes appeared in the peripheral circulation. Soon after the surra organisms disappeared or could scarcely be determined in the blood by microscopic examination, the animal was subjected to intrathecal puncture. In some of the animals this operation was postponed until after the second paroxysm of the organisms in the peripheral circulation had occurred. The cerebrospinal fluid amounting to no less than 15 cc was subsequently collected and immediately injected intraperitoneally to two white rats, each receiving approximately one-half of the fluid obtained. Moreover, after the treatment the intrathecal operation was also repeated at variable periods to determine whether or not the trypanosomes in the cerebrospinal fluid at the time of the treatment had been killed by the action of the drug given intravenously.

The weight of the animal having been determined just before treatment, and the dose of the drug in the horse being 20 milligrams per kilogram of live body weight, the total weight of the drug to be used can be accurately estimated by simple arithmetical calculation. This amount was weighed carefully in a sensitive balance and then dissolved in enough sterile water to make a 10 per cent solution. In case of the free-acid etharsanol, the drug after weighing was placed in a sterile 50-cc beaker, and an appropriate amount of sterile water added, so that when the 10 per cent sodium hydroxide solution was added, a little at a time, to dissolve the free-acid etharsanol, the whole solution would be in 10 per cent concentration and at the same time neutral to litmus paper.

After the preliminary aseptic precautions were taken, the preparation was injected slowly into the jugular vein. On the fourth and on the eighth day the injections were repeated, following the same procedure.

In the meantime the tail blood of the rats injected with the cerebrospinal fluid was also microscopically examined daily to determine the presence of the trypanosome in the injected material. When they remained negative for twenty-five days, their susceptibility was tested by inoculation with virulent surra blood, after which they invariably succumbed to the injection.

It should be noted that the horses used in this experiment were kept in a fly-proof inclosure from the day they were infected until they were about to be killed as a result of the relapses or were safe from future relapses and cured of the disease. Due to the limited capacity of the inclosure where the experimental animals were kept, they were infected, treated, and observed at different times. The results of this experiment are presented in Table 1.

TREATMENT OF EXPERIMENTAL EQUINE SURRA WITH NAGANOL

Experiment 2.—The procedure employed above was closely observed in this experiment, with the exception of the dosage of the drug and the interval of administration. Moreover, in dissolving naganol enough distilled water was placed first in the sterile container to make the 10 per cent solution, and then the drug sprinkled on top of it. No stirring was necessary to turn it into solution.

The dose was 20 milligrams per kilogram of live body weight, but this amount had to be given in broken dosage. The first dose was one-half of the total dose, the second and the third doses were one-fourth each. All these doses were administered intravenously within two weeks. All of the animals employed showed naganol intoxication in the form of periproctitis and sometimes œdema of the pendant portions of the body, which of course disappeared later. Curious rings in the hoof were also observed in the majority of the animals treated. In one case I tried giving the total dose at one time, with the consequent more-marked symptoms of naganol poisoning. The animal lost its appetite entirely for four days after the injection. Dermatitis with

TABLE 1.—*Showing the results obtained in the treatment of experimental surra in native horses with etharsanol.*

Horse No.—	Height.	Age.	Date infected.	Period of incubation.	Weight of animal before treatment.	Presence of trypanosomes in the cerebrospinal fluid.					
						Before treatment.			After treatment.		
						Date of intrathecal puncture.	Fluid obtained.	Result of animal inoculation.	Date of intrathecal puncture.	Fluid obtained.	Result of animal inoculation.
	cm.	*Yrs.*		*Days.*	*kg.*		*cc.*			*cc.*	
40	109	4	June 24, 1932	7	100	July 15, 1932 (15) [a]	15	—	----------	----------	----------
41	106.5	2	July 8, 1932	5	105	July 25, 1932 (13) [a]	20	—	----------	----------	----------
45	106.5	3	Aug. 3, 1932	7	130	Aug. 22, 1932 (13) [a]	15	+	Aug. 31, 1932 (2) [b]	4	+
47	110	5	Aug. 29, 1932	5	140	Sept. 8, 1932 (6) [a]	8	—	Sept. 16, 1932 (1) [b]	15	—
48	99	2	Sept. 10, 1932	6	94	Sept. 30, 1932 (15) [a]	15	+	Oct. 15, 1932 (8) [b]	15	+
52	106	3	Oct. 24, 1932	6	115	Nov. 4, 1932 (6) [a]	15	—	Nov. 16, 1932 (5) [b]	15	—
62	116	2	Aug. 20, 1933	7	118	Sept. 10, 1933 (15) [a]	24	—	Sept. 24, 1933 (7) [b]	20	+

Horse No.—	Height.	Age.	Date of treatment.	Amount of drug used.		Results.
				Salt.	Acid.	
	cm.	Yrs.		g.	g.	
40	109	4	July 15, 1932	2	------	Relapsed July 24, 1932. Killed five days later for anatomy specimen.
			July 18, 1932	2	------	
			July 22, 1932	2	------	
41	106.5	2	Aug. 1, 1932	2.1	------	Died before treatment completed, probably due to etharsanol poisoning.
			Aug. 4, 1932	2.1	------	
45	106.5	3	Aug. 22, 1932	2.6	------	Relapsed September 1, 1932. Killed fifteen days later.
			Aug. 25, 1932	2.6	------	
			Aug. 29, 1932	2.6	------	
47	110	5	Sept. 8, 1932	------	2.8	No relapse up to the present writing (December 20, 1933); animal in excellent condition. Animal inoculation negative (blood).
			Sept. 11, 1932	------	2.8	
			Sept. 15, 1932	------	2.8	
48	99	2	Sept. 30, 1932	------	1.88	Relapsed October 18, 1932. Killed October 25, 1932.
			Oct. 3, 1932	------	1.88	
			Oct. 7, 1932	------	1.88	
52	106	3	Nov. 4, 1932	------	2.3	No relapse. Due to sub-luxation of the coxo-femoral articulation, killed July 27, 1933. Animal inoculation negative (blood).
			Nov. 7, 1932	------	2.3	
			Nov. 11, 1932	------	2.3	
62	116	2	Sept. 10, 1933	------	2.36	Relapsed September 25, 1933. Killed three days later.
			Sept. 13, 1933	------	2.36	
			Sept. 17, 1933	------	2.36	

[a] Days after first appearance of trypanosomes in the peripheral circulation.

[b] Days after last injection.

tenderness of the skin and falling of hair were also observed. The face became swollen and paraphimosis occurred which lasted for some time. The results of this experiment are presented in Table 2.

THE TREATMENT OF EXPERIMENTAL SURRA IN EQUINES WITH SIMULTANEOUS INJECTIONS OF ETHARSANOL AND NAGANOL

Experiment 3.—The technic used was essentially the same as that in the two foregoing experiments. The drugs, having been calculated, weighed in a sensitive balance, and prepared in sterile aqueous solutions, were injected simultaneously into each jugular vein of the horse, the etharsanol being given first and immediately followed by the naganol. The dosage of the drugs was the same as in the previous experiments, except for the free-acid etharsanol which was reduced to 15 milligrams per kilogram of live body weight, for reasons that will be discussed later in this report. All the horses used showed trypanosomes in the cerebrospinal fluid by inoculation to white rats. Naganol intoxication was noted in all the animals employed in this experiment. The individual records of the horses used are summarized in Table 3.

TABLE 2.—*Showing the results obtained in the treatment of experimental surra in native horses with naganol.*

Horse No.—	Height.	Age.	Infected.	Period of incubation.	Weight of animal before treatment.	Presence of trypanosomes in the cerebrospinal fluid. Before treatment. Date of intrathecal puncture.	Amount of fluid obtained.	Result of animal inoculation.
	cm.	*Yrs.*		*Days.*			*cc.*	
38	114	3	Feb. 15, 1932	7	139	Mar. 9, 1932. (17) [a]	20	+
39	122	8	June 16, 1932	7	175	July 1, 1932. (9) [a]	25	+
56	119	4	Jan. 18, 1933	6	178	Jan. 28, 1933. (5) [a]	18	+
57	116	8	Jan. 18, 1933	6	171	Jan. 28, 1933. (5) [a]	17	—
59	96.5	1.5	Feb. 11, 1933	8	80	Feb. 22, 1933. (4) [a]	13	—
63	114	3	Sept. 12, 1933	8	145	Sept. 28, 1933. (9) [a]	10	+
64	104	2.5	Sept. 13, 1933	8	111	Oct. 1, 1933. (11) [a]	20	+

TABLE 2.—*Showing the results obtained in the treatment of experimental surra in native horses with naganol*—Continued.

Horse No.—	Height.	Age.	Presence of trypanosomes in the cerebrospinal fluid. After treatment. Date of intrathecal puncture.	Fluid obtained.	Result of animal inoculation.	Date of treatment.	Amount of drug used.	Results.
	cm.	*Yrs.*		*cc.*			*g.*	
38	114	3	July 3, 1932. (100) [b]	20	+	Mar. 12, 1932 Mar. 19, 1932 Mar. 25, 1932	1.4 0.7 0.7	Relapsed July 6, 1932. Killed five days later.
39	122	8	----------	------	------	July 6, 1932 July 12, 1932 July 19, 1932	1.75 0.875 0.875	July 23, 1932, developed tetanus. Died four days later.
56	119	4	Mar. 29, 1933. (47) [b]	17	+	Jan. 28, 1933 Feb. 3, 1933 Feb. 10, 1933	1.78 0.89 0.89	Relapsed March 29, 1933. Killed April 3, 1933.
57	116	8	Apr. 22, 1933. (71) [b]	26	—	Jan. 28, 1933 Feb. 3, 1933 Feb. 10, 1933	1.71 0.855 0.855	The horse developed laminitis during the period of observation. Still alive at the present writing (December 20, 1933); animal inoculation negative (blood).
59	96.5	1.5	June 29, 1933. (114) [b]	20	—	Feb. 22, 1933 Feb. 28, 1933 Mar. 7, 1933	0.8 0.4 0.4	Animal still alive at the present writing (December 20, 1933); condition excellent. Animal inoculation negative (blood).
63	114	3	Nov. 7, 1933. (27) [b]	20	+	Sept. 28, 1933 Oct. 4, 1933 Oct. 11, 1933	1.45 0.73 0.72	Relapsed November 7, and died December 3, 1933.
64	104	2.5	Oct. 28, (1933. (27) [b]	15	+	Oct. 1, 1933	2.22	Relapsed October 31, 1933.

[a] Days after first appearance of trypanosomes in the peripheral circulation.
[b] Days after last injection.

TABLE 3.—*Showing the results obtained in the treatment of experimental surra in horses with simultaneous injections of etharsanol and naganol.*

Horse No.—	Height.	Age.	Infected.	Period of incubation.	Weight of animal before treatment.	Presence of trypanosomes in the cerebrospinal fluid.					
						Before treatment.			After treatment.		
						Date of intrathecal puncture.	Fluid obtained.	Result of animal inoculation.	Date of intrathecal puncture.	Fluid obtained.	Result of animal inoculation.
	cm.	*Yrs.*		*Days.*	*kg.*		*cc.*			*cc.*	
35	115.5	2	Nov. 16, 1931	7	175	Dec. 3, 1931. (11)[a]	15	+	Mar. 16, 1932. (91)[b]	20	—
36	104	2	Jan. 5, 1932	6	134	Jan. 20, 1932. (10)[a]	15	+	Feb. 29, 1932. (16)[b]	8	—
54	89	2.5	Nov. 25, 1932	6	109	Dec. 22, 1932. (22)[a]	15	+	Apr. 17, 1933. (103)[b]	25	—

Horse No.—	Height.	Age.	Date of treatment.	Treatment with—			Results.
				Etharsanol.		Naganol.	
				Salt.	Acid.		
	cm.	*Yrs.*		*g.*	*g.*	*g.*	
35	115.5	2	Dec. 3, 1931	3.5	----------	1.75	No relapse. Animal still alive. Animal inoculation negative (blood). Increase in weight and in excellent condition.
			Dec. 9, 1931	3.5	----------	0.875	
			Dec. 16, 1931	3.5	----------	0.875	
36	104	2	Jan. 31, 1932	2.68	----------	1.34	No relapse; animal inoculation negative (blood). Increase in weight and in excellent condition at the time the horse was traded for a new animal (March 31, 1933).
			Feb. 7, 1932	2.68	----------	0.67	
			Feb. 13, 1932	2.68	----------	0.67	
54	89	2.5	Dec. 22, 1932	----------	1.63	1.09	No relapse. Animal still alive. Animal inoculation negative (blood). Increase in weight and in excellent condition.
			Dec. 28, 1932	----------	1.63	0.545	
			Jan. 4, 1933	----------	1.63	0.545	

[a] Days after first appearance of trypanosomes in the peripheral circulation.

[b] Days after last injection.

THE TREATMENT OF HORSES NATURALLY INFECTED WITH SURRA WITH SIMULTANEOUS INJECTIONS OF ETHARSANOL AND NAGANOL

Experiment 4.—Because of the encouraging results obtained with the simultaneous treatment of etharsanol and naganol in artificially infected horses, it was tried with the field cases of surra in native horses encountered in the ambulatory clinic conducted in the towns of Biñang, Calamba, and Santa Rosa, Laguna Province, during the academic year 1932–33. Ten horses were employed, most of them only moderately affected.

The following is a summary of the clinical manifestations observed in these animals. Slow and heavy attitude, dyspnea, and knuckling of the fetlocks of the hind legs. In some of the cases a staggering gait was noted. The conjunctival mucous membrane was pale and petichiated, and in some cases even icteric. The temperature was several degrees above normal; the appetite variable, as a rule impaired during the pyretic period and good as soon as the body temperature returned to normal. Emaciation was a constant symptom. An œdematous condition of the limbs, breast, and belly was not commonly observed. In this connection other cases with œdema as a principal symptom were observed, yet they were not surra cases. The laity generally confuses surra with such a condition, hence stories of some quacks having cured surra were often heard by the students in towns visited by the ambulatory clinic of the College of Veterinary Science. Possibly this confusion exists in other provinces of the Philippine Archipelago. In the localities where the clinical cases were encountered, the term "bayawak," a Tagalog coined word, is indiscriminately applied to this œdematous condition of the belly and to surra.

The clinical diagnosis of these cases was clinched by microscopic examination of the moist-blood preparation, as well as by animal inoculation. The weights of these animals were roughly determined, as the pit-stock scale was not available in places where these clinical cases of surra were met with. The procedure in the administration of drugs was identical with that followed in experiment 3. Moreover, as may be noted in the following table, the dosage of naganol was changed not in the total amount but in the amount of the individual doses, which seems to be more readily tolerated than those of the former method. With the fatal termination of two cases, the dose of the free-acid etharsanol was reduced to 15 milligrams per kilogram of live body weight.

All of the animals treated showed symptoms of naganol poisoning in the form of periproctitis, and in one case the appetite was impaired for about a week. As a rule, however, a day after the first treatment the appetite invariably improved until the termination of the treatment. Moreover, the owner of horses 60 and 61 reported that there were about twenty other horses that died in the locality where his horses were located. He reported that these animals presented symptoms identical with those of his horses. In view of the satisfactory results obtained with his animals, some of the owners regretted not having presented their horses for treatment. The individual records of the ten horses are presented in Table 4.

DISCUSSION

Treatment of experimental surra with etharsanol.—Of the three horses (horses 40, 41, and 45) presented in Table 1, that were treated with the monosodium preparation of etharsanol, two were able to tolerate the total course of injections, but relapses were observed later. Horse 41 died, after having received the second injection, apparently due to etharsanol intoxication. The results obtained indicate that the monosodium preparation, beyond establishing a temporary sterilization of the peripheral circulation, is useless against equine surra, when administered alone. On the other hand, with the use of the free-acid preparation on the three other animals (horses 47, 52, and 62) with negative cerebrospinal fluids, horses 47 and 52 recovered from the artificial infection, while the other relapsed (horse 62). Apparently the free-acid etharsanol can control surra infection in horses to a certain extent, provided the cerebrospinal system is trypanosome free. The origin of the recurrence of the disease in the case of horse 62 may be attributed to backwashes from circulation or from tissue spaces as claimed by Yorke (1921), inasmuch as the cerebrospinal fluid is free of the organism at the time of treatment. In case the infection has already gained entrance into the subarachnoid space, the prospect of controlling the disease appears even more remote, as aptly illustrated with horse 48. As relapses in surra infection are generally believed to originate from the cerebrospinal involvement, the failure of the drug in this case may be due to failure to penetrate in trypanocidal concentration through the meninges of the brain and cord, notwithstanding the observation of Stratman-Thomas and Loevenhart (1928) to the effect that this drug readily passes into the central nervous system.

Treatment of experimental surra with naganol.—According to the results presented by horses 38, 56, 63, and 64 under experiment 2, naganol is valueless, as far as permanent cure is concerned, when the surra organisms have already invaded the fluid of the cerebrospinal system. However, so long as the central nervous system is negative of the trypanosomes, as in horses 57 and 59, the control of infection in experimental surra can be attained, possibly even during the early stage of natural cases. Moreover, these results are supported to a certain extent by the observations of Rodenwalt and Douwes (1922), and Bubberman, Douwes, and van Bergen, to the effect that in equine surra Bayer 205 should not be given to animals that are seriously ill, and that this agent, when used alone, is likely to effect cure only in early stage of infection. Edwards attributed this circumstance to the low diffusibility of naganol, possibly owing to the large size of the molecule with the consequent lack of power to penetrate the meninges in sufficient concentration to affect the cerebrospinal infection.

The periproctitis observed in the horses subjected to naganol treatment and to the simultaneous administration of etharsanol and naganol, may give some pathogenic organisms entrance into the body of the animal, as illustrated in the case of horse 39, which died of tetanus contracted four days after the last injection. Bubberman and others made mention of a similar observation in their studies on the use of Bayer 205 in equine surra in the Dutch East Indies.

Observations on how long Trypanosoma evansi appeared in the cerebrospinal fluid after the first appearance in the peripheral circulation.—As shown in Tables 1, 2, and 3, the length of time that the surra trypanosome was found in the fluid of the central nervous system after its first appearance in the peripheral circulation was variable. Of the seventeen horses subjected to the intrathecal puncture, ten animals demonstrated the presence of the surra trypanosome in the cerebrospinal fluid by subinoculation to white rats, while the remainder were negative. The average number of days after which organisms were found in the cerebrospinal fluid was 12.2 days, the minimum 5 days, and the maximum 22 days. On the other hand, among horses with negative cerebrospinal fluid the average period was 9.14 days, the minimum 4, and the maximum 15. In view of this uncertainty and variation of the length of time the cerebrospinal fluid becomes infected, and the lack of clinical manifestation, especially in the early stage of the disease, suggestive

TABLE 4.—*Showing the results obtained in the treatment of field cases of surra in native horses with simultaneous injection of etharsanol and naganol.*

Horse No.—	Height.	Age.	Approximate weight.	Location.	Date of treatment.	Treatment with— Etharsanol. Salt.	Treatment with— Etharsanol. Acid.	Treatment with— Naganol.	Duration between last injection and final observation.	Animal inoculation. Time of treatment.	Animal inoculation. Time of final observation.	Condition at the time of treatment.	Final observation.
	cm.	*Yrs.*	*kg.*			*g.*	*g.*	*g.*	*Mos. days.*				
42	127	6	200	Calamba	July 15, 1932	4	-------	2	11 3	+	—	Fair	No relapse, condition good. Due to severe contracted tendons of the anterior limbs, the horse was killed for meat.
					July 22, 1932	4	-------	1					
					July 28, 1932	4	-------	1					
43	129.5	7	200	do	July 16, 1932	4	-------	2	16 22	+	—	do	No relapse; condition excellent, animal still alive.
					July 22, 1932	4	-------	1					
					July 29, 1932	4	-------	1					
44	134.5	5	200	do	July 29, 1932	4	-------	2	16 10	+	—	do	Do.
					Aug. 5, 1932	4	-------	1					
					Aug. 11, 1932	4	-------	1					
50	119	10	200	Santa Rosa	Sept. 16, 1932	4	-------	2	14 21	+	—	Poor	Do.
					Sept. 23, 1932	4	-------	1					
					Sept. 29, 1932	4	-------	1					
51	127	5	200	do	Sept. 29, 1932	-------	4	2	-------	+	-------	Fair	Died, probably due to drug poisoning.
					Oct. 6, 1932	-------	4	1					
53	112	5	150	do	Nov. 18, 1932	-------	3	1.5	-------	+	-------	Poor	Do.
					Nov. 25, 1932	-------	3	0.75					

58	119	6	170	do	Feb. 9, 1933	--------	2.55	0.68	--------	+	--------	Fair	153 days after last injection the horse was reported dead, probably as a result of a relapse.
					Feb. 15, 1933	--------	2.55	1.36					
					Feb. 22, 1933	--------	2.55	1.36					
60	122	6	180	Biñang	Feb. 14, 1933	--------	2.7	0.72	9 21	+	—	Poor	No relapse; condition excellent, animal still alive.
					Feb. 20, 1933	--------	2.7	1.44					
					Feb. 27, 1933	--------	2.7	1.44					
61	122	5	170	do	Feb. 15, 1933	--------	2.5	1.7	9 20	+	—	Fair	Do.
					Feb. 21, 1933	--------	2.5	0.85					
					Feb. 28, 1933	--------	2.5	0.85					
65	119	7	170	do	Sept. 25, 1933	--------	2.55	0.68	--------	+	--------	Poor	62 days after last injection, the animal was reported dead, probably due to a relapse.
					Oct. 2, 1933	--------	2.55	1.36					
					Oct. 8, 1933	--------	2.55	1.36					

of the presence of the surra trypanosome in the central nervous system, as many of the horses used did not manifest nervous derangement, but on inoculation of the cerebrospinal fluid obtained from them to white rats demonstrated the presence of surra organisms; if this finding is true in naturally infected animals, the value of either of the trypanocides investigated when used intravenously alone appears very limited. Another factor that should be considered in this connection is the difficulty of determining with accuracy the duration of natural infection in horses. Moreover, this finding may also serve to elucidate the failure of naganol in some surra cases treated and reported by various investigators who had no reason for believing that there is already nervous involvement, yet relapses were observed.

Treatment of experimental surra with simultaneous injection of etharsanol and naganol.—The uniform results recorded in experiment 3 illustrate beyond reasonable doubt the value of the combined administration of etharsanol and naganol against equine surra even when the surra organism is already found in the cerebrospinal fluid of the animals treated. From the length of time the peripheral circulation remained negative, both to microscopic examination and to animal blood inoculation, and the excellent condition of the animals employed, it can be stated with some degree of certainty that the horses are cured of the artificial infection. Furthermore, the negative results obtained by inoculating the cerebrospinal fluid taken from them to susceptible laboratory animals denote that even this fluid is free from surra trypanosomes. This finding may further suggest that there is a synergistic relation between the two drugs employed in the treatment, possibly responsible for the penetration of the meninges of the brain and cord in trypanocidal concentration and consequently not only bringing about circulatory but also nervous sterilization.

Treatment of natural cases of surra in native horses with simultaneous injection of etharsanol and naganol.—Reference to horses 42, 43, 44, 50, 60, and 61, in Table 4, may furnish further evidence in support of the value of the simultaneous injections of etharsanol and naganol as a promising treatment in natural cases of equine surra. However, in order that the treatment be effective both drugs should be given in nonlethal but slightly toxic doses. The fatal terminations in horses 51 and 53 are due to drug intoxication, as in neither case the complete set of injections was tolerated. By changing the broken doses of naganol, as may be noted in horses 58, 60, and

65, it is believed that the line of treatment under discussion will be made less toxic to the animals than it would be otherwise, but its efficacy is apparently lowered, as illustrated by horses 58 and 65, which died possibly as a result of relapses. Moreover, it may also be surmised that the monosodium salt of etharsanol is tolerated better in combination with naganol than the free-acid preparation. Again, as far as the results of this experiment go, there seems to be no material difference between the efficacy of the two combinations. Finally, in equine surra with severe nervous involvement the writer entertains little hope in the value of the treatment discussed, notwithstanding the finding in experiment 3.

SUMMARY AND CONCLUSIONS

Experiments to determine the value of etharsanol and naganol alone and in combination in native horses affected with surra were performed.

It has been found that the monosodium preparation of etharsanol is useless against equine surra. The free-acid etharsanol to a certain degree can control artificial infection, provided the cerebrospinal fluid is free of the surra trypanosomes. On the other hand, where there is already cerebrospinal involvement, its value is very limited as far as permanent recovery is concerned.

In the use of naganol against artificially infected horses, it has been observed that so long as the fluid of the cerebrospinal system is free of the surra organism, it is safe to state that infection can be controlled permanently. However, with the involvement of the nervous system, naganol has limited value. In the four horses artificially infected and with positive cerebrospinal fluid, the drug was a complete failure.

Attempts to determine the length of time the surra trypanosome appeared in the cerebrospinal fluid after its appearance in the peripheral circulation were made on seventeen horses artificially infected with surra organisms. The results were variable. Ten of the seventeen animals were positive and the remainder negative. The average period before the fluid of the central nervous system was positive was 12.2 days, the minimum was 5 days, and the maximum 22 days. On the other hand, among horses with negative cerebrospinal fluid, the average period was 9.14 days, the minimum was 4, and the maximum 15. This finding invariably limits the value of either etharsanol and naganol as trypanocidal agents, when given alone and intravenously.

By administering both etharsanol and naganol in nonlethal but slightly toxic doses and in simultaneous injections, three experimental surra horses with positive cerebrospinal fluid and six of ten naturally infected animals were cured. Some of the results of the experiments indicate that there is a synergistic relation between the two drugs used, which is possibly responsible for the complete sterilization of the cerebrospinal fluid concurrently with the circulatory system. Lastly, the simultaneous injection of etharsanol and naganol is far superior to the use of either of the two drugs given alone and intravenously for the treatment of equine surra.

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STUDIES IN SURRA, II

PSEUDOREACTIONS IN COMPLEMENT-FIXATION TESTS FOR TRYPANOSOMIASIS

By RAYMOND RANDALL

Major, Veterinary Corps, United States Army; Member, United States Army Medical Department Research Board
Bureau of Science, Manila

The complement-fixation test for determining infection with *Trypanosoma evansi*, the only type of pathogenic trypanosome known to exist in the Philippine Islands, provides a means of diagnosis in those cases in which the first crisis has occurred and the trypanosomes have become so scarce in the circulation that repeated microscopic examinations of fresh blood and stained thick films are negative. Negative microscopical findings with strongly positive complement fixation have been found to occur in naturally infected horses, mules, carabaos, and cattle, as well as in laboratory-infected horses, mules, guinea pigs, and rabbits. An advantage of the complement-fixation test is that a strongly positive reaction that is biologically specific is obtained in the early stages and is continuous for the duration of the disease.

As there is considerable variation in different laboratories in the volume of reagents and kind of erythrocytes employed and in the method used in adjusting the hæmolytic system, the test should be standardized to meet local conditions, apparently a more important consideration in the Tropics, in order to avoid oversensitiveness.

False positive and suspicious reactions have been obtained in a few instances in horses and mules in the Philippine Islands that were free of trypanosomiasis. The following technic was used, which in the United States, in the experience of the writer, has given comparatively satisfactory results.

ORIGINAL TECHNIC

Three tubes containing 2 cc of physiological sodium chloride solution were employed for each specimen. Two tubes in the front row contained 0.2 cc and 0.1 cc of serum, respectively, and the serum control tube in the rear row contained 0.2 cc of the particular serum. The horse serums were inactivated in the water bath at 58° C. for thirty minutes and the mule serums at 62° C. for thirty-five minutes. The hæmolytic system consisted of 1 cc of a 3 per cent suspension of washed sheep cells, one and one-half units of pooled guinea-pig complement and one and one-half units of antisheep hæmolysin, each diluted to 1 cc with physiological sodium chloride solution. The unit of hæmolysin was determined by titration with 1 cc of a 5 per cent pooled guinea-pig complement, the complement unit by titrating against one and one-half units of hæmolysin. Both titrations were conducted at 37.5° C. for thirty minutes. The antigen consisted of a suspension of *Trypanosoma evansi* and was prepared from infected rats as described by Reynolds and Schoening.(1) The stock antigen was usually diluted 1: 20 and titrated in the presence of known positive and negative serums and two units used as the antigenic test dose, provided twice the antigenic dose was not anticomplementary in the presence of a negative serum. Complement and antigen were added to the serum and incubated at 37.5° C. for forty-five minutes. The hæmolysin and washed sheep cells were added, incubation continued for thirty minutes, and the tests read.

With this technic serum, antigen, and hæmolytic-system controls showed complete hæmolysis, although it was noted that in many of those serums later proven to have given pseudoreactions, the serum control tubes were slower to show complete hæmolysis than in those giving negative reactions.

Results with original technic.—The results shown in Table 1 were obtained with serums from horses and mules imported into the Philippines, over 90 per cent of which had been in the Islands for at least one year.

TABLE 1.—*Results of complement-fixation test by original technic.*

	Horses.	Mules.
Total examined	147	304
Strongly positive (4-plus)	None.	None.
Weakly positive (3-plus)	None.	7 (2.3 per cent.)
Suspicious (2-plus or less)	4 (2.7 per cent.)	19 (6.2 per cent.)

Practically parallel results were obtained by testing many of the reacting serums with a cholesterolized alcoholic extract of beef-heart antigen and to a lesser degree with equine infectious abortion and glanders antigens, indicating the nonspecific nature of these weak positive and suspicious reactions.

The test animals were bled with sterile needles into sterile test tubes and the serums recovered were free of bacterial contamination and hæmoglobin. If not tested within twenty-four hours the serums were preserved by using phenol to a concentration of 0.5 per cent. Inhibition of hæmolysis was more marked in serums separated as soon as the blood clotted than in those allowed to stand in contact with the clot for twenty-four hours.

Over 50 per cent of the serums giving pseudofixation reactions were obtained in animals during, or shortly after, an acute febrile condition of uncertain origin (temperature 40 to 40.5° C.) lasting for three to ten days. Repeated miscroscopical examinations and animal inoculation of the blood of these animals failed to reveal trypanosomes. Two mules, the serums of which showed the most constant and marked antilytic properties, were destroyed. Rats, rabbits, guinea pigs, horses, and mules injected with blood, spinal fluid, and organ emulsions from these mules, failed to develop any evidence of trypanosomiasis or change in their serum reactions. The autopsy findings on the two destroyed mules were negative with the exception of a few encapsulated parasitic nodules in the lungs and liver.

The opinion has been expressed(2) that one or more of the following factors—age of the animal, work, physical condition, and climate, particularly heat and humidity—tend to produce in the Philippine Islands this transitory febrile condition in both horses and mules. This febrile state evidently causes a metabolic disturbance that leads to the presence in the serum of a thermostabile component that is antilytic, and that may be demonstrated in varying amounts for a maximum of three months.

Serums from horses that had been in the Philippines less than three months did not give false positive or suspicious reactions. This group constituted slightly less than 10 per cent of the animals tested. No pseudoreactions were obtained in selected serums of horses and mules having microfilaria in their blood or those having intestinal parasites.

Mackenzie and Marshall(3) working with human serums of native dispensary patients in Northern Nigeria found 70 per cent to be anticomplementary, occurring most frequently in cases of human trypanosomiasis. The anticomplementary condition was thermostabile and while the significance of this phenomenon was not understood, it was strong enough to interfere with the satisfactory carrying out of the complement-fixation tests by their usual methods. They also found that in the hot season guinea-pig complement was of such poor quality that they were unable to use it. It has also been observed by the writer that hot weather and humidity may markedly affect the guinea pig as regards the hæmolytic activity of its serum.

We find the lytic activity of the complement usually to be uniform if obtained from at least three healthy, nonpregnant guinea pigs weighing about 400 to 500 g each that have not been fed for sixteen hours. It was found that removing drinking water in the fasting period, or removing the animals from their open pens to the laboratory overnight before bleeding, markedly reduced the lytic activity of the complement. The guinea pigs were bled from the heart on the morning of the test, the clots held at 37° C. for one hour, separated, and then centrifuged to recover the clear serum.

To lessen the chances of hæmagglutinins interfering with hæmolysis the antisheep hæmolytic system was varied to include washed erythrocytes from two sheep, and hæmolysins prepared against them, and complement serums obtained from widely separated groups of guinea pigs. These combinations were used without a great variance in the results obtained.

This experience with the false reactions indicated that the prescribed hæmolytic system was too closely adjusted for conditions in the Philippine Islands. It was found that in using one and one-half units each of complement and hæmolysin an insufficient amount of complement was left to activate completely the hæmolytic system at the end of a test on some negative serums. These findings lead to an effort to modify the technic to meet local conditions.

The equipment required for the original technic was not available in sufficient quantity for the volume of work this problem entailed. To utilize the standard Army Wassermann equipment on hand, also to effect an economy of reagents, the necessary modifications were made.

In addition, the method of preparing the antigen was modified and the hæmolytic system adjusted in an attempt to avoid oversensitiveness and still retain the desired degree of specificity.

MODIFIED TECHNIC

For each specimen three tubes containing 0.5 cc of physiological sodium chloride solution are employed with 0.1 cc and 0.05 cc, respectively, of serum for the test proper, and 0.1 cc of serum in the control tube. Inactivation of the serums is carried out as in the original technic.

The hæmolytic system contains 0.25 cc of 3 per cent washed sheep cells, two units of hæmolysin so diluted as to be contained in 0.25 cc, and two units of 10 per cent pooled guinea-pig complement, in contrast to some systems that use as high as five units of hæmolysin. The unit of complement is determined by titrating with two units of hæmolysin to prevent an excess of hæmolysin from lowering the volume of complement beyond the minimum required to avoid pseudocomplement fixation. It will be shown later that in antilytic serums the complement is absorbed and if the amount used in the test is low due to a large dose of hæmolysin, nonspecific complement-fixation reactions will occur due to an unbalanced hæmolytic system.

The complement is discarded if the unit as determined by the titration is below 0.05 cc or above 0.07 cc. The unit of complement is that amount contained in the first tube showing complete, crystal-clear hæmolysis when read through the bottom by means of a perforated tube rack.

The antigen is prepared according to the original method except that the citrated rat blood is centrifuged for four to five minutes at 2,000 revolutions to throw the red cells to the bottom of the centrifuge tubes. The supernatant and stratum of trypanosomes are collected nearly free of red blood cells. This method reduces the number of unlaked red blood cells and the amount of stroma from hæmolyzed cells in the finished antigen. The unit of antigen is always smaller than with the original technic and gives a much wider range between the antigenic and the anticomplementary doses. In the test three antigen control tubes are included, containing one, two, and three test doses of antigen, respectively, to test its anticomplementary properties with the particular guinea-pig complement used.

Comparative results with other types of antigens.—Dahmen's(4) alcoholic and watery extracts of trypanosomes were also used as antigens in conducting complement-fixation tests for *Trypanosoma evansi* infection. Neither antigen showed any advantage over the one mentioned above. In addition, the time consumed in preparing antigens by his methods and the very small yield obtained are objectionable features.

Sensitiveness and specificity of the modified technic.—To test the sensitiveness and specificity of this modified technic, a horse was selected whose serum was not antilytic and the animal inoculated with 0.1 cc of guinea-pig blood containing *Trypanosoma evansi.* Fresh blood films were examined and the temperature taken daily. On the seventh day the temperature of the animal was elevated to 39.4° C. and a microscopic examination of the fresh blood revealed two trypanosomes per microscopic field; the complement-fixation test was negative. The following day the complement-fixation test was one-plus and eight trypanosomes were found per field. On the following, or ninth day, the complement fixation was three-plus with only three trypanosomes per field, and on the following, or tenth day after inoculation, the complement fixation was four-plus and continued so for the duration of the infection. It has also been found in other cases that about seventy-two hours after the first finding of trypanosomes in the blood the complement-fixation test becomes strongly positive.

PROPERTIES OF THE ANTILYTIC SERUMS

By conducting the complement-fixation tests with the modified technic, the number of serums that had formerly given false weakly positive and suspicious reactions was materially reduced but not entirely eliminated.

Determination of the antilytic titer of the serums.—Serums from those animals which gave the more-pronounced reactions were obtained and tested to determine their effect on the complementary activity of guinea-pig serum in comparison with known positive and nonreacting negative serums. This was determined by adding increasing amounts of 10 per cent complement to a series of ten tubes containing 0.1 cc of the particular inactivated serum in 0.5 cc of physiological sodium chloride solution, followed by incubation in the water bath at 37.5° C. for forty-five minutes. Two units of hæmolysin and 0.25 cc of a 3 per cent suspension of washed sheep cells were added to each tube and incubation continued for thirty minutes. The extent of the antilytic properties of each serum was then determined by comparing with a control series titrated without the addition of serum. The experiment was repeated with the addition of one test dose of antigen to each tube at the time the complement was added.

Table 2 shows that serum from Army horses and mules in the Philippine Islands will, at times, if obtained while the animal is in an acute febrile state and to lesser degrees for varying periods thereafter, contain a thermostabile component that is markedly antilytic. With the addition of antigen it is shown that the degree of pseudoreactions obtained is greater than the summation of the antilytic effect of the particular serum and the test dose of antigen.

TABLE 2.—*Antilytic titer of negative serums with and without antigen.*

[S = Complement titration plus 0.1 cc of inactivated mule serum. A = One dose of antigen added.]

		Cubic centimeter of 10 per cent complement.									
		0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
Complement titration		+	+	—	—	—	—	—	—	—	—
Complement titration with antigen		+	+	+	—	—	—	—	—	—	—
Mule 1	S	+	+	+	+	+	—	—	—	—	—
	S+A	+	+	+	+	+	+	+	+	—	—
Mule 2	S	+	+	+	+	+	+	+	—	—	—
	S+A	+	+	+	+	+	+	+	+	+	—
Mule 3	S	+	+	+	+	+	+	—	—	—	—
	S+A	+	+	+	+	+	+	+	+	+	—
Mule 4	S	+	+	+	+	+	+	—	—	—	—
	S+A	+	+	+	+	+	+	+	+	—	—
Control mule	S	+	+	+	—	—	—	—	—	—	—
	S+A	+	+	+	+	+	—	—	—	—	—
Control horse	S	+	+	—	—	—	—	—	—	—	—
	S+A	+	+	+	—	—	—	—	—	—	—
Filaria infected horse	S	+	+	+	—	—	—	—	—	—	—
	S+A	+	+	+	+	+	—	—	—	—	—

Duration of antilytic properties.—To determine the persistence of this antilytic property of serums occurring in febrile states, two mules with temperatures above 40° C. were bled and the antilytic titer of their serums determined. This was repeated after six days when the animals' temperatures had returned to normal and again after approximately a year. As shown in Table 3, marked antilytic properties were demonstrated during the febrile state, diminishing six days after when the temperatures were normal, and found to have disappeared after a lapse of approximately a year.

TABLE 3.—*Titer and duration of antilytic properties in mule serums.*

[A = Serums obtained while mules were in acute febrile state. B = Serums obtained six days after temperatures had returned to normal. C = Serums obtained approximately one year later.]

		Cubic centimeter of 10 per cent complement.									
		0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
Complement titration		+	+	+	—	—	—	—	—	—	—
Mule C423	A	+	+	+	+	+	+	+	—	—	—
	B	+	+	+	+	+	—	—	—	—	—
	C	+	+	+	+	—	—	—	—	—	—
Mule 2C52	A	+	+	+	+	+	+	—	—	—	—
	B	+	+	+	+	—	—	—	—	—	—
	C	+	+	+	—	—	—	—	—	—	—

Tests for native complement and antisheep hæmolysin in the antilytic serums.—There is an apparent tendency of certain pathologic conditions, especially of a febrile nature, to increase the anticomplementary properties of the serum, and in these conditions there occurs, at times, a known diminution of native complement. Coca,(5) working with serums from a strain of guinea pigs that were lacking in complement, found that the midpiece and endpiece of the complement is present but the thirdpiece is very small in amount. This lacking portion, which is thermostabile, can be replaced by adding inactivated guinea-pig or human serum containing this third component, thereby enhancing the hæmolytic activity of the complement about three times.

No native complement could be demonstrated in the active serums included in Table 2. This may have been due to the masking effect of the antilytic properties of the serums. In amounts as low as 0.025 cc certain active mule serums were found to inhibit hæmolysis with two units of guinea-pig complement and two units of hæmolysin, nor could native complement be demonstrated when the experiment was repeated with the addition of either inactivated human or guinea-pig serums. In addition, native antisheep hæmolysin could not be demonstrated.

Auxilytic effect of inactivated guinea-pig serums with inactivated antilytic serums.—Havens and Frank(6) titrated twelve lots of normal guinea-pig serums in different combinations and found that the addition to each tube of 0.1 cc of inactivated human serum containing the thermostabile component of complement had fortified the complementary action of eleven of them, so that less of the latter was required to cause complete hæmolysis. Their work indicates that the complementary activity of normal serum complement can be enhanced by the addition of an inactivated serum containing the third or thermostabile component of complement. Hyde(7) in his work demonstrated that the thermostabile portion of complement may be removed by absorption with yeast.

To determine what effect the addition of inactivated guinea-pig serum containing the thermostabile portion of complement to known antilytic inactivated mule serums would have on the complementary activity of guinea-pig complement, the following experiments were conducted:

1. After several trials a guinea-pig complement was obtained that was not enhanced by the addition of inactivated guinea-pig serum in amounts used in the subsequent determinations.

2. The inactivated mule serums, known to be antilytic, were tested individually in 0.1 cc amounts to determine their effect on the complementary activity of the guinea-pig complement. The procedure was repeated with the addition of 0.01 cc per tube of inactivated guinea-pig serum and the effect noted.

3. The above titrations were repeated with one of the mule serums that had been absorbed with yeast.

TABLE 4.—*Auxilytic effect of inactivated guinea-pig serum with antilytic mule serums.*

[S=Complement titration plus 0.1 cc of inactivated mule serum. SY=Same as S but serum absorbed with yeast. G=0.01 cc of inactivated guinea-pig serum added.]

		Cubic centimeter of 10 per cent complement.									
		0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
Complement titration		+	+	—	—	—	—	—	—	—	—
0.01 cc inactivated guinea-pig serum added		+	+	—	—	—	—	—	—	—	—
Mule 28W1	S	+	+	+	+	+	+	—	—	—	—
	S+G	+	+	+	+	—	—	—	—	—	—
Mule E116	S	+	+	+	+	+	—	—	—	—	—
	S+G	+	+	+	—	—	—	—	—	—	—
Mule BO39	S	+	+	+	+	+	—	—	—	—	—
	S+G	+	+	+	—	—	—	—	—	—	—
Mule BO39	SY	+	+	+	+	+	+	+	—	—	—
	SY+G	+	+	+	+	+	—	—	—	—	—

The results are shown in Table 4. It was found that while inactivated guinea-pig serum in amounts of 0.01 cc per tube in the complement titration did not enhance the complementary power for this particular guinea-pig complement, the addition of the same amount of inactivated guinea-pig serum markedly reduced the antilytic properties of the inactivated mule serums. It was also found in inactivated mule serum absorbed with yeast that the antilytic range of the serum was increased, whereas the addition of 10 per cent inactivated guinea-pig serum to the same yeast-absorbed serum reduced the antilytic properties, apparently showing that the antilytic mule serum had contained the thermostabile portion of native complement.

Serums from *Trypanosoma evansi*-infected animals were then run in duplicate, with and without the addition of 0.01 cc per tube of inactivated guinea-pig serum, for the determination of the complement-fixing units. The results showed that the addition of the inactivated guinea-pig serum did not reduce the titer of the positive serums although the antilytic properties of certain negative serums were somewhat reduced.

The absorption of "protectin" from antilytic mule serums with sheep erythrocytes.—According to Noguchi(8) antilytic serums may contain lipoidal substances designated by him as "protectin" which are absorbed by the erythrocytes of the hæmolytic system, thereby increasing their resistance to hæmolysis. Kolmer(9) states that he has not found sheep erythrocytes exposed to human, rabbit, and dog serums, previously heated for periods from one-half to three hours at 56° to 58° C., to acquire any increased resistance to either serum or saponin hæmolysis, but found the corpuscles were usually somewhat more susceptible to these agents than the control suspension.

Of the three mule serums included in Table 4, one was found to be less antilytic after absorption and the sheep erythrocytes used for absorption more resistant to hæmolysis. No change was observed in the other two serums, nor in the cells used, showing that the antilytic properties in the serums under discussion are not wholly dependent upon the presence of "protectin."

Influence of heat on antilytic properties and complement-fixing antibodies in serums.—The complement-inhibiting properties of certain antilytic horse and mule serums that had been determined after inactivating horse serums at 58° C. for thirty minutes and mule serums at 62° C. for thirty-five minutes were inactivated at 60° and 65° C., respectively, for the same periods of time. The antilytic properties were only slightly decreased in the horse serums but showed a decided decrease in the mule serums. The titers of positive mule serums run as checks at 65° C. were reduced to such an extent as to preclude this temperature as the proper inactivating temperature for mule serums. Only two positive horse serums were available at this time and the diminution of their titers was so slight as to be of no great consequence.

Antilytic component of the albumin and globulin fractions of the serums.—Kolmer(9) states that it has been the general result of his experiments that both the thermolabile and thermostabile antilysins of human serum and spinal fluid are associated with the globulin fractions. To determine what fractions of antilytic mule serums contained the thermostabile antilysins, two of the antilytic mule serums were fractioned by adding ammonium sulphate to 50 per cent of saturation. The precipitate containing the globulin fractions was removed by filtration. The globulin fractions and the filtrate containing the albumin fraction were dialyzed against running water for seventy-two hours to remove the ammonium salt. A few drops of chloroform were added to the dialyzed material as a preservative. The fractions were adjusted to the original volume of the serum with sodium chloride solution. The fractions and original serums were then inactivated and titrated in amounts to represent 0.1 cc of serum against graduated doses of 10 per cent complement. It was found that while the globulin fractions were the more antilytic the albumin fraction showed marked antilytic properties.

THE ADJUSTMENT OF THE HÆMOLYTIC SYSTEM

Kolmer(9) states that in building up a hæmolytic system it is of prime importance to so adjust the quantities of corpuscles and hæmolysin that the complement unit will never fall below a certain minimum because the amount or unit of complement required for complete lysis of a given amount of corpuscles may be reduced so greatly by an excess of powerful hæmolysin as to render the unit entirely worthless in complement-fixation tests, owing to the anticomplementary effects of antigen and serum alone and the deterioration of complement during the period of primary incubation. Conversely, a deficiency in hæmolysin in the complement-fixation test may also result in false reactions with negative serums.

Effect of increasing the units of hæmolysin.—An attempt was made to determine if increasing the number of units of hæmolysin would compensate for a deficiency of complement due to its nonspecific fixation by certain horse and mule serums that in some instances approximated the one and one-half units formerly used in the routine test. These antilytic horse and mule serums from animals free of trypanosomiasis were tested with hæmolytic systems composed of three units of hæmolysin with one unit and one and one-half units of complement, respectively, the complement unit having been determined by titration with three units of hæmolysin.

Table 5 shows that although the number of units of hæmolysin is increased the amount of complement serum used in the test is lowered to such an extent that there is an increase in the number and degree of pseudoreactions. It is also shown that with these hæmolytic systems many of the serum-control tubes did not completely hæmolyze.

TABLE 5.—*Effect of increasing the units of hæmolysin.*

Animal.	Three units of hæmolysin.			
	One unit of compl ment.		One and one-half units of complement.	
	Test proper.	Serum control tube.	Test proper.	Serum control tube.
Mule 1	+++	+	++	—
Mule 2	+++	++	++	±
Mule 3	+++	++	+++	+
Mule 4	+++	++	++	±
Mule 5	+++	+	++	—
Mule 6	++++	+++	+++	++
Mule 7	+++	++	+++	+
Mule 8	++	—	+	—
Horse 1	++	+	—	—
Horse 2	+	±	±	—
Horse 3	+	±	±	—
Horse 4	++	+	±	—

Comparative results with two exact and two full units of complement.—These serums were retested with hæmolytic systems containing (*a*) two exact units of complement and two units of hæmolysin and (*b*) two full units of complement and two units of hæmolysin, the complement unit having been determined by titration with two units of hæmolysin. The full unit of complement was a modification of Kolmer's full unit as antigen was omitted during the titration.

As shown in Table 6, two units of hæmolysin with two units of complement markedly reduced the number of pseudoreactions, while two units of hæmolysin with two full units of complement gave a negative reaction in each instance.

Comparative tests were made on serums of horses and mules infected with *Trypanosoma evansi*, using hæmolytic systems as in (*a*) and (*b*) above. Serums from animals in the early stages of the disease that gave weakly positive and suspicious reactions in the former system would at times give reactions that were only suspicious or occasionally negative when tested with a system containing two full units of complement. Serum obtained forty-eight to seventy-two hours after the original specimen was collected usually gave a positive reaction with both hæmolytic systems showing a rapid rise in the titer of the complement-fixing antibodies.

TABLE 6.—*Effect of increasing the units of complement.*

Animal.	Two units of hæmolysin.			
	Two exact units of complement.		Two full units of complement.	
	Test proper.	Serum control tube.	Test proper.	Serum control tube.
Mule 1	+	—	—	—
Mule 2	++	—	—	—
Mule 3	++	—	—	—
Mule 4	+	—	—	—
Mule 5	±	—	—	—
Mule 6	++	±	—	—
Mule 7	±	—	—	—
Mule 8	—	—	—	—
Horse 1	—	—	—	—
Horse 2	—	—	—	—
Horse 3	—	—	—	—
Horse 4	—	—	—	—

RESULTS WITH THE MODIFIED TECHNIC

With the modified complement-fixation test for trypanosomiasis, using a hæmolytic system containing two exact units each of complement and hæmolysin, over 1,000 serums have been examined routinely and the results obtained have been very satisfactory. However, it is essential with serums giving weakly positive or suspicious reactions, to determine the antilytic titer of the particular serum by titrating with graduated doses of complement, two units of hæmolysin, and without antigen. If antilytic, the particular serum is retested with the additional amount of complement that the serum is shown to absorb or neutralize.

SUMMARY

In performing the complement-fixation test for trypanosomiasis in the Philippine Islands, some weakly positive and suspicious reactions have occurred in horses and mules free of trypanosomiasis. These have been shown to be pseudoreactions due to a thermostabile antilytic component in the serums. This phenomenon occurs frequently during, and for some period following, an acute febrile state of unknown origin.

The properties of these antilytic serums have been investigated by various methods and the results recorded. The nature of the antilytic substance or component has not been determined.

A modification of the complement-fixation test for trypanosomiasis is presented which in the Philippine Islands has resulted in the practical elimination of the pseudoreactions formerly obtained.

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MALARIA AND ANOPHELES RECONNAISSANCE IN THE PHILIPPINES, II [1]

By Paul F. Russell

Of the International Health Division of the Rockefeller Foundation

ONE PLATE

INTRODUCTION

This paper continues the report of Holt and Russell(1) on the incidence of malaria in the Philippines, presenting new data and a resumé of spleen and blood surveys. It will not be necessary, therefore, to review other malaria and *Anopheles* surveys made in the past, as this was done in the first paper, (1). where there was also given a brief discussion of climatological conditions in the Philippines, with maps and tables.

SPLEEN RECONNAISSANCE

The conclusions of the first report as regards the value of spleen rates in a malaria reconnaissance in the Philippines are still held. Here, as elsewhere, the spleen index appears to be what Ross, Christophers, and Perry(2) called it, the "most readily and extensively applicable, and at the same time the most reliable measure of the amount of malaria in a community."

The technic of examination has been, wherever possible, the more sensitive method of Darling.(3) The child is placed in a recumbent position with thighs and legs flexed. The clothing is removed or loosened so that the hand of the examiner can be

[1] The surveys and laboratory studies on which this paper is based were made by the staff of Malaria Investigations, a project jointly supported by the Bureau of Science, Manila, and the International Health Division of the Rockefeller Foundation. The Bureau of Health is coöperating through the assignment to Malaria Investigations of Mr. F. E. Baisas, chief malaria inspector, to whom the author is greatly indebted for collaborating in the identification of anopheline specimens. Thanks are also due Mr. A. M. Nono, and Mr. Domingo Santiago, chief field inspector and field inspector, respectively, of Malaria Investigations, for their collecting zeal. Finally, the author is indebted to Maj. G. C. Dunham, medical adviser to the Governor-General of the Philippine Islands, for his assistance several times during this reconnaissance.

placed upon the bare skin of the abdomen. Standing at the child's right, the examiner gently but firmly explores the upper left quadrant of the abdomen with the finger tips, feeling for an enlarged spleen. If the spleen is not palpable, the child is instructed to inspire deeply. The tips of the fingers of the examiner's right hand are held just below the costal margin. As the child inspires, slight pressure is made with the fingers and sometimes the spleen, apparently pushed downwards by the diaphragm, becomes palpable.

Palpable spleens were classed as follows, after Boyd:(4)

Spleen 0. Not palpable.
Spleen P. D. I. Palpable only on deep inspiration.
Spleen 1. Palpable at the costal margin on normal respiration.
Spleen 2. Palpable and extending halfway to the umbilicus.
Spleen 3. Palpable and extending to the umbilicus.
Spleen 4. Palpable and extending below the umbilicus.

On the basis of the experience of the surveys reported here and in the first paper(1) it appears that spleen rates of more than 5 per cent are indicative of malaria. But unless the spleen rate is more than 10 per cent there is probably no transmission of malaria in the community. Rates between 5 and 10 per cent have pointed to imported cases. For example, in the barrio of Camp Labi there was no indication of malaria transmission, the carrying anopheline being absent and local histories negative. A spleen rate of 7 per cent was found. On investigation it was shown that some of the inhabitants had come from malarious regions and gave a positive history of malaria prior to coming to Camp Labi. In Manila, the spleen rate in 215 examinations was 3.3 per cent. This is probably a normal, nonmalarious rate. In 100 of these cases blood smears were taken and found negative. In Bay, Laguna, the spleen rate was 12.6 per cent. The carrying mosquito exists in Bay and there were positive histories showing that transmission undoubtedly occurs in Bay.

The spleen survey statistics are given in Tables 1 and 2. As noted in the first table, a total of 991 spleen examinations are reported from seven provinces. Spleen rates varied from 3.0 in Manila and 3.5 in Cebu to 90.0 in Bongabong Saw Mill and 68.1 in Puerto Princesa.

In Table 2, spleen palpations are summarized by provinces, including those reported in the first paper. The total is 8,791, in 122 localities, with 1,655 or 18.8 per cent palpable. Percentages by provinces are not given for they may be misleading. Not enough samples have been taken yet from the various provinces to give a fair grading as regards malaria. As elsewhere, so in the Philippines, malaria is not evenly distributed. In most provinces there are nonmalarious areas, and also localities where malaria is faintly, mildly, or severely endemic. The disease is found in every province in the Archipelago and is probably being transmitted in every one but Manila. The spleen surveys have borne out the conclusion of the first paper (1) that malaria in the Philippines is primarily a disease of foothill regions.

PARASITE STUDIES

The results of blood-smear examinations are given in Tables 3, 4, and 5. It will be noted that in a total of 1,065 examinations, reported in Table 3, there were 264, or 24.8 per cent, positive smears. Of the species, *Plasmodium vivax* was commonest and *P. malariæ* was least often found.

In Table 4, the results of the first reconnaissance have been included, making a total of 2,302 blood-smear examinations with 544, or 23.6 per cent, positive.

Table 5 reveals a correlation between spleen size and percentage of positive smears. Only 1.7 per cent of those with negative spleens and whose blood was examined had a positive smear. Of those having a size 4 spleen, 87.5 per cent were also blood positive. It is interesting to note that 54.4 per cent of those whose spleens were only palpable on deep inspiration had positive blood smears.

ANOPHELES RECONNAISSANCE

In this report practically the same classification is used as was given (with some misprints) in the first paper (1) although this is provisional and will doubtless have to be modified. This classification is as follows:

1. *Anopheles aitkeni* var. *bengalensis* Puri, 1930.
2. *Anopheles barbirostris* van der Wulp, 1884.
3. *Anopheles filipinæ* Manalang, 1930.
4. *Anopheles fuliginosus* Giles, 1900.
5. *Anopheles gigas* var. *formosus* Ludlow, 1909.
6. *Anopheles hyrcanus* var. *nigerrimus* Giles, 1900.

7. *Anopheles hyrcanus* var. *sinensis* Wiedemann, 1828.
8. *Anopheles insulæflorum* Swellengrebel and Swellengrebel de Graaf, 1920.
9. *Anopheles karwari* James, 1903.
10. *Anopheles kochi* Dönitz, 1901.
11. *Anopheles leucosphyrus* Dönitz, 1901.
12. *Anopheles lindesayi* var. *benguetensis* King, 1931.
13. *Anopheles litoralis* King, 1932. ("Salt-water *ludlowi.*")
14. *Anopheles ludlowi* Theobald, 1903. ("Fresh-water *ludlowi.*")
15. *Anopheles maculatus* Theobald, 1901.
16. *Anopheles mangyanus* Banks, 1907.
17. *Anopheles minimus* var. *flavirostris* Ludlow, 1914.
18. *Anopheles parangensis* Ludlow, 1914.
19. *Anopheles philippinensis* Ludlow, 1902.
20. *Anopheles pseudobarbirostris* Ludlow, 1902.
21. *Anopheles subpictus* var. *indefinitus* Ludlow, 1904. ("*A. rossi.*")
22. *Anopheles tessellatus* Theobald, 1901.
23. *Anopheles umbrosus* Theobald, 1903 (variety).
24. *Anopheles vagus* var. *limosus* King, 1932.
25. *Anopheles kolambuganensis* Baisas, 1931.
26. *Anopheles* species from Balabac, Palawan. (?)
27. *Anopheles aitkeni* variety from Banahao, Laguna. (?)

In the above list Nos. 25 to 27 were not given in the first report. Descriptions of Nos. 26 and 27 will be published in due time. The *funestus-minimus* subgroup (see King, 5) has been greatly confused in the past. For example, probably *A. mangyanus* has included *A. minimus* var. *flavirostris* and *A. filipinæ*. It seems likely that *A. minimus* var. *flavirostris* has included "*A. funestus,*" "*A. minimus,*" *A. filipinæ*, and *A. mangyanus*.

The species of anopheles larvæ collected are listed in Table 6 by localities and type of breeding place. This table includes collections made in twenty-two provinces in the year 1933. If the collections reported in the first paper(1) are included, then forty-eight of the forty-nine provinces are represented, only Camarines Norte being unvisited in this reconnaissance. In this province, therefore, as well as in Capiz, Iloilo, Manila, Romblon, and Surigao, the important *A. minimus* var. *flavirostris* has not been reported in the table of this reconnaissance. In the case of all but Manila this is due to the inadequacy of the collecting and not to an absence of this anopheline. The species apparently does not exist in Manila, as numerous collections have not shown it. However, in San Francisco del Monte, a suburb of Manila, in Rizal Province, *A. minimus* var. *flavirostris* has been found.

The collections reported in this paper continue to bear out the observations of the first report(1) in that malaria and *A. minimus* var. *flavirostris* are closely associated, more so than in the case of any other species. In the first paper it was noted that *A. barbirostris* was also frequently found in malarious places. But this species has never been found infected in nature. Walker and Barber(6) were able to infect six in one hundred *A. barbirostris* experimentally. But Manalang(7) in several thousand dissections of wild-caught *A. barbirostris* has not found this mosquito infected. It does not appear to play an important rôle in the transmission of malaria in the Philippines, if indeed it has any rôle at all.

In Table 6 all of the local anophelines are represented in the collections excepting *A. gigas* var. *formosus*. This species was reported in the first paper(1) so that during this reconnaissance all of the accepted species of anophelines in the Islands have been collected, as well as an apparently new species from Balabac, Palawan, and a new variety from Banahao, Laguna. These will be described in another paper. It also appears that certain larvæ called *A. umbrosus* are really *A. baezai* Gater, 1933, hitherto unreported from the Philippines. This finding will also be discussed in due time.

The number of times each species has been collected is shown in Table 7 and the association of certain species is shown in Table 8. It will be seen that *A. barbirostris* and *A. minimus* var. *flavirostris* have been most often taken; also that the association between these two species is the commonest one encountered.

CONCLUSIONS

In a continuation of the malaria reconnaissance of Holt and Russell(1) in the Philippines, new data are presented which are in line with the conclusions of the first paper. As a result of the combined studies it is concluded that:

1. Malaria is widespread throughout the Philippine Archipelago.
2. The disease is primarily one of foothill regions, being found wherever there are streams containing the larvæ of *A. minimus* var. *flavirostris*. The littoral when flat, the inland plains, and the mountains above 2,000 feet are not malarious.
3. Spleen palpations furnish a useful index to the incidence of malaria in Philippine communities.
4. There is a positive correlation between degree of splenic enlargement and percentage of positive blood smears.

TABLE 1.—*Spleen survey by locality and size of spleen.*

Province and locality.	Date.	Examined.	Negative.	Size of spleen.					Positive.	
				P. D. I.	1	2	3	4	Number.	Per cent.
Bataan:										
Mariveles	Apr., 1932	48	44	4					4	8.4
Cabcaban	Apr., 1932	11	5		5		1		6	54.5
Cebu:										
Cebu	Oct., 1933	136	131	3	1	1			5	3.5
Laguna:										
Bay	Nov., 1933	86	75	5	5	1			11	12.6
Calauan	Nov., 1933	76	45	16	7	5	2	1	31	40.0
Magdalena	Nov., 1933	72	34	14	17	5	2		38	52.5
Manila:										
San Andres School	Oct., 1933	100	97	3					3	3.0
Nueva Ecija:										
Camp Labi	June, 1933	41	38	3					3	7.0
Bongabong Saw Mill	June, 1933	10	1	2	3	2	2		9	90.0
Bongabong Lower Camp	June, 1933	10	9		1				1	10.0
Nueva Vizcaya:										
Aritao	Feb., 1933	30	20	4	3	2	1		10	33.3
Palawan:										
Culion nonleper school	Dec., 1933	84	72	9	3				12	14.0
Culion leper school	Dec., 1933	28	26	2					2	7.0
Iwahig school	Dec., 1933	146	107	25	9	2	3		39	26.7
Puerto Princesa School	Dec., 1933	113	36	31	27	12	6	1	77	68.1
Total		991	740	121	81	30	17	2	251	25.3

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TABLE 2.—*Spleen examinations by provinces.*

Province.	Localities visited.	Examined.	Positive.
Abra	2	160	48
Albay	3	186	21
Antique	1	115	18
Bataan	12	1,135	144
Batangas	4	298	47
Cagayan	4	164	33
Camarines Sur	3	184	42
Capiz	1	89	2
Cebu	1	225	7
Davao	4	175	10
Ilocos Norte	3	287	93
Ilocos Sur	3	187	50
Isabela	2	126	34
Laguna	7	618	202
La Union	3	164	33
Leyte	2	118	18
Manila	3	215	7
Masbate	1	99	7
Mindoro	3	103	55
Mountain	4	79	0
Nueva Ecija	7	256	97
Nueva Vizcaya	5	178	136
Palawan	4	371	130
Pampanga	4	1,143	38
Pangasinan	4	251	32
Rizal	1	99	3
Samar	1	47	13
Sorsogon	4	220	38
Sulu	10	578	130
Tayabas	7	386	54
Zambales	5	224	27
Zamboanga	4	311	86
Total	122	8,791	1,655

TABLE 3.—*Blood smear examinations by locality and findings.*

Province and locality.	Examined.	Positive.		Species of *Plasmodium*.					Date.
				Vivax.	*Falciparum.*	*Malariæ.*	Undetermined.	Mixed.	
			P.ct.						
Cebu:									
Cebu	5	0	0.0						Oct., 1933.
Laguna:									
Bay	86	6	7.0	3	2		1		Nov., 1933.
Calauan	76	22	28.8	15	7		1	1	Nov., 1933.
Magdalena	72	33	45.8	16	18		1	2	Nov., 1933.
Manila:									
San Andres School	100	0	0.0						Oct., 1933.
Nueva Ecija:									
Bongabong Saw Mill	7	5	71.4	3	2				July, 1933.
Nueva Vizcaya:									
Aritao	300	95	31.7	67	26	2			Feb., 1933.
Palawan:									
Culion, nonleper school	83	5	6.0	3	1		1		Dec., 1933.
Culion, leper school	28	0	0.0						Dec., 1933.
Culion, Pilapil	16	5	31.3	1	5			1	Dec., 1933.
Culion, Baldat	24	11	45.8	4	7				Dec., 1933.
Culion, Patag	9	1	11.1	1					Dec., 1933.
Iwahig Penal Colony	146	24	13.7	14	10				Dec., 1933.
Puerto Princesa School	113	57	50.4	32	23	1	4	3	Dec., 1933.
Total	1,065	264	24.8	159	101	3	8	7	

TABLE 4.—*Summary of blood-smear examinations.*[a]

	Number.	Per cent.
Provinces	9	
Localities	20	
Smears examined	2,302	
Smears positive	544	23.6
Plasmodium vivax	328	[b] 60.3
Plasmodium malariæ	6	[b] 1.1
Plasmodium falciparum	244	[b] 44.9
Mixed	29	[b] 5.3
Undetermined	11	[b] 2.0

[a] Table includes figures from the first report. (1) [b] Percentage of positive smears.

TABLE 5.—*Spleen size and blood smears.*[a]

Spleen size.	Total smears.	Positive smears.	
		Number.	Per cent.
Negative	521	9	1.7
P. D. I	114	62	54.4
1	109	71	65.1
2	52	36	69.2
3	26	19	73.1
4	8	7	87.5

[a] Includes figures from first report. (1)

TABLE 6.—*Anopheles larvæ taken during reconnaissance in 1933, listed by province, locality, and species.*

Locality.	Lot No.	Date.	Larvæ.[b]	Breeding places.[b]	Remarks.
		1933			
AGUSAN					
Ampayon, Butuan	R33	May 13	2, 15, 16, 17	S C G	
BATANES					
Basco	5	Mar. 27	17	S C G	
San Pioquinto	6	Mar. 29	3, 15, 17	S C U	
Do.	7	Mar. 29	2, 19	P C U	
BUKIDNON					
Maloco	R35a	May 14	4, 19	P C G	
Lonocan	R35b	May 14	17	S C G	
CAGAYAN					
Aparri	9a	Mar. 30	7	W C G	
COTABATO					
Awang	R25a	May 7	17	S C G	Copiton Creek.
Do.	R25b	May 7	2, 17	S M G	Do.
Cocal	R25c	May 7	21	O D M	
Cotabato	R25d	May 7		Canal	Cotabato Canal. No *Anopheles*.
Tibud	R26	May 8	13	O P U	West of Tinaca Light.
DAVAO					
Santa Ana	R27	May 9	13	O P U	
Matina	R27a	May 9	15, 16, 17	S C G	
Mati	R29	May 10	2, 15	Tank	Spring water.
ILOCOS NORTE					
Deriquie	4	Mar. 26	2, 3, 17	S C G	
ILOCOS SUR					
Vigan	3a	Mar. 25	2, 3, 19, 21	P C G	North of provincial building.

LAGUNA					
Calauan Mountain	2, 2a, 2b	Mar. 9	2, 15, 16, 17	S C G	
Calauan	(a)		2, 3, 6, 7, 10, 16, 17, 21, 22, 24	Various	Routine collections.
Do	(a)	Apr. 26	2, 17	W C G	Water 7 feet from surface of ground.
Los Baños	(a)		2, 11, 17	S C G	Molawin Creek.
Banahao	4–11	Mar. 21–22	11, 12, 15, 27	S C G	
San Antonio Mountain	3a to j	Mar. 15	3, 4, 7, 9, 10, 24		
LANAO					
Kolambugan			16, 17, 25	S C G	
Boroon, Iligan	R37a	May 15	17	S C G	
Tinoja, Iligan	R37b	May 15	17	S C G	
Camp Overton	R37c	May 15	8	S C U	
Abaga, Dansalan	R37d	May 15	17	S C U B	
Lanao	R37e	May 15	21	L C U	Lake Lanao.

[a] Various.

[b] The species of mosquito larvæ collected are indicated by numbers and the types of breeding places by letters, as follows:

Anopheles—
1. *aitkeni* var. *bengalensis.*
2. *barbirostris.*
3. *filipinæ.*
4. *fuliginosus.*
5. *gigas* var. *formosus.*
6. *hyrcanus* var. *nigerrimus.*
7. *hyrcanus* var. *sinensis.*
8. *insulæflorum.*
9. *karwari.*

Anopheles—
10. *kochi.*
11. *leucosphyrus.*
12. *lindesayi* var. *benguetensis.*
13. *litoralis.*
14. *ludlowi.*
15. *maculatus.*
16. *mangyanus.*
17. *minimus* var. *flavirostris.*
18. *parangensis.*

Anopheles—
19. *philippinensis.*
20. *pseudobarbirostris.*
21. *subpictus* var. *indefinitus.*
22. *tessellatus.*
24. *vagus* var. *limosus.*
25. *kolambuganensis.*
26. Balabac species.
27. Banahaw variety.

BREEDING PLACES

S, stream.
R, river.
P, pool.
L, lake.

D, ditch, still.
I, irrigation ditch, flowing.
W, well.
O, ocean, salt water.
B, bamboo.

G, shaded.
U, unshaded.
C, clear.
M, muddy.

TABLE 6.—*Anopheles larvæ taken during reconnaissance in 1933, listed by province, locality, and species*—Continued.

Locality.	Lot No.	Date.	Larvæ. [a]	Breeding places. [b]	Remarks.
		1933			
LA UNION					
San Fernando	1	Mar. 24	13	O P U	
Do	2	Mar. 24	17	S C U	Overflow from a well.
MARINDUQUE					
Boac	R44a	May 23	14, 15	R C U	Boac River.
Do	R44b	May 23	10, 14, 17	S C G	Small stream in Boac.
Do	R44c	May 23	24	P M U	
MINDORO					
Calapan	R45	May 24	24	P M U	
Cabra Island	R11	Apr. 23			No anophelines.
Apo Reef	R12	Apr. 23			Do.
Ambolong	R13	Apr. 23			Do.
NUEVA ECIJA					
Camp Labi		July	1, 2, 8, 15–16	S C U	
Bongabon Saw Mill		July	2, 3, 8, 15, 16, 17	S C U	
Balete Pass		June	3 16, 17	S C G	Km. 194–195.
NUEVA VIZCAYA					
Aritao			15, 17	S C G	
OCCIDENTAL MISAMIS					
Jimenez	R39	May 16	17	D M U	
Oroquieta	R40	May 16	17, 20	D M U	
Tagolo Point	R41	May 16	2, 17, 21	S C G	
OCCIDENTAL NEGROS					
Pulupandan	R42a	May 19	13	O P U	
Do	R42b	May 19	13	O P U	

ORIENTAL MISAMIS						
Mambajao, Camiguin Island	R34a	May	13	16, 17	S M G	Behind church.
Do	R34b	May	13	21, 24	P C G	
Laposan, Cagayan	R36a	May	14	13	O P U	
Bigaan, Cagayan	R36b	May	14	2, 3, 17	R C G	Bigaan River.
Omalag, Cagayan	R36c	May	14	2, 7, 20, 21	P C G	
Agusan, Cagayan	R36d	May	14	18, 21	P C G	
PALAWAN						
Culion, Baldat	R48b	Dec.	5	2, 17	S C G	North stream.
Do	R48c	Dec.	5	17	S C G	South stream.
Culion, Pilapil	R14a	Apr.	25	19, 21	P C U	
Do	R14b	Apr.	25	13, 21	O P U	
Do	R48d	Dec.	5	17	S C G	
Do	R48e	Dec.	5	23	O P U	(Probably *A. baezai*.)

[a] Various.

[b] The species of mosquito larvæ collected are indicated by numbers and the types of breeding places by letters, as follows:

Anopheles—
1. *aitkeni* var. *bengalensis*.
2. *barbirostris*.
3. *filipinæ*.
4. *fuliginosus*.
5. *gigas* var. *formosus*.
6. *hyrcanus* var. *nigerrimus*.
7. *hyrcanus* var. *sinensis*.
8. *insulæflorum*.
9. *karwari*.

Anopheles—
10. *kochi*.
11. *leucosphyrus*.
12. *lindesayi* var. *benguetensis*.
13. *litoralis*.
14. *ludlowi*.
15. *maculatus*.
16. *mangyanus*.
17. *minimus* var. *flavirostris*.
18. *parangensis*.

Anopheles—
19. *philippinensis*.
20. *pseudobarbirostris*.
21. *subpictus* var. *indefinitus*.
22. *tessellatus*.
23. *umbrosus*.
24. *vagus* var. *limosus*.
25. *kolambuganensis*.
26. Balabac species.
27. Banahaw variety.

BREEDING PLACES

S, stream.
R, river.
P, pool.
L, lake.

D, ditch, still.
I, irrigation ditch, flowing.
W, well.
O, ocean, salt water.
B, bamboo.

G, shaded.
U, unshaded.
C, clear.
M, muddy.

TABLE 6.—*Anopheles larvæ taken during reconnaissance in 1933, listed by province, locality, and species*—Continued.

Locality.	Lot No.	Date.	Larvæ.[a]	Breeding places.[b]	Remarks.
PALAWAN—Continned		1933			
Culion, Patag	R14d	Apr. 25	2	P C G	Negative Barrio.
Do	R15e	Apr. 25	2, 9, 17	S C G	
Do	R48	Dec. 5	1, 17	S C G	
Do	R48a	Dec. 5	17	S C U	Irrigation canal.
Iwahig, Gumbia	R15b	Apr. 28	21	D M U	
Iwahig, Quinina	R49, 49a	Dec. 10	2, 17, 24	R C G	
Iwahig, Malamig	R49d	Dec. 10	17	I C U	
Iwahig, Balsahan	R49e	Dec. 10	17	R C U	
Iwahig, Esperanza	R49i	Dec. 12	7, 17, 21	S C G	
Iwahig, Lakandoia	R49j	Dec. 12	2, 6, 7, 17	S C G	
Iwahig, Laundry	R49l	Dec. 12	17	S C G B	
Iwahig, Binuan	R49p	Dec. 12	2, 17	S M U	
Iwahig, East Central	R49q	Dec. 13	23	O P U	(Probably *A. baezai.*)
Puerto Princesa	R50	Dec. 15	17	S M G	
Aborlan	R16a	Apr. 28	2, 17	S C G	Heraan stream.
Brooke's Point	R17	Apr. 29	17	S C G	Pangobilihan stream.
Balabac	R18	Apr. 30	2, 26	P C G	
RIZAL					
Antipolo	R15, 16	Dec. 28	2, 3, 15, 17, 24	S C G	
Wawa	51b	Dec. 28	2, 15, 24	P C U	
Do	51c	Dec. 28	2, 3, 17	S C U	Back of mill of Philippine Lime Corporation.
Do	51d	Dec. 28	2, 15, 16, 17	S C U	
Do	51e	Dec. 28	2, 3, 15, 16, 17	S C G	
ROMBLON					
Romblon	R43	May 23	15	P C G	Seepage from spring.

SULU					
Cagayan, Lupa pula	R19a	May 1	17	S C G	Pillian Creek.
Do	R19b	May 1	2, 15, 17	W C G	Shallow well.
Do	R19c	May 1	13, 23	O P U	
Sibutu	R20	May 2			No anophelines.
Jolo	R21a	May 3	21	O P U	In city.
Do	R21b	May 4	21	P C U	Asturias spring.
Do	R21c	May 4	20, 21	P C U	
Do	R21d	May 4	21	O D U	
SURIGAO					
Surigao, Malico	R32	May 12	20	D C U	
ZAMBOANGA					
Zamboanga	R22	May 6	13, 21	O P U	
Sibago Island	R23	May 6	21, 24	P M G	
Langil Island	R24	May 6	13	O P U	

[a] Various lots.

[b] The species of mosquito larvæ collected are indicated by numbers and the types of breeding places by letters, as follows:

Anopheles—
1. *aitkeni* var. *bengalensis.*
2. *barbirostris.*
3. *filipinæ.*
4. *fuliginosus.*
5. *gigas* var. *formosus.*
6. *hyrcanus* var. *nigerrimus.*
7. *hyrcanus* var. *sinensis.*
8. *insulæflorum.*
9. *karwari.*

Anopheles—

10. *kochi.*
11. *leucosphyrus.*
12. *lindesayi* var. *benguetensis.*
13. *litoralis.*
14. *ludlowi.*
15. *maculatus.*
16. *mangyanus.*
17. *minimus* var. *flavirostris.*
18. *parangensis.*

Anopheles—

19. *philippinensis.*
20. *pseudobarbirostris.*
21. *subpictus* var. *indefinitus.*
22. *tessellatus.*
23. *umbrosus.*
24. *vagus* var. *limosus.*
25. *kolambuganensis.*
26. Balabac species.
27. Banahaw variety.

BREEDING PLACES

S, stream.
R, river.
P, pool
L, lake.

D, ditch, still.
I, irrigation ditch, flowing.
W, well.
O, ocean, salt water.
B, bamboo

G, shaded.
U, unshaded.
C, clear.
M, muddy.

TABLE 7.—*Species of Anopheles encountered in survey and number of times found.*

Species No.	Species name.	Times collected.		
		First report.	This report.	Total.
1	*aitkeni* var. *bengalensis*	5	2	7
2	*barbirostris*	254	29	283
3	*filipinæ*	68	10	78
4	*fuliginosus*	35	2	37
5	*gigas* var. *formosus*	7	0	7
6	*hyrcanus* var. *nigerrimus*	17	2	19
7	*hyrcanus* var. *sinensis*	48	6	54
8	*insulæflorum*	14	3	17
9	*karwari*	2	2	4
10	*kochi*	6	3	9
11	*leucosphyrus*	0	2	2
12	*lindesayi* var. *benguetensis*	6	1	7
13	*litoralis*	10	10	20
14	*ludlowi*	25	2	27
15	*maculatus*	109	15	124
16	*mangyanus*	50	9	59
17	*minimus* var. *flavirostris*	378	48	426
18	*parangensis*	0	1	1
19	*philippinensis*	21	3	24
20	*pseudobarbirostris*	30	4	34
21	*subpictus* var. *indefinitus*	61	15	76
22	*tessellatus*	15	1	16
23	*umbrosus*	4	3	7
24	*vagus* var. *limosus*	53	8	61
25	*kolambuganensis*	0	1	1
26	Balabac species	0	1	1
27	Banahao variety	0	1	1

TABLE 8.—*Association of two or more species of Anopheles.*

Species Nos.	Species in association.	Times found together.		
		First report.	This report.	Total.
2 and 17	*barbirostris* and *minimus*	178	21	199
15 and 17	*maculatus* and *minimus*	101	9	110
16 and 17	*mangyanus* and *minimus*	25	8	33
2, 15, and 17	*barbirostris*, *maculatus*, and *minimus*	36	7	43
3 and 17	*filipinæ* and *minimus*	61	7	68
3, 15, and 17	*filipinæ*, *maculatus*, and *minimus*	17	4	21
2, 3, and 17	*barbirostris*, *filipinæ*, and *minimus*	44	7	51
17 and 24	*minimus* and *vagus*	21	3	24
2, 17, and 24	*barbirostris*, *minimus*, and *vagus*	16	3	19
2, 17, and 21	*barbirostris*, *minimus*, and *subpictus*	13	2	15

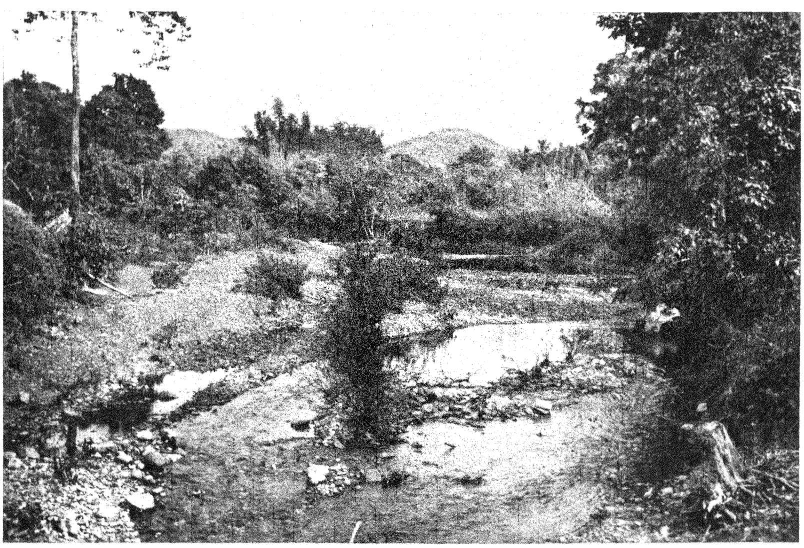
ILLUSTRATION

PLATE 1

FIG. 1. Breeding place of *Anopheles minimus* var. *flavirostris* at Baldat, Culion.

2. Breeding place of *Anopheles minimus* var. *flavirostris* at Iwahig, Palawan.

1



2

PLATE 1.

THE VITAMIN CONTENT OF PHILIPPINE FOODS, III

VITAMIN B IN VARIOUS FRUITS AND VEGETABLES

By A. J. HERMANO and GAVINO SEPULVEDA, Jr.
Of the Bureau of Science, Manila

ONE PLATE

The American committee on vitamin B nomenclature(1) decided that the antineuritic vitamin should be called vitamin B, and the growth-promoting vitamin should be vitamin G. The two vitamins are fractions of the original vitamin B complex. These vitamins, which are quite different, may be found in the same Philippine fruits and vegetables in varied proportions. Fruits and vegetables are abundantly consumed in the Philippines, but adequate information concerning their vitamin B content is still wanting. People often pay a high price for the extract of rice polishings when this essential factor may be obtained from fruits and vegetables at a low cost. The object of this investigation was to make comparative tests of the vitamin B content of various fruits and vegetables raised in the Philippines. Those that are rich sources of vitamin B tend to make up the deficiency in the Filipino diet which consists mostly of highly polished rice. Since the antineuritic vitamin is essential in maintaining the proper myelinization of the nerves, it is especially important in curing the numerous cases of beriberi which occur annually in the Philippine Islands.

For a little more than two decades, the original vitamin B was regarded as a complex substance, comprising Eijkman's(2) and Funk's(3) antineuritic substance, Goldberger's(4) antipellagric vitamin, and Smith's(5) essential factor in nutrition in addition to the present vitamin B. Since the first publication on the existence of an antineuritic vitamin, many attemps have been made to prepare concentrated products and to isolate this vitamin from rice polishings, yeast, wheat germ, and mongo beans (*Phaseolus aureus*). Many investigators claimed to have produced higher active crystalline substances possessing the properties of vitamin B, and biological tests have been tried on pigeons, bondols, rats, mice, and dogs. The curative effects and maintenance of pigeons and bondols by feeding and by injection of these products, have been shown by Funk,(3) Edie et al.,(6) Suzuki and Odake,(7) Abderhalden and Schaumann,(8) Bowman and Yee,(9) Seidell,(10) Jansen and Donath,(11) Levene,(12) Kinnersley et al.,(13) Guha and Drummond,(14) and Cowgill.(15) The results of these feeding experiments are summarized in Table 1.

MATERIALS AND EXPERIMENTAL PROCEDURE

Vitamin B appears to be widely distributed in the various tissues and juices of plants, but is more concentrated in the germ and bran as in rice and wheat. The materials used in this investigation consisted of 109 samples of leafy vegetables, flowers, ripe fruits, immature fruits used as vegetables, and underground portions used for food. The samples were purchased mostly in the local markets in Manila, though some were obtained from Baguio in the Mountain Province.

In this investigation six hundred healthy pigeons, weighing from 200 to 320 grams each, were selected for the comparative vitamin tests on various fruits and vegetables. Each cage contained fifteen pigeons (Plate 1, fig. 1). These birds were given plenty of highly polished rice and artesian well water. Each pigeon was also fed daily with about one gram of powdered and dried lean meat (beef) the vitamin B of which had been removed by repeated boiling, washing, and pressing. The feeding was continued and the pigeons were observed daily until each bird developed symptoms of polyneuritis (Plate 1, fig. 2). The sick pigeons were then separated and placed in hospital cages which were protected from flies by very fine wire screens.

During the course of these experiments most of the pigeons were incidentally discovered to be infested with blood-sucking flies, *Pseudolynchia maura,* the transmitting agent of a blood parasite, *Hæmoproteus columbæ.* The infested birds were anæmic and weak and, in some cases, the infestation was so severe as to prove fatal. In this connection, it may be stated that advanced symptoms of hæmoproteiasis columbæ have sometimes been confused with those of polyneuritis columbarum. As a precaution the pigeons were kept in cages which were covered with fine-mesh wire (No. 24) to prevent access of the flies, and the first experiments were repeated.

TABLE 1.—*Results obtained by various investigators in feeding or injecting pigeons with prepared products.*

Investigator.	Dosage of purified products.	Mode of administration.	Remarks.
Funk (3)	From yeast (4 mg)	By injection	Improvement after 3 hours and complete recovery the next day.
Edie et al. (6)	From yeast (3 to 6 mg).	Feeding orally	Convulsions controlled in 4 hours and complete recovery in 48 hours.
Susuki and Odake (7).	From rice polishings (5 mg).	Feeding by mouth	Gradually improved and cured in 10 days.
Abderhalden and Schaumann (8).	From yeast (5 mg)	By injection	Gradually improved and cured and gave protection for 19 days.
Bowmann and Yee (9).	From mongo beans (*Phaseolus aureus*) (2 to 3 mg).	do	Cured within 1 hour. Pigeons moved normally.
Seidell (10)	From brewer's yeast (0.100 to 0.200 g)	Fed on alternate days.	Gradually improved and cured in 8 days.
Jansen and Donath (11).	From rice polishings ($C_6H_{10}ON_2$) (2 mg).	Feeding orally	Fed to 30 bondols for 15 days; only one contracted polyneuritis.
Levene (12)	From brewer's yeast (0.07 to 0.1 mg)[a].	Fed daily to white rat.	Sufficient to maintain normal growth of rats.
Kinnersley et al. (13).	From yeast (0.1 mg) per day.	Feeding by mouth	Curative as pigeon dose.
	1.6 $\pm$ 0.4 day dose	Feeding orally	Highest potency administered and cured in 1 day.
Guha and Drummond (14).	From wheat embryo (0.005 to 0.015 mg)[a].	Daily doses	Good growth in rats.
Cowgill (15)	From wheat germ (90 to 100 mg).	Feeding orally	Correct daily maintenance dose for birds of 420 and 465 g.

[a] Products tested on rats.

The effects of deprivation of vitamin B in pigeons, thus producing typical head-stooping polyneuritis, have been shown by Emmett and Peacock,(16) Vedder and Feliciano,(17) McCarrison,(18) Rosedale and Oliveiro,(19) and many others. This method of studying vitamin B deficiency was selected because pigeons are more susceptible to polyneuritis than other laboratory animals and, furthermore, this procedure has been used extensively in determining the value of foods as a source of antineuritic vitamin.

In establishing the curative dose of the fruits and vegetables, polyneuritic pigeons were first numbered and placed in separate cages. The rations used in treating these sick pigeons were as follows:

Ration—	Fresh fruit or vegetable.	Dried lean meat (beef).
	g.	g.
A	0.5	1.0
B	1.0	1.0
C	1.5	1.0
D	2.0	1.0
E	3.0	1.0
F	4.0	1.0
G	5.0	1.0
H	6.0	1.0
I	7.0	1.0
J	8.0	1.0

A small dosage of the fruit (1 gram) and 1 gram of dried lean meat (ration B) were first given by mouth, as a preliminary test to one beriberi pigeon. If this ration cured we tried three other pigeons as a check. We next tried ration A containing one-half gram of the fruit. Some fruits required other rations (from C to J) containing more than one gram of the fruit. The appropriate dosage that cured the pigeons was reported as the curative amount (Table 5).

Weighed amounts of leafy vegetables, underground portions or immature fruits (used as vegetables) were prepared and cooked with very little water, according to the Filipino method, and then fed to beriberi pigeons as described under fruits. Curative doses were determined and are reported in Tables 2, 3, 4, and 6.

SUMMARY AND CONCLUSION

Variable amounts of vegetables and fruits were found to cure beriberi pigeons as summarized in Tables 2, 3, 4, 5, and 6.

The vitamin contents of these various fruits and vegetables were recorded as follows:

+++ The fruit or vegetable is an excellent source of vitamin B.
++ The fruit or vegetable is a good source of vitamin B.
+ The fruit or vegetable merely contains vitamin B.
— The fruit or vegetable contains only an appreciable amount of vitamin B.

From the resulting data on leafy vegetables (Table 2), kolitis, alugbati, sili, Indian spinach, prickly-seeded spinach, tamarind shoots, himbaba-o, tango, endive, squash, camote, lettuce, amantec, and laba-laba were found to be excellent sources of vitamin B.

TABLE 2.—*Results of feeding leafy vegetables to polyneuritic pigeons.*

Names of vegetables.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Allaeanthus luzonicus (Blanco) F.-Vill.	Himbaba-o, karúd, kabág, boñgon, alokón.	Fresh leaves	2.0	+++
Amaranthus viridis Linn.	Kolites, kulitis, kalúnai, halom.	Fresh leaves and shoots.	1.0	+++
Apium graveolens Linn	Kinchay, celery	Fresh leaves	3.0	++
Athyrium esculentum Copel.	Pako, pakó	do	4.0	++
Bambusa spinosa Roxb	Bamboo, kauáyan, baugín, batákan.	Fresh shoot	3.0	++
Basella rubra Linn	Alugbáti, libáto, arogbáti, grana.	Fresh leaves and shoots.	1.0	+++
Bauhinia leptopus Perk.	Kalibangbang, malakmi	Fresh leaves	4.0	++
Brassica chinensis Linn.	Pechay, pechai, selgas, messay.	do	4.0	++
Brassica integrifolia (West) O. E. Schulz.	Mustard, mostaza	do	4.0	++
Brassica oleracea Linn. var. *capitata* Hort.	Cabbage (red), repollo, kobis.	do	4.0	++
Brassica oleracea Linn. var. *acephala* DC.	Kolis, kales	do	5.0	+
Capsicum frutescens Linn.	Chili, sili, katumbal, kitikot, chileng-bundok, siling-labúyo.	Fresh leaves and shoots.	1.0	+++
Chrysanthemum coronarium Linn.	Tañgo, tungháo	do	2.0	+++
Cichorium endivia Linn	Endive	do	2.0	+++
Colocasia esculentum (Linn.) Schott.	Gabi, dagmai, abá, gauai	Fresh leaves	6.0	+
Do	do	Fresh petiole	5.0	+
Corchorus olitorius Linn.	Saluyot, tagabang, pasau	Fresh leaves and shoots.	3.0	++
Coriandrum sativum Linn.	Wansoy, culantró, ongsóy, coriander.	Fresh leaves	5.0	+
Cucurbita maxima Duchesne.	Squash, calabáza, kalabása, karabása, kalabasáng-pulá.	Fresh leaves and shoots.	2.0	+++
Helminthostachys zeylanica (Linn.) Hook.	Túkod-lañgit	do	4.0	++
Ipomea batatas (Linn.) Poir.	Camote, tigsi, kamóte	do	2.0	+++
Ipomea reptans (Linn)	Kankóng, kangkóng, tangkong.	do	3.0	++
Lactuca sativa Linn	Lechuga, lettuce	Fresh leaves	2.0	+++
Momordica charantia Linn.	Amargóso, apaliá, ampalayá, margóso, ampaliá.	Fresh leaves and shoots.	3.0	++
Moringa oleifera Lam	Camalungái, balungai, malungái, kalungai, maluñgit.	Fresh leaves	3.0	++

TABLE 2.—*Results of feeding leafy vegetables to polyneuritic pigeons*—Continued.

Names of vegetables.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Petroselinum hortense Hoffm.	Beregil, parsley	Fresh leaves	7.0	—
Phaseolus calcaratus Roxb.	Tauhúri, kapilán, anípai	do	4.0	++
Rumex ambiguus Gren.	Sorrel spinach, Indian spinach.	Fresh leaves and shoots.	1.0	+++
Spinacia oleracea Linn.	Prickley-seeded spinach	do	1.0	+++
Solanum nigrum Linn.	Amantec, kamátes-manók	Fresh leaves	2.0	+++
Tamarindus indica Linn.	Tamarind, sampáloc, sambag, salomági.	Fresh shoots and tender leaves.	1.0	+++
Tetragonia expansa Murr.	New Zealand spinach	Fresh leaves and shoots.	2.0	+++
(?)	Laba-laba (Algæ)	Fresh sample	2.0	+++

TABLE 3.—*Results of feeding flowers to polyneuritic pigeons.*

Names of vegetables.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Allaeanthus luzonicus (Blanco) F.-Vill.	Himbaba-o, karúd, kabág, boñgon, alokón.	Fresh flowers	2.0	+++
Brassica oleracea Linn. var. *botrytis* DC.	Cauliflower	do	2.0	+++
Cucurbita maxima Duchesne.	Squash, calabasa, karabása, kalabása.	do	4.0	++
Musa paradisiaca Linn. var. *compressa* (Blanco) Teodoro.	Pusó, banana	Fresh "puso"	6.5	—
Sesbania grandiflora (Linn.) Pers.	Katúrai, gauai-gáuai, catódaí.	Fresh flowers	4.0	++
Tamarindus indica Linn.	Tamarind, sampálok, sambag, salomági.	do	1.0	+++

Pako, pechay, kinchay, bamboo shoot, alibang-bang, mustard, cabbage, saluyot, wansoy, kangkong, amargoso, camalungai, and tahuri were found to be good sources of vitamin B.

Kolis, gabi leaves and gabi petiole merely contained the vitamin B.

TABLE 4.—*Results of feeding immature fruits used for vegetables to polyneuritic pigeons.*

Names of vegetables.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Abelmoschus esculentus (Linn.) Moench.	Okra	Fresh fruit	3.0	++
Artocarpus communis Forst.	Rímas, kamansí, dalangían	Fresh immature fruit.	4.0	++
Cajanus cajan (Linn.) Millsp.	Kadiós, kaldis, kardis, kagyús.	Fresh soft seeds	3.0	++
Canavalia ensiformis (Linn.) DC.	Jack bean, sitao Americano	Fresh pods with seeds.	5.0	+
Capsicum annuum Linn	Sweet pepper, sili	Fresh green fruit	4.0	++
Carica papaya Linn	Papáya, kapáya, tapáyas	do	3.0	++
Cocos nucifera Linn	Coconut, niog, lubi, coco, figot-figot.	Soft fresh meat	8.0	—
Cucurbita maxima Duchesne.	Squash, kalabasang-pulá	Fresh fruit	4.0	++
Dolichos lablab Linn	Bátau, bátao, báglau, parda, búlai.	Fresh pods and seeds.	2.0	+++
Lagenaria leucantha (Duch.) Rusby.	Upo (Japanese variety)	Fresh fruit	6.0	+
Do	Upo (long), ópo, kalúbai, tabúñgau.	Fresh green fruit	3.0	++
Luffa acutangula (Linn.) Roxb.	Patóla, saykua	Fresh and tender green fruit.	6.0	+
Momordica charantia Linn.	Apaliá, amargóso, ampalayá, margoso, ampaliá.	Fresh immature fruit.	2.0	+++
Pachyrrhizus erosus (Linn.) Urb.	Sincamás, sinkama, kamás, kikamas, hinkamas.	Fresh green pods with seeds.	5.0	+
Phaseolus aureus Roxb.	Mungo, balátong	Fresh sprouted seeds	1.5	+++
Phaseolus vulgaris Linn.	Habichuelas, biriñgi, mula	Fresh pods with seeds.	5.0	+
Pisum sativum Linn	Sweet peas, chícharo	Fresh green pods with seeds.	4.0	++
Psophocarpus tetragonolobus (Linn.) DC.	Winged beans, seguidilla, cigarrillas, kalamismis, segadilla.	Fresh pods with seeds.	5.0	+
Sechium edule Sw	Chayote	Fresh green fruit	3.0	++
Solanum melongena Linn.	Eggplant, talóng, tarong	Fresh immature fruit.	3.0	++
(?)	Bush wax beans	Fresh pods with seeds.	3.0	++
Vigna sinensis (Linn.) Savi.	Tagtaga, otóng, cowpeas, batóng, balatong.	do	3.0	++
Vigna cylindrica Skeels	String beans, balatong	do	2.0	+++

TABLE 5.—*Results of feeding ripe fruits to polyneuritic pigeons.*

Names of fruits.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Achras zapota Linn.	Chico, siku	Fresh pulp	1.0	+++
Anacardium occidentale Linn.	Kasoy, cashew, kachúi, balubad.	do	1.0	+++
Ananas comosus (Linn.) Merr.	Pineapple, var. smooth Cayenne, piña.	do	1.0	+++
Anona muricata Linn.	Guayabáno, guanabano, gabáno.	do	2.0	+++
Anona squamosa Linn.	Atis, sugar-apple, ates	do	5.0	+
Artocarpus integra (Thunb.) Merr.	Jackfruit, lángka, nángka, nanka.	Edible yellow pulp	4.0	++
Averrhoa carambola Linn.	Balimbíng, galañgán, dalígan.	Fresh pulp without seed.	5.0	+
Carica papaya Linn.	Papáya, kapáya, tapáyas	Fresh pulp	4.0	++
			cc.	
Citrus aurantium Linn.	Kagel, kahél, dalandan	Juice of the fresh fruit.	1.0	+++
Citrus maxima (Burm.) Merr.	Lukbán, suhá, suá	do	5.0	+
Citrus mitis Blanco	Kalamondín, kalamansí, limonsito, kalamunding.	do	1.0	+++
			g.	
Cucumis melo Linn.	Melón, atimón, katimon	Pulp of the fresh fruit.	1.0	+++
Cyphomandra calycina Sendt.	Cyndra	Fresh pulp	7.0	—
Diospyros discolor Willd.	Mabolo, kamagóng	do	4.0	++
Eugenia cumini (Linn.) Druce.	Dúhat, lombói, lúngboi	Fresh pulp with peeling.	1.0	+++
Eugenia javanica Lam.	Makópa, yambo	Fresh fruit	4.0	++
Flacourtia indica (Burm. f.) Merr.	Serali, bitúñgol	do	4.0	++
Lansium domesticum Correa.	Lansones, lanzon	Fresh pulp	5.0	+
Lycopersicum esculentum Mill.	Tomato, kamatis, tomáte	Fresh fruit	3.0	++
Mangifera indica Linn.	Mango, mangang-calabao	Fresh pulp	1.0	+++
Mangifera altissima Blanco.	Pahótan, páho, malapáho	do	3.0	++
Mangifera indica Linn.	Mangang-piko	do	1.0	+++
Musa sapientum Linn. var. *suaveolens* (Blanco) Teodoro.	Buñgulan (banana)	Ripe fruit	6.0	+
Musa sapientum Linn. var. *ternatensis* (Blanco) Teodoro.	Glória (banana) ternáte	do	8.0	—

TABLE 5.—*Results of feeding ripe fruits to polyneuritic pigeons*—Ctd.

Names of fruits.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Musa sapientum Linn. var. *inarnibal* Teodoro.	Inarnibal (banana)	Ripe fruit	6.0	+
Musa sapientum Linn. var. *lacatan* (Blanco) Teodoro.	Lacatan (banana), lakatán, bañgáran.	do	6.0	+
Musa sapientum Linn. var. *cinerea* (Blanco) Teodoro.	Latundán (banana), letondal; tórdan.	do	6.0	+
Musa sapientum Linn. var. *violacea* (Blanco) Teodoro.	Murado, morado (banana)	do	6.0	+
Musa sapientum Linn. var. *compressa* (Blanco) Teodoro.	Sabá (banana)	do	7.0	—
Passiflora edulis Sims	Pasionária, pasion, maraflora.	Fresh pulp with seeds.	7.0	—
Pithecolobium dulce (Roxb.) Benth.	Kamanchilí, damortis, kamansilí.	Sweet fresh fruit	3.0	++
Psidium guajava Linn	Guava, bayábas, bayáuas, guayábas.	Ripe fruit (pink contents).	4.0	++
Do	do	Ripe fruit (white contents).	4.0	++
Sandoricum koetjape (Burm. f.) Merr.	Santol, santor	Meat of fresh fruit	2.0	+++
			cc.	
Do	do	Pulp of seeds	3.0	++
			g.	
Spondias purpurea Linn.	Siniguélas, ciruéla, siriguélas, sarguélas.	Pulp of ripe fruit	3.0	++

The data in Table 3 show that himbaba-o, cauliflower and tamarin were excellent sources of vitamin B. Squash and katurai were just good sources. Banana (puso) contained no appreciable amount of the vitamin.

The experimental results on immature fruits, reported in Table 4, show that batau, amargoso, mungo, and balatong are excellent sources of antineuritic vitamin.

Okra, kadios, sweet pepper, papaya, squash, upo, sweet peas, chayote, eggplant, bush-wax beans, and cowpeas were good sources of vitamin B.

Sitao (American), upo (Japanese), patola, sincamas, habichuelas, and seguidillas merely contained the antineuritic vitamin. Rimas and immature soft coconut meat contained no appreciable amount of the vitamin B.

As shown by the results reported on Table 5, mango (kalabao and piko), chico, kasoy, pineapple, kagel, kalamondin, melon (Tagalog), duhat, guayabano, and santol (meat) were found to be excellent sources of the antineuritic vitamin.

Tomato, malapaho, kamanchili, santol (pulp), siniguelas, langka, papaya, mabolo, macopa, serali, and guava were found to be good sources of vitamin B.

Atis, balimbing, lukban, lansones, and bananas (buñgulan, inarnibal, lacatan, latundan, and murado) were found to contain antineuritic vitamin. Cyndra and bananas (gloria and sabá) contained no appreciable amount of the vitamin B.

From the experimental results shown in Table 6, labanos was found to be an excellent source of vitamin B. Carrot, ubi, and sincamas were found to be good sources of the antineuritic vitamin. Onion, bauang, gabi (Cebu), tugi, and kamote (white and yellow) were found to contain the vitamin B.

TABLE 6.—*Results of feeding underground portions of plants to polyneuritic pigeons.*

Names of vegetables.		Parts used.	Amount used.	Vitamin B (B_1).
Scientific name.	Common names.			
			g.	
Allium cepa Linn.	Onion (small), sibuyas, lasoná, cebollas.	Fresh rhizomes and leaves.	5.0	+
Allium sativum Linn.	Báuang, garlic, ájos	do	5.0	+
Colocasia esculentum (Linn.) Schott Melet.	Gabi, (Cebu), dagmái, abá, áua, linsá.	Peeled fleshy root	6.0	+
Daucus carota Linn.	Carrot, zanahoria	Fresh fleshy root	3.0	++
Dioscorea alata Linn.	Úbi (purple or violet), kinampái.	do	3.5	++
Dioscorea esculenta (Lour.) Burkill Blanco.	Túgi, toñgo, boga	do	6.0	+
Ipomoea batatas (Linn.) Poir.	Kamote, tigsi	White peeling, yellow contents fleshy root.	5.5	+
Do	do	Red peeling, white contents fleshy root.	6.0	+
Pachyrrhizus erosus (Linn.) Urb.	Sincamas, kamás, sikamás	Fresh fleshy root	3.0	++
Raphanus sativus Linn.	Labanos, radish (Chinese)	do	2.0	+++

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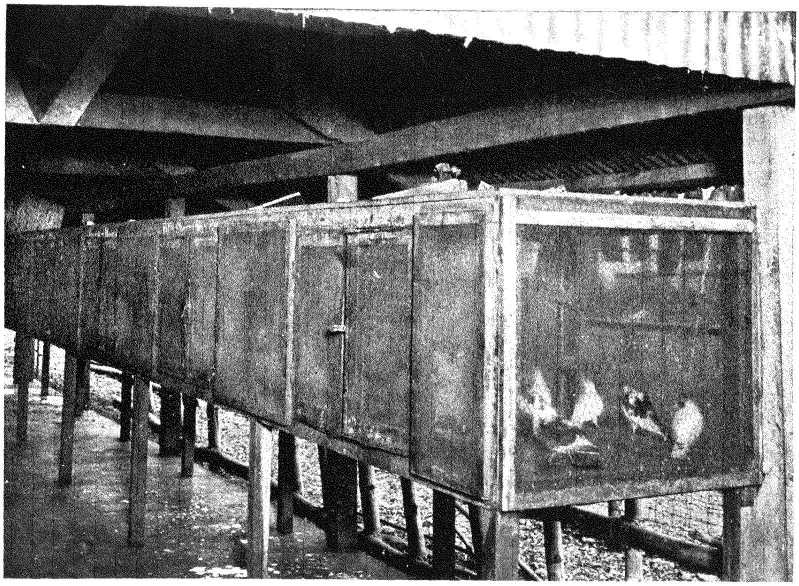
ILLUSTRATION

PLATE 1

FIG. 1. Portion of cages.
2. Pigeon ill with polyneuritis.
3. Same pigeon cured after feeding a sample.



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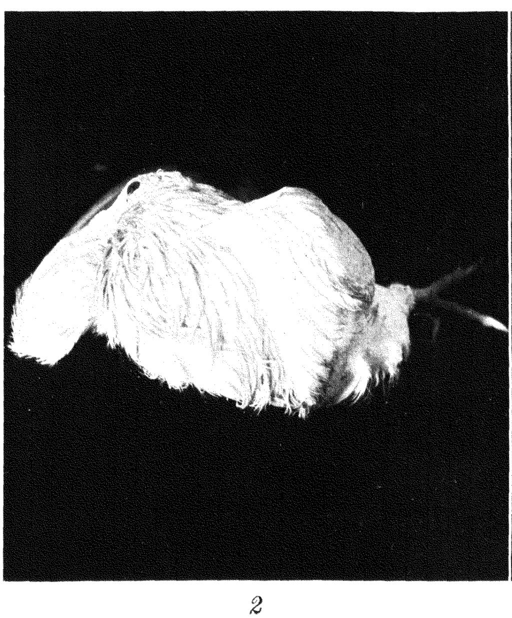

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PLATE 1.

PHILIPPINE PANAO (DIPTEROCARP) RESIN

By SIMEONA SANTIAGO TANCHICO and AUGUSTUS P. WEST
Of the Bureau of Science, Manila
and
J. FONTANOZA [1]
Late of the Bureau of Forestry, Manila

THREE PLATES

The dipterocarp, or lauan, is by far the most prominent family of trees in the Philippines. These woods are everywhere utilized for a wider range of uses than those of any other family. The most characteristic feature of these trees is that they contain resin ducts. When the bark and sapwood are cut the oily resin exudes more or less freely and, on exposure to the air, the resin hardens into a sticky, pasty mass.

The dipterocarp family contains several genera, of which the largest is *Dipterocarpus.* The tree known as panao (*Dipterocarpus vernicifluus* Blanco) is one of the important members of this genus.

We have examined the resin which is obtained by cutting the panao tree. When distilled this is separated into an oil which passes over as a distillate and a glassy resin which remains behind as a residue. The constants of both panao oil and resin were determined. The resin seems to be suitable for making a spirit varnish for lamp shades. Probably it could be used for other similar purposes.

An excellent account of Philippine dipterocarp forests is given by Whitford [2] and also by Brown and Mathews.[3]

According to Whitford [4] the dipterocarp forests are of preeminent importance in the Philippines. These forests cover about 75 per cent of the virgin forest area (30,000 square miles) and contain approximately 95 per cent of the standing timber

[1] Mr. Fontanoza was unfortunately taken sick and died about ten months after he collected the samples of resin for this investigation.

[2] The Forests of the Philippines, Bull. P. I. Bur. Forestry **10** (1911).

[3] Philip. Journ. Sci. § A **9** (1914) 413.

[4] The Forests of the Philippines, Bull. P. I. Bur. Forestry **10** (1911) 18 and 60.

in the Islands. They are found on nearly all types of topography, from immediately behind the frontal zone of the beach to an altitude of approximately 800 meters on the slopes of the largest mountains.

Practically all the species of the dipterocarps are large trees, reaching heights of 40 to 50 meters and diameters of 100 to 150 centimeters or more, and it is not rare to find even these dimensions exceeded. They have straight, regular boles and practically all the dipterocarps are evergreens, for the new leaves are formed before the old ones drop.

A detailed description of the wood of panao and other species of the genus *Dipterocarpus* is given by Schneider.[5]

Some years ago the exudations from two species of dipterocarp trees were investigated. Clover [6] and also Bacon [7] examined balao resin from the tree known locally as apitong (*Dipterocarpus grandiflorus*). Balao is used at present for varnishing and caulking native boats. As a varnish it gives a tough and durable coat but has the disadvantage of drying very slowly.

Clover [8] also investigated the resin obtained from the panao tree (*Dipterocarpus vernicifluus*). These resins (balao and panao) appear to have somewhat similar properties. They seem to contain a certain amount of combined water which causes a troublesome frothing when the attempt is made to distil them. They dissolve readily in chloroform and ether but with difficulty in alcohol.

Concerning panao resin Clover states:

> All of the different samples were found to consist of water, sesquiterpene oil, and solids. On subjecting the resin to distillation with a free flame its behavior is similar to that of Balao. A fresh sample from Ambos Camarines gave 25 per cent of water, 35 per cent of oil, and 40 per cent of solid residue. The distillation was discontinued at the point where decomposition became evident. Another sample showed a somewhat different percentage of water and of oil, the difference probably being due to the time and method of collecting.

EXPERIMENTAL PROCEDURE

The panao trees selected for this investigation were growing in the dipterocarp forest near the town of Hermosa, Bataan Province, Luzon (Plate 1). The exact location where the trees

[5] Commercial Woods of the Philippines, Bull. P. I. Bur. Forestry 14 (1916) 163.

[6] Philip. Journ. Sci. 1 (1906) 195.

[7] Philip. Journ. Sci. § A 4 (1909) 121.

[8] Philip. Journ. Sci. 1 (1906) 198.

were tapped for resin was near a place called Cocobog in the barrio (district) of Colo (Plate 2). The measurements of these trees are given in Table 1.

TABLE 1.—*Measurements of Philippine panao (dipterocarp) trees tapped for panao resin.*

Tree No.	Diameter.	Thickness of—		Box.			
		Sapwood.	Bark.	Location.[a]	Size.		
					Height.	Width.	Depth.
	cm.	*cm.*	*cm.*		*cm.*	*cm.*	*cm.*
1	110.0	3.5	0.6	SE	24.0	19.0	8.0
2	53.0	4.5	0.7	NE	32.0	26.0	13.5
3	90.0	2.5	0.5	SE	41.0	24.0	10.0
4	70.0	3.0	0.7	S	32.0	21.0	8.0
5	50.0	3.5	0.6	NE	41.0	25.0	7.0
6	62.0	2.5	0.5	S	44.0	20.0	7.0
7	100.0	3.5	0.5	N	26.0	17.0	8.0
8	90.0	4.0	0.5	S	28.0	21.0	9.0
9	100.0	4.0	0.4	W	32.0	25.0	6.0
10	92.0	5.0	0.8	N	31.0	17.0	7.0

[a] The letters indicate the side where the tree was boxed, as SE for southeast, N for north, etc.

Experiments carried out by Mr. Fontanoza showed that the highest yields of resin were obtained by boxing the trees. This consists in cutting a cup-shaped cavity in the body of the tree and allowing the resin to exude and collect in it. As shown by the photograph (Plate 3) the exudation comes from the sapwood and not from the bark or heartwood. Some trees were also tapped by means of the cup and gutter system but the yields obtained were rather poor.

The yields of resin obtained and the dates the resin was collected and weighed are given in Table 2.

When the tree was cut the resin flowed rather freely, but the rate of flow gradually decreased and after a few days very little yield was obtained. The resin was then collected and the cut in the tree reopened by chipping. This allowed the resin to exude again for the next collection. No other treatment, such as heating, was applied to the boxes during the collecting period.

In our investigation of panao resin we carried out a number of experiments similar to those reported by Clover and Bacon and obtained about the same results. The crude resin contains some water and also a volatile oil. In separating these constituents from the resin we found it convenient to use the following procedure: The crude resin was dissolved in chloroform and the impurities, such as chips of bark and twigs, removed by filtration. This was a slow and tedious process as the filter paper became clogged with viscous resin and filtration was delayed. This difficulty was overcome by using, as a filter, cotton moistened with chloroform. The filtered solution was distilled at first on a water bath to remove most of the solvent. It was then distilled in vacuo to eliminate the water and volatile oil. The hot residue remaining in the flask was then poured into paper molds. This product, which had a glassy appearance (glassy resin), was powdered and recrystallized repeatedly with methyl alcohol. The purified panao resin is a white powder.

TABLE 2.—*Yield of resin from Philippine panao (dipterocarp) trees.*

Tree No.	Date tapped.	Resin obtained.					
		April 25.	April 30.	May 5.	May 16.	May 26.	Total.[a]
	1931	g.	g.	g.	g.	g.	g.
1	Apr. 20	159.0	76.0	100.0	59.0	22.0	416.0
2	Apr. 20	113.0	58.0	104.0	60.0	29.0	364.0
3	Apr. 20	91.0	58.0	82.0	36.0	20.0	287.0
4	Apr. 20	93.5	51.0	64.0	18.0	25.0	251.5
5	Apr. 20	75.5	54.0	75.0	12.0	7.0	223.5
6	Apr. 21	96.0	57.0	95.5	60.0	42.0	350.5
7	Apr. 21	91.0	52.0	44.0	65.0	55.0	307.0
8	Apr. 21	107.0	53.0	77.5	30.0	13.0	280.5
9	Apr. 21	92.0	57.0	87.0	37.0	24.0	297.0
10	Apr. 21	89.5	53.0	83.0	35.0	34.0	294.5

[a] Grand total, 3,071.50 g; average per tree, 307.15 g.

TABLE 3.—*Constants of panao oil.*

Specific gravity ($d \frac{30°}{4°}$ C.)	0.9143
Optical rotation ($A \frac{30° \text{ C.}}{D}$), 10-cm tube	−11.03
Refractive index ($N \frac{30° \text{ C.}}{D}$)	1.4696
Acid value (A)	1.11
Saponification value (B)	51.29
Ester value (B–A)	50.18

Panao oil, removed from the panao resin by distilling, gave positive tests for double-bond compounds and also for aldehydes as follows:

Decolorized both bromine water and dilute permanganate solution.
Orange color with glacial acetic acid solution of benzidine.
Reduced Fehling's solution giving cuprous oxide precipitate.
Gave positive test with Tollen's reagent.

The constants of panao oil are given in Table 3 and in Table 4 are given the constants of panao resin.

TABLE 4.—*Constants of panao resin.*

Constants.	Glassy resin (residue from distillation).	Purified resin (white powder).[a]
Acid value (A)	21.2	32.99
Saponification value (B)	27.42	36.44
Ester value (B—A)	6.22	3.45
Specific rotation $\left(A\frac{30^{\circ}C.}{D}\right)$, 10-cm tube	+32.6	+36.41
Specific gravity	1.075	

[a] Obtained by crystallizing the glassy resin.

Attempts to make a wood varnish with panao resin were not very promising, as the varnish film obtained was not very hard and durable. We made a spirit varnish according to the following proportions:

Panao resin, grams	16
Ethyl alcohol, cubic centimeters	30
Turpentine, cubic centimeters	5

This preparation appeared to be very suitable for varnishing paper lamp shades and similar fragile articles.

SUMMARY

The tree known as panao (*Dipterocarpus vernicifluus*) is one of the important members of the genus *Dipterocarpus*. When the bark and sapwood of this tree are cut an oily resin exudes. Ten panao trees were measured and tapped (boxed). The panao resin was collected and weighed. The average yield of resin per tree was 307.15 grams.

Crude panao resin contains some water and also a volatile oil. These were removed by distilling the resin. The constants of panao oil and purified resin were determined.

A spirit varnish suitable for varnishing paper lamp shades and similar fragile articles may be made from panao resin.

ILLUSTRATIONS

PLATE 1

The Bataan-Zambales road passing through the dipterocarp forest near Sitio Bulate, Barrio Colo, Hermosa, Bataan Province, Luzon.

PLATE 2

Location in the forest where tapping experiments for panao resin were conducted. This place was near Sitio Cocobog, Barrio Colo, Hermosa, Bataan Province, Luzon. The panao trees are distinguished by their prominent, straight, white boles.

PLATE 3

Panao tree No. 2, five days after boxing. The gum exudes from the sapwood (lighter portion of the wood) and not from the bark and heartwood. The box is 32 by 26 by 13.5 centimeters.

PLATE 1.

PLATE 2.

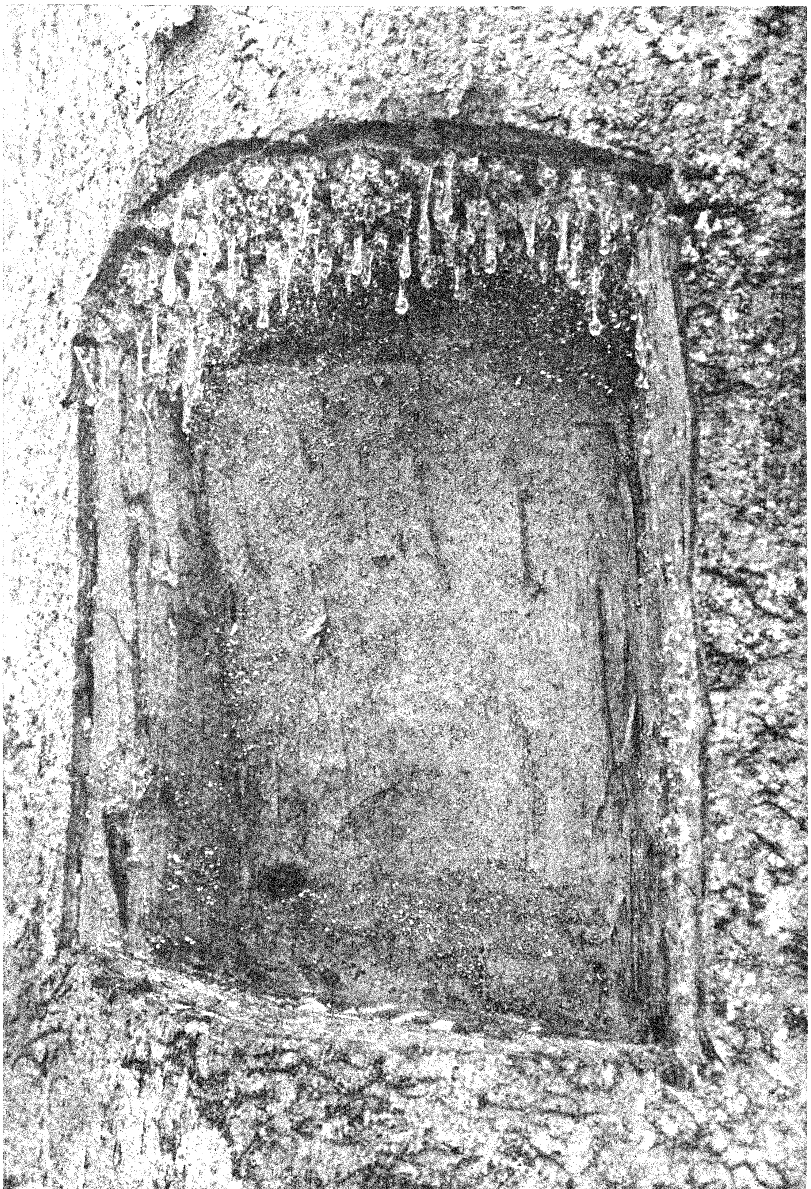

PLATE 3.

THE LANE-EYNON VOLUMETRIC METHOD FOR THE DETERMINATION OF LACTOSE IN MILK

By F. T. ADRIANO
Chief, Agricultural Chemistry, Bureau of Plant Industry, Manila

S. B. OLIVEROS
Assistant Agricultural Chemist, Bureau of Plant Industry, Manila

and

L. G. MIRANDA
Superintendent, San Miguel Brewery, Manila

Chemical control in factories is always facilitated by methods that are economical in time and labor, easy to follow, and as accurate as the methods in use in technical laboratories. Like other items in the chemical control of a milk plant, the determination of lactose must be rapid and accurate. Lactose is accurately determined through its reducing effect upon copper salts, in which respect it acts like invert sugar. The methylene blue volumetric method for invert sugar has given very satisfactory results in the chemical control in sugar-cane factories, and is now widely used whenever numerous determinations have to be made with a fairly high degree of precision in a short period of time. In the work here reported the volumetric method of Eynon and Lane for determining reducing sugars was compared with three other methods in use: the polariscopic or optical method, the copper-reduction method, and the alkaline potassium permanganate volumetric method reported by Adriano in 1920.

METHODS

THE OPTICAL METHOD

The optical method used follows the official method of analysis of the American Association of Official Agricultural Chemists.(1) The specific gravity of the milk sample was obtained by means of a pycnometer at room temperature. A volume of milk based upon twice the normal weight of lactose was measured into a volumetric flask graduated at 102.6 ml. The volume taken, depending upon the specific gravity, was as follows:(1, 4)

TABLE 1.—*Volumes of milk corresponding to double normal weight of lactose.*

Specific gravity.	Volume.	Specific gravity.	Volume.	Specific gravity.	Volume.
1.024	64.25	1.029	63.95	1.034	63.65
1.025	64.20	1.030	63.90	1.035	63.55
1.026	64.15	1.031	63.80	1.036	63.50
1.027	64.05	1.032	63.75		
1.028	64.00	1.033	63.70		

To the milk was added 1 ml of an acid mercuric nitrate solution made by dissolving mercury metal in twice its weight of nitric acid and diluting with an equal volume of water. The flask was filled to the mark, shaken, and the contents filtered through a dry filter. The filtrate was polarized in a 400-mm tube. The polariscope reading was divided by 4 to obtain the percentage of lactose in the sample.

MUNSON-WALKER GRAVIMETRIC METHOD

Twelve and one-half grams of the sample were placed in a 250-ml volumetric flask with 200 ml of water added. To the mixture was added 5 ml of copper sulphate solution containing 69.278 g copper sulphate crystals per liter, and a sufficient quantity of $N/2$ NaOH solution to produce an acid reaction. The flask was filled to the mark, mixed, and the contents filtered through a dry filter.

Twenty-five millimeters of asbestos-filtered copper sulphate solution containing 69.278 g copper sulphate pentahydrate per liter were measured into a 400-ml beaker and 25 ml of an alkaline tartrate solution containing 346 g Rochelle salts and 100 g NaOH per liter were added. Twenty-five millimeters of the clear, protein-free milk sample were added, and the entire volume was made up to 100 ml with water. The beaker was covered with a watch glass and heated over a regulated heater so that the contents began to boil after exactly four minutes. After exactly two minutes boiling, the hot solution was at once filtered through a dry and tared Gooch crucible with an asbestos mat, using suction. The precipitate was washed thoroughly with hot water, then with 10 ml of alcohol and 10 ml of ether. The crucible was dried in an electric oven at 100° C. for thirty minutes and then weighed. From Munson and Walker's tables (1) the weight of lactose was obtained.

THE ALKALINE POTASSIUM PERMANGANATE METHOD (ADRIANO, 1920)

Twenty-five grams of milk were placed in a 500-ml graduated flask, diluted with 400 ml water and then 10 ml of the copper sulphate solution used in the Munson-Walker method above and a sufficient quantity of $N/2$ NaOH were added, so that the solution remained acid, with copper in solution. The flask was then filled to the mark and shaken, and the contents were filtered through a dry filter. Ten millimeters of the clear solution were used for analysis.

The 10 ml of the filtrate were placed in a 500-ml Erlenmeyer flask, 50 ml of 0.1 N standardized potassium permanganate, 25 ml of a solution of sodium carbonate containing 8.48 g of anhydrous salt per liter, and sufficient water to make 100 ml were added. The flask was heated over a heating device so regulated that the temperature of the contents was raised to 95° C. in two minutes. After two more minutes heating, 25 ml of 30 per cent sulphuric acid were added and, from a burette, 0.1 N standardized oxalic acid was added until the solution was colorless. The excess of the oxalic acid was then titrated with the potassium permanganate solution. The lactose value was taken from the following revised table:(3)

TABLE 2.—*Weight of lactose corresponding to potassium permanganate.*

Volume 0.1 N $KMnO_4$.	Lactose.	Volume 0.1 N $KMnO_4$.	Lactose.	Volume 0.1 N KMnO4.	Lactose.
ml.	*mg.*	*ml.*	*mg.*	*ml.*	*mg.*
1	2.51	15	17.85	28	30.60
2	3.21	16	19.04	29	31.49
3	4.04	17	20.16	30	32.55
4	4.39	18	20.96	31	34.65
5	5.47	19	21.50	32	35.69
6	6.52	20	22.89	33	36.16
7	7.69	21	23.63	34	37.26
8	9.13	22	24.87	35	38.26
9	9.98	23	25.92	36	38.64
10	11.37	24	26.67	37	39.28
11	12.30	25	28.10	38	40.16
12	13.80	26	28.39	39	40.56
13	15.41	27	29.50	40	41.47
14	16.72				

LANE-EYNON METHYLENE BLUE METHOD

This method is given in the Official Methods,(1) in the Hawaiian Methods,(2) and discussed by Lane and Eynon.(5) The reagents used were: (1) One per cent aqueous solution of methylene blue, specified for indicator use; (2) Soxhlet's modification of Fehling's solution; (*a*) 69.278 g chemically pure copper sulphate crystals per liter, filtered through asbestos, and (*b*) alkaline tartrate consisting of 346 g Rochelle salts and 100 g chemically pure sodium hydroxide per liter, filtered through asbestos; (3) clarifying solution: 54 Brix normal (neutral) lead acetate, and for deleading, a solution of 30 g potassium oxalate and 70 g disodium phosphate separately dissolved per liter. For standardizing the copper sulphate solution, a standard invert sugar solution was made as follows: 9.5000 g pure sucrose were weighed, 5 ml concentrated HCl added and made up to about 100 ml. The solution was allowed to stand three days, then made up to 1 liter in a glass-stoppered volumetric flask. For use, 50 ml of this solution was measured in a 250-ml flask, neutralized with sodium carbonate, and made up to the mark. One hundred ml of this solution contained 0.02 g invert sugar. The copper sulphate solution was standardized as if analyzing this invert sugar solution, and readjusted so that exactly 25.64 ml of the standard invert sugar solution will require 10 ml of the Fehling's solution. In the table for invert sugar, 25.64 ml of invert sugar solution are set equivalent to 200 mg invert sugar or 270.91 mg hydrated lactose, $Cl_2H_{22}O_{11}.H_2O$.

Twenty-five grams of milk were diluted in a 500-ml flask with about 400 ml water. The neutral lead acetate solution was added avoiding any excess, shaken, and the mixture deleaded by adding the phosphate-oxalate mixture until no further precipitation occurred. The mixture was made up to the mark, and filtered through a dry filter.

Five millimeters of each of the copper sulphate and alkaline tartrate solutions were measured from 5-ml graduated burettes into a 250-ml Erlenmeyer flask. Twenty millimeters of the clear milk sample were added from a graduated burette and the flask heated to boiling over a wire gauze. About fifteen seconds after boiling, more of the sample was added until only the faintest perceptible blue color remained. Three drops of the methylene blue indicator were added, then the titration was completed by adding more of the milk sample dropwise. The end point, accurate to one drop of titre, was reckoned when the blue color was discharged.

For precise titrations, to the reagents in the flask was added cold the milk sample up to 0.5 to 0.8 ml of the total volume required in the first or incremental titration. The mixture was then boiled for two minutes, after which time three drops of the indicator were added, and the titration was completed within the next minute. From the quantity of the titre used, the lactose was calculated from Table 3, also given in the Official Methods (1) and by Lane and Eynon. (5)

TABLE 3.—*Lactose table for the methylene blue method.*

Volume of sugar solution required.	For 10 ml Fehling's solution hydrated lactose $C_{11}H_{22}O_{11}\cdot H_2O$.		Volume of sugar solution required.	For 10 ml Fehling's solution hydrated lactose $C_{11}H_{22}O_{11}\cdot H_2O$.	
ml.	*Mg lactose.*	*Mg per 100 ml.*	*ml.*	*Mg lactose.*	*Mg per 100 ml.*
15	68.3	455.0	33	67.8	205.6
16	68.2	426.0	34	67.9	199.7
17	68.2	401.0	35	67.9	194.0
18	68.1	378.0	36	67.9	188.6
19	68.1	358.0	37	67.9	183.5
20	68.0	340.0	38	67.9	178.7
21	68.0	323.8	39	67.9	174.1
22	68.0	309.1	40	67.9	169.7
23	67.9	295.4	41	68.0	165.9
24	67.9	282.9	42	68.0	161.9
25	67.9	271.6	43	68.0	158.1
26	67.9	261.0	44	68.0	154.7
27	67.8	251.1	45	68.1	151.3
28	67.8	242.1	46	68.1	148.0
29	67.8	233.8	47	68.2	145.1
30	67.8	226.0	48	68.2	142.1
31	67.8	218.7	49	68.2	139.2
32	67.8	211.9	50	68.3	136.6

RESULTS

The results of the comparative study of the four methods of determining lactose in milk are given in Table 4.

DISCUSSION OF RESULTS

Table 4, giving a comparison of the percentage of lactose in milk samples as determined by four methods, shows that the maximum deviation of lactose percentage given by the methylene blue method from that given by the gravimetric method does not go beyond 0.1 per cent difference. From the point of view of precision, therefore, the methylene blue method is satisfactory. The optical method apparently gives erratic results, the difference in percentage of lactose from that determined by the gravimetric method coming to as high as 0.53 per cent. Better results could be obtained by the optical method following the double-dilution method given by Sherman, (6) but this procedure entails too much time to be satisfactorily employed in factory-control work, although the single-dilution method is rapid.

TABLE 4.—*Comparison of four methods of lactose determination.*

Sample.	Method.			
	Gravimetric.	Optical.	Adriano.	Lane-Eynon.
	4.799	4.82	4.736	4.732
Evaporated canned, diluted 1 : 1	4.856	4.83	4.922	4.746
	4.828	4.83	4.829	4.739
	4.716	4.83	4.755	4.644
Fresh carabao milk	4.621	4.83	4.683	4.628
	4.669	4.83	4.719	4.636
	4.586	4.85	4.815	4.630
Do	4.578	4.83	4.646	4.531
	4.582	4.84	4.731	4.581
	4.955	4.82	4.851	4.860
Reconstituted milk	4.950	4.81	4.872	4.870
	4.953	4.82	4.862	4.865
	4.944	4.42	4.894	4.812
Natural sterilized milk	4.940	4.40	4.925	4.872
	4.942	4.41	4.910	4.842
	4.689	4.78	4.547	4.784
Evaporated canned, diluted 1 : 1	----------	4.76	4.584	4.746
	4.689	4.77	4.566	4.765
	4.941	----------	4.572	4.806
Do	4.810	----------	4.524	4.737
	4.876	----------	4.548	4.772

The official gravimetric method is held to be the most accurate, if the milk samples are properly clarified. The objection to the use of this method is the number of weighings with the analytical balance that has to be made in the analysis. The method developed by the senior author(3) is also fast and accurate, but requires the handling of several burettes, and takes more time than the Lane-Eynon method. The latter after a few trials gives satisfactory results that can be easily duplicated. Trials have been made using unclarified milk with the methylene blue method. These trials gave an average difference of about 7 mg lactose per 100 ml of solution, the unclarified sample giving a higher percentage of lactose. When it is necessary to secure rapidity even at the expense of accuracy, or when comparisons of the same kind of products are to be made, clarification of the milk sample can be dispensed with.

SUMMARY

A comparison of four methods of determining lactose in milk—by the the Munson-Walker gravimetric method, optical method, alkaline potassium permanganate method, and volu-

metric methylene blue method—has shown that the volumetric methylene blue method can be used for this purpose with very satisfactory results in point of rapidity, convenience, and accuracy.

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MUTILLIDÆ OF THE PHILIPPINE ISLANDS [1]

By CLARENCE E. MICKEL
Of the University of Minnesota

ONE PLATE

Some ten years ago the late Prof. C. F. Baker, then dean of the College of Agriculture, Los Baños, Philippine Islands, sent a large number of specimens of Mutillidæ to the United States National Museum for identification. The material was sent to me at that time for study. Later I received several sendings of specimens direct from Professor Baker, and when the United States National Museum acquired Professor Baker's collections after his death a final lot of material was sent me. A preliminary survey of the first sendings revealed that the Philippine mutillid fauna was much greater than anyone had supposed. It was also apparent from this first brief study that considerable confusion existed in the records of Mutillidæ from the islands in the Pacific Ocean and that further confusion could only be avoided by a study of the type material of species known from that general region. The study then lay dormant for several years due to the fact that nearly all the type specimens were in the collections of European museums, which necessitated a period of study abroad. In 1930, the John Simon Guggenheim Memorial Foundation, by means of a fellowship, made it possible for me to spend a year in Europe studying mutillid type material. A part of this time was devoted to the study of the mutillids described from all of the islands of the Pacific Ocean. A paper has already been published giving the results with respect to the fauna of Formosa. The present paper deals only with the mutillid fauna of the Philippine Islands. A third, in preparation, treats of all the species known from the islands of the Pacific Ocean, including Formosa and the Philippines. In addition to the Baker collection I have been privileged to study material from the collections of the Philippine Bureau of Science,

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the Research Bureau of the Philippine Sugar Association, the Experiment Station of the Hawaiian Sugar Planters' Association, and Cornell University, Ithaca, New York.

Robert Brown (1906) published a catalogue of the Hymenoptera described or recorded from the Philippine Islands in which thirteen species of Mutillidæ were listed. Since that date the species *browni* Rohwer and *itambusa* Cockerell have been described, and *vicina* Sichel and Radoskowski, *nigra* Smith, and *ianthea* Smith have been added to Brown's list. The status of the species described with type localities in the Philippine Islands is as follows: The first species of Mutillidæ recorded from the Philippine Islands was the female sex of *Timulla* (*Trogaspidia*) *philippinensis,* described by Frederick Smith in 1855. The male of this species was described as *Trogaspidia bicolor* by Ashmead, 1905. *Timulla accedens,* described in 1869 by Sichel and Radoskowski, is a synonym of *philippinensis.* A second species, *luzonica,* was described by Radoskowski in 1885. Ashmead described two additional species, *semperi* in 1904 and *minor* in 1905, and Brown described *manilensis* and *parva* in 1906. *Timulla browni,* described by Rohwer in 1910, is a synonym, the female sex of *minor.* The holotype of *Trogaspidia itambusa* Cockerell has been examined and found to be a subspecies of *philippinensis* Smith. Thus seven valid species and subspecies have been previously described with type localities in the Philippine Islands.

The eight additional species, with type localities elsewhere than the Philippines, may be disposed of as follows: *Mutilla maculofasciata* Saussure was described in 1867 with type localities Ceylon, Timor, and Luzon. The Ceylon specimen is available in Vienna, Austria, and has been examined. Nothing like it is known from the Philippines. I have been unable to locate the Luzon or Timor specimens in any of the European collections and cannot say what they may have been. Even though Saussure's Luzon specimen of *maculofasciata* cannot be identified, the species can be eliminated from the Philippine list since it is certain the Luzon specimen was not the same as the Ceylon species. The specimen from Luzon recorded by Sichel and Radoskowski in 1869 as *analis* Lepeletier has been examined and found to be a specimen of *minor* subsp. *minor* Ashmead. *Mutilla analis* Lepeletier from India is an entirely different species. The specimen from Luzon recorded by Sichel and Radoskowski in the same work as *dimidiata* Lepeletier is not available for examination, but the information given by the authors leaves no doubt that the specimen was a male of *philippinensis* Smith. The type of *dimidiata* Lepeletier has been examined and it is certain that this species is not known from the Philippine Islands. The type locality of *vicina* Sichel and Radoskowski, 1869, is given as Amboina and Luzon. The specimen from Luzon was examined and found to be a female of *minor* subsp. *minor* Ashmead. I consider the Amboina specimen the lectotype of *vicina.* The species recorded as *nigra* Smith by Bingham in 1895 has been examined and found to be an example of *Smicromyrme viriata* subsp. *nitela* subsp. nov., described hereafter. The specimens that Bingham recorded as *suspiciosa* Smith in the same paper proved to be a composite series of *Timulla (Trogaspidia) philippinensis, T. (T.) minor* subsp. *whiteheadi, T. (T.) depressula,* and *T. (T.) eremita* subsp. *umbra.* None of the specimens was the same as *suspiciosa* Smith, the type of which was examined. André in 1903 recorded *Mutilla discreta* Cameron from the Philippines. I have not been able to examine André's specimen to determine its identity, but it is certainly not *discreta* Cameron. That species should be eliminated from the Philippine list. The specimen recorded by Zavattari, 1913, as *ianthea* Smith is probably a female specimen of *philippinensis* Smith.

This analysis shows that eighteen species have been described or recorded from the Philippines, thirteen of them having been listed in Brown's catalogue. Ten of these were originally described from the Philippine Islands. Eight are species described from other localities, and as indicated above all are to be rejected as non-Philippine species. Of the ten originally described from the Philippines three fall as synonyms. Therefore, seven species are definitely known from the Philippine Islands. In the following pages forty-eight species and twenty-one subspecies are discussed. These are distributed among the following genera: *Squamulotilla,* seventeen species, one subspecies; *Odontomutilla,* three species; *Timulla (Trogaspidia),* fifteen species, fourteen subspecies; and *Smicromyrme,* thirteen species, six subspecies. Fifty-six of these species and subspecies are new, thirteen having previously been described.

The host relations of the Philippine species may be briefly summarized as follows: F. X. Williams (1919) has reared a female, which is undoubtedly *Timulla (T.) minor* subsp. *minor* (Ashmead), from the cocoons of *Tiphia lucida* Ashmead. He also succeeded in getting the females of this mutillid to oviposit in cocoons of *Tiphia lucida* and in rearing the larvæ to maturity. A. W. Lopez (1931) reports a male mutillid wasp as having been reared from a scoliid wasp cocoon. I have examined this male and find it to be *T.* (*T.*) *minor* subsp. *visayensis* subsp. nov.

Six hundred fifty-four of the twenty-one hundred specimens studied—that is, almost one-third—were found to be examples of *T.* (*T.*) *minor* (Ashmead). These specimens were from localities widely distributed throughout the Islands and were not a homogeneous lot. They were clearly a mixed group. A study of the genitalia of the male specimens showed that six different forms of genitalia were present. The specimens were then arranged according to the different forms of male genitalia, and it was found that each form of male genitalia was limited to specimens from a definite geographic area. These areas were as follows: (*a*) The extreme northern part of Luzon Island (Cape Engaño); (*b*) Tayabas Province, including Polillo Island; (*c*) all of Luzon north and west of Tayabas Province, with the above exceptions; (*d*) Luzon Island south and east of Tayabas Province, and Samar, Biliran, Leyte, Bohol, Mindanao, and Basilan Islands; (*e*) Sibuyan, Batbatan, Panay, Negros, and Cebu Islands; and (*f*) Palawan Island. For the purposes of discussion I have named these areas, respectively, (*a*) northern Luzon, (*b*) Tayabas, (*c*) western Luzon, (*d*) Mindanao, (*e*) Visayas, and (*f*) Palawan. The males of *minor* from each of these six areas have a distinct form of male genitalia, although the general type of male genitalia is the same in all six and the external characters by which they may be separated are not very clear-cut. The females from western Luzon are easily separated from all the rest, but those from Tayabas, Visayas, and Mindanao are inseparable by morphological criteria; female specimens were not seen from northern Luzŏn and Palawan. I have, therefore, chosen to rank these six forms of *minor* as subspecies, each of which appears to inhabit an isolated geographic area.

It is interesting to note that the geographic areas defined on the basis of subspecific geographic distribution in the species *minor* appear to have validity with respect to all the Mutillidæ from the Philippine Islands. There are exceptions, but of the sixty-nine species and subspecies treated in this paper, forty-eight, or slightly over two-thirds, are limited in their distribution to a single one of these areas. The following table shows the distribution of the sixty-nine species of Mutillidæ in these six geographic areas.

Distribution of Mutillidæ in six geographic areas of the Philippines.

	(a) Northern Luzon.	(b) Tayabas.	(c) Western Luzon.	(d) Visayas.	(e) Mindanao.	(f) Palawan.
Squamulotilla:						
byblis			×	×		
subtriangularis					×	
galatea			×			
deserta			×			
oblectabilis			×			
fucosa					×	
ocypote		×				
dictynna					×	
imparilis			×			
disjuncta			×			
concava					×	
roxane				×		
subdebilis			×			
sulpicilla					×	
teuta subsp. *teuta*			×			
teuta subsp. *vicinaria*				×		
eminula			×			
umbrosa			×			
Odontomutilla:						
familiaris			×	×	×	
pedaria					×	×
andromeda			×	×	×	
Timulla (Trogaspidia):						
philippinensis subsp. *philippinensis*	×	×	×	×	×	×
philippinensis subsp. *williamsi*			×			
philippinensis subsp. *itambusa*		×				
minor subsp. *minor*			×			
minor subsp. *whiteheadi*	×					
minor subsp. *tayabasensis*		×				
minor subsp. *visayensis*				×		
minor subsp. *islandica*					×	
minor subsp. *princesa*						×
eremita subsp. *eremita*		×	×	×	×	
eremita subsp. *umbra*			×			
luzonica subsp. *luzonica*			×			
luzonica subsp. *panayensis*				×		
ovatula subsp. *ovatula*				×		
ovatula subsp. *aurifera*			×			
depressula	×		×			
bakeri					×	
tegularia			×	×	×	
tethys						×
manilensis	×		×	×	×	×
proserpina subsp. *proserpina*				×	×	
proserpina subsp. *tibiata*			×		×	
proserpina subsp. *sibuyanensis*				×		
ira subsp. *palawana*						×
temeraria			×			
fortuita				×	×	×
nigerrima		×			×	
sticticornis subsp. *sticticornis*					×	
sticticornis subsp. *nigridia*					×	

Distribution of Mutillidæ in six geographic areas of the Philippines—Ctd.

	(a) Northern Luzon.	(b) Tayabas.	(c) Western Luzon.	(d) Visayas.	(e) Mindanao.	(f) Palawan.
Smicromyrme:						
ilerda subsp. *sparsilis*	------	------	------	------	×	------
hyale	------	------	------	------	×	------
viriata subsp. *viriata*	------	------	×	×	×	------
viriata subsp. *nitela*	------	------	×	×	×	------
fura subsp. *fura*	------	------	×	×	×	------
fura subsp. *anthracipes*	------	------	×	------	------	------
caerulea	------	------	------	------	×	------
basalis subsp. *basalis*	------	------	------	------	×	------
basalis subsp. *annularis*	------	------	×	------	------	------
parva	------	------	×	------	×	------
fluctuata	------	------	------	×	×	------
zebina	------	------	×	------	×	------
palawanensis	------	------	------	------	------	×
autonoe	------	------	------	------	------	×
semperi subsp. *semperi*	------	×	×	×	------	------
semperi subsp. *nigrogastra*	------	------	×	------	------	------
bakeri	------	------	------	------	------	×
lavinia subsp. *lavinia*	------	------	×	------	×	------
lavinia subsp. *atrata*	------	------	------	------	×	------

An analysis of the information in the above table shows the following:

Six species are found in the Philippine Islands which are also known from localities without, thus:

One species occurs in western Luzon, the Visayas, and Mindanao of the Philippines, as well as in Borneo and the Malay Peninsula (there may be some doubt about the latter locality).

One species occurs in western Luzon and Mindanao, as well as in Borneo.

One species occurs in the Visayas and Mindanao, as well as in Borneo.

One species occurs in the Visayas and Mindanao, as well as in Morty Islands.

One species occurs in Mindanao, as well as in Bachian.

One species occurs in western Luzon, as well as in Celebes.

Only one species or subspecies occurs in all six of the Philippine areas.

A second species occurs in five of the areas and is absent from northern Luzon.

A third species occurs in four of the areas and is absent from northern Luzon and Palawan.

Seven species and subspecies occur in only three of the areas:

Five of these are found in western Luzon, the Visayas, and Mindanao.

One occurs in western Luzon, Tayabas, and the Visayas.

One occurs in the Visayas, Mindanao, and Palawan.

Seven species and subspecies occur in only two of the areas:
- One is found in northern Luzon and western Luzon.
- One is found in western Luzon and the Visayas.
- Three occur in western Luzon and Mindanao.
- One occurs in Tayabas and Mindanao.
- One is found in Mindanao and Palawan.

One subspecies occurs only in the northern Luzon area.
Three species and subspecies occur only in the Tayabas area.
Seventeen species and subspecies occur only in the western Luzon area.
Six species and subspecies occur only in the Visayas area.
Thirteen species and subspecies occur only in the Mindanao area.
Six species and subspecies occur only in the Palawan area.

At least one generalization may be drawn from the above data; namely, the Mutillidæ of the Philippine Islands are, in general, local in their distribution; in most cases, a species or a subspecies is restricted to a small geographic area; the cases of wide geographic distribution are comparatively rare. A preliminary survey leads me to believe that this generalization is true regarding the Mutillidæ in all parts of the world. The fact that the opposite view has been held by some of the earlier students of Mutillidæ has led to vast confusion in the identification and records of species and subspecies.

In the case of previously described species recorded herein, the type of each species has been examined and Philippine material compared with it to verify the determinations. All of the specimens have been examined, studied, or described with the aid of a wide-field binocular microscope at a magnification of 27.5 diameters. Every specimen studied bears a label giving my specific determination of that specimen. The genitalia of male specimens have been studied for all species of which the male sex is represented. In most instances the genitalia as removed from the tip of the abdomen have been mounted on a paper point and placed on the pin beneath the specimen. In a few cases it has been found advantageous to dissect the genitalia apart and to make permanent slide mounts. In all cases where the male genitalia are a necessary aid to identification they are figured. The figures are composite due to the fact that all views could not be made from a slide mount; therefore, the latter, and a second partially dissected specimen mounted on a paper point, have been used in making the drawings. Allowance must be made, when using the figures as criteria for identification, for the position of the genitalia when they are examined; a slight rotation of the genitalia to the right or left, or to the front and back makes a striking change in the appearance of the same specimen. All such factors have been taken into account in the present study.

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Key to the Philippine genera of Mutillidæ.

MALES

1. Tegulæ small, scalelike, convex, smooth and shining, the hind margin not reflexed; mandibles beneath unarmed; tergites 3 to 7 with a distinct, median, longitudinal carina.................... *Squamulotilla* Bischoff.
   Tegulæ distinctly larger, the hind margin distinctly reflexed; or, if not, the latter coarsely sculptured; mandibles beneath armed or not; tergites 3 to 7 without a median carina.. 2.
2. First abdominal segment broad and transverse; posterolateral angles of scutellum produced, thus more or less dentate.
   Odontomutilla Ashmead.
   First abdominal segment of rather slender form, sessile but never strongly, transversely developed; posterolateral angles of scutellum not produced .... 3.
3. Vertex not at all elevated posteriorly, not flattened, rounded throughout, the posterior margin not truncate, punctate throughout without any trace of striæ; distance between origin of vein M on vein R and the base of the stigmatic cell scarcely greater than the length of the latter .... *Timulla* (*Trogaspidia*) Ashmead.
   Vertex elevated posteriorly, more or less flattened, truncate posteriorly at the middle, distinctly longitudinally striate-punctate throughout; distance between origin of vein M on vein R and the base of the stigmatic cell equal to twice the length of the latter.
   Smicromyrme Thomson.

FEMALES

1. Mesopleuræ with a very prominent, vertical, lamelliform projection just above the middle coxæ .... *Squamulotilla* Bischoff.
   Mesopleuræ without such a vertical, lamelliform projection.......... 2.
2. First abdominal segment strongly transverse, short, sharply truncate anteriorly, presenting a broad, anterior surface at right angles to the abdomen; thorax more or less hexagonal, the sides converging anteriorly and posteriorly .... *Odontomutilla* Ashmead.
   First abdominal segment sessile, but not strongly transverse, not sharply truncate anteriorly; thorax rectangular, the sides approximately parallel .... 3.
3. Second abdominal tergite ornamented with a pair of pale pubescent spots .... *Timulla* (*Trogaspidia*) Ashmead.
   Second abdominal tergite either without spots, or with unpaired, pale pubescent spots, sometimes only one, sometimes three.
   Smicromyrme Thomson.

Genus SQUAMULOTILLA Bischoff

Key to the species.

MALES

1. Wings with only one cubital cell, R_5 and R_4 absent.......... 2.
   Wings with two cubital cells, only R_4 absent.......... 5.
2. Lateral margins of pronotum with a small, median tubercle; second tergite with moderate, distinct punctures, for the most part separated by their own diameter.......... *ocypote* sp. nov.
   Lateral margins of pronotum not tuberculate medially; second tergite usually more sparsely punctate, the punctures separated by from one to three times their own diameter.......... 3.
3. Lateral margins of pronotum straight, not at all sinuate; punctures of second abdominal tergite separated by about three times their own diameter .... *dictynna* sp. nov.
   Pronotum narrowed anteriorly, the lateral margins not forming a straight line but more or less sinuate; punctures of second abdominal tergite for the most part separated by one to two times their own diameter .... 4.
4. Sides of propodeum with small, distinct punctures; second abdominal tergite with small punctures separated by one to two times their own diameter .... *imparilis* sp. nov.
   Sides of propodeum distinctly reticulate; second abdominal tergite with fine punctures separated by two to three times their own diameter.
   disjuncta sp. nov.
5. Entirely black or dark metallic blue.......... 6.
   At least the thorax more or less ferruginous.......... 9.
6. Second abdominal sternite conspicuously concave, glabrous.
   concava sp. nov.
   Second abdominal sternite convex, not at all concave.......... 7.
7. First abdominal sternite with a distinct, well-developed, median, longitudinal carina; lateral margins of pronotum, each with a distinct, median tubercle .... *umbrosa* sp. nov.

First abdominal sternite without a median, longitudinal carina; lateral margins of pronotum very slightly angulate medially but without a distinct, median tubercle .... 8.

8. Hypopygium with a conspicuous, transverse, arcuate carina at its proximal margin; length, 9 millimeters .... *roxane* sp. nov.
Hypopygium with a very feeble, transverse, arcuate carina at its proximal margin; length, 5 millimeters .... *subdebilis* sp. nov.

9. First abdominal sternite with a distinct, well-developed, median, longitudinal carina .... *eminula* sp. nov.
First abdominal sternite without a median, longitudinal carina .... 10.

10. Hypopygium with a conspicuous, transverse, arcuate carina at the proximal margin; thorax more or less ferruginous, but at least the tegulæ very dark brown to black .... 11.
Hypopygium with only a feeble, transverse carina at the proximal margin; thorax including the tegulæ entirely pale ferruginous.
sulpicilla sp. nov.

11. Thorax largely ferruginous, sometimes the mesonotum and scutellum blackish .... *teuta* subsp. *teuta* sp. et subsp. nov.
Thorax largely blackish, only the metapleuræ and propodeum ferruginous .... *teuta* subsp. *vicinaria* subsp. nov.

FEMALES

1. Thorax somewhat longer than broad, the dorsum distinctly, longitudinally striate-punctate, the lateral margins of mesonotum not conspicuously dentate, at least anteriorly; sides of propodeum glabrous, impunctate .... 2.
Thorax as broad as long or broader, the dorsum not striate-punctate, entirely densely, confluently punctate, the lateral margins of the mesonotum conspicuously dentate; sides of propodeum with small, close, distinct punctures .... 5.

2. Integument beneath pale pubescent, apical band of second tergite black; tergites three to five each with a median, apical spot of pale pubescence; posterior margin of dorsum of propodeum armed with a row of erect teeth .... *deserta* (Smith).
Integument beneath pale pubescent, apical band of second tergite whitish; at least tergite three without a median, pale pubescent spot; posterior margin of dorsum of propodeum comparatively unarmed, at the most defined by a crenulate raised line, or with a median tooth .... 3.

3. Lamellate process of mesopleuræ moderately developed, the ventrodorsal dimension the greatest; femora entirely black.
galatea sp. nov.
Lamellate process of mesopleuræ very conspicuous, the proximodistal dimension as great as or greater than the ventrodorsal dimension; at least the proximal half of femora ferruginous .... 4.

4. Proximodistal dimension of lamellate process about equal to the ventrodorsal dimension, the distal margin of the process arcuate; fourth abdominal tergite without a median, pale pubescent spot; posterior margin of dorsum of propodeum with a median tooth.
byblis sp. nov.
Proximodorsal dimension of lamellate process distinctly greater than the ventrodorsal dimension, the distal margin of the process acutely

angulate, the process subtriangular; fourth tergite with a small, median, apical, pale pubescent spot; posterior margin of dorsum of propodeum defined by a crenulate raised line.
subtriangularis sp. nov.

5. Posterior margin of dorsum of propodeum armed with a row of erect teeth; dorsum of propodeum angulately separated from the posterior face, the latter with sparse, obscure punctures......*oblectabilis* sp. nov.

Posterior margin of dorsum of propodeum defined by an obscure, serrate, raised line; dorsum of propodeum rounded into the posterior face, the latter with small, dense punctures................ *fucosa* sp. nov.

SQUAMULOTILLA BYBLIS sp. nov.

Female.—Black, except the thorax entirely, scape, pedicel, first abdominal sternite, coxæ, trochanters, proximal half of femora, and distal four tarsal segments, all ferruginous, and the integument beneath the pale pubescent markings on first and second abdominal segments white; posterior margin of dorsum of propodeum with a prominent, median tooth; first abdominal tergite with an apical, median spot, the second tergite with a broad, apical band slightly dilated medially, both of pale, glittering pubescence; fifth tergite with a large, median, transverse spot of pale pubescence. Length, 9 millimeters.

Head black, the scape and pedicel pale ferruginous; flagellum beneath, beyond the second segment, tinged with ferruginous; distal half of mandibles dark mahogany red; mandibles somewhat broadened distally, the distal end blunt and rounded and with two small teeth within near the apex; clypeus with an elevated, arcuate ridge medially, the lateral termini of the ridge at the anterior margin, the median point of the ridge at the posterior margin, the ridge trituberculate, a distinct tubercle at each of the lateral termini and at the median point; antennal tubercles glabrous, impunctate, contiguous at their base; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum almost equal in length to the second and third united; antennal scrobes distinctly carinate above; front, vertex and genæ with moderate, dense, confluent punctures, the front and vertex with long, scattered, erect, and sparse, short, semirecumbent pubescence, the genæ with sparse, pale pubescence; a few pale hairs on the front at the base of the antennal tubercles; posterior margin of genæ defined by a crenulate carina; a prominent, transverse, sharp ridge midway between the gular orifice and the foramen; head moderately well developed behind the eyes, the distance between the eye margins and the posterolateral angles equal to five-ninths of the greatest diameter of the eyes; relative widths of head and thorax, 4.4: 4.1.

Thorax entirely ferruginous; dorsum of thorax densely, longitudinally striate-punctate, the punctures moderate, except near the lateral margins of the mesonotum a slightly convex area with the punctures small, also with a more or less distinct, median, longitudinal carina, clothed throughout with long, scattered, erect, and sparse, short, semirecumbent, obscurely ferruginous pubescence; lateral margins of dorsum of thorax margined; pronotum wider than remainder of thorax, the lateral margins roundly angulate medially, anteriorly with a pair of very distinct tubercles, one each at a point two-fifths the distance from the posterolateral angles to the midline; lateral margins of mesonotum straight and parallel on anterior half, the posterior half with three tubercles, the anterior two rounded, blunt, the posterior one acute, prominent, and situated just anterior to the propodeal spiracles; thorax distinctly constricted at the propodeal spiracles; dorsum of propodeum with moderate, dense, confluent punctures; propodeum without a transverse row of erect, distinct teeth separating the dorsal and posterior faces, but with a prominent median tooth at the posterior margin of the dorsum; posterior face of propodeum with a median, longitudinal carina its entire length, shallowly, obscurely reticulate, clothed with sparse, long, erect, obscurely ferruginous pubescence; lateral margins of posterior face of propodeum dentate; anterior margin of propleuræ sinuate with a prominent, thick, blunt tubercle midway between the ventral and dorsal angles; lamellate process on mesopleuræ above middle coxæ large and conspicuous, the anterior face distinctly concave, the posterior face convex; dorsoventral width of lamellate process equal to one-third the distance from the coxal cavities to the dorsal margin of mesopleuræ; pleural areas throughout glabrous, obscurely micropunctate and with sparse, appressed, pale micropubescence.

Abdomen black, except the first sternite ferruginous and the integument beneath the median, pale pubescent spot of first tergite and apical pale pubescent band of second tergite, whitish; anterior face of first tergite micropunctate and also with scattered, small punctures, clothed with sparse, erect, pale fuscous pubescence; dorsal face of first tergite with small, dense punctures and short, black pubescence, except a large, median spot of dense, appressed, pale, glittering pubescence; second tergite with small, dense punctures on the disk, laterally with moderate, separated punctures, the disk clothed with short, black pubescence, and scattered, erect, black hairs, the lateral areas with sparse, erect, pale hairs, the apical margin with a moderately broad, apical band, roundly dilated medially, of thick, appressed, pale, glittering pubescence; lateral margins of second tergite with short, thick, pale pubescence; third and fourth tergites with fine, dense punctures, clothed with sparse, appressed, and scattered, erect, black pubescence, except laterally the erect hairs pale, and the lateral margins with obscure, pale pubescence; fifth tergite punctured and pubescent like the third and fourth except for a large, transverse, median spot of thick, appressed, pale pubescence, the anterior margin of the pale spot arcuate; last tergite with small, dense punctures and sparse, pale pubescence, except the pygidial area glabrous, impunctate, nor margined laterally; first sternite with a prominent, median, longitudinal carina; second sternite with a median, longitudinal carina on the anterior two-thirds, and with a distinct, slightly concave area each side of the median carina, with moderate, close punctures, except the concave areas more or less glabrous and obscurely punctate, clothed with sparse, pale pubescence; sternites three to five with moderate, close to dense punctures posteriorly; sternites two to five, each with a thin, apical fringe of pale hairs; hypopygium acute at the apex, with small, dense punctures and sparse, pale pubescence.

Coxæ, trochanters, proximal half of femora, and the four distal tarsal segments, all ferruginous; distal half of femora, tibiæ, and first tarsal segment black; legs finely punctured and clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49314, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, 7 females, Mount Maquiling (*Baker*); female, Los Baños (*Baker*); 2 females, Mount Banahao, February 23, 1917 (*F. X. Williams*); 4 females, Mount Banahao (*Baker*); female, Mount Banahao. SIBUYAN, female (*Baker*).

Related to *deserta* Smith, *subtriangularis* Mickel, and *galatea* Mickel, all of which have the thorax of the same general form; it differs from those species in the form of the lamellate process of the mesopleuræ, in the pubescent markings of the abdomen, and in the color of the legs, as well as in the arming of the posterior margin of the dorsum of propodeum.

SQUAMULOTILLA SUBTRIANGULARIS sp. nov.

Female.—Head, abdomen, distal two-thirds of femora above, tibiæ entirely, and first segment of tarsi, all black, except the integument beneath the apical pale pubescent band of second abdominal tergite, whitish; thorax entirely, coxæ, trochanters, proximal third of femora above, femora entirely beneath, and four distal tarsal segments, all ferruginous; posterior margin of dorsal surface of propodeum entirely unarmed; first abdominal tergite with a transverse, median, apical spot, the second tergite with a broad, apical band dilated medially, of thick, appressed, pale, glittering pubescence; fourth tergite with a small, median, apical spot, the fifth with a large, transverse spot of thick, appressed, pale pubescence. Length, 8 millimeters.

Head entirely black, except the distal half of mandibles dark mahogany red; mandibles slightly broadened at the tips, the apex blunt and rounded, with two small teeth within near the apex; clypeus elevated medially into an arcuate ridge, the lateral ends of the ridge at the anterior margin, the median point at the posterior margin, the ridge weakly trituberculate, a tubercle at each lateral extremity and one medially; antennal tubercles contiguous, glabrous, impunctate distally, closely punctate and with sparse, pale pubescence on the proximal two-thirds; scape finely, closely punctate, clothed with fine, sparse, pale pubescence; first segment of flagellum approximately equal in length to the second and third united; antennal scrobes distinctly carinate above; front, vertex, and genæ with moderate, dense, confluent punctures, the front and vertex clothed with long, scattered, erect, and sparse, short, recumbent, dark fuscous pubescence, except the front immediately posterior to the antennal scrobes with sparse, pale pubescence; genæ with sparse, pale pubescence; posterior margin of genæ defined by a denticulate ridge not extending to the posterolateral angles; head moderately well developed behind the eyes, the distance between the eye margins and the posterolateral angles equal to five-ninths the greatest diameter of the eyes; relative widths of head and thorax, 4.2 : 3.8.

Thorax entirely ferruginous; dorsum of thorax distinctly and densely, longitudinally striate-punctate, except the lateral fifths of the mesonotum convex and with small, dense punctures, clothed with scattered, long, erect, and sparse, short recumbent, obscurely ferruginous pubescence; lateral margins of pronotum straight and parallel except for a prominent, acute tubercle medially; pronotum anteriorly with a distinct tubercle at a point one-fifth the width of the thorax from the humeral angles; lateral margins of mesonotum straight and parallel on the anterior half, slightly converging on the posterior half and each margin of the latter with three rounded, obscure tubercles; thorax distinctly constricted at the propodeal tubercles; posterior margin of dorsum of propodeum entirely unarmed, without a row of erect teeth, or without a median tooth; posterior face of propodeum with a median, longitudinal carina its entire length, shallowly, obscurely reticulate, clothed with sparse, erect, pale fuscous hairs; lateral margins of posterior face of propodeum dentate; anterior margin of propleuræ defined by a sinuate carina; lamellate process of mesopleuræ enormously developed, the length from the proximal margin to the apex slightly greater than the width, subtriangular in shape, the anterior face only slightly concave, the posterior face convex, the margins translucent; pleural areas throughout glabrous, micropunctate and with pale micropubescence.

Abdomen entirely black, except the first sternite ferruginous, and the integument of the second tergite beneath the apical, pale pubescent band, whitish; anterior face of first tergite obscurely micropunctate and with scattered, moderate punctures, clothed with scattered, long, erect, pale fuscous pubescence; dorsal face of first tergite with fine, dense punctures, clothed with sparse, short, black pubescence, except a large, transverse, median spot of thick, appressed, pale, glittering pubescence; second tergite except the lateral fifths with fine, dense punctures, the lateral fifths with small, close punctures, and sparse, pale pubescence, the disk with scattered, erect, dark fuscous and sparse, short, black pubescence, and the apical margin with a broad band distinctly dilated medially of thick, appressed, pale, glittering pubescence; lateral margins of second tergite with thick, pale pubescence; third tergite with fine, dense punctures, scattered, erect, dark fuscous hairs, and short, sparse, black pubescence except the lateral extremes with sparse, pale pubescence; fourth tergite punctured and clothed like the third except with a small, median, apical spot of appressed, pale pubescence; fifth tergite punctured and clothed like the fourth except the median, apical spot of pale, appressed pubescence large, transverse and with its anterior margin arcuate; last tergite with small, dense punctures and sparse, pale pubescence except the pygidial area glabrous, impunctate and without defined lateral margins; first sternite with a median, longitudinal carina; second sternite with a median, longitudinal carina on the anterior half, a large, obscurely concave area each side of the carina, the apical margin slightly but distinctly depressed; second sternite with moderate, close, somewhat confluent punctures except the concave areas with the punctures separated, clothed with sparse, erect, pale pubescence; distal areas of sternites three to five with moderate to small, dense punctures, and sparse, pale pubescence; sternites two to five, each with a thin, apical fringe of pale pubescence; hypopygium with small, dense punctures and sparse, pale pubescence, the apex acute.

Legs ferruginous, except the distal two-thirds of femora above, tibiæ entirely and first segment of tarsi, black; legs finely punctate and clothed with pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49315, United States National Museum, MINDANAO, Iligan (*Baker*).

Paratype.—MINDANAO, female, Iligan (*Baker*).

Related to *byblis* Mickel, *deserta* Smith, and *galatea* Mickel. Easily recognized by the enormous, subtriangular, lamellate process of the mesopleuræ, the unarmed posterior margin of the dorsum of propodeum, and the small spot of pale pubescence on the fourth abdominal tergite.

SQUAMULOTILLA GALATEA sp. nov.

Female.—Head, abdomen, and legs except the coxæ, black, except the integument beneath the apical, pale pubescent band of the second abdominal tergite, whitish; thorax and coxæ ferruginous; dorsum of propodeum with a small, inconspicuous, median tooth at the posterior margin; lamellate process of mesopleuræ distinct but not conspicuously developed as in *byblis* and *subtriangularis;* first abdominal tergite with a large, median, apical, transverse spot of dense, pale, glittering pubescence extending slightly onto the base of the second tergite, the latter also with a broad, apical band, dilated medially, of similar pubescence; fifth tergite with a median, apical, transverse spot of thick, appressed, pale pubescence. Length, 8.5 millimeters.

Head entirely black, except the flagellum beneath tinged with ferruginous and the distal half of the mandibles dark mahogany red; mandibles somewhat broadened at the tips, the apices bluntly rounded and with two small teeth within near the apex; clypeus arcuately elevated medially, the elevated margin obscurely trituberculate, a tubercle at each lateral end of the ridge and one at the median point; antennal tubercles contiguous, for the most part glabrous, impunctate, but at the base with moderate, close punctures and sparse, pale pubescence; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum approximately equal in length to the second and third united; antennal scrobes distinctly carinate above; front, vertex, and genæ with moderate, dense, confluent punctures; front and vertex with scattered, long, erect, and sparse, short, recumbent, dark fuscous pubescence except the front at the extreme anterior margin with some sparse, pale pubescence; genæ clothed with sparse, pale pubescence; genæ defined posteriorly by an obscure, crenulate ridge; head moderately well developed behind the eyes, the distance between the eye margins and the posterolateral angles equal to eleven-eighteenths the greatest diameter of the eyes; relative widths of head and thorax, 4.3 : 3.9.

Thorax entirely ferruginous; dorsum of thorax densely, longitudinally striate-punctate, the punctures moderate in size, except the lateral fifths of the mesonotum slightly convex and with small, dense punctures, clothed with scattered, long, erect, and short, sparse, recumbent, obscurely ferruginous pubescence; lateral margins of pronotum distinctly angulate, the pronotum with a small tubercle anteriorly at about one-sixth of the width of the pronotum from the humeral angle; anterior half of lateral margins of mesonotum approximately straight and parallel, the posterior half slightly converging and trisinuate; thorax distinctly constricted at the propodeal tubercles; posterior margin of dorsum of propodeum formed by a crenulate line, with a small, inconspicuous tooth medially; posterior face of propodeum with a median, longitudinal carina its entire length, obscurely reticulate, clothed with scattered, long, erect, pale fuscous pubescence; lateral margins of posterior face of propodeum dentate; anterior margin of propleuræ defined by a sinuate carina; lamellate process of mesopleuræ distinct but not unusually prominent, its dorsoventral dimension about twice its cephalocaudal dimension; pleural areas glabrous throughout, obscurely micropunctate and sparsely clothed with pale micropubescence.

Abdomen entirely black, except the first sternite ferruginous and the integument of the second tergite beneath the apical, pale pubescent band, whitish; anterior face of first tergite micropunctate, also with scattered, moderate punctures, and scattered, erect, pale pubescence; dorsal face of first tergite with fine, dense punctures, clothed with sparse, short, black pubescence, except laterally with sparse, pale pubescence, and medially with a large, apical subquadrate spot of thick, appressed, pale, glittering pubescence, this spot extending slightly onto the anterior margin of the second tergite; second tergite with small, dense punctures, except laterally the punctures slightly larger and not so dense, the disk clothed with scattered, long, erect, and short, sparse, recumbent, black pubescence, the lateral fifths with sparse, pale pubescence, the apical margin with a broad, apical band dilated medially, of thick, appressed, pale, glittering pubescence, and the lateral margins with thick, pale pubescence; tergites three to five with fine, dense punctures, clothed with scattered, long, erect, and sparse, short, recumbent, black pubescence, except near the lateral margins the pubescence pale, and the fifth tergite with a median, apical, transverse spot of thick, appressed, pale pubescence, the anterior margin of the pale pubescent spot arcuate; last tergite with small, dense punctures and sparse, pale pubescence except the pygidial area glabrous, impunctate, not margined laterally; first sternite with a median, longitudinal carina; second sternite with a median, longitudinal carina on the anterior half, a distinct slightly concave area each side of the carina; second sternite with moderate, close punctures, the latter more separated on the concave areas, and clothed with sparse, pale pubescence; sternites three to five with small, dense punctures posteriorly, clothed with sparse, pale pubescence: sternites two to five each with a thin, apical fringe of pale hairs; hypopygium with small, dense punctures and sparse, pale pubescence, the apex acute.

Legs entirely black, except the ferruginous coxæ, finely, closely punctate, and clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49316, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, 2 females, Mount Maquiling (*Baker*); female, Los Baños, August, 1916 (*F. X. Williams*); female, Los Baños, September, 1917 (*F. X. Williams*); 2 females, Los Baños, 1916 (*F. X. Williams*); female, Los Baños (*F. X. Williams*); 2 females, Los Baños (*Baker*); female, Baguio, June, 1917 (*F. X. Williams*); female, Paete.

Related to *byblis* Mickel, *subtriangularis* Mickel, and *deserta* Smith. It differs from the first two in the relatively weak development of the lamellate process of the mesopleuræ; also differs from the first in the color of the legs and scape, and from the second in the color of the legs and absence of the pale pubescent spot on the fourth tergite; it differs from *deserta* in the absence of pale pubescent spots on tergites three and four and in the absence of a transverse row of teeth at the posterior margin of the dorsum of propodeum.

SQUAMULOTILLA DESERTA (Smith).

1879. *Mutilla deserta* SMITH, Descr. New Species Hymen. 200, female.
1879. *Mutilla deserta* DALLE TORRE, Cat. Hymen. 8: 30, female.
1903. *Mutilla deserta* ANDRÉ, Gen. Ins. 1, fasc. 11: 39, female.

Holotype.—Female, Celebes, in British Museum of Natural History.

Specimens examined.—LUZON, 3 females, Los Baños, August, 1916 (*F. X. Williams*); female, Los Baños, September, 1917 (*F. X. Williams*); 2 females, Los Baños, 1917 (*F. X. Williams*); 2 females, Los Baños (*Baker*); female, Manila, January 29, 1906 (*C. S. Banks*); female, Mount Maquiling (*Baker*); female, Baguio, Benguet (*Baker*); female.

This species is related to the three preceding species but differs from all of them in having a distinct, transverse row of teeth at the posterior margin of the dorsum of propodeum, in having the integument beneath the apical, pale pubescent band of the second abdominal tergite black instead of whitish, and in the presence of a median, apical, pale pubescent spot on each of tergites three to five. The thorax in all four species is of the same general outline, differing from that of the two following species. Unfortunately, I have not had an opportunity to compare these specimens with Smith's type from Celebes although I have examined the latter. Neither my notes nor Smith's description gives any basis for discriminating between specimens of the two localities; it is possible a direct comparison of the two might disclose differences between them.

SQUAMULOTILLA OBLECTABILIS sp. nov.

Female.—Head and abdomen black, except the integument beneath the median, pale pubescent spot of first tergite and apical pale pubescent band of second tergite, whitish; thorax, proximal half of mandibles, scape, pedicel, coxæ, trochanters, and femora, all ferruginous; tibiæ and tarsi dark brown; thorax broader than long, the lateral margins of the dorsum conspicuously dentate; posterior margin of dorsum of propodeum armed with a transverse row of vertical teeth; sides of propodeum with small, distinct punctures; first sternite without a distinct, longitudinal, median carina. Length, 5 millimeters.

Head black, except the antennal tubercles, scape, pedicel, and proximal half of mandibles, pale ferruginous; distal half of mandibles dark mahogany red; mandibles not broadened at the tips, more or less acute, with a single tooth within near the apex; clypeus elevated medially into an arcuate ridge, the latter trituberculate, with a small tubercle medially, and one at each lateral extremity; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum about equal in length to the second and third united; flagellum tinged beneath with pale ferruginous; antennal scrobes distinctly carinate above; front, vertex, and genæ with small, dense, confluent punctures; front, vertex with scattered, long, erect, pale fuscous hairs, and short, sparse, recumbent, dark fuscous pubescence; genæ clothed with sparse, pale pubescence; genæ rounded posteriorly, the posterior margin not well defined but with a small, inconspicuous tooth anteriorly a short distance posterior to the insertion of the mandibles; head weakly developed behind the eyes, the distance between the eye margins and the posterolateral angles equal to about one-third the greatest diameter of the eyes; relative widths of head and thorax, 2.5 : 2.6.

Thorax entirely pale ferruginous, slightly broader than long; lateral margins of the dorsum dentate, the lateral margin of the pronotum with a small, acute tooth, the margins of the mesonotum with a small, blunt, anterior tooth and a large median tooth, the margins crenulate where not toothed; dorsum of thorax with moderately small, dense, confluent punctures throughout, not at all striate-punctate, clothed with sparse, short, recumbent, ferruginous pubescence; anterior margin of pronotum with a small tubercle each side at about one-sixth the width of the thorax mesad of the humeral angles; thorax distinctly constricted at the propodeal tubercles; posterior margin of dorsum of propodeum armed with a transverse row of erect teeth separating distinctly the dorsum of the thorax and the posterior face of propodeum, the latter with sparse, obscure punctures, and scattered, long, erect, pale hairs; lateral margins of posterior face of propodeum dentate; anterior margin of propleuræ defined by a sinuate carina; lamellate process of mesopleuræ moderately developed, the distal margin with two distinct angles; pleural areas glabrous, micropunctate and micropubescent, except the sides of the propodeum with small, close, distinct punctures.

Abdomen black, except the first sternite ferruginous, and the integument beneath the median, pale pubescent spot of the first tergite and the apical, pale pubescent band of the second tergite, whitish; anterior face of first tergite with small, close, distinct punctures, sparser anteriorly and laterally, clothed with scattered, long, erect, pale fuscous pubescence; dorsal face of first tergite with fine, dense punctures, clothed with short, black pubescence, except a large, subquadrate, transverse, median spot of appressed, pale pubescence; second tergite with small, dense, confluent punctures, the latter slightly separated laterally, clothed with scattered, erect, long, dark fuscous hairs, and short, black, recumbent pubescence, except the median spot of the first tergite extending obscurely on the base of the second, the lateral fifths of the latter with sparse, pale pubescence, and the apical margin of the second with an apical band, broadly dilated medially of sparse, appressed, pale pubescence; tergites three to five with small, dense punctures becoming finer and denser toward their posterior margins, clothed with scattered, long, erect, dark fuscous hairs and sparse, short, recumbent, black pubescence, except the lateral extremes with pale pubescence, and the fifth tergite with a narrow, transverse, median, apical spot of pale pubescence; last tergite with small, dense punctures and sparse, pale pubescence, except the pygidial area glabrous, unsculptured, not margined laterally; first sternite without a median, longitudinal carina; second sternite with moderately small, close, distinct punctures, becoming sparser anteriorly, clothed with sparse, pale pubescence; sternites three to five with small, dense punctures posteriorly, clothed with sparse, pale pubescence; sternites two to five each with a thin, apical fringe of pale hairs; hypopygium with small, dense punctures and sparse, pale pubescence, the apex acute.

Legs ferruginous, except the tibiæ and tarsi dark brown, with fine punctures and sparse, pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49317, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, 9 females, Mount Maquiling (*Baker*); female, Baguio, Benguet (*Baker*).

This and the following species differ from the preceding four in the shape and sculpture of the thorax, and the dentition of the lateral margins of the thorax. *Squamulotilla oblectabilis* differs from *fucosa* in having the posterior margin of the dorsum of propodeum armed and in the posterior face of the propodeum being only obscurely punctured.

SQUAMULOTILLA FUCOSA sp. nov.

Female.—Head and abdomen black, except the first sternite ferruginous, and the integument beneath the median, apical, pale pubescent spot of the first abdominal tergite and the apical, pale pubescent band of the second tergite, yellowish; thorax, scape, and legs entirely pale ferruginous; thorax about as broad as long, the lateral margins of the dorsum dentate and crenulate; dorsum of propodeum rounded into the posterior face of propodeum, the posterior margin of the dorsum unarmed, indicated only by an obscure, serrate, raised line; posterior face of propodeum densely punctate; sides of propodeum with small, distinct punctures; first abdominal sternite without a median, longitudinal carina. Length, 5.5 millimeters.

Head black, except the front with an obscure, dark ferruginous tinge, and the mandibles, clypeus, antennal tubercles, scape, and pedicel, pale ferruginous; mandibles not noticeably broadened at the tips, the apices bluntly rounded and with a small, inconspicuous tooth within near the apex; clypeus elevated into an arcuate ridge, the latter not noticeably tuberculate; antennal tubercles contiguous, glabrous; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum about equal in length to the second and third segments united; antennal scrobes distinctly carinate above; front, vertex, and genæ with small, dense, confluent punctures; front and vertex clothed with scattered, long, erect, and sparse, short, recumbent, fuscous pubescence; genæ with sparse, pale pubescence; posterior margin of genæ defined by an obscure ridge, the latter terminating anteriorly in a small, blunt tooth; head weakly developed behind the eyes, the distance between the eye margins and the posterolateral angles equal to about five-twelfths the greatest diameter of the eyes; relative widths of head and thorax, 2.6 : 2.5.

Thorax entirely ferruginous, the dorsum moderately, densely, confluently punctate throughout, clothed with scattered, long, erect, and sparse, short, recumbent, ferruginous pubescence; lateral margins of dorsum of thorax conspicuously dentate and crenulate, the pronotum with the humeral angles dentate and with a conspicuous, median tooth on the lateral margins, the lateral margins of the mesonotum strongly angulate just anterior to the middle and with a prominent postmedian tooth; thorax distinctly constricted at the propodeal spiracles; anterior margin of pronotum with a small, inconspicuous tubercle about one-sixth the width of the thorax mesad of the humeral angles; an obscure arcuate carina separating the mesonotum and dorsum of propodeum but not extending to the lateral margins of the thorax; posterior margin of dorsum of propodeum unarmed, indicated only by an obscure, serrated, raised line, the dorsum of propodeum rounded into the posterior face, the latter with small, dense punctures and sparse, long, erect, pale pubescence; anterior margin of propleuræ defined by a sinuate carina; lamellate process of mesopleuræ moderately developed, the ventral distal angle most prominent; propleuræ micropunctate and micropubescent, the mesopleuræ and metapleuræ glabrous, impunctate, bare; sides of propodeum with small, close, distinct punctures; lateral margins of posterior face of propodeum conspicuously dentate.

Abdomen black, except the first abdominal sternite ferruginous, the integument beneath the pale pubescent markings of the first and second tergites, yellowish, and the margins of the tergites more or less ferruginous; anterior face of first tergite with small, sparse punctures becoming close posteriorly, clothed with scattered, long, erect, pale pubescence; dorsal face of first tergite with fine, dense punctures and short, sparse, recumbent, black pubescence, except laterally with sparse, pale pubescence and medially with a large, subquadrate spot of sparse, appressed, pale pubescence; second tergite with small, dense, confluent punctures, except laterally the punctures separated and more distinct, clothed with scattered, erect, dark fuscous pubescence, and short, sparse, recumbent, black pubescence, except laterally with sparse, pale pubescence and the apical margin with a broad band, broadly dilated medially, of sparse, appressed, pale pubescence; tergites three to five with small, dense punctures, clothed with scattered, erect, dark fuscous pubescence and short, sparse, recumbent, black pubescence, except the lateral extremes pale pubescent and the fifth tergite with a small, median, apical spot of pale pubescence; last tergite with small, dense punctures and sparse, pale pubescence except the pygidial area glabrous, impunctate and not margined laterally; first abdominal sternite without a median, longitudinal carina; second sternite with moderate, distinct punctures and sparse, pale pubescence; sternites three to five with small, close punctures posteriorly, clothed with sparse, pale pubescence; sternites two to five each with a thin, apical fringe of pale pubescence; hypopygium with small, dense punctures, distinctly angulate at the apex.

Legs entirely ferruginous, finely punctured, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49318, United States National Museum, MINDANAO, Surigao (*Baker*).

Paratypes.—MINDANAO, female, Surigao (*Baker*); female, Tangkulan, Bukidnon Province (*Baker*); female, Iligan (*Baker*).

The color of the front, vertex, and genæ in the paratypes varies from distinctly ferruginous to black tinged with ferruginous. Related to *oblectabilis* from which it differs by the absence of the row of vertical teeth at the posterior margin of dorsum of propodeum, and by the posterior face being densely punctate and rounded into the dorsum.

SQUAMULOTILLA OCYPOTE sp. nov.

Male.—Head and abdomen dark metallic blue, except the base of the first abdominal segment ferruginous; thorax ferruginous except the pronotum, mesonotum and scutellum suffused with metallic blue; legs dark mahogany red, except the coxæ pale ferruginous; second abdominal tergite with moderate, distinct punctures separated by about their own width; first sternite without a median, longitudinal carina; hypopygium not elevated anteriorly; wings with only a single cubital cell, both R_5 and R_4 absent. Length, 6 millimeters.

Head dark metallic blue, clothed throughout with sparse, pale pubescence; mandibles slender, acute at the tips, and with two distinct teeth within near the apex; subtriangular median area of clypeus slightly elevated, the anterior margin of the elevation somewhat concave; scape not carinate beneath, with fine, close punctures and sparse, pale pubescence; first segment of flagellum equal in length to the second; antennal scrobes distinctly carinate above; front and vertex with small, close, more or less confluent punctures, the genæ with small, dense punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 2.5: 2.5.

Thorax ferruginous, except the pronotum, mesonotum and scutellum suffused with metallic blue, clothed throughout with sparse, pale pubescence, somewhat thicker on the mesopleuræ than elsewhere; pronotum and mesonotum with moderate, close, somewhat confluent punctures; lateral margins of pronotum with a small, median, inconspicuous tubercle; scutellum moderately, evenly convex, with moderate, dense punctures; dorsum and posterior face of propodeum distinctly, shallowly reticulate, rounded into one another, the dorsum without a median, inclosed space; propleuræ defined anteriorly by a distinct carina, with moderate, close punctures; mesopleuræ convexly elevated ventrally and dorsally, the two areas separated by a furrow, the entire surface with moderate, close punctures; metapleuræ glabrous, impunctate; sides of propodeum with moderate, dense punctures; lateral margins of posterior face of propodeum crenulate; tegulæ obscure ferruginous, small, subcircular, with small punctures and pale pubescence throughout.

Abdomen dark metallic blue, except the anterior portion of the first segment ferruginous, clothed throughout with very sparse, long, erect, pale pubescence; first tergite with scattered, moderate, shallow punctures; second tergite with moderate, distinct punctures separated by about their own width, except becoming close at the anterolateral margin; tergites three to six with moderate, distinct punctures; last tergite with small, dense punctures and somewhat thick, pale pubescence; first sternite without a median, longitudinal carina; second sternite rather evenly convex, with moderate, close punctures, and with a small tubercle at the median anterior margin; sternites three to six with small, close to separated punctures posteriorly; hypopygium not elevated anteriorly.

Legs dark mahogany red, except the coxæ pale ferruginous, finely punctate and clothed with sparse, pale pubescence; calcaria pale.

Wings subfuscous; cell 2d $R_1 + R_2$ large, triangular in outline, the apex acute; only a single cubital cell present, both R_5 and R_4 absent.

Holotype.—Male, catalogue No. 49319, United States National Museum, LUZON, Tayabas Province, Malinao (*Baker*).

Related to *dictynna* and *imparilis* but differs in having the lateral margins of the pronotum tuberculate, in the metallic blue color of the pronotum, mesonotum, and scutellum, and in the puncturation of the second abdominal segment.

SQUAMULOTILLA DICTYNNA sp. nov.

Male.—Head and abdomen dark metallic blue, except the base of the first abdominal segment ferruginous; scape and pedicel obscurely pale ferruginous, the flagellum blackish; thorax and coxæ ferruginous; legs excepting coxæ blackish; lateral margins of pronotum forming straight lines, not tuberculate, crenulate, or denticulate; second abdominal tergite with sparse, fine punctures, separated for the most part by three times their own diameter; first sternite without a median, longitudinal carina; hypopygium not elevated anteriorly; wings with a single cubital cell, cells R_5 and R_4 both absent. Length, 6 millimeters.

Head entirely dark metallic blue, clothed throughout with scattered, long, erect, and sparse, short, recumbent, pale pubescence; mandibles slender, bluntly rounded at the tips, and with two small teeth within near the apex; median triangular area of clypeus convexly and slightly elevated, the anterior angles of the elevation feebly tuberculate; antennal tubercles contiguous and glabrous; scape with fine, close punctures and sparse, pale pubescence; antennal scrobes carinate above; front with small, close but distinct punctures, the vertex and genæ with small, very close, confluent punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 2.3 : 2.5.

Thorax entirely ferruginous, clothed throughout with sparse, erect and recumbent, pale pubescence, thickest on the mesopleuræ; pronotum and mesonotum with moderate, close, more or less confluent punctures; lateral margins of pronotum straight not at all tuberculate; scutellum evenly convex, with moderate, dense punctures; dorsum of propodeum and posterior face of propodeum distinctly shallowly reticulate, the one rounded into the other, the dorsum without a median, inclosed space; lateral margins of posterior face of propodeum obscurely crenulate; propleuræ defined anteriorly by a sinuate carina, with small, dense punctures; mesopleuræ convexly elevated ventrally and dorsally, the two regions separated by a furrow, the ventral elevation with small, sparse punctures, the dorsal with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum punctate-reticulate; tegulæ small, convex, subcircular, sparsely punctured and pubescent.

Abdomen dark metallic blue, except the first segment at the base, ferruginous; first tergite with scattered, small punctures, somewhat closer anteriorly; second tergite with sparse, fine punctures, separated for the most part by three times their own diameter; tergites three to six with small, distinct, sparse to close punctures; last tergite with small, close punctures; first sternite without a median, longitudinal carina; second sternite with small, sparse, distinct punctures; sternites three to six with small, close, distinct punctures; hypopygium not elevated anteriorly.

Coxæ ferruginous, the remainder of the legs blackish, finely punctate and clothed with sparse, pale pubescence; calcaria pale.

Wings subhyaline; cell 2d $R_1 + R_2$ large, triangular, acute at the apex; only a single cubital cell present, cells R_5 and R_4 absent.

Holotype.—Male, catalogue No. 49320, United States National Museum, MINDANAO, Tangkulan, Bukidnon (*Baker*).

Related to *ocypote* and *imparilis.* It differs from *ocypote* in the entirely ferruginous thorax, straight lateral margins of the pronotum, clypeus of slightly different form, and sparser punctuation of the second abdominal tergite.

SQUAMULOTILLA IMPARILIS sp. nov. Plate 1, fig. 1.

Male.—Head dark metallic blue, thorax entirely ferruginous, abdomen above dark metallic blue, below with violaceous reflections, except the base of the first segment ferruginous; coxæ ferruginous, remainder of legs blackish; anterior half of pronotum slightly constricted, the lateral margins sinuate, not forming a straight line; second tergite with sparse, small punctures separated by one to two times their own diameter; first abdominal sternite without a median, longitudinal carina; hypopygium not elevated anteriorly; wings with a single cubital cell, R_5 and R_4 entirely absent. Length, 6 millimeters.

Head entirely dark metallic blue, except the mandibles ferruginous and the antennæ blackish, clothed throughout with sparse, pale pubescence; mandibles slender, somewhat blunt at the tips and with two small teeth within near the apex; median, triangular area of clypeus slightly, convexly elevated, with fine, sparse punctures, the angles at the anterior margin slightly tuberculate; antennal tubercles slightly separated by a shallow, median furrow on the front; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum about equal in length to the second; antennal scrobes distinctly carinate above; front with small, distinct punctures separated by somewhat less than their own diameter; vertex and genæ with small, dense punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax at the tegulæ, 2.4 : 2.4.

Thorax entirely ferruginous, clothed throughout with sparse, erect and recumbent, pale pubescence, thickest on the mesopleuræ; pronotum and mesonotum with moderate, close, more or less confluent punctures; scutellum slightly but evenly convex, with moderate, dense punctures; pronotum slightly constricted on the anterior half, the lateral margins sinuate, not forming a straight line; dorsum and posterior face of propodeum distinctly but shallowly reticulate, the one rounding into the other, and the dorsum without an inclosed space; anterior margin of propleuræ defined by a distinct carina, the propleuræ obscurely punctate; mesopleuræ elevated ventrally and dorsally, the two areas separated by a furrow, and both with moderate, shallow, close but distinct punctures; metapleuræ glabrous, impunctate; lateral margins of posterior face of propodeum defined by a crenulate raised line; sides of propodeum with small, distinct punctures; tegulæ small, subcircular, dark ferruginous, with small, scattered punctures and sparse, pale pubescence.

Abdomen above dark metallic blue, below with violaceous reflections, except the base of the first segment ferruginous, clothed throughout with sparse, erect, pale pubescence; first tergite with small, sparse punctures; second tergite with small, sparse punctures, separated by one to two times their own diameter, somewhat closer anteriorly than posteriorly; tergites three to six with small, close, distinct punctures; last tergite with small, dense punctures; first abdominal sternite without a median, longitudinal carina; second sternite with small, close, but distinctly separated punctures; sternites three to six with small, close punctures; hypopygium not elevated anteriorly.

Coxæ dark ferruginous, remainder of legs dark mahogany red; finely punctate and clothed with sparse pubescence; calcaria pale.

Wings subhyaline; cell 2d $R_1 + R_2$ triangular, the apex acute; only a single cubital cell present, both R_5 and R_4 absent.

Holotype.—Male, catalogue No. 49321, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Related to *dictynna* and *disjuncta.* May be separated from both by the small, distinct punctures on sides of propodeum. Differs from *dictynna* in the sinuate lateral margins of pronotum and less sparsely punctured second abdominal tergite. Differs from *disjuncta* in the puncturation of the second tergite and the closer puncturation of the second sternite.

SQUAMULOTILLA DISJUNCTA sp. nov.

Male.—Head dark metallic blue; thorax entirely ferruginous; abdomen with dark metallic blue to violaceous reflections; coxæ ferruginous, remainder of legs dark mahogany red; anterior half of pronotum narrow, the lateral margins not forming a straight line but sinuate; second tergite with sparse, fine punctures, separated by two to three times their own diameter; second sternite with sparse, fine punctures; first sternite without a median, longitudinal carina; hypopygium not elevated anteriorly; wings with a single cubital cell, both R_5 and R_4 absent. Length, 4.5 millimeters.

Head entirely dark metallic blue, except the mandibles ferruginous, and the antennæ obscure dark ferruginous, clothed throughout with sparse, pale pubescence; mandibles slender, blunt at the tip with two small teeth within near the apex; median, triangular area of clypeus slightly, convexly elevated, the anterior angles slightly tuberculate, with sparse, fine punctures; antennal tubercles distinctly separated; scape with fine punctures and sparse, pale pubescence; first segment of flagellum about equal in length to the second; antennal scrobes carinate above; front with small, close, distinct punctures, the vertex and genæ with small, dense punctures; front with a shallow, but distinct median, longitudinal furrow; posterior margin of genæ rounded, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 1.8 : 1.8.

Thorax entirely ferruginous, clothed throughout with sparse, erect and recumbent, pale pubescence, thickest on the mesopleuræ; pronotum slightly but distinctly narrowed anteriorly, the lateral margins slightly sinuate; pronotum and mesonotum with small, dense, more or less confluent punctures; scutellum with small, dense punctures; dorsum of propodeum and posterior face of propodeum shallowly, distinctly reticulate, the one rounded into the other, the lateral margins of the posterior face defined by a crenulate, raised line; anterior margin of propleuræ defined by a carina, the propleuræ obscurely punctate; mesopleuræ slightly, convexly elevated ventrally and dorsally, the two elevations separated by a furrow, with fine, close distinct punctures becoming sparse anteriorly and posteriorly; metapleuræ glabrous, impunctate; sides of propodeum distinctly reticulate; tegulæ small, subcircular with sparse punctures and pubescence.

Abdomen with dark metallic blue and violaceous reflections, clothed throughout with sparse, long, erect, pale pubescence; first tergite with sparse, fine punctures; second tergite with fine punctures separated by two to three times their own diameter, closer anteriorly; tergites three to six with sparse, fine punctures; last tergite with fine, close punctures; first sternite without a median, longitudinal carina; second sternite with sparse, fine punctures separated by almost twice their own diameter; sternites three to six with fine close punctures; hypopygium not elevated anteriorly.

Coxæ ferruginous, remainder of legs dark mahogany red, with fine punctures and sparse, pale pubescence; calcaria pale.

Wings subhyaline; cell 2d $R_1 + R_2$ triangular, the apex acute; only a single cubital cell, R_5 and R_4 entirely absent.

Holotype.—Male, catalogue No. 49322, United States National Museum, LUZON, Baguio, Benguet (*Baker*).

Paratype.—LUZON, male, Mount Maquiling (*Baker*).

The paratype differs from the type in having the mesonotum and scutellum suffused with metallic blue. *Squamulotilla disjuncta* may be recognized from the preceding related species by the distinctly reticulate sides of propodeum, the separated antennal tubercles, and the puncturation of the second abdominal tergite and sternite.

SQUAMULOTILLA CONCAVA sp. nov.

Male.—Entirely dark metallic blue, almost black, clothed throughout with sparse, pale pubescence, thickest on the genæ and mesopleuræ, except the last two abdominal segments with fuscous pubescence; posterior face of propodeum with a distinct median, longitudinal carina; second abdominal sternite distinctly concave; first abdominal sternite without a median, longitudinal carina; hypopygium with a transverse, conspicuous carina near the proximal margin, the carina more strongly elevated and almost subangulate medially; wings with two cubital cells, only R_4 absent. Length, 8 millimeters.

Head entirely dark metallic blue, almost black, except the mandibles dark mahogany red, clothed with sparse, pale pubescence, thickest on the genæ; mandibles subacute at the apex, with two distinct teeth within; median area of clypeus slightly, convexly elevated, the anterior margin of the elevation shallowly concave, the clypeus with small, close punctures; antennal tubercles distinctly separated; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum equal in length to the second; antennal scrobes with a distinct, median tubercle above, without a complete carina; front with small, distinct punctures; vertex with small to moderate dense punctures; genæ with small, close punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 2.6 : 2.75.

Thorax dark metallic blue, almost black, except the pleural areas dark mahogany red, clothed with sparse, pale pubescence; erect and recumbent on the pronotum and mesonotum, erect and long on the dorsum and posterior face of propodeum, thickest on the mesopleuræ; pronotum and mesonotum with small to moderate, more or less confluent punctures; scutellum with small, close, confluent punctures; dorsum and posterior face of propodeum shallowly, distinctly reticulate, the dorsum with a median, elongate inclosed space about three times as long as broad, the posterior face with a median, elongate carina extending from the inclosed space to the posterior margin; lateral margins of posterior face of propodeum not defined, rounded into the sides; anterior margin of propleuræ defined by a carina, the propleuræ with obscure, small punctures; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by a furrow, with fine to small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum punctate-reticulate; tegulæ small, convex, subcircular, with small, sparse punctures, and sparse, pale pubescence.

Abdomen entirely dark metallic blue, almost black, clothed with long, erect, pale pubescence, except the last two segments with the pubescence fuscous; first tergite with fine, scattered punctures; second tergite with very small punctures, very sparse medially, closer at the sides; tergites three to six with small punctures, somewhat sparse on the third segment, becoming close on the sixth segment; last tergite with small, almost dense punctures, except an obscure triangular area distally very finely, closely punctate; first abdominal sternite without a median, longitudinal carina; second sternite distinctly concave almost throughout, with only a narrow area laterally and apically surrounding the concave area, the latter glabrous, obscurely rugose, the margin surrounding the concave area with small, close punctures; sternites three to six with small, distinct punctures, the latter closer on the posterior sternites than on the anterior; hypopygium with small, close punctures, and with a transverse, conspicuous, elevated ridge near the proximal margin, the ridge highest and almost subangulate medially.

Legs dark mahogany red, finely punctured and clothed with sparse, pale pubescence; calcaria pale.

Wings subfuscous with the costal area of cell 2d $R_1 + R_2$ darker than the rest of the wing; cell 2d $R_1 + R_2$ large, two and one-half times as long as broad; two distinct cubital cells, only R_4 absent; R_5 small, pentagonal; vein M_2 present but indistinct, joining vein M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—Male, catalogue No. 49323, United States National Museum, MINDANAO, Tangkulan, Bukidnon (*Baker*).

Paratypes.—MINDANAO, 5 males, Tangkulan, Bukidnon (*Baker*).

Related to *roxane* and *subdebilis* but differs from all the Philippine species of this genus by the concave second abdominal sternite.

SQUAMULOTILLA ROXANE sp. nov.

Male.—Entirely black, except the abdomen above with obscure metallic blue reflections; clothed throughout with sparse, pale pubescence, except the last two abdominal segments with fuscous pubescence; lateral margins of pronotum slightly sinuate, the humeral angles acute; first abdominal sternite without a median, longitudinal carina; hypopygium with a conspicuous, transverse, arcuate carina near the proximal margin; wings with two cubital cells, only R_4 absent. Length, 9 millimeters.

Head entirely black, clothed throughout with sparse, pale pubescence; mandibles subacute at the apex with two small, distinct teeth within; median area of clypeus slightly, convexly elevated, the elevated margin shallowly concave, the elevated area punctate and pubescent; antennal tubercles distinctly separated; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum very slightly shorter than the second; antennal scrobes distinctly carinate above; front with small, close, somewhat confluent punctures, the vertex and genæ with small, dense punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 3.2 : 3.6.

Thorax entirely black, clothed throughout with sparse, pale pubescence, erect and recumbent on the pronotum and mesonotum, erect and long on the dorsum and posterior face of propodeum, thickest on the mesopleuræ; lateral margins of pronotum slightly sinuate, the humeral angles slightly produced into a small, acute tubercle; pronotum and mesonotum with moderate, close, confluent punctures; scutellum convex, with a distinct, median, longitudinal furrow and small, dense punctures; dorsum and posterior face of propodeum distinctly reticulate throughout, the dorsum without an inclosed space, the posterior face without a longitudinal carina and without well-defined lateral margins but angulately separated from the sides; anterior margin of propleuræ defined by a carina, the propleuræ obscurely punctate; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by a furrow, with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum reticulate; tegulæ convex, small, with small, sparse punctures, and sparse, pale pubescence.

Abdomen black, the dorsal surface with obscure metallic blue reflections, clothed with sparse, pale pubescence, except the last two segments with fuscous pubescence; first tergite with fine, sparse punctures; second tergite with small, sparse punctures, becoming close at the anterior margin, the lateral margins broadly glabrous, impunctate; tergites three to six with small, well-separated, almost sparse punctures, the fifth also with very small, close punctures at the extreme anterior margin; last tergite with small, dense punctures, except the median line and a small, terminal, triangular area impunctate; first sternite without a median, longitudinal carina; second sternite with a feeble, median, longitudinal carina on the anterior half, and with small, sparse punctures throughout; sternites three to six with small punctures, becoming close posteriorly; hypopygium with a conspicuous, transverse, arcuate carina near the proximal margin, with fine, close punctures posterior to the carina.

Legs black, finely punctured and sparsely clothed with pale pubescence; calcaria pale.

Wings subfuscous; cell 2d $R_1 + R_2$ large, slightly more than twice as long as broad; two cubital cells present, only R_4 absent; R_5 small, pentagonal; vein M_2 uniting with M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—Male, catalogue No. 49324, United States National Museum, NEGROS, Cuernos Mountains (*Baker*).

Related to *concava* and *subdebilis;* differs from the former in the form of the second abdominal sternite; differs from the latter in the darker wings, the stronger development of the hypopygial carina, and the larger size.

SQUAMULOTILLA SUBDEBILIS sp. nov.

Male.—Entirely black, except the legs dark brown, clothed throughout with sparse, pale pubescence, thickest on the mesopleuræ; lateral margins of pronotum sinuate, the humeral angles dentate; first abdominal segment without a median, longitudinal carina; hypopygium with a very feeble, transverse carina near the proximal margin; wings subhyaline, with two cubital cells, only R_4 absent. Length, 5 millimeters.

Head entirely black, clothed throughout with sparse, pale pubescence; mandibles subacute at the apex and with two small teeth within near the apex; median area of clypeus slightly, convexly elevated, with fine, close punctures, the anterior margin distinctly concave; antennal tubercles distinctly separated; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum equal in length to the second; antennal scrobes carinate above; front with small, distinct, separated punctures, the vertex and genæ with small, close, confluent punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax at the tegulæ, 2.1: 2.1.

Thorax entirely black, clothed throughout with sparse, pale pubescence, thickest on the mesopleuræ; lateral margins of pronotum slightly sinuate, the humeral angles produced into a small, acute tubercle; pronotum and mesonotum with small, close, distinct punctures; scutellum with small, close, somewhat confluent punctures, with only a faint indication of a median, longitudinal furrow; dorsum and posterior face of propodeum shallowly, distinctly reticulate, the reticulations on the dorsum much broader than on the posterior face and inclosing fine punctures, the lateral margins of the posterior face not well defined; anterior margin of propleuræ defined by a carina, the propleuræ obscurely punctate; mesopleuræ elevated ventrally and dorsally, the elevations separated by a furrow, the ventral elevation with fine, sparse punctures, the dorsal elevation with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum punctate-reticulate; tegulæ small, convex, with small, sparse punctures and sparse, pale pubescence.

Abdomen entirely black, clothed throughout with sparse, pale pubescence; first tergite with fine, sparse punctures; second tergite with small punctures, sparse medially and posteriorly, becoming close laterally and anteriorly; tergites three to six with small, distinct, separated punctures; last tergite with small, close punctures, except along the median, longitudinal line; first sternite without a median, longitudinal carina; second sternite with a very feeble, median, longitudinal carina on the anterior half, with small, close punctures becoming sparser anteriorly and laterally; sternites three to six with small, close, distinct punctures; hypopygium with a feeble, transverse carina near the proximal margin, with inconspicuous fine punctures posterior to the carina.

Legs dark brown, finely punctate and clothed with sparse, pale pubescence; calcaria pale.

Wings subhyaline; cell 2d $R_1 + R_2$ large, twice as long as broad; two cubital cells present, R_5 small, only R_4 absent; vein M_2 indistinct, uniting with vein M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—LUZON, male, Los Baños, 1917 (*F. X. Williams*), in collection of University of Minnesota.

Paratype.—LUZON, male, Los Baños, 1917 (*F. X. Williams*).

Related to *roxane* but differs in the weakly developed hypopygial carina, the lighter wings, sculpturation of the propodeum, and smaller size.

SQUAMULOTILLA SULPICILLA sp. nov.

Male.—Head black, thorax ferruginous, abdomen with violaceous reflections, coxæ and trochanters pale ferruginous, remainder of legs black, clothed throughout with sparse, pale pubescence, except the last two abdominal segments with fuscous pubescence; lateral margins of pronotum distinctly sinuate; posterior face of propodeum separated from the sides by a thin, elevated carina; first abdominal sternite without a median, longitudinal carina; hypopygium with only a feeble, transverse carina near the proximal margin; wings subhyaline, with two cubital cells, only R_4 absent. Length, 6 millimeters.

Head entirely black, clothed throughout with sparse, pale pubescence; mandibles subacute at the tips and with two small teeth within near the apex; clypeus with a small, triangular, convexly elevated area, the latter with fine, close punctures, and with the anterior margin slightly concave; antennal tubercles very distinctly separated; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum distinctly shorter than the second; antennal scrobes distinctly carinate above; front with small, distinct, separated punctures, the vertex and genæ with small, close punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 2.5 : 2.5.

Thorax entirely ferruginous, sparsely clothed with pale pubescence, erect and recumbent on the pronotum and mesonotum, erect and long on the dorsum and posterior face of propodeum, and thickest on the mesopleuræ; lateral margins of pronotum distinctly sinuate, the humeral angles sharply dentate; pronotum, mesonotum and scutellum with moderate, close, somewhat, confluent punctures; dorsum and posterior face of propodeum shallowly, distinctly reticulate, the dorsum without an inclosed space, the lateral margins of the posterior face defined by a high, thin carina, the latter not uniform in height; anterior margin of propleuræ defined by a prominent, sharp carina, the propleuræ obscurely punctate; mesopleuræ elevated ventrally and dorsally, the elevated areas separated by a furrow, the ventral area with fine, sparse punctures, the dorsal area with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum reticulate; tegulæ small, convex, with sparse, fine punctures, and sparse, pale pubescence.

Abdomen dark, with violaceous reflections, clothed with sparse, pale pubescence, except the last two segments with fuscous pubescence; first tergite with fine, sparse punctures; second tergite with small, sparse punctures, the latter becoming fine and scattered posteriorly; tergites three to six with small, sparse punctures; last tergite with small, close punctures, except along the median line; first sternite without a median, longitudinal carina; second sternite with a feeble, median, longitudinal carina on the anterior half, with small, distinct, sparse punctures throughout; sternites three to six with small, close but distinct punctures; hypopygium with a feeble, transverse carina near the proximal margin and with fine, sparse punctures posterior to the carina.

Coxæ and trochanters pale ferruginous, the remainder of legs blackish, finely punctured and clothed with sparse, pale pubescence; calcaria pale.

Wings subhyaline; cell 2d $R_1 + R_2$ large, slightly more than twice as long as broad; two cubital cells present, R_5 small and pentagonal; vein M_2 indistinct, received by vein M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—Male, catalogue No. 49325, United States National Museum, MINDANAO, Dapitan (*Baker*).

Paratypes.—MINDANAO, two males, Dapitan (*Baker*).

Differs from all the preceding species with two cubital cells, in the ferruginous thorax, the strongly sinuate lateral margins of the pronotum, and the conspicuously defined lateral margins of the posterior face of propodeum. Also related to *teuta* but differs from that species in the defined margins of the posterior face of propodeum, the much more sparsely punctured body, and the weakly developed hypopygial carina.

SQUAMULOTILLA TEUTA subsp. TEUTA sp. et subsp. nov. Plate 1, fig. 2.

Male.—Head, abdomen, legs, and tegulæ black, the mandibles, lateral areas of clypeus and thorax entirely, ferruginous, clothed throughout with sparse, pale pubescence, except the last two abdominal segments with fuscous pubescence; lateral margins of pronotum slightly sinuate; lateral margins of posterior face of propodeum not defined; first abdominal sternite without a median, longitudinal carina; second sternite with a transverse, gibbose, subapical ridge; hypopygium with a conspicuous, transverse, arcuate carina near the proximal margin; wings subfuscous, with two cubital cells, only R_4 absent. Length, 7 millimeters.

Head black, except the mandibles and lateral areas of clypeus, ferruginous, clothed throughout with sparse, pale pubescence;

mandibles subacute at the tips and with two small teeth within near the apex; median triangular area of clypeus elevated, black, with fine, close punctures and sparse, pale pubescence, the anterior margin slightly concave; antennal tubercles almost contiguous; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum almost equal in length to the second; antennal scrobes distinctly carinate above; front with small, close, scarcely confluent punctures, the vertex and genæ with small, dense punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 2.7 : 2.7.

Thorax entirely ferruginous except the tegulæ, blackish; lateral margins of pronotum slightly sinuate, the humeral angles, angulate; pronotum, mesonotum and scutellum with moderate, very close, confluent punctures; dorsum and posterior face of propodeum, shallowly, distinctly reticulate, the dorsum without an inclosed space, the lateral margins of the posterior face not defined; anterior margin of propleuræ defined by a carina, the propleuræ obscurely punctate; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by a furrow, with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum reticulate posteriorly; tegulæ small, glabrous, convex, with small, scattered punctures and sparse, pale pubescence.

Abdomen entirely black, except first sternite ferruginous; clothed with sparse, pale pubescence, except the last two segments with fuscous pubescence; first tergite with sparse, small punctures; second tergite with sparse, small punctures becoming closer at the anterior margin, sparser and smaller towards the posterior margin; tergites three to six with small, distinct, separated punctures; last tergite with small, close, confluent punctures; first sternite without a median, longitudinal carina; second sternite with a feeble, longitudinal, median carina on the anterior two-thirds, and a transverse, subapical, gibbose ridge extending from one side to the other, with small, distinct, separated punctures throughout; sternites three to six with small, close, distinct punctures; hypopygium with a conspicuous, transverse, arcuate carina near the proximal margin, and with fine, close punctures posterior to the carina.

Legs entirely black, finely punctured and clothed with sparse, pale pubescence; calcaria pale.

Wings subhyaline; cell 2d $R_1 + R_2$ large, twice as long as broad; two cubital cells present, R_5 small, pentagonal, R_4 entirely absent; vein M_2 received by vein M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—Male, catalogue No. 49326, United States National Museum, LUZON, Los Baños (*Baker*).

Paratypes.—LUZON, 3 males, Los Baños, July–August, 1917 (*F. X. Williams*); male, Los Baños (*Baker*); two males, Mount Maquiling (*Baker*).

Related to *sulpicilla* but differs in having the lateral margins of propodeum undefined, in the conspicuous, arcuate carina of the hypopygium, and in the gibbose ridge of the second sternite.

Three of the paratypes from Los Baños have the thorax entirely ferruginous like the type; the two from Mount Maquiling have the scutellum black; and one from Los Baños has both the mesonotum and the scutellum entirely black.

SQUAMULOTILLA TEUTA subsp. VICINARIA subsp. nov.

Male.—Exactly like *teuta* subsp. *teuta*, except the thorax black, with only the metapleuræ and propodeum ferruginous.

Holotype.—Male, catalogue No. 49327, United States National Museum, NEGROS, Cuernos Mountains (*Baker*).

Paratype.—NEGROS, Cuernos Mountains (*Baker*).

Very close to subsp. *teuta* from Luzon, differing only in the black coloration of the prothorax and mesothorax. Certain Luzon specimens show a tendency to develop black on the notal areas, and the Negros specimens show this fully developed in the two anterior segments of the thorax. The holotype and the paratype are alike in coloration.

SQUAMULOTILLA EMINULA sp. nov.

Male.—Head and legs black, thorax except the metapleuræ and propodeum entirely ferruginous, abdomen dark metallic blue, except the median posterior margin of the second tergite, yellowish; lateral margins of pronotum slightly angulate medially; first sternite with a distinct, median, longitudinal carina; hypopygium with a pair of low, obscure tubercles, one at each anterolateral angle; wings subfuscous, with two cubital cells, only R_4 absent. Length, 11 millimeters.

Head entirely black, except the distal half of mandibles, dark ferruginous, clothed with sparse, pale pubescence, thickest on the genæ; mandibles acute at the tips and with two small teeth within near the apex; median, triangular area of clypeus slightly elevated, with fine, close punctures, and the anterior margin slightly concave; antennal tubercles slightly separated; scape finely, closely punctured and with sparse, pale pubescence; first segment of flagellum distinctly shorter than the second; antennal scrobes distinctly carinate above; front with small, distinct separated punctures, the vertex and genæ with small, close, somewhat confluent punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 3.7 : 4.0.

Thorax black, except the metapleuræ and propodeum entirely ferruginous, clothed with sparse, pale pubescence, thickest on the mesopleuræ; lateral margins of pronotum slightly angulate medially, the humeral angles angulate; pronotum and mesonotum with moderate, very close but mostly distinct punctures; scutellum with moderate, more or less confluent punctures and with an obscure, median, longitudinal furrow; dorsum and posterior face of propodeum shallowly but distinctly reticulate, the dorsum without an inclosed space and the lateral margins of the posterior face not defined; anterior margin of propleuræ defined by a carina, the propleuræ with very fine, close punctures; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by a furrow, the ventral area with small, sparse, and fine, close punctures intermixed, the dorsal area with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum reticulate posteriorly; tegulæ convex, with small, separated punctures, and sparse, pale pubescence.

Abdomen dark metallic blue, except the median, apical margin of the second tergite, yellowish, clothed with sparse, pale pubescence, except the last two segments with fuscous pubescence; first tergite with very small, sparse punctures throughout; second tergite with small, sparse punctures becoming very small and close at the anterior margin; tergites three to six with small, sparse punctures; last tergite with small, close punctures except along the median line; first sternite with a distinct, median, longitudinal carina; second sternite with a feeble, longitudinal, median carina on the anterior third, and with moderate, distinct, separated punctures; sternites three to six with moderately small, distinct, mostly separated punctures; hypopygium with very small, sparse punctures, and with a pair of low, obscure tubercles, one at each anterolateral angle.

Legs entirely black, finely punctuate and clothed with sparse, pale pubescence; calcaria pale.

Wings subfuscous; cell 2d $R_1 + R_2$ large, slightly more than twice as long as broad; two cubital cells present, R_5 small and pentagonal, R_4 entirely absent; vein M_2 received by vein M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—Male, catalogue No. 49328, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, male, Los Baños, July–August, 1917 (*F. X. Williams*); 2 males, Los Baños, September, 1917 (*F. X. Williams*); male, Los Baños (*Baker*); male, Los Baños (*G. Villegas*); 7 males, mount Maquiling (*Baker*).

This species differs from all the preceding males in having a distinct, median, longitudinal carina on the first sternite; its large size, coloration of the thorax, and the narrow, yellowish, transverse stripe at the apical margin of the second tergite will also aid in its recognition.

SQUAMULOTILLA UMBROSA sp. nov.

Male.—Entirely black with obscure metallic blue reflections, except the distal half of mandibles dark ferruginous, clothed throughout with sparse, pale pubescence except the last two abdominal segments with fuscous pubescence; first segment of flagellum equal in length to the second; lateral margins of pronotum distinctly sinuate; first abdominal sternite with a distinct, median, longitudinal carina; hypopygium with a pair of low, obscure tubercles, one at each anterolateral angle; wings subfuscous, with two cubital cells, only R_4 absent. Length, 11 millimeters.

Head entirely black with obscure metallic blue reflections, except distal half of mandibles dark ferruginous, clothed throughout with sparse, pale pubescence; mandibles subacute at the tips and with two small teeth within near the apex; median, triangular area of clypeus convexly elevated, with intermixed fine and small, close punctures, the anterior margin of the area slightly concave, and the anterior angles prominent; antennal tubercles slightly but distinctly separated; scape with fine, close punctures and sparse, pale pubescence; first segment of flagellum equal in length to the second; antennal scrobes carinate above; front with moderate, close but distinctly separated punctures; vertex and genæ with moderate, very close, confluent punctures; genæ rounded posteriorly, the posterior margin not defined; relative widths of head and thorax including the tegulæ, 3.8 : 4.2.

Thorax entirely black with obscure, metallic blue reflections, clothed throughout with sparse, pale pubescence, erect and recumbent on the pronotum and mesonotum, erect and long on the propodeum, thickest on the mesopleuræ; lateral margins of pronotum distinctly sinuate, with an angulate tubercle medially, and the humeral angles strongly angulate; pronotum, mesonotum, and scutellum with moderate, very close, confluent punctures, the scutellum without a longitudinal furrow; dorsum and posterior face of propodeum shallowly, distinctly reticulate, the dorsum without an inclosed space, the lateral margins of the posterior face not defined; anterior margin of propleuræ defined by a prominent carina, the latter elevated into a distinct tubercle medially, the propleuræ with very fine, close punctures; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by a furrow, the ventral area with intermixed small and fine punctures, the dorsal area with small, close punctures; metapleuræ glabrous, impunctate; sides of propodeum reticulate posteriorly; tegulæ convex, with small, close punctures and sparse, pale pubescence.

Abdomen entirely black with obscure metallic blue reflections, clothed with sparse, pale pubescence, except the last two segments with fuscous pubescence; first tergite with very small, sparse punctures; second tergite with small, sparse punctures throughout except the anterior two-thirds of the lateral margins finely, closely punctate; tergites three to six with small, sparse punctures; last tergite with small, close punctures; first sternite with a distinct, median, longitudinal carina; second sternite with a feeble, median, longitudinal carina on the anterior two-thirds and with moderately small, close, occasionally confluent punctures throughout; sternites three to six with small, close distinct punctures; hypopygium with a pair of low, obscure tubercles, one at each anterolateral angle, and with fine punctures posterior to the carina.

Legs entirely black, finely punctured and sparsely clothed with pale pubescence, the latter thickest on the tibiæ; calcaria pale.

Wings subfuscous, the costal area of cell 2d $R_1 + R_2$ darker, the latter large, slightly more than twice as long as broad; two cubital cells present, R_5 small and pentagonal, R_4 entirely absent; vein M_2 received by vein M_{1+2} considerably beyond the apex of cell R_5.

Holotype.—Male, catalogue No. 49329, United States National Museum, LUZON, Mount Banahao (*Baker*).

Paratype.—LUZON, male, Mount Maquiling (*Baker*).

Related to *eminula*. Differs in having the first segment of flagellum equal in length to the second, the distinctly sinuate lateral margins of pronotum, the entirely black color, and subtle differences in puncturation.

Genus ODONTOMUTILLA Ashmead

Key to the species.

MALES

1. Posterolateral angles of dorsum of propodeum produced, prominently angulate; ventral third of mesopleuræ, ventral half of metapleuræ, and propodeum entirely, black .... *familiaris* (Smith).
   Posterolateral angles of dorsum of propodeum not at all produced, evenly rounded; thorax entirely ferruginous .... 2.
2. Femora mostly black, only the proximal fourth ferruginous; second tergite with moderate, distinct punctures throughout the discal area; pale pubescent band of third tergite narrowly interrrupted medially. *andromeda* sp. nov.
   Femora entirely ferruginous; second tergite with the discal area glabrous, sparsely punctate; pale pubescent band of third tergite complete .... *pedaria* sp. nov.

FEMALES

1. Second tergite with a large, anterolateral pubescent fovea; legs entirely black .... *familiaris* (Smith).
   Second tergite without any such fovea; at least the femora in part ferruginous .... 2.
2. Basal two-thirds of second tergite with moderate, confluent punctures; scape and legs entirely ferruginous .... *pedaria* sp. nov.
   Basal two-thirds of second tergite with fine, dense, more or less confluent punctures; coxæ, trochanters, and proximal two-thirds of femora ferruginous; remainder of legs and scape entirely, black. *andromeda* sp. nov.

ODONTOMUTILLA FAMILIARIS (Smith).

1858. *Mutilla familiaris* SMITH, Journ. Proc. Linn. Soc., Zool. 2: 84, female.
1897. *Mutilla familiaris* DALLE TORRE, Cat. Hymen. 8: 39, female.
1903. .... *familiaris* ANDRÉ, Gen. Ins. 1, fasc. 11: 70, female.

Holotype.—Female, Singapore, Malay Peninsula, in Saunders's collection, Oxford University, England.

The description of the male, which is heretofore undescribed, is as follows:

Male.—Head, abdomen, and legs black, the thorax bright ferruginous except the sternum, ventral third of mesopleuræ, ventral half of metapleuræ and propodeum entirely, black; posterolateral angles of dorsum of propodeum prominently angulate; third abdominal tergite clothed with dense, appressed, pale pubescence, the latter narrowed and broadly interrupted medially; wings very dark fuscous. Length, 16 millimeters.

Head entirely black, the front and vertex clothed with sparse, erect, obscure ferruginous pubescence, the remainder of the head clothed with sparse, erect, pale pubescence; mandibles not excised beneath, edentate at the apices and with a distinct tooth within near the apex; median triangular area of clypeus elevated, the anterior margin defined by a narrow, glabrous rim, the contour of the elevation from anterior to posterior margins almost evenly convex, the elevation with a pair of median, approximate, distinct tubercles, and the posterior half of the elevation densely, shallowly, confluently punctate; antennal tubercles connected by a distinct carina slightly angulate at the median line; scape weakly bicarinate beneath, above with close, intermixed small and moderate punctures; first segment of flagellum approximately one-half the length of the second; antennal scrobes strongly carinate above; front, vertex, and genæ coarsely, confluently punctate, the posterior margin of the latter defined by a distinct, sharp carina; gular margins carinate, the carinæ elevated into a distinct tooth a short distance posterior to the insertion of the mandibles; relative widths of head and thorax including the tegulæ, 4.4: 7.0.

Thorax bright ferruginous, except the sternum, ventral third of mesopleuræ, ventral half of metapleuræ and propodeum entirely, black, the ferruginous areas clothed with sparse, erect, ferruginous pubescence, the black areas clothed with sparse, erect, pale pubescence and very short, inconspicuous, subappressed, pale pubescence; pronotum, mesonotum, and scutellum with dense, coarse, confluent punctures; humeral angles acute, subdentate, the lateral margins of pronotum sinuate; mesonotum with a median, longitudinal carina, the parapsidal furrows obsolete; scutellum depressed along the median longitudinal line, the posterolateral angles slightly, bluntly produced; propleuræ with the anterior margin defined by a strong, sharp carina, the strongly depressed ventral third of propleuræ separated from the dorsal two-thirds by a strong transverse oblique carina; propleuræ micropunctate with a few, shallow, large punctures dorsally; mesopleuræ evenly convex throughout, the anterior fifth micropunctate, the remainder coarsely, deeply, confluently punctate; metapleuræ for the most part micropunctate, ventrally with large, shallow, confluent punctures; posterolateral angles of dorsum of propodeum prominently and angulately produced, the tip of the process forming approximately a right angle; dorsum and posterior faces of propodeum otherwise rounded into one another, broadly and deeply reticulate; sides of propodeum much more narrowly and shallowly reticulate than the dorsal and posterior faces, except the anterior fourth micropunctate;

tegulæ very large, equal in length to three-fourths the length of the mesonotum, ferruginous, clothed with sparse, ferruginous pubescence, micropunctate and also with scattered, shallow, moderate, inconspicuous punctures.

Abdomen entirely black; first segment, anterior third of second tergite and second sternite entirely with sparse, erect and suberect, pale pubescence; posterior two-thirds of second tergite with sparse, fuscous pubescence; third tergite with dense, appressed, pale pubescence narrowed and broadly interrupted medially; apical fringes of second and third sternites pale and the posterolateral angles of the same sternites with small spots of dense, appressed, pale pubescence; remainder of abdomen with sparse, black pubescence; anterior face of first tergite with large, close punctures, the anterior half of dorsal face of same tergite with large, dense, confluent punctures, the posterior half glabrous, impunctate; second tergite with large close punctures anteriorly and laterally, the punctures becoming moderately small and somewhat separated posteriorly, the disk glabrous, impunctate; third tergite with moderately small punctures anteriorly, fine, close punctures beneath the dense, pale pubescence, and scattered, small punctures medially; tergites four to six with moderate, separated punctures, those on six closer and denser than on four and five, the latter with the punctures sparse at the median line, and all three with a broad, posterior margin glabrous, impunctate; last tergite with moderate, dense, confluent punctures throughout; first sternite with a median, longitudinal carina, the proximal and distal ends of the carina moderately elevated; second sternite with a low, median, longitudinal carina on the anterior third, with large, distinct punctures throughout, sparsest at the median, lateral areas, and becoming small and close at the posterior margin; sternites three to six with moderate punctures, separated laterally, close medially; hypopygium broader than long with moderate, close punctures.

Legs entirely black, clothed throughout with moderately thick, appressed and erect pubescence; calcaria pale.

Wings very dark fuscous; cell 2d $R_1 + R_2$ broadly, squarely truncate at the apex; cell R_5 receiving vein M_{3+4} at the middle; cell R_4 obsolete.

Allotype.—MINDANAO, male, Dapitan (*Baker*), in United States National Museum.

Specimens examined: LUZON, female, Los Baños (*Baker*); 3 females, 4 males, Mount Maquiling (*Baker*); female, Lamao, 1912 (*C. S. Banks*); male, Bangui, November, 1923. SAMAR, 3 females, 8 males (*Baker*). NEGROS, female, Cuernos Mountains (*Baker*); female, Nakalang, February 25, 1902. MINDANAO, 3 males, Surigao (*Baker*); male, 2 females, Surigao; male, Butuan (*Baker*); male, Tangkulan, Bukidnon (*Baker*); 2 males,, 2 females, Bukidnon Province, June 3, 1931 (*L. H. Philips*); 4 males, Iligan (*Baker*); female, male, Kolambugan, 1914 (*C. S. Banks*); 2 females, 4 males, Kolambugan (*Baker*); 3 males, Dapitan (*Baker*); female, 4 males, Davao (*Baker*); female, 2 males, Zamboanga (*Baker*); 2 males, Momungan. BASILAN, 3 males (*Baker*).

I have examined the holotype of this species at Oxford and can find no differences between it and the Philippine specimens; Borneo material is also identical with the holotype and with the Philippine material. I have had the opportunity of examining two collections of material from the Malay Peninsula which contained a number of specimens of this genus but found no representatives of this species in the two collections. The holotype remains a unique specimen as far as Malaya is concerned. There is a remote possibility that the locality has been cited incorrectly in the original description although the label on the specimen agrees with that in the description; that is, "Singapore." The female specimens from the Philippines vary in having the pale pubescent band of the third tergite uninterrupted in some, narrowly interrupted in others. The males vary in length from 10 to 16 millimeters.

ODONTOMUTILLA PEDARIA sp. nov.

Male.—Head, abdomen, tibiæ, and tarsi black; thorax, coxæ, trochanters, and femora ferruginous; third tergite with a complete, broad band of pale pubescence; disk of second tergite very sparsely punctate, glabrous, laterally and anteriorly with close punctures; proximal half and apical sixth of wings hyaline, the remainder subfuscous with a dark cloud in cells R + 1st R_1 and 2d $R_1 + R_2$. Length, 7 millimeters.

Head entirely black, except the tip of the scape and the pedicel obscurely ferruginous, clothed throughout with sparse, erect, pale pubescence; mandibles edentate at the tip and with a small tooth within near the apex; median triangular area of clypeus elevated, the anterior half glabrous, impunctate, and with a transverse furrow, the posterior half densely, confluently punctate; scape with a single carina beneath, clothed with short, thick, pale pubescence; first segment of flagellum approximately one-half the length of the second; front, vertex, and genæ with large, dense, more or less confluent punctures, the genæ defined posteriorly by a distinct, sharp carina; gular margins distinctly carinate and elevated into a distinct tooth a short distance posterior to the insertion of the mandibles; relative widths of head and thorax including the tegulæ, 2.6 : 2.9.

Thorax entirely ferruginous, the pronotum, mesonotum, and scutellum clothed with sparse, ferruginous pubescence, the remainder of the thorax with sparse, pale pubescence; pronotum, mesonotum, and scutellum with moderate, dense punctures, confluent on the pronotum and scutellum, distinct on the mesonotum; humeral angles angulate, not prominent; lateral margins of pronotum straight; parapsidal furrows of mesonotum obsolete; posterolateral angles of scutellum produced into a short, subspinose process; posterolateral angles of dorsum of propodeum not at all produced, evenly rounded into the posterior face, the latter and the dorsum of propodeum broadly, deeply reticulate; propleuræ micropunctate, the anterior margin defined by a distinct, sharp carina; mesopleuræ evenly convex, the anterior fourth micropunctate, the remainder with large, shallow, close punctures; metapleuræ glabrous, impunctate except ventrally with shallow, indistinct punctures; anterior fourth of sides of propodeum glabrous, weakly micropunctate, the remainder narrowly, shallowly reticulate; tegulæ large, slightly longer than two-thirds the length of the mesonotum, ferruginous, with moderate, scattered punctures and sparse, ferruginous pubescence.

Abdomen black, except the first sternite and anterior margin of first tergite ferruginous, clothed throughout with sparse, erect, inconspicuous, pale pubescence; anterior face of first tergite with large, scattered punctures, the dorsal face glabrous, except a transverse row of moderate, deep, confluent punctures at the anterior margin; second tergite with moderate punctures, separate and distinct anteriorly, becoming close laterally, and close and smaller posteriorly except the disk very sparsely punctate, almost impunctate; third tergite with small, distinct punctures, and with a band of dense, appressed, pale pubescence, somewhat narrowed medially but complete; tergites four to six with small, close, distinct punctures, except the broad posterior margin of each glabrous, impunctate; last tergite with small, dense, confluent punctures throughout; first sternite with a distinct, median, sharp carina somewhat elevated posteriorly; second sternite with an obscure, median, longitudinal carina on the anterior third, and with moderate, distinct punctures throughout, sparser on the anterior median area than elsewhere; sternites three to six with small, close punctures; hypopygium with small, dense, confluent punctures throughout.

Coxæ, trochanters, and femora ferruginous, the tibiæ and tarsi blackish; legs clothed with moderately thick, erect and appressed, pale pubescence; calcaria pale.

Proximal half and apical sixth of wings hyaline, the remainder subfuscous with a dark cloud in cells R + 1st R_1 and 2d $R_1 + R_2$, the latter rounded at apex, not at all truncate; cell R_5 receiving vein M_{3+4} at one-third the distance from base to apex; cell R_4 entirely absent; veins m-cu and M_{3+4} parallel.

Female.—Head and abdomen black, the scape, thorax, and legs entirely ferruginous; third abdominal tergite with a complete, uninterrupted band of pale pubescence; anterior two-thirds of second tergite with moderate, dense, confluent punctures, the latter becoming small and close on the posterior third, the distal margin of the tergite glabrous, impunctate; second tergite without a pubescent fovea at the anterolateral angles. Length, 6 millimeters.

Head black, except the scape, pedicel and flagellum beneath, ferruginous; front and vertex clothed with sparse, erect and suberect, dark fuscous pubescence, the genæ with sparse, pale pubescence; mandibles slender, edentate at the tip and with a small tooth within near the apex; median triangular area of clypeus elevated, the anterior half glabrous, impunctate and bounded posteriorly by a carina interrupted medially, the posterior half with a prominent, short, subarcuate carina midway between the interrupted carina and the apex of the triangular median area; scape not carinate beneath, with fine, close punctures, and short, sparse, pale pubescence; first segment of flagellum slightly shorter than the second, distinctly so when viewed from beneath; antennal scrobes strongly carinate above, the carinæ connected by a transverse carina joining the antennal tubercles; front, vertex, and genæ with moderately coarse, dense, confluent punctures, the posterior margin of the genæ defined by a strong carina; gular carina strong and elevated posterior to the insertion of the mandibles into a distinct tooth; relative widths of head and thorax, 2.5 : 2.6.

Thorax entirely ferruginous, the dorsum clothed with sparse, erect and recumbent, ferruginous pubescence, the sides with scattered, erect, pale hairs and inconspicuous, pale micropubescence; humeral angles angulate but not prominent; lateral margins of pronotum with a blunt tubercle just posterior to the humeral angles; lateral margins of mesonotum broadly angulate anteriorly, the thorax widest at this angulation, and with the sides gradually converging posterior to this angle; dorsum of thorax with moderate, dense, confluent punctures; scutellar scale entirely absent; anterior half of posterior face of propodeum coarsely rugose, the posterior half with scattered, moderate punctures; lateral margins of posterior face of propodeum slightly denticulate anteriorly; propleuræ closely micropunctate, the anterior margin defined by a strong carina; mesopleuræ with a distinct, well-defined, ventrodorsal ridge terminating dorsally at the apex of the angle in the lateral margins of mesonotum; mesopleural area posterior to the ridge and the metapleural area, glabrous, impunctate; sides of propodeum glabrous, with a few, scattered, small, indistinct punctures.

Abdomen black, except the first sternite and the anterior margin of the first tergite, ferruginous; anterior face of first tergite with moderate, elongate, close, somewhat confluent punctures, clothed with sparse, erect, pale hairs, and sparse, recumbent, fuscous pubescence; anterior half of dorsal face of first tergite with moderate, dense, confluent punctures, and sparse, erect, fuscous pubescence, the posterior half glabrous, impunctate; anterior two-thirds of second tergite with moderate, dense, confluent punctures, the latter becoming small and close on the posterior third, the distal margin of the tergite glabrous; second tergite clothed with sparse, erect and recumbent, blackish pubescence, except the lateral fourths with sparse, pale pubescence; third tergite with small, close, shallow punctures anteriorly, and with a broad, complete band of dense, appressed, pale pubescence; tergites four and five with small, shallow, close, somewhat confluent punctures, except the broad, distal margin of each, glabrous and impunctate, clothed with sparse, erect and recumbent, fuscous pubescence; last tergite rugose-punctate throughout, clothed with sparse, pale pubescence; first sternite with a median, longitudinal carina elevated posteriorly into a small tooth; second sternite with moderate, distinct, well-separated punctures, sparser medially, clothed with very sparse, pale pubescence and with a thin, apical fringe of pale hairs; sternites three to five with small, close punctures and each with a thin, apical fringe of pale hairs; hypopygium with small, close, distinct punctures and sparse, erect, pale hairs.

Legs entirely ferruginous, the tarsi slightly darker than the remainder of the legs, clothed with erect and appressed, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49330, United States National Museum, MINDANAO, Iligan (*Baker*).

Allotype.—MINDANAO, female, Iligan (*Baker*), in United States National Museum.

Paratypes.—MINDANAO, 5 females, Surigao (*Baker*) ; female, Surigao; 4 males, 4 females, Iligan (*Baker*); 15 males, 7 females, Kolambugan (*Baker*) ; 2 females, Dapitan (*Baker*) ; 3 males, 2 females, Zamboanga (*Baker*). BASILAN, male, 4 females (*Baker*). PALAWAN, female (*Baker*).

Closely related to *cassiope* Smith from Borneo. The female differs from that species in having the legs entirely ferruginous, and in the denser, coarser puncturation of the second tergite. The male of *cassiope* is undescribed.

ODONTOMUTILLA ANDROMEDA sp. nov.

Male.—Head, abdomen, distal three-fourths of femora, tibiæ and tarsi, black; thorax, coxæ, trochanters, and proximal fourth of femora, ferruginous; second abdominal tergite with moderate punctures throughout; third abdominal tergite with a broad band of dense, appressed, pale pubescence, narrowly subinterrupted at the middle; proximal half of wings hyaline, the distal half subfuscous, cells R + 1st R_1 and 2d $R_1 + R_2$ with a darker cloud. Length, 7.5 millimeters.

Head entirely black, clothed throughout with sparse, erect and suberect, pale pubescence; mandibles edentate at the tip and with a small tooth within near the apex; median, triangular area of clypeus elevated, with a broad, transverse, glabrous groove anteriorly, posteriorly densely, finely, confluently punctate; scape not carinate beneath, with fine, close punctures and sparse, pale pubescence; tip of scape, and pedicel obscurely ferruginous; first segment of flagellum approximately three-fourths the length of the second; antennal scrobes distinctly carinate above; front, vertex, and genæ with moderately large, dense, shallow, confluent punctures, the posterior margin of genæ defined by a distinct carina; gular carinæ distinct, elevated into a small, distinct tooth, posterior to the insertion of the mandibles; relative widths of head and thorax, including the tegulæ, 2.9 : 3.3.

Thorax entirely ferruginous, the pronotum, mesonotum, and scutellum clothed with sparse, erect and recumbent, ferruginous pubescence, the dorsum and posterior face of propodeum with sparse, long, erect, pale hairs, elsewhere with sparse, pale pubescence; humeral angles angulate but not prominent; lateral margins of pronotum straight; pronotum, mesonotum, and scutellum with moderately large, dense, deep, confluent punctures; parapsidal furrows entirely obsolete; posterolateral angles of scutellum slightly, angulately produced; posterolateral angles of dorsum of propodeum not at all produced, evenly rounded into the posterior face, the latter and the dorsum of propodeum broadly reticulate throughout; propleuræ closely micropunctate and micropubescent, the anterior margin defined by a strong, sharp carina; mesopleuræ evenly convex throughout, the anterior fifth micropunctate, the remainder with moderate, shallow, close, somewhat confluent punctures; metapleuræ glabrous, indistinctly micropunctate, except ventrally with large, shallow, confluent punctures; anterior fifth of sides of propodeum glabrous, the remainder narrowly, shallowly reticulate; tegulæ large, their length approximately two-thirds the length of the mesonotum, the disk with moderate, dense, confluent punctures, the margins impunctate.

Abdomen entirely black; anterior face of first tergite with large, scattered punctures and sparse, erect, pale hairs; dorsal face of first tergite with a row of moderate, dense, confluent punctures at the anterior margin, the remainder of the dorsal face glabrous, impunctate; second tergite with moderately large, somewhat shallow, separated punctures, becoming closer laterally, closer and smaller posteriorly, but with no impunctate area on the disk, very sparsely clothed with erect, pale hairs and recumbent, short, blackish pubescence; third tergite with small, close punctures anteriorly, and with a broad, band of dense, appressed, pale pubescence, the latter narrowly subinterrupted medially (that is, appearing to be interrupted, but under the microscope the interrupted area is seen to have pale pubescence but much thinner and sparser than the band itself); tergites four to six with small, close, distinct punctures, except the broad, distal margin of each tergite glabrous, impunctate, clothed with sparse, erect and recumbent black pubescence, except the erect hairs of the fourth and fifth segments pale in certain lights; last tergite with small, dense, confluent punctures; first sternite with a high, thin, translucent carina; elevated anteriorly and posteriorly; second sternite with an obscure, median, longitudinal carina on the anterior fourth, with moderate, close, distinct punctures, and very sparse, erect, pale hairs, as well as a thin apical fringe of pale hairs; tergites three to six with small, close punctures, and each with a thin, apical fringe of pale hairs; hypopygium with small, dense, deep, confluent punctures.

Coxæ, trochanters, and proximal fourth of femora ferruginous; distal three-fourths of femora, tibæ and tarsi, black, except the ferruginous of the femora suffused into the black, and the definite amount of ferruginous or black can only be approximated; legs clothed throughout with sparse, erect and appressed, pale pubescence; calcaria pale.

Proximal half of wings hyaline, the distal half subfuscous, and cells R + 1st R_1 and 2d $R_1 + R_2$ with a still darker cloud; cell 2d $R_1 + R_2$ rounded at the apex, not at all truncate; cell R_5 receiving vein M_{3+4} just before the middle; cell R_4 entirely obsolete; veins m-cu and M_{3+4} parallel.

Female.—Head, abdomen, tips of femora, tibiæ, and tarsi black; thorax, coxæ, trochanters, and proximal three-fourths of femora ferruginous; second tergite without a pubescent fovea at the anterolateral angles, with small to fine, dense, confluent punctures throughout; third tergite with a band of dense, appressed, pale pubescence, narrowly but distinctly interrupted medially.

Head entirely black, except the scape beneath, pedicel, and flagellum beneath obscure ferruginous; front and vertex clothed with sparse, erect and recumbent, fuscous pubescence, the genæ with sparse, pale pubescence; mandibles slender, edentate at the tip and with a small tooth within near the apex; median, triangular area of clypeus elevated, with a transverse, glabrous groove anteriorly, a transverse median carina just posterior to the groove (the carina not interrupted medially as in *pedaria*) and a prominent, transverse, arcuate carina near the apex posteriorly; scape not carinate beneath, with fine, close punctures and sparse, short, pale pubescence; first segment of flagellum slightly but distinctly longer than the second; antennal scrobes strongly carinate above, the carinæ continuous with a transverse carina connecting the antennal tubercles; front, vertex, and genæ with moderately large, dense, confluent punctures, the posterior margin of the genæ defined by a strong carina; gular margins strongly carinate, the carina elevated into a distinct tooth a short distance posterior to the insertion of the mandibles; relative widths of head and thorax, 2.9 : 3.2.

Thorax entirely ferruginous, the dorsum clothed with sparse, erect and recumbent, ferruginous pubescence, the posterior face of propodeum with scattered, erect, long, pale hairs, and elsewhere with sparse, pale pubescence; humeral angles weakly angulate, the pronotum slightly broadened medially, thus the lateral margins gradually converging posteriorly; dorsum of thorax with moderately large, dense, deep, confluent punctures, becoming longitudinally rugose-punctate posteriorly; scutellar scale entirely absent; anterior portion of posterior face of propodeum coarsely rugose-punctate, the posterior half with scattered, small punctures; anterior margin of propleuræ defined by a strong carina, the propleuræ closely micropunctate and sparsely micropubescent; mesopleuræ with a prominent ridge extending dorsally from the anterior margin of the coxal cavity, the mesopleural area anterior to the ridge closely micropunctate and sparsely micropubescent, the area posterior to the ridge with indistinct, moderate, confluent punctures; metapleuræ glabrous, impunctate, except a few, indistinct punctures ventrally; sides of propodeum glabrous, very obscurely micropunctate and micropubescent; lateral margins of posterior face of propodeum very slightly crenulate.

Abdomen entirely black; anterior face of first tergite with small, more or less close, shallow, elongate punctures and with sparse, long, erect, pale hairs; anterior margin of dorsal face of first tergite with a row of moderate, dense, confluent punctures, and sparse, erect, fuscous hairs, the remainder of the dorsal face glabrous, impunctate; second tergite without a pubescent fovea at the anterolateral angles; with very dense, confluent punctures, small anteriorly, becoming fine posteriorly, laterally the punctures slightly larger, shallower and less dense, clothed with erect and recumbent, sparse, black pubescence, except laterally the pubescence longer and pale; third tergite with small, close to dense punctures, and with a broad band of dense, appressed, pale pubescence, narrowly interrupted medially; tergites four and five with small, dense punctures, except each with a broad, distal margin glabrous, impunctate, clothed with sparse, erect and recumbent, blackish pubescence; lateral areas of last tergite distinctly asperated, the median, distal triangular area granulate; first sternite with a median, longitudinal carina somewhat elevated posteriorly; second sternite with moderate, more or less confluent punctures, clothed with scattered, pale pubescence and with a thin, apical fringe of pale hairs; sternites three to six with moderately small, dense, confluent punctures, and each with a thin, apical fringe of pale hairs; hypopygium with small, close, distinct punctures and sparse, erect, pale hairs.

Coxæ, trochanters, and proximal three-fourths of femora ferruginous, the tips of the femora, tibiæ and tarsi, black; legs clothed with sparse, erect and appressed, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49331, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Allotype.—LUZON, female, Mount Maquiling (*Baker*), in United States National Museum.

Paratypes.—LUZON, female, Los Baños (*Baker*); female, Los Baños; 7 males, 4 females, Mount Maquiling (*Baker*); female, Mount Banahao (*Baker*); male, Limay. SAMAR, female, Catbalogan. NEGROS, female, Cuernos Mountains (*Baker*). MINDANAO, 2 females, Surigao (*Baker*).

Related to *pedaria* and *cassiope.* The female differs from both in the finer, denser puncturation of the second tergite, the interrupted pubescent band of the third tergite, and the asperated pygidium. The male differs from *pedaria* in the evenly distributed puncturation of the second tergite, the subinterrupted pubescent band of the third tergite, and the subfuscous apical area of the wings.

Genus TIMULLA Ashmead

Subgenus TROGASPIDIA Ashmead

Key to the species.

MALES

1. Hypopygium with lateral, elevated ridges, terminating in a distinct tubercle; scutellum usually distinctly gibbose, rarely not at all gibbose, only slightly convex .... 2.
   Hypopygium simple, without ridges or tubercles; scutellum not gibbose, only slightly convex .... 17.
2. Mandibles deeply excised beneath, thus forming a distinct tooth beneath near the base .... 4.
   Mandibles not excised beneath, without a ventral, basal tooth .... 3.
3. Abdominal segments two to four, or two to five ferruginous. *philippinensis* subsp. *philippinensis* (Smith).
   Abdomen entirely black........ *philippinensis* subsp. *itambusa* (Cockerell).
4. Clypeus with a prominent, submarginal carina anteriorly, extending from one side to the other .... 16.
   Clypeus not transversely carinate anteriorly .... 5.
5. Last tergite with a broad, median, tumescent, glabrous area, the latter rounded off posteriorly, not terminating in a tubercle .... 11.
   Last tergite with a narrow, median, glabrous area, the latter not tumescent, but terminating in a low, blunt, distinct tubercle........ 6.
6. First abdominal segment very dark mahogany red to black, much darker than the second segment, sometimes the posterior third or fourth suffused with ferruginous .... 7.

First abdominal segment bright ferruginous, concolorous with the second segment .... 8.

7. Abdominal segments two to five entirely ferruginous; hypopygial ridges long, extending onto the posterior half of hypopygium.
minor subsp. *princesa* subsp. nov.

Only the second and third abdominal segments ferruginous, remainder of abdomen black; hypopygial ridges short, not extending onto the posterior half of hypopygium.
minor subsp. *tayabasensis* subsp. nov.

8. Last abdominal tergite with the area distad of the median tubercle distinctly transversely concave, the thin apical margin of the tergite strongly reflexed........ *minor* subsp. *islandica* subsp. nov.

Last abdominal tergite with the area distad of the median tubercle practically flat, the thin apical margin of the tergite scarcely reflexed.. 9.

9. Space between the ocelli and the eyes closely, distinctly punctate; pronotum with comparatively thick, appressed, pale pubescence in addition to the sparse, erect, pale pubescence........ 10.

Space between the ocelli and the eyes sparsely shallowly punctate; pronotum without appressed, pale pubescence, or with very sparse, appressed, pale pubescence in addition to the sparse, erect, pale pubescence .... *minor* subsp. *visayensis* subsp. nov.

10. Second tergite clothed with very sparse, pale pubescence, the thin apical fringe entirely pale .... *minor* subsp. *minor* (Ashmead).

At least the thin apical fringe, excluding the lateral sixths, dark, almost black, and the median two-thirds of the posterior fourth of the second tergite with more or less dark to black, very sparse pubescence. Cape Engaño .... *minor* subsp. *whiteheadi* subsp. nov.

11. First and second segments of flagellum subequal in length; median area of clypeus with a low, median, longitudinal, inconspicuous ridge 12.

First segment of flagellum distinctly longer than the second; median area of clypeus prominently elevated along the median line into a blunt ridge, terminating anteriorly in a prominent, submarginal, blunt tubercle .... 13.

12. At least the second and third abdominal segments ferruginous.
eremita subsp. *eremita* sp. et subsp. nov.

At least the third abdominal segment black, and usually the second broadly along the longitudinal midline, thus the second tergite with a pair of large, lateral, ferruginous spots.
eremita subsp. *umbra* subsp. nov.

13. Median carina of first sternite conspicuously elevated posteriorly, the elevation broadened, strongly, transversely compressed and with the apex squarely truncate; posterior fourth of last tergite (area caudad of glabrous, tumescent area) elevated along the longitudinal midline, sloping to the sides, and with close, small punctures........ 14.

Median carina of first sternite only slightly elevated posteriorly, the apex of the elevation not broadened, nor flattened, nor truncate; posterior fourth of last tergite (area caudad of glabrous, tumescent area) not sloping to the sides from an elevated longitudinal midline........ 15.

14. Only the second and third abdominal segments, or segments one to three, ferruginous .... *luzonica* subsp. *luzonica* (Radoskowski).
    Second, third, and fourth abdominal segments, or segments one to four, ferruginous .... *luzonica* subsp. *panayensis* subsp. nov.
15. Posterior third of last tergite separated from the anterior two-thirds by a distinct, transverse depression extending the full width of the tergite; glabrous, tumescent area distinctly triangular in shape. *depressula* sp. nov.
    Posterior third of last tergite not separated from the anterior two-thirds by a depression, slightly concave and with small, sparse punctures; glabrous, tumescent area elongate, subrectangular, the sides only slightly diverging .... *bakeri* sp. nov.
16. Tegulæ glabrous, impunctate; first five abdominal segments ferruginous; abdominal tergites without transverse, pale pubescent bands. *tethys* sp. nov.
    Tegulæ finely, closely punctate and pubescent throughout; only first three or, sometimes, first four abdominal segments ferruginous; fifth abdominal tergite with a broad, apical, band of dense, pale pubescence. *tegularia* sp. nov.
17. At least the first segment of the flagellum beneath, and often the proximal half of the second segment beneath, distinctly yellow................ 21.
    Flagellum entirely black throughout.. 18.
18. First segment of flagellum equal in length to the second; tegulæ microreticulate, subopaque, feebly rugose near the outer and posterior margins .... *ira* subsp. *palawana* subsp. nov.
    First segment of flagellum slightly but distinctly shorter than the second; tegulæ glabrous, more or less punctate and pubescent........ 19.
19. Abdomen more or less ferruginous.. 20.
    Head, thorax, and abdomen entirely black.................... *nigerrima* sp. nov.
20. Tegulæ punctate and pubescent throughout; only abdominal segments one and two ferruginous; second tergite with moderate, deep, well-separated punctures; pronotum and mesonotum with moderate, close, more or less confluent punctures................................ *temeraria* sp. nov.
    Outer posterior fourth of tegulæ mostly impunctate; abdominal segments one to three ferruginous; second tergite with fine, very sparse punctures; pronotum and mesonotum with moderate to small, well-separated to sparse punctures.. *fortuita* sp. nov.
21. At least the second abdominal segment, in whole or in part, ferruginous .... *sticticornis* subsp. *sticticornis* sp. et subsp. nov.
    Head, thorax and abdomen entirely black. *sticticornis* subsp. *nigridia* subsp. nov.

FEMALES

1. Pygidium longitudinally striated.. 5.
   Pygidium sculptured otherwise .... 2.
2. Pygidial area glabrous, unsculptured; at least the coxæ, trochanters and femora except the tips, ferruginous... 11.
   Pygidial area not glabrous, roughly sculptured; legs entirely black.... 3.

3. Pygidial area irregularly rugose throughout; longitudinal carina of first sternite entire, not emarginate .... 4.
   Basal half of pygidial area irregularly rugose, the apical half granulated; longitudinal carina of first sternite emarginate, thus interrupted .... *manilensis* (Brown).
4. Fourth tergite entirely black pubescent.
   philippinensis subsp. *philippinensis* (Smith).
   Fourth tergite with a pair of lateral spots of pale pubescence.
   philippinensis subsp. *williamsi* subsp. nov.
5. Pale pubescent spots of second tergite subcircular in form, only very slightly longer than broad .... 6.
   Pale pubescent spots of second tergite strongly elongate-ovate in form, about twice as long as broad .... 10.
6. Antennal tubercles distinctly ferruginous; pale pubescent band of third tergite entire, not at all emarginate nor interrupted medially .... 7.
   Antennal tubercles entirely black; pale pubescent band of third tergite either distinctly interrupted medially, or with an anterior median emargination, seldom entire .... 9.
7. Apical margin of second tergite with a thin, apical fringe of pale pubescence; pygidial striæ reaching or almost reaching the posterior margin of pygidium .... *minor* susbp. *minor* (Ashmead).
   Apical margin of second tergite entirely black pubescent, except the lateral extremes; pygidial striæ usually not extending onto the posterior third of pygidium .... 8.
8. Tayabas area (see introduction) .... *minor* subsp. *tayabasensis* subsp. nov.
   Visayas area .... *minor* subsp. *visayensis* subsp. nov.
   Mindanao area .... *minor* subsp. *islandica* subsp. nov.
9. Pale pubescent band of third tergite with a more or less well-developed anterior, median, triangular emargination.
   eremita subsp. *eremita* sp. et subsp. nov.
   Pale pubescent band of third tergite distinctly interrupted medially with black .... *eremita* subsp. *umbra* subsp. nov.
10. Pubescent markings of abdomen pale silvery; distance between pubescent spots of second tergite one and one-half times their transverse diameter; pygidium striate only on basal half.
    ovatula subsp. *ovatula* sp. et subsp. nov.
    Pubescent markings of abdomen distinctly golden; distance between pubescent spots of second tergite about equal to their transverse diameter; pygidial striæ extending almost to posterior margin.
    ovatula subsp. *aurifera* subsp. nov.
11. Second tergite with a pair of anterior, subcircular, pale pubescent spots .... 12.
    Second tergite with a pair of parallel lines of pale pubescence on the anterior half, the lines extending to the anterior margin.
    proserpina subsp. *sibuyanensis* subsp. nov.
12. Apex of femora, and tibiæ entirely black, much darker in color than the ferruginous femora .... *proserpina* subsp. *tibiata* subsp. nov.
    Apex of femora, and tibiæ, ferruginous, practically concolorous with the femora .... *proserpina* subsp. *proserpina* (Smith).

TIMULLA (TROGASPIDIA) PHILIPPINENSIS subsp. PHILIPPINENSIS (Smith).

1855. *Mutilla philippinensis* SMITH, Cat. Hymen. Brit. Mus. 3: 40, female.
1869. *Mutilla accedens* SICHEL and RADOSKOWSKI, Horae soc. ent. Rossicae 6: 227–228, female.
1869. *Mutilla dimidiata* SICHEL and RADOSKOWSKI, Horae soc. ent. Rossicae 6: 285–286, male (in part; Luzon specimens).
1895. *Mutilla suspiciosa* BINGHAM, Ann. & Mag. Nat. Hist. VI 16: 440–441, female and male (in part) (nec Smith).
1897. *Mutilla philippinensis* DALLE TORRE, Cat. Hymen. 8: 73, female.
1903. *Mutilla philippinensis* ANDRÉ, Gen. Ins. 1, fasc. 11: 40, female.
1904. *Mutilla philippinensis* ASHMEAD, Proc. U. S. Nat. Mus. 28: 152, female.
1905. *Trogaspidia bicolor* ASHMEAD, Proc. U. S. Nat. Mus. 28: 962, male.
1906. *Mutilla accedens* BROWN, Philip. Journ. Sci. 1: 689, female.
1906. *Mutilla philippinensis* BROWN, Philip. Journ. Sci. 1: 689, female.
1906. *Mutilla suspiciosa* BROWN, Philip. Journ. Sci. 1: 689, male and female.
1906. *Trogaspidia bicolor* BROWN, Philip. Journ. Sci. 1: 689, male.
1906. *Mutilla dimidiata* BROWN, Philip. Journ. Sci. 1: 689, male.
1913. *Mutilla ianthea* ZAVATTARI, Boll. soc. ent. Ital. 45: 75, female (in part) (Manila specimen).
1927. *Trogaspidia bicolor* COCKERELL, Philip. Journ. Sci. 33: 277, male.
1927. *Trogaspidia dimidiata* COCKERELL, Philip. Journ. Sci. 33: 277, male.

Holotype.—Female, Philippine Islands, in British Museum of Natural History.

Specimens examined.—LUZON, male, Los Baños, June, 1916 (*F. X. Williams*); male, Los Baños, June–July, 1917 (*F. X. Williams*); female, 2 males, Los Baños, July, 1916 (*F. X. Williams*); 3 females, male, Los Baños, July–August, 1917 (*F. X. Williams*); 3 females, 21 males, Los Baños, August, 1916 (*F. X. Williams*); female, male, Los Baños, September, 1916 (*F. X. Williams*); female, male, Los Baños, 1917 (*F. X. Williams*); 6 females, 5 males, 1 pair in coitu, Los Baños, 1917 (*F. X. Williams*); 3 females, 8 males, Los Baños (*Baker*); 2 females, 11 males, Mount Maquiling (*Baker*); male, Manila; 2 males, Lamao, March–June, 1911 (*C. V. Piper*); 2 females, 2 males, Mount Banahao (*Baker*); female, Mount Banahao (*W. Schultze*); male Montalban, Rizal, 1913 (*G. Villegas*); female, Nueva Ecija Province (*W. Schultze*); female, Olongapo, Zambales Province, June 8, 1907 (*C. S. Banks*); female, Baguio, Benguet Subprovince, March 3 (*C. S. Banks*); female, Balali, Benguet (*A. Shick*); male, Irisan, May 21, 1903 (*R. C. McGregor*); male, Peña

Blanca, Cagayan, October, 1922 (*R. C. McGregor*); female, Sanchez Mira, Cagayan (*C. R. Jones*); female, three males, Cape Engaño (*Whitehead*); male, Limay; male, Imugan; female, Isabela; male, Buraner; female, male (*C. R. Jones*). POLILLO, 2 females (*Taylor*). CEBU, 2 females, April, 1917 (*F. X. Williams*). NEGROS, male, Cuernos Mountains (*Baker*); male, Maao, July 25, 1902 (*C. S. Banks*); male, Maao, July 30, 1902 (*C. S. Banks*); female, Dumoguere, April, 1917 (*F. X. Williams*). PANAY, female, Culasi, June 6, 1918 (*R. C. McGregor*); female, Culasi, June (*R. C. McGregor*). MINDANAO, female, 5 males, Dapitan (*Baker*); female, Cagayan (*Baker*). PALAWAN, 3 males, Puerta Princesa (*Baker*).

The male of this species is readily distinguished from other Philippine species by its large size and the absence of a distinct excision on the mandibles beneath near the base. The male specimens examined vary in length from 18 to 25 millimeters. The females are distinctive on account of the pygidium being irregularly rugose throughout and their large size. The female specimens vary in length from 12 to 18 millimeters. The two sexes have been correlated on evidence from pairs taken in coitu; one pair at Cape Engaño, reported by Bingham, and a pair in the material collected at Los Baños by Dr. F. X. Williams, as noted above. I have examined Smith's type of *philippinensis* and Ashmead's type of *bicolor;* the specimens listed above agree specifically with the two types; *bicolor*, being the most recent name, falls as a synonym.

I have been unable to locate any specimen that satisfies the requirements for a type of *accedens* Sichel and Radoskowski. A specimen determined by Radoskowski as *accedens* is in the Zoologisches Museum der Universität, Berlin. It agrees with the original description, but the locality label reads "Jalajala," while the description cites the type locality as Manila. This specimen is identical with Smith's type of *philippinensis*. A second specimen is in the Musée Physiographique de l'Academie Polonaise des Sciences Cracovie which was also determined by Radoskowski as *accedens*. This specimen has no locality label. It is a specimen of the subspecies *williamsi* described hereafter. This subspecies has a pair of lateral, pale pubescent spots on the fourth tergite, of which no mention is made in the original description of *accedens*. On the basis of the characters cited in the original description and the specimens determined by Radoskowski, which have been examined, there can be no doubt that *accedens* should fall as a synonym of *philippinensis* Smith.

The Luzon specimen of *dimidiata* mentioned by Sichel and Radoskowski can be definitely placed as a male specimen of this species from the description of the color of the abdomen and the large size. The specimens assigned by them to the species *philippinensis* were incorrectly determined and are the same as a new species described hereafter.

I have also examined the specimens from Cape Engaño which were determined by Bingham as *suspiciosa* Smith. This series consists of several species a part of which are specimens, both male and female, of *philippinensis*.

I have not seen the specimen from Manila determined by Zavattari as *ianthea*, but judging by the characters Zavattari used in keying out *ianthea* in his paper I think it probable that he had a specimen of this species.

This species is very uniform in sculpture and coloration throughout its range in the Philippine Islands. I have examined the specimens carefully, including the genitalia of the males, for subspecific differences in specimens from the various islands but have found no indication of any subspecific variation.

TIMULLA (TROGASPIDIA) PHILIPPINENSIS subsp. WILLIAMSI subsp. nov.

Female.—Head, abdomen, and legs black; thorax entirely ferruginous; second abdominal tergite with a pair of large, elongate, ovate spots of pale pubescence on the anterior half, the spots not extending to the anterior margin of the tergite; fourth tergite with a pair of lateral, subquadrate, somewhat obscure, pale pubescent spots, the latter not extending to the lateral margins of the tergite; fifth tergite entirely black pubescent; pygidial tergite, except the pygidial area, clothed with thick, erect, pale pubescence; pygidial area irregularly rugose throughout; apical margins of second and third sternites with thick, appressed, pale pubescence; the apical margins of the fourth and fifth sternites, each with a thin fringe of pale fuscous pubescence. Length, 13 millimeters.

Holotype.—LUZON, female, Los Baños, March, 1917 (*F. X. Williams*), in collection of University of Minnesota.

Paratype.—LUZON, female, Los Baños.

This subspecies is exactly like typical *philippinensis* females, except for the pale spots on the fourth tergite and its smaller size. The specimen without locality label determined by Radoskowski as *accedens*, mentioned above as being in the Musée Physiographique at Krakow, Poland, is an example of this subspecies. The paratype differs from the holotype in having obscure pale spots on the fifth tergite as well as on the fourth and is still smaller, being only 10 millimeters in length. It appears to be an abnormally colored specimen in other respects than the pale maculations.

TIMULLA (TROGASPIDIA) PHILIPPINENSIS subsp. ITAMBUSA (Cockerell).

1927. *Trogaspidia itambusa* COCKERELL, Philip. Journ. Sci. **33**: 275–277, male.

Holotype.—LUZON, male, Lucban, Tayabas Province, May, 1926 (*McGregor*), in the United States National Museum.

I have seen only the unique type of this subspecies. It is exactly like the males of *philippinensis*, except that the body is entirely black.

TIMULLA (TROGASPIDIA) MINOR subsp. MINOR (Ashmead). Plate 1, fig. 3.

1869. *Mutilla vicina* SICHEL and RADOSKOWSKI, Horae soc. ent. Rossicae **6**: 228, female (in part; Luzon specimen).
1869. *Mutilla analis* SICHEL and RADOSKOWSKI, Horae soc. ent. Rossicae **6**: 284–285, male (in part; Luzon specimen).
1905. *Trogaspidia minor* ASHMEAD, Proc. U. S. Nat. Mus. **28**: 963, male.
1906. *Mutilla analis* BROWN, Philip. Journ. Sci. **1**: 689, male.
1906. *Trogaspidia minor* BROWN, Philip. Journ. Sci. **1**: 689, male.
1910. *Mutilla browni* ROHWER, Proc. U. S. Nat. Mus. **37**: 658, female.
1919. *Mutilla* sp. WILLIAMS, Bull. Ent. Ser., Hawaiian Sugar Planter's Exp. Station **14**: 63, female.

Holotype.—LUZON, male, Manila, in United States National Museum.

Specimens examined.—LUZON, female, male, Los Baños, March, 1917 (*F. X. Williams*); 4 males, Los Baños, March–June, 1925 (*Pemberton*); male, Los Baños, Laguna, March, 1910 (*E. M. Ledyard*); female, male, Los Baños, June–July, 1917 (*F. X. Williams*); 2 females, 3 males, Los Baños, July, 1916 (*F. X. Williams*); 6 females, 2 males, Los Baños, July–August, 1917 (*F. X. Williams*); 7 females, 2 males, Los Baños, August, 1916 (*F. X. Williams*); male, Los Baños, August, 1917 (*F. X. Williams*); male, Los Baños, September, 1916 (*F. X. Williams*); female, Los Baños, September, 1917 (*F. X. Williams*); 2 females, male, and 2 pairs in coitu, Los Baños, 1916 (*F. X. Williams*); 14 females, 37 males, and 3 pairs in coitu, Los Baños, 1917 (*F. X. Williams*); female, Los Baños (*F. X. Williams*); 17 females, 39 males, Los Baños (*Baker*); male, Los Baños (*G. Villegas*); 5 females, 30 males, Mount Maquiling (*Baker*); 2 females, 2 males, Mount Banahao (*Baker*); male, Manila, August, 1923

(*R. C. McGregor*); male, Manila, February, 1919 (*R. C. McGregor*); male, Manila; female, Montalban Gorge, Rizal, March, 1906 (*C. S. Banks*); female, Imugan, Nueva Vizcaya Province (*Baker*); female, male, Baguio, Benguet (*Baker*); male, Fort William McKinley, Rizal Province, September 7, 1920; male, Lamao, Bataan Province, September, 1912 (*W. Schultze*); two males (*C. S. Banks*); female, male (*C. R. Jones*).

This and the five subspecies that follow are very closely related subspecies of *minor* Ashmead. These six subspecies are restricted to definite geographic areas in the Philippines. The species *minor* appears to be one which has recently given rise, or is in the process of giving rise, to subspecies and ultimately species. It appears to be due, in part at least, to the factor of geographic isolation. It has been possible to construct a key for the separation of the six subspecies of males based on external characters, but this key is far from infallible and must be used in connection with the structures of the male genitalia and our knowledge of the geographic distribution of the various subspecies. The genitalia of the males exhibit distinct differences which appear to be constant in each subspecies. The separation of the males of the various subspecies is therefore based primarily on the variations in the form of the uncus of the genitalia of the males. The geographic distribution of each subspecies is based on information from specimens identified by means of the genitalia. The females, with the exception of the type subspecies, are inseparable except on the basis of geographic distribution and their association with the males. After hours of minute and critical examination of numerous specimens of females no character has been found that will serve to differentiate the females of the various subspecies, with the exception that the characters cited in the key will separate the subspecies *minor* from the others.

The subspecies *minor* has been reared from the cocoons of *Tiphia lucida* Ashmead by Dr. F. X. Williams (1919). Although I have not seen the specimens actually reared by Williams, there can be no question, after a study of his published figure and the locality where the females were collected, that this is the species and subspecies which he had.

It will be noted above that five males and five females have been taken in coitu so that the association of the two sexes has been substantiated several times over. I have examined Ashmead's holotype and find it to be the same as the subspecies *minor.* Rohwer's holotype of *browni* has also been examined and the females placed here are identical with it. Since the name *minor* has priority *browni* must fall as a synonym. The specimen from Luzon recorded by Sichel and Radoskowski as *analis* Lepeletier has also been examined and found to be identical with this species. The specimen of *vicina* from Luzon mentioned by the same authors is in the Krakow Museum, and upon examination proved to be the same as the females placed here.

The collections studied indicate that *minor* subsp. *minor* is the commonest mutillid in the vicinity of Manila and Los Baños.

The figures that illustrate this species were made from mounted genitalia of a specimen in the collection of the University of Minnesota, slide No. 5, mutillid genitalia.

TIMULLA (TROGASPIDIA) MINOR subsp. WHITEHEADI subsp. nov. Plate 1, fig. 4.

1895. *Mutilla suspiciosa* BINGHAM, Ann. & Mag. Nat. Hist. VI 16: 440–441, male (in part) (nec Smith).

Male.—Head, thorax, posterior half of fifth abdominal tergite, sixth and seventh abdominal segments entirely, and legs, black; abdominal segments one to four, and anterior half of fifth, ferruginous; exactly like *minor* subsp. *minor* except the posterior third of the second tergite medially with sparse, dark fuscous pubescence, the lateral fourths of the same tergite with pale pubescence throughout; the thin, apical fringe of second tergite, except lateral sixths, also dark fuscous. Length, 14 millimeters.

Holotype.—LUZON, male, Cape Engaño (*Whitehead*), in British Museum of Natural History. Genitalia of type specimen mounted on slide No. 12.

Paratype.—LUZON, male, Cape Engaño (*Whitehead*).

Two of the male specimens determined by Bingham as *suspiciosa* belong here. Externally these specimens are exceedingly like the subsp. *minor,* but the second tergite is in part clothed with dark fuscous pubescence as described above. The uncus of the genitalia is very different from that of subsp. *minor* as will be seen from the figure. Apparently *whiteheadi* is very restricted in distribution as a specimen from Mountain Province, Baguio, Benguet, is typical subsp. *minor* both externally and with reference to the uncus of the genitalia.

TIMULLA (TROGASPIDIA) MINOR subsp. TAYABASENSIS subsp. nov. Plate 1, fig. 5.

Male.—Head, thorax, legs, and first, fourth, fifth, sixth, and last abdominal segments black; second and third abdominal segments ferruginous; exactly like subsp. *minor* except the first abdominal segment almost entirely black, the posterior fourth slightly suffused with ferruginous. Length, 13 millimeters.

Female.—Head, abdomen, and legs black; thorax ferruginous; antennal tubercles ferruginous; differs from subsp. *minor* in having the apical fringe of the second abdominal tergite, except lateral eighths, entirely black, and the striæ of the pygidium present only on the anterior three-fourths, the posterior fourth of pygidium faintly granulate. It agrees in both these characters with the following subspecies and is inseparable morphologically from them. Length, 8 millimeters.

Holotype.—Male, catalogue No. 49332, United States National Museum, POLILLO (*Baker*), taken in coitu with allotype female.

Allotype.—POLILLO, female (*Baker*), taken in coitu with holotype male.

Paratypes.—POLILLO, male (*Baker*); female (*R. C. McGregor*). LUZON, male, Malinao, Tayabas Province (*Baker*); female (*S. Jagor*).

The males of *tayabasensis* are easily separated from all the other subspecies by the almost entirely black first abdominal segment, and by the form of the uncus and squamæ of the genitalia. The specimen from Malinao has been carefully compared with the holotype and found to be identical in all respects. The figures of the male genitalia are drawn from the Malinao specimen, slide No. 13. The females are readily distinguishable from the subsp. *minor* as mentioned above, but although an exhaustive search has been made to find some means of separating *tayabasensis* females from the following subspecies, no serviceable characters have been found.

TIMULLA (TROGASPIDIA) MINOR subsp. VISAYENSIS subsp. nov. Plate 1, fig. 6.

1931. *Trogaspidia minor* LOPEZ, Ann. Rept. Research Dept., Philip. Sugar Assoc. for 1930–31, pp. 246–247, pl. 7, fig. 3, male.

1931. *Trogaspidia browni* LOPEZ, Ann. Rept. Research Dept., Philip. Sugar Assoc. for 1930–31, p. 247, female.

Male.—Head, thorax, legs, posterior half of fifth abdominal segment, sixth and last abdominal segments, all black; first four abdominal segments, and anterior half of fifth, all ferruginous; space between ocelli and eyes sparsely punctate; pronotum clothed for the most part with sparse, erect, pale pubescence, the sparse, appressed, pale pubescence obscure. Length, 16 millimeters.

Female.—Head, abdomen, and legs black; thorax ferruginous; antennal tubercles ferruginous; pygidium longitudinally striate, the striæ not extending to the apical margin, the posterior fourth of pygidium faintly granulate. Indistinguishable from subsp. *tayabasensis*. Length, 10 millimeters.

Holotype.—Male, catalogue No. 49333, United States National Museum, PANAY, northwestern part (*Baker*), taken in coitu with allotype female.

Allotype.—PANAY, female, northwestern part (*Baker*), taken in coitu with allotype male.

Paratypes.—PANAY, female, Culasi, Antique Province, May 1, 1918 (*R. C. McGregor*); male, Culasi, May 11, 1918 (*R. C. McGregor*); female, Culasi, May 16, 1918 (*R. C. McGregor*); female, Culasi, June 6, 1918 (*R. C. McGregor*); 2 females, 2 males, Culasi, June (*R. C. McGregor*); 6 males, Culasi, July 6, 1918 (*R. C. McGregor*); 4 males, Culasi (*R. C. McGregor*); 4 females, 10 males, northwestern part (*Baker*). BATBATAN, male, June, 1918 (*R. C. McGregor*). SIBUYAN, 20 females, 13 males (*Baker*); 2 females, June, 1904 (*R. C. McGregor*). NEGROS, female and male in coitu, Cadiz, August 28, 1929; female, Cadiz, July 3, 1929; female and male, Victorias, February 13, 1930; male, Victorias, July 10, 1928; female, Victorias, August 24, 1930; female, Victorias, August 28, 1930; female, Victorias, November 16, 1928; male, La Carlota Central, March 10, 1931; male, La Carlota Central, April 18, 1931; female, La Carlota Central, July 30, 1931; 5 males, Hawaiian-Philippine Central, June 20, 1930; male, Hawaiian-Philippine Central, August 25, 1929; 2 males, Binalbagan, May 28, 1931; male, Maao, July 27, 1902 (*C. S. Banks*); 2 males, Maao, July, 1902 (*C. S. Banks*); male, Bago, June, 1906; female, 5 males, Cuernos Mountains (*Baker*); 2 males. CEBU, 5 females, April, 1917 (*F. X. Williams*).

The male of this subspecies may be separated from related subspecies by the characters mentioned above. The male genitalia are very different from the related forms (see figure). The genitalia of male specimens from Panay, Batbatan, Sibuyan, and Negros have been examined and all found to be the same. I have had the opportunity of examining the specimens mentioned by Lopez (1931) and find them identical with this subspecies. The females are indistinguishable from the subspecies *tayabasensis* and *islandica*. It will be noted that a second pair taken in coitu is mentioned above from Cadiz, Occidental Negros. The figures of the uncus and squamæ of the male genitalia were drawn from a specimen collected in northwestern Panay (*Baker*) and are mounted on slide No. 7.

TIMULLA (TROGASPIDIA) MINOR subsp. ISLANDICA subsp. nov. Plate 1, fig. 7.

Male.—Head, thorax, last three abdominal segments, and legs black; abdominal segments one to four entirely ferruginous; front, pronotum, dorsum of propodeum, and elevated area of mesopleuræ with dense, appressed, pale pubescence; thin apical margin of last tergite strongly reflexed, thus the area distad of the pygidial tubercle distinctly, transversely concave. Length, 15 millimeters.

Female.—Head, abdomen, and legs black; thorax ferruginous; antennal tubercles ferruginous; pygidium longitudinally striate, the striæ not extending to the apical margin, the posterior fifth of pygidium faintly granulate. Indistinguishable from the subspecies *tayabasensis* and *visayensis*. Length, 9 millimeters.

Holotype.—Male, catalogue No. 49334, United States National Museum, MINDANAO, Surigao (*Baker*).

Allotype.—MINDANAO, female, Surigao (*Baker*).

Paratypes.—LUZON, male, Damalon. SAMAR, female, male, Catbalogan; female, May 23, 1924 (*R. C. McGregor*); female, June 4, 1924 (*R. C. McGregor*); male, June 14, 1924 (*R. C. McGregor*); male, June 24, 1924 (*R. C. McGregor*); 4 females, 11 males (*Baker*). BILIRAN, female, 4 males (*Baker*). BOHOL, male. MINDANAO, 40 females, 88 males (*Baker*); 3 females, 7 males, Butuan (*Baker*); male, Butuan; male, Camiguin; female, 2 males, Cagayan (*Baker*); 5 males, Tangkulan (*Baker*); female, 2 males, Iligan (*Baker*); 5 females, 2 males, Kolambugan (*Baker*); male, Kolambugan, 1914 (*C. S. Banks*); 22 females, 55 males, Dapitan (*Baker*); female, Mati, Davao, March, 1927 (*E. A. McGregor*); 10 females, 41 males, Davao (*Baker*); female, 6 males, Zamboanga (*Baker*); female, Malangas, 1919 (*C. S. Banks*). BASILAN, female, 6 males (*Baker*).

The dense, appressed pubescence of the pronotum, the transversely concave area on the posterior portion of the last tergite, and the characteristic male genitalia serve to distinguish the male of this subspecies. The males vary in the number of ferruginous abdominal segments; about 60 per cent of the males have abdominal segments one to four only, ferruginous, while 40 per cent have segments one to five ferruginous. The sexes have not been taken in coitu, but since the females are indistinguishable from the subspecies *tayabasensis* and *visayensis*, the specimens placed here are assigned to these males on the basis of geographic distribution.

TIMULLA (TROGASPIDIA) MINOR subsp. PRINCESA subsp. nov. Plate 1, fig. 8.

Male.—Head, thorax, first and last two abdominal segments, and legs black; abdominal segments two to five ferruginous; pronotum clothed only with sparse, erect, inconspicuous, pale pubescence; first abdominal tergite tinged with ferruginous at the posterior margin; hypopygial ridges extending on to the posterior half of the hypopygium. Length, 15 millimeters.

Holotype.—Male, catalogue No. 49335, United States National Museum, PALAWAN, Puerta Princesa (*Baker*).

Paratype.—PALAWAN, male, Puerta Princesa (*Baker*).

The subspecies *princesa* and *tayabasensis* differ from the other subspecies of *minor* in having the first abdominal segment largely black; *princesa* also differs from *islandica* in having the pronotum with only sparse, erect, pale pubescence. It differs from *tayabasensis* in having abdominal segments two to five ferruginous, instead of two to four, and in the longer hypopygial ridges. The uncus and squamæ of the genitalia differ as indicated in the figure. Genitalia are mounted on slide No. 11.

TIMULLA (TROGASPIDIA) EREMITA subsp. EREMITA sp. et subsp. nov.

Male.—Head, thorax, last four abdominal segments, and legs black; first three abdominal segments ferruginous; mandibles deeply excised beneath near the base; median area of clypeus slightly concave, with a median, weak, longitudinal ridge; first segment of flagellum subequal in length to the second; last tergite with a median, elongate, tumescent area, rounded off apically and not terminating in a tubercle; lateral areas of pygidial tergite with thick, erect, black pubescence. Length, 18 millimeters.

Head entirely black, the front, vertex, and genæ clothed with sparse, erect, black pubescence, the front and genæ also with sparse, appressed, pale pubescence; mandibles deeply excised beneath forming a strong tooth beneath near the base; lateral areas and posterior margin of clypeus pale pubescent; median area of clypeus large, pentagonal in outline, slightly concave, with a weak, median, longitudinal ridge, and entirely glabrous, impunctate, except a submarginal, transverse row of close punctures and erect, pale hairs at the anterior margin; scape distinctly bicarinate beneath, clothed with sparse, pale pubescence; first segment of flagellum subequal in length to the second;

antennal scrobes distinctly carinate above; front with large, close, confluent punctures, becoming shallow, obsolete anteriorly between the antennal tubercles; space between the ocelli and the eyes sparsely punctate; vertex with large, shallow, separated punctures, the genæ with moderate, shallow, separated punctures; ocelli small, the distance between the lateral ocelli and the eye margins five to six times the diameter of a lateral ocellus; relative widths of head and thorax including the tegulæ, 6.0 : 8.5.

Thorax entirely black; pronotum, mesonotum, and scutellum clothed with sparse, erect, black pubescence; dorsum and posterior face of propodeum with sparse, erect, pale pubescence, the dorsum also with sparse, appressed, pale pubescence; propleuræ clothed with sparse, erect, pale pubescence; mesopleuræ with sparse, pale pubescence, that on the elevated areas thicker and appressed; metapleuræ and sides of propodeum with pale micropubescence; pronotum and mesonotum with large, deep, confluent punctures; parapsidal furrows deep and distinct on the posterior two-thirds of mesonotum; scutellum with large, dense, deep, confluent punctures, strongly elevated, the anterior half with a median, longitudinal, broad, glabrous, furrowed line, terminating at the apex of the elevation; dorsum and posterior face of propodeum rounded into one another, distinctly reticulate, somewhat more broadly so on the dorsum than on the posterior face; lateral margins of dorsum of propodeum defined by a raised, glabrous line; dorsum of propodeum with an elongate, triangular, inclosed area, the latter two and one-half times as long as broad at the base and elevated into a slight tubercle posteriorly; propleuræ rugose-punctate; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by a deep furrow, and with large, dense, confluent punctures, the latter shallow and obsolete at the anterior and posterior margins of mesopleuræ; metapleuræ micropunctate, glabrous, with large, shallow punctures ventrally; sides of propodeum micropunctate at the anterior margin, shallowly reticulate on the posterior three-fourths; tegulæ large, glabrous, impunctate, except the anterior and inner margins punctate and black pubescent.

Abdomen black, except the first three abdominal segments ferruginous; first tergite with large, shallow, separated punctures becoming smaller and closer at the posterior margin and clothed with sparse, erect, pale golden pubescence; second tergite almost impunctate and bare medially, the lateral areas with moderate, sparse punctures, and very sparse, erect, pale golden pubescence; tergites three to six with sparse, moderate punctures, the third with sparse, erect, pale golden pubescence, the fourth, fifth, and sixth with sparse, erect, black pubescence; last tergite with a median, longitudinal, glabrous, tumescent area rounded off posteriorly, not terminating in a tubercle, the lateral areas of the tergite with very thick, erect, black pubescence; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina somewhat elevated posteriorly; second sternite with moderately large, distinct, well-separated punctures becoming smaller at the posterior margin, clothed with very sparse, pale golden pubescence; sternites three to six with moderate, close punctures posteriorly, the third with sparse, pale golden pubescence, the fourth with similar fuscous pubescence, the fifth and sixth with black pubescence; seventh sternite with a pair of small, obscure tubercles at the posterolateral angles; hypopygium with a pair of lateral, elevated, glabrous ridges on the anterior half and extending slightly on to the posterior half, slightly converging posteriorly, the interspace with moderately small, close punctures and sparse, erect, black pubescence.

Wings fuliginous with violet reflections; cell 2d $R_1 + R_2$ broadly truncate at the apex, slightly longer than cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at five-eighths the distance from base to apex; cell R_4 present but less distinct than R_5 and receiving vein M_2 at three-fifths the distance from base to apex.

Legs entirely black, clothed with sparse, pale pubescence; calcaria pale.

Female.—Head, abdomen, and legs black, the thorax entirely ferruginous; second tergite with a pair of elongate, ovate spots of dense, appressed, pale pubescence on the anterior half; third tergite with a broad band of dense, appressed, pale pubescence, distinctly, triangularly emarginate anteriorly at the middle; pygidium longitudinally striate, the striæ not extending to the posterior margin. Length, 12 millimeters.

Head entirely black including the antennal tubercles, and excepting the flagellum beneath beyond segment two tinged with ferruginous; front and vertex with sparse, erect, black pubescence, except the anterior margin of the front with scattered, pale hairs; genæ with sparse, appressed, pale pubescence; mandibles slender, edentate at the apex and with a very small tooth within near the apex; clypeus elevated posteriorly, the elevated posterior margin slightly arcuate, and with a small tubercle just posterior to the arcuate margin medially; antennal tubercles approximate; scape with shallow, indistinct punctures and sparse, pale pubescence; first segment of flagellum almost twice as long as the second; antennal scrobes distinctly carinate above; front and vertex moderately, longitudinally rugose-punctate; genæ with moderate, close, somewhat confluent punctures; relative widths of head and thorax, 4.9 : 4.7.

Thorax entirely ferruginous, the dorsum clothed with long, erect, and short, semierect, fuscous pubescence; humeral angles somewhat rounded, not sharply angulate; lateral margins of pronotal area with a small tubercle just behind the middle; mesonotal area slightly narrower than the pronotum and propodeum, the lateral margins crenulate and slightly converging posteriorly; dorsum of thorax coarsely, densely, longitudinally rugose-punctate; scutellar scale broad and distinct; dorsum of propodeum deeply, broadly reticulate and asperated, the asperations formed by the elevated angles of the reticulations, this sculpture extending on to the anterior half of the posterior face of propodeum; posterior half of propodeum with small, separated punctures; pleural areas and sides of propodeum closely micropunctate and with pale micropubescence, the sides of propodeum also with a few, scattered, moderate punctures.

Abdomen entirely black; first tergite with scattered, moderate punctures and scattered, erect, pale hairs except the posterior fourth with dense, appressed and sparse, erect, black pubescence; second tergite with dense, appressed and sparse, erect, black pubescence, except the anterior half with a pair of elongate-ovate spots of dense, appressed, pale pubescence, the spots separated by a distance twice their transverse diameter, and the posterior two-thirds of the lateral margins with dense, appressed, pale pubescence; lateral areas of second tergite with the moderate, shallow, separated punctures distinct, elsewhere the punctures partially visible through the pubescence; third tergite with a broad band of dense, appressed, pale pubescence, deeply, triangulately emarginate anteriorly at the middle with black pubescence; fourth and fifth tergites clothed with thick, erect and recumbent, black pubescence; anterior margin of pygidial tergite with black pubescence, the areas adjoining the margin of the pygidium with pale pubescence; pygidium distinctly longitudinally striate, the striæ not extending to the posterior margin, the posterior fifth of the pygidium granulate; first sternite with a high, longitudinal carina on the anterior two-thirds, slightly elevated posteriorly; second sternite glabrous, with moderate, distinct, well-separated punctures; posterior margin of second and third sternites with a narrow band of dense, appressed, pale pubescence; sternites three to five with small, dense punctures at the posterior margin; apical fringe of fourth sternite intermixed with pale and black hairs, that of the fifth entirely black; hypopygium with small, close punctures and sparse, erect, pale pubescence.

Legs entirely black, clothed with pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49336, United States National Museum, MINDANAO, Tangkulan, Bukidnon Province (*Baker*).

Allotype.—MINDANAO, female, Tangkulan, Bukidnon Province (*Baker*).

Paratypes.—LUZON, 2 males, 12 females, Mount Maquiling (*Baker*); female, Mount Banahao (*Baker*); female, Los Baños (*G. Villegas*); male, Limay, Bataan Province; 3 females, Baguio, Benguet (*Baker*); female, Malinao, Tayabas (*Baker*). SAMAR, male, 4 females (*Baker*). BILIRAN, male (*Baker*). NEGROS, 2 females (*Baker*). PANAY, male, 2 females, northwestern part (*Baker*). MINDANAO, male, 8 females, Surigao (*Baker*); female, Surigao; 3 males, Tangkulan, Bukidnon (*Baker*); male, 4 females, Iligan (*Baker*); male, 2 females, Kolambugan (*Baker*); 5 males, 8 females, Dapitan (*Baker*); 4 females, Davao (*Baker*); female, Zamboanga (*Baker*); female, Mumungan. BASILAN, 2 females (*Baker*).

The two sexes united here have not been taken in coitu, but the evidence from geographic distribution regarding this and the following subspecies warrants this view. The geographic distribution of the females placed here coincides exactly with that of the males, except that in the latter where less material is available no specimens are at hand from LUZON, Baguio, Benguet; NEGROS; and MINDANAO, Davao.

The males vary in length from 13 to 21 millimeters; they also vary in the color of the first abdominal segment, some having the first segment black, others having it ferruginous; the male may be distinguished by the small number of ferruginous abdominal segments, by the form of the median area of the clypeus and by the brushlike pubescence on the lateral areas of the pygidial tergite. The females vary in length from 9 to 13 millimeters, and there is some variation in the depth of the emargination of the pubescent band on the third tergite; in some the emargination is very deep, in others very shallow. The female sex is easily confused with the subspecies of *minor;* it may be recognized by the black antennal tubercles and the emarginate pubescent band of the third tergite.

TIMULLA (TROGASPIDIA) EREMITA subsp. UMBRA subsp. nov.

1895. *Mutilla suspiciosa* BINGHAM, Ann. & Mag. Nat. Hist. VI **16**: 440, female and male (in part) (nec Smith).

Male.—Exactly like typical *eremita* except the color of the abdomen; the latter entirely black except the second abdominal tergite with the lateral thirds, and the second sternite entirely, ferruginous. Length, 17 millimeters.

Female.—Exactly like typical *eremita* except the broad band a pale pubescence on the third abdominal tergite completely interrupted medially with black pubescence, the width of the interruption posteriorly equal to one-half the width of the pale pubescent band, the interruption slightly broader anteriorly. Length, 13.5 millimeters.

Holotype.—Male, catalogue No. 49337, United States National Museum, LUZON, Mount Banahao (*Baker*).

Allotype.—LUZON, female, Mount Banahao (*Baker*).

Paratypes.—LUZON, female, Los Baños, March–June, 1925 (*Pemberton*); female, Los Baños, September 10, 1920; female, Los Baños, 1917 (*F. X. Williams*); 6 females, 3 males, Mount Banahao (*Baker*); 7 females, 5 males, Mount Maquiling (*Baker*); 2 females, Balbalan; female, Malinao, Tayabas (*Baker*); female, Bangui, November, 1923; female, Lubuagan; female, Ripang; female, Imugan, Nueva Vizcaya (*Baker*); female, Baguio, Benguet (*Baker*); female, Calauan, Laguna Province, December 10, 1910 (*R. C. McGregor*); female, Isabela; female and male, Cape Engaño (*Whitehead*). POLILLO, female.

I have compared the males and females placed here critically with typical male and female *eremita* and find only the differences mentioned above. The genitalia of the two males are exactly the same. The males vary in length from 16 to 19 millimeters, and also vary considerably in the amount of black on the second abdominal tergite. The holotype and other specimens have the median third of the second tergite and a fairly broad posterior margin of the same tergite, black; while others have only the posterior margin dark; intergrades occur. In all specimens seen the first segment and the third tergite are black. The females vary in length from 8 to 13 millimeters. The male and female listed above from Cape Engaño were recorded by Bingham as *suspiciosa* Smith.

TIMULLA (TROGASPIDIA) LUZONICA subsp. LUZONICA (Radoskowski). Plate 1, fig. 9.

1885. *Mutilla luzonica* RADOSKOWSKI, Horae soc. ent. Rossicæ 19: 27, pl. 4, fig. 28, male.
1897. *Mutilla luzonica* DALLE TORRE, Cat. Hymen. 8: 55, male.
1899. *Mutilla luzonica* ANDRÉ, Ann. soc. ent. France 68: 31, male. (Redescription of type.)
1903. *Mutilla luzonica* ANDRÉ, Gen. Ins. 1, fasc. 11: 40, male.
1906. *Mutilla luzonica* BROWN, Philip. Journ. Sci. 1: 689, male.

Holotype.—LUZON, male; in Musée Physiographique de l'Académie Polonaise des Sciences Cracovie, Krakow, Poland.

Specimen examined.—LUZON, male, Los Baños, March, 1917 (*F. X. Williams*); 6 males, Los Baños (*Baker*); 3 males, Los Baños (*G. Villegas*); 2 males, Los Baños; 12 males, Mount Maquiling (*Baker*); male, Manila (*R. C. McGregor*); male, Manila; male, Baguio, Benguet.

The holotype of this species in the Krakow Museum has been examined and the specimens placed here are identical with it. The species may be recognized at once by the long first flagellar segment (distinctly longer than the second), the form of the clypeus (median area of clypeus prominently, bluntly elevated along the median, longitudinal line and the ridge so formed terminating anteriorly in a prominent, submarginal, blunt tooth), and the form of the carina of the first abdominal sternite (conspicuously elevated posteriorly, the elevation broadened, transversely compressed and with the apex squarely truncate). The typical subspecies (material placed here) is distinguished from the following subspecies by the number of ferruginous abdominal segments and the form of the uncus of the genitalia. Genitalia mounted on slide No. 16. The female is unknown but may be *ovatula* subsp. *aurifera* described hereafter.

TIMULLA (TROGASPIDIA) LUZONICA subsp. PANAYENSIS subsp. nov. Plate 1, fig. 10.

Male.—Head, thorax, legs, first abdominal segment anteriorly, and last three abdominal segments, black; first abdominal segment posteriorly, second, third, and fourth segments, ferruginous; median area of clypeus with a thick, blunt ridge along the median, longitudinal line, the ridge terminating before the anterior margin in a thick, blunt tooth; first segment of flagellum slightly compressed, distinctly longer than the second; last abdominal tergite with a median, glabrous, tumescent area, rounded off posteriorly, not terminating in a tubercle; area on last tergite posterior to tumescent area slightly elevated along the median line, gently sloping to the lateral margins, with very small, close punctures; median carina of first sternite well developed, high, strongly elevated posteriorly into a prominent tooth, the tooth broadened, transversely compressed, and squarely truncate at the tip. Length, 17 millimeters.

Holotype.—Male, catalogue No. 49338, United States National Museum, PANAY, Culasi, 1918 (*McGregor*).

Paratypes.—PANAY, 6 males, northwestern part (*Baker*). NEGROS, 2 males, Cuernos Mountains. SIBUYAN, 13 males (*Baker*).

This subspecies is almost exactly like subspecies *luzonica* externally, with the exception of the color of the abdominal segments. The uncus of the genitalia is distinctly different, as illustrated. The genitalia are mounted on slide No. 17. The female of this subspecies is unknown but is probably *ovatula* described below.

TIMULLA (TROGASPIDIA) OVATULA subsp. OVATULA sp. et subsp. nov.

Female.—Head, abdomen, and legs black, the thorax entirely ferruginous; second abdominal tergite with a pair of elongate-ovate, pale pubescent spots, the latter not extending on to the posterior half of the tergite, about twice as long as broad, and separated by slightly more than one and one-half times their transverse diameter; third tergite with a broad, complete band of pale pubescence; pygidial area longitudinally striated only on the anterior half, the posterior half granulated. Length, 9 millimeters.

Head entirely black, except the antennal tubercles and the flagellum beyond segment two tinged with ferruginous, the front and genæ clothed with long, sparse, suberect, pale fuscous pubescence, except the posterior margin of the vertex with a band of dense, appressed, pale pubescence; genæ with sparse, erect and appressed, pale pubescence; mandibles slender, edentate at the apex and with a small tooth within near the apex; clypeus elevated posteriorly, the elevated posterior margin slightly arcuate, and with a small tubercle medially immediately posterior to the elevated margin; antennal tubercles approximate; scape with small, sparse, shallow punctures, and sparse, pale pubescence; first segment of flagellum almost twice the length of the second; antennal scrobes strongly carinate above; front, vertex, and genæ with moderately large, dense, deep, confluent punctures, those on the genæ somewhat less coarse than on the front and vertex; relative widths of head and thorax, 4.0 : 3.6.

Thorax entirely ferruginous, the dorsum clothed with sparse, erect and recumbent, dark ferruginous pubescence; humeral angles distinctly angulate; lateral margins of pronotum with a distinct tubercle just behind the middle; lateral margins of mesonotal area sinuate, slightly converging posteriorly; dorsum of thorax densely, deeply, longitudinally rugose-punctate; scutellar scale broad and distinct; dorsum of propodeum strongly reticulate, rounded into the posterior face of propodeum, the sculpture becoming longitudinally rugose on the anterior half of the posterior face, punctate with moderate, scattered punctures on the posterior half; posterior face of propodeum clothed with sparse, erect, pale pubescence; lateral margins of posterior face of propodeum denticulate; pleural areas throughout closely micropunctate and micropubescent.

Abdomen entirely black; first tergite glabrous, with small, scattered punctures and sparse, erect, pale hairs, except the posterior margin with a band of dense, appressed, black pubescence; second tergite clothed with dense, appressed, black pubescence, and scattered, erect, dark hairs, except the posterior two-thirds of the lateral margins broadly, with dense, appressed, pale pubescence, and a pair of elongate-ovate spots of dense, appressed pale pubescence on the anterior half (not extending on to the posterior half at all) ; the pale spots about twice as long as broad and separated by slightly more than one and one-half times their transverse diameter; apical fringe of second tergite entirely black except at the posterolateral angles; third tergite with a broad, complete band of dense, appressed, pale pubescence; fourth and fifth tergites clothed with thick, short, black pubescence and sparse, erect, dark hairs interspersed with pale fuscous hairs; anterior margin of pygidial tergite with black pubescence, the marginal areas adjoining the pygidium with pale, erect pubescence; pygidium longitudinally striate on the anterior half, granulate on the posterior half; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina strongly, bluntly elevated posteriorly; second sternite glabrous, with moderate, very sparse punctures, finely, closely punctate at the posterior and lateral margins; second and third sternites each with a band of thick, appressed, pale pubescence at the apical margin; sternites three to five with small punctures, becoming close at the posterior margin of each; sternites four and five with a thin, apical fringe of pale hairs; hypopygium with small, close punctures and sparse, erect, pale hairs.

Legs entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49339, United States National Museum, SIBUYAN (*Baker*).

Paratypes.—SIBUYAN, 2 females (*Baker*).

This species is easily recognizable by the unusually elongate, pale pubescent spots of the second abdominal tergite and the sculpture of the pygidium. These females from Sibuyan are the only ones in the material before me that may possibly be associated with the thirteen male specimens of *luzonica* subsp. *panayensis* from the same island. I think it likely that *ovatula* is the female of *panayensis*.

TIMULA (TROGASPIDIA) OVATULA subsp. AURIFERA subsp. nov.

1869. *Mutilla Philippinensis* SICHEL and RADOSKOWSKI, Horae soc. ent. Rossicae 6: 226–227, female.

Female.—Head, abdomen, and legs black; thorax ferruginous; second abdominal tergite with a pair of elongate-ovate, distinctly golden pubescent spots, the latter extending slightly but distinctly onto the posterior half of the tergite, about twice as long as broad, and separated by approximately their own transverse diameter; third tergite with a broad band of dense, appressed, golden pubescence; pygidium longitudinally striated, the striæ not extending to the posterior margin, the posterior fourth of the pygidium faintly granulate. Length, 6 millimeters.

Front and vertex densely, longitudinally rugose-punctate, clothed with sparse, erect and suberect, pale fuscous pubescence; genæ with thick, appressed, pale pubescence; relative widths of head and thorax, 2.7: 2.3.

Second abdominal tergite with the scattered, erect hairs pale, and the very thin, apical fringe also pale; the golden, elongate spots of second tergite more posterior in position than the pale spots in typical *ovatula;* pygidial area with striæ extending more posteriorly than in typical *ovatula*, only the posterior fourth of pygidium weakly granulate.

Holotype.—LUZON, female, Balbalan; in collection of University of Minnesota.

Paratype.—LUZON, female, Ripang.

This subspecies is very similar to subspecies *ovatula* except as noted above. It may be easily recognized by the shape, color, and position of the pubescent spots on the second tergite and the striation of the pygidium. The description given for *philippinensis* by Sichel and Radoskowski corresponds to the specimens described here, and a specimen labeled *"philippinensis"* by Radoskowski, in the Krakow Museum, has been examined and is identical with the above holotype; therefore, the synonymy given above. This is probably the female of *luzonica* Radoskowski.

TIMULLA (TROGASPIDIA) DEPRESSULA sp. nov.

1895. *Mutilla suspiciosa* BINGHAM, Ann. & Mag. Nat. Hist. VI 16: 440–441, male (in part) (nec Smith).

Male.—Head, thorax, first, and last four abdominal segments, and legs black; abdominal segments two and three ferruginous; first segment of flagellum distinctly longer than the second; median area of clypeus elevated into a low, broad, blunt ridge terminating before the anterior margin; at least the first four abdominal segments clothed with sparse, very pale pubescence; posterior third of last tergite separated from the anterior two-thirds by a distinct, transverse depression extending the full width of the tergite; glabrous, tumescent area of last tergite distinctly triangular; carina of first sternite not broadened at posterior elevation. Length, 17 millimeters.

Head entirely black; front and anterior part of vertex clothed with sparse, erect, black pubescence, the front also with thick, recumbent, pale pubescence; posterior part of vertex with the erect pubescence pale fuscous; genæ with sparse, erect, and sparse, appressed, pale pubescence; mandibles strongly excised beneath forming a distinct tooth near the base, edentate at the tips and with a small, distinct tooth within near the tip; median area of clypeus glabrous, impunctate, except a few punctures between the termination of the median ridge and the anterior margin; median area of clypeus elevated as described above; scape with sparse, small punctures, and sparse, pale pubescence, bicarinate beneath, the ventral carina sharp and more distinct than the dorsal carina; first segment of flagellum slightly compressed and distinctly longer than the second; antennal scrobes distinctly carinate above; front and vertex with moderately large, close, somewhat confluent punctures, a small, elongate area adjacent and posterior to the lateral ocelli, impunctate; genæ with similar punctures, but closer and more confluent, the punctures sparse adjacent to the eye margins; relative widths of head and thorax at the tegulæ, 6.1 : 6.7.

Thorax entirely black; pronotum with large, close, somewhat confluent punctures, clothed with sparse, erect, pale pubescence; mesonotum with large, deep, distinct punctures, clothed with sparse, erect, black pubescence; parapsidal furrows deep and distinct on the posterior three-fourths; scutellum elevated, and with a glabrous, impunctate, broad, sulcate, median, longitudinal line on the anterior half, the line terminating at the apex of the elevation; scutellum with very large, dense, deep, confluent punctures, clothed with sparse, erect, black pubescence; dorsum and posterior face of propodeum reticulate, the dorsum with sparse, erect, and sparse, appressed, pale pubescence, the posterior face with only sparse, erect, pale pubescence; lateral margins of dorsum of propodeum defined by a raised, glabrous line; inclosed area of dorsum of propodeum a very elongate triangle, about two and one-half times as long as broad at the base, the sides slightly sinuate, the apex elevated into a small tubercle, and with a median, longitudinal, raised line within; posterior face of propodeum with a median, longitudinal carina extending from the tip of the dorsal inclosed space to the posterior margin; propleuræ coarsely, longitudinally rugose-striate; mesopleuræ elevated ventrally and dorsally, the two elevated areas separated by an oblique furrow, the ventral elevated area much larger than the dorsal; elevated areas of mesopleuræ with large, dense, confluent punctures, and clothed with sparse, erect and sparse, appressed, pale pubescence, the anterior and posterior marginal areas only micropunctate and micropubescent; metapleuræ micropunctate and micropubescent except for large, shallow punctures ventrally; anterior half of sides of propodeum micropunctate and micropubescent, the posterior half shallowly reticulate; tegulæ large, glabrous, impunctate, except the anterior and inner margins punctate and black pubescent.

Abdomen black, except the posterior margin of the first, and the second and third entirely ferruginous, the first four segments clothed with sparse, erect, very pale pubescence, the fifth with intermixed pale and black pubescence, and the remainder with black pubescence; first tergite with moderate, scattered punctures; second tergite with a large, median area glabrous, impunctate, the lateral areas of the anterior two-thirds with moderate, distinct punctures, the posterior third of the tergite with very sparse, small punctures; tergites three to six with sparse, small punctures; last tergite with a median, triangular, glabrous, tumescent area on the anterior two-thirds, the posterior third separated from it by a distinct transverse depression at the posterior margin of the tumescent area; posterior third of last tergite with the lateral margins elevated, glabrous, and the median area obscurely, finely punctate; first sternite with a prominent, high carina on the anterior two-thirds, the carina conspicuously elevated posteriorly but the elevation not transversely compressed; second sternite with large, sparse, shallow punctures; sternites three to six with moderate, close punctures towards the lateral and posterior margins; seventh sternite, with a pair of small, distinct tubercles at the posterolateral angles; hypopygium with a pair of lateral, glabrous, almost parallel ridges on the anterior three-fifths, the ridges very widely separated, the space between with small, close punctures.

Wings dark fuscous with violaceous reflections; cell 2d $R_1 + R_2$ squarely truncate at the apex, equal in length to cell R + 1st R_1; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 present but less distinct than R_5 and receiving vein M_2 distinctly beyond the middle.

Legs black, clothed with sparse, erect and appressed, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49340, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, 2 males, Los Baños (*Baker*); 3 males, Mount Maquiling (*Baker*); 5 males, Mount Banahao (*Baker*); male, Bangui, November, 1923; male, Lamao, September, 1912 (*W. Schultze*); male, Nueva Vizcaya; male, Cape Engaño (*Whitehead*).

This species resembles *luzonica* superficially but is easily distinguished from the latter by the form of the pygidial tergite and the lower median ridge of the clypeus, as well as the carina of the first sternite, the posterior elevation of which is not transversely compressed. One of the specimens recorded by Bingham as *suspiciosa* belongs here. Specimens vary in length from 13 to 17 millimeters and in some specimens the first abdominal segment is almost entirely ferruginous.

TIMULLA (TROGASPIDIA) BAKERI sp. nov.

Male.—Head, thorax, first and last four abdominal segments, and legs black; second and third abdominal segments ferruginous; median area of clypeus with a median, broad, blunt, elevated ridge terminating before the apical margin; first segment of flagellum distinctly longer than the second; tumescent area of last tergite subovate, the sides almost parallel; posterior third of last tergite not separated from the anterior two-thirds by a transverse depression, but with the lateral margins glabrous and elevated, and with small, distinct punctures; first four abdominal segments clothed with sparse, distinctly fulvous pubescence, the remaining segments with black pubescence; first abdominal sternite with a median longitudinal carina on the anterior two-thirds, the carina elevated posteriorly, the elevation not transversely compressed. Otherwise as in *depressula*. Length, 17 millimeters.

Holotype.—Male, catalogue No. 49341, United States National Museum, MINDANAO, Kolambugan (*Baker*).

Paratypes.—SAMAR, male, June 10, 1924 (*R. C. McGregor*); male, Catbalogan; 29 males (*Baker*). MINDANAO, 12 males, Surigao (*Baker*); male, Tangkulan, Bukidnon (*Baker*); 5 males, Iligan (*Baker*); 3 males, Kolambugan (*Baker*); 21 males, Dapitan (*Baker*); male, Mati, Davao, March, 1927 (*McGregor*); 3 males, Davao (*Baker*); male, Zamboanga (*Baker*). BASILAN, 5 males (*Baker*).

This species is very closely related to *depressula*. It differs in external characters as defined above and is not difficult to distinguish. On account of the differences in external characters as well as genitalia characters, I have preferred to give it specific rather than subspecific rank. The unci of the genitalia are very distinct in the two species. The specimens vary in length from 13 to 19 millimeters; a few specimens have the first abdominal segment ferruginous and occasionally the third segment is tinged with ferruginous.

TIMULLA (TROGASPIDIA) TEGULARIA sp. nov.

Male.—Head, thorax, last three abdominal segments, and legs black; first four abdominal segments ferruginous; clypeus concave, with a prominent, transverse, submarginal carina anteriorly; tegulæ with small, close punctures and clothed with black pubescence; fifth abdominal tergite with a broad, apical band of thick, appressed, pale pubescence. Length, 12 millimeters.

Head black, clothed throughout with sparse, erect, pale pubescence, the front anteriorly also with thick, recumbent, pale pubescence; mandibles deeply excised beneath, thus with a strong tooth beneath near the base, edentate at the apices; clypeus concave, glabrous, with a prominent, anterior, submarginal carina as described above, the median, submarginal area thus formed, with moderate punctures; scape distinctly bicarinate beneath, with small, close punctures and sparse, pale pubescence; first segment of flagellum almost subequal in length to the second, only very slightly longer than the second; antennal scrobes distinctly carinate above; front and vertex with moderate, the genæ with moderately small, dense, confluent punctures throughout; relative widths of head and thorax at the tegulæ, 4.1 : 4.5.

Thorax black; pronotum with moderate, dense, confluent punctures, clothed with dense, appressed, pale pubescence; mesonotum with moderate, close, deep punctures, clothed with sparse, erect, black pubescence, the parapsidal furrows present and distinct on the posterior two-thirds; scutellum only moderately elevated, the anterior half with a median, longitudinal, glabrous line terminating at the apex of the elevation; scutellum with moderate, dense, deep, confluent punctures, the anterior half with black, the posterior half with pale, sparse, erect pubescence; dorsum and posterior face of propodeum reticulate, the reticulations broader on the dorsum than on the posterior face; both the dorsum and posterior face of propodeum with sparse, erect, pale pubescence, the dorsum also with thick, appressed, pale pubescence; lateral margins of dorsum of propodeum defined by a raised glabrous line; inclosed, median space of dorsum of propodeum elongate, subtriangular, about three times as long as it is broad at the base, the apex elevated into a small tubercle; propleuræ longitudinally rugose-punctate, the anterior margin defined by a carina; mesopleuræ elevated ventrally and dorsally, the ventral elevation largest in area, the two separated by an oblique furrow; elevated areas of mesopleuræ with moderate, dense, deep, confluent punctures and sparse, erect, as well as thick, recumbent, pale pubescence; anterior and posterior marginal areas of mesopleuræ micropunctate; metapleuræ micropunctate and micropubescent, except ventrally with moderate, distinct punctures; anterior half of sides of propodeum micropunctate and micropubescent, the posterior half narrowly reticulate; tegulæ large, convex, with fine, close punctures and sparse, recumbent, black pubescence throughout, except a narrow outer marginal area impunctate and bare.

First four abdominal segments ferruginous; remainder of abdomen black; first four abdominal segments with sparse, erect, pale pubescence; fifth tergite with a broad, complete, apical band of thick, appressed, pale pubescence; remaining segments with sparse, black pubescence, except the apical fourth of the last tergite and sternite with pale pubescence; first tergite with moderate punctures, scattered anteriorly, becoming close posteriorly; second tergite slightly transversely gibbose, the median area practically impunctate, the lateral areas with moderate, close, mostly distinct punctures; tergites three and four with small, sparse punctures; tergite five with small, close punctures;

tergite six with fine, very close punctures, last tergite with very small, close but distinct punctures, and with a median, longitudinal, glabrous ridge on the anterior three-fourths; first sternite with a median, longitudinal carina on the anterior two-thirds, scarcely elevated posteriorly; second sternite with an elongate, median area glabrous, impunctate, elsewhere with moderately large, close punctures; sternites three to six with small, close punctures at the posterior margin; seventh sternite with a pair of lateral, submarginal, glabrous ridges; hypopygium with a pair of lateral, parallel, glabrous, prominent ridges on the anterior half, the interspace with fine, distinct punctures.

Wings subfuscous; cell 2d $R_1 + R_2$ obscurely truncate at the apex, equal in length to cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at two-thirds the distance from base to apex; cell R_4 present but less distinct than R_5 and receiving vein M_2 at two-thirds the distance from base to apex.

Legs black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49342, United States National Museum, LUZON, Los Baños (*Baker*).

Paratypes.—LUZON, male, Los Baños, June–July, 1917 (*F. X. Williams*); male, Los Baños, July–August, 1917 (*F. X. Williams*); male, Los Baños, August, 1916 (*F. X. Williams*); male, Los Baños, 1916 (*F. X. Williams*); 4 males, Los Baños, 1917 (*F. X. Williams*); 25 males, Los Baños (*Baker*); 16 males, Mount Maquiling (*Baker*); 5 males, Malinao, Tayabas (*Baker*); 2 males, Manila, February, 1919 (*R. C. McGregor*); male, Manila, May, 1924 (*R. C. McGregor*); 2 males, Manila (*Robert Brown*); 2 males, Mount Banahao (*Baker*); male, Arayat, August, 1920 (*P. T.*). SIBUYAN, male (*Baker*). SAMAR, 4 males, Catbalogan; male (*Baker*). NEGROS, 10 males, Cuernos Mountains (*Baker*); male, Isabela Central, June 13, 1930 (*A. W. Lopez*). PANAY, male, Culasi, June (*R. C. McGregor*); male, Culasi, July 6, 1918 (*R. C. McGregor*). MINDANAO, 3 males, Butuan (*Baker*); 7 males, Dapitan (*Baker*); male, Davao (*Baker*).

This species is related to *pustulata* Smith from Japan, *elpinice* Mickel from Formosa, and the following species from Palawan. All have the same type of clypeus and pygidial tergite. *Timulla tegularia* differs from all of them in the closely punctate and black pubescent tegulæ. The paratypes vary in length from 8 to 12 millimeters. The fourth abdominal segment varies in color from ferruginous to black. As may be noted above the species is present in four of the geographic areas of the Philippine Islands. I have examined the specimens from the various areas critically but find no evidence externally or in the genitalia of subspecific differences.

TIMULLA (TROGASPIDIA) TETHYS sp. nov.

Male.—Head, thorax, last two abdominal segments, and legs black; first five abdominal segments ferruginous; clypeus concave, with a transverse, anterior, submarginal, prominent carina; all of the abdominal tergites with sparse pubescence, none with a transverse band of appressed, pale pubescence. Length, 13 millimeters.

Head entirely black, clothed throughout with sparse, erect, pale pubescence, the front anteriorly and the genæ also with sparse, appressed, pale pubescence; mandibles deeply excised beneath, thus with a strong tooth beneath near the base, edentate at the apex and with a small tooth within near the apex; clypeus as described above, like that in *tegularia;* scape distinctly bicarinate beneath, with small, close punctures and sparse, pale pubescence; first segment of flagellum subequal in length to the second, only very slightly longer than the latter; antennal scrobes distinctly carinate above; front and vertex with moderately large, dense, shallow, confluent punctures; genæ with moderate, dense, confluent punctures; relative widths of head and thorax at the tegulæ, 4.6 : 4.9.

Thorax entirely black; pronotum with moderately large, dense, confluent punctures, clothed with sparse, erect, and sparse, appressed, pale pubescence; mesonotum with moderately large, close, confluent punctures, clothed with sparse, erect, black pubescence; the parapsidal furrows present and distinct on the posterior two-thirds; scutellum moderately convexly elevated, with moderately large, dense, deep, confluent punctures, the anterior half with a median, longitudinal, raised, glabrous line terminating at the apex of the elevation, clothed on the anterior half with sparse, black pubescence, on the posterior half with sparse, pale pubescence; dorsal and posterior faces of propodeum reticulate, the reticulations broader on the dorsum than on the posterior face; both dorsum and posterior face with sparse, erect, pale pubescence, the dorsum also with somewhat thick, recumbent, pale pubescence; lateral margins of dorsum of propodeum defined by a raised glabrous line; inclosed area of dorsum of propodeum elongate, about two and one-half times as long as broad, the apex elevated into a slight tubercle; propleuræ longitudinally rugose-punctate, the anterior margin defined by a carina; mesopleuræ convexly elevated ventrally and dorsally, the two elevated areas separated by an oblique furrow, with moderately large, dense, confluent punctures and sparse, erect and appressed, pale pubescence; anterior and posterior marginal areas of mesopleuræ micropunctate; metapleuræ micropunctate and micropubescent, except ventrally with moderately large, shallow punctures; anterior third of sides of propodeum micropunctate and micropubescent, the posterior two-thirds reticulate; tegulæ large, convex, glabrous, impunctate, except the anterior and inner margins punctate and black pubescent.

First five abdominal segments ferruginous, and clothed with very sparse, pale pubescence; remainder of abdomen black, clothed with sparse, black pubescence above, sparse, pale pubescence beneath; first tergite with moderately large, sparse, shallow punctures, becoming closer posteriorly, and with a few small punctures at the posterior margin; second tergite slightly transversely gibbose, the median area glabrous, practically impunctate, the lateral areas with moderate, distinct, close punctures; tergites three to six with small, very sparse punctures; pygidial tergite with small, dense, confluent punctures except medially a longitudinal, glabrous ridge on the anterior three-fourths, the ridge terminating in a slight tubercle; first sternite with a median, longitudinal carina on the anterior two-thirds, scarcely elevated posteriorly; second sternite with a median, elongate, impunctate, glabrous area, and laterally with moderately large, distinct, shallow punctures; sternites three to six with small, close punctures towards the posterior margin; seventh sternite with a pair of lateral, submarginal, low, glabrous ridges; hypopygium with a pair of lateral, prominent, glabrous ridges on the anterior half, terminating posteriorly in a small, distinct, posteriorly directed tooth, the interspace with small punctures.

Wings subfuscous; cell 2d $R_1 + R_2$ squarely truncate at the apex, equal in length to cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at two-thirds the distance from base to apex; cell R_4 present but less distinct than R_5 and receiving vein M_2 at two-thirds the distance from base to apex.

Legs black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49343, United States National Museum, PALAWAN, Puerto Princesa (*Baker*).

Paratypes.—PALAWAN, 7 males, Puerto Princesa (*Baker*).

Related to *tegularia* but differs in the impunctate, glabrous tegulæ, the absence of any band of appressed, pale pubescence on the abdominal tergites, and by having the first five abdominal segments ferruginous. It is very similar to *elpinice* Mickel from Formosa but has the hypopygial ridges much more strongly developed than the Formosa species, while the latter has a band of appressed, pale pubescence on the fourth abdominal tergite; *pustulata* Smith from Japan differs in having only the first two abdominal segments ferruginous and in having pale pubescent bands on tergites three and four. Paratypes vary in length from 9 to 12 millimeters.

TIMULLA (TROGASPIDIA) MANILENSIS (Brown).

1906. *Mutilla manilensis* BROWN, Philip. Journ. Sci. 1: 685, female.

Type.—Female, Manila. Location of type specimen unknown.

Specimens examined.—LUZON, female, Los Baños, July–August, 1917 (*F. X. Williams*); female, Los Baños, August, 1916 (*F. X. Williams*); female, Los Baños, 1917 (*F. X. Williams*); 7 females, Los Baños (*Baker*); 6 females, Mount Maquiling (*Baker*); female, Mount Banahao (*Baker*); female, Manila, February, 1919, (*R. C. McGregor*); female, Manila (*Brown*); female, Manila, December 18, 1911 (*C. S. Banks*); female, Manila, December 22, 1905; female, Arayat, August, 1920; female, Baguio, June, 1917 (*F. X. Williams*); female, Trinidad, Benguet, December 3, 1907 (*C. S. Banks*); 2 females, Imugan, Nueva Vizcaya (*Baker*); female, Pagsan; female. PANAY, 2 females, Culasi, June (*R. C. McGregor*). NEGROS, female, Cuernos Mountains (*Baker*); female, La Carlota Central, September 26, 1929 (*A. W. Lopez*); female, Sicaba, February 15, 1928; female, Victorias, February 13, 1928. MINDANAO, female, Butuan (*Baker*); female, Kolambugan (*Baker*); 3 females, Dapitan (*Baker*); female, Davao (*Baker*). BASILAN, female (*Baker*). PALAWAN, female, Puerto Princesa (*Baker*).

I have not been able to locate a specimen that fulfils the requirements for the type of Brown's *manilensis.* The Philippine Bureau of Science has loaned me its collection for study but no specimen labeled or determined by Brown is in the material; neither is there any such specimen in the collections of the United States National Museum. A specimen in the Philippine Bureau of Science material determined as *manilensis* by someone other than Brown is obviously very different from the original description. I have considered all the possibilities; that is, all the species taken at Manila, the type locality of *manilensis,* and am certain that the material placed here is the species Brown described in spite of one discrepancy between these specimens and the original description. The length of the specimens and the pale maculations of the second tergite agree exactly with Brown's description, but the latter specifies "third and fifth segments covered with transverse bands of silvery pubescence." This is a puzzle since no species of the subgenus *Trogaspidia,* to which *manilensis* must be assigned on account of the maculation of the second tergite, known to me from the Philippines has the fifth abdominal segment with a band of pale pubescence. The species in this group known from the Philippines always have the fifth segment black. However, the base of the pygidial, or sixth segment, has rather thick, pale pubescence in the specimens placed here, and this is also true of most other species of *Trogaspidia* from the Philippines. My opinion is that Brown in writing the description mistook this pale pubescence of the sixth segment to be on the fifth. This seems all the more likely to me since Bingham (1895) made the same error in his description of females from Cape Engaño as the female sex of *suspiciosa* Smith. The only other possibility among species occurring at Manila is the female of *minor* Ashmead. The latter is evidently not the species Brown had before him since the spots on the second tergite are somewhat ovate, not round; in the specimens placed here the pale pubescent spots are small and round, which agrees with the original description.

Timulla manilensis is easily recognized by the sculpture of the pygidium, irregularly rugose on the anterior half and granulate on the posterior half, and by its small size. The specimens vary in length from 5 to 7.5 millimeters. There is also a variation in specimens from the same locality in the color of the antennal tubercles, most of them having the tubercles ferruginous, but a few, black.

The locality records of this species and of *tegularia* indicate the possibility that the latter is the male of *manilensis,* but there is no other evidence and I prefer to treat them as separate species for the present. However, if *tegularia* should prove to be the male of *manilensis,* then the specimen of the latter from Palawan must be the female of *tethys.* I have studied the Palawan specimen with this in mind but could find no basis for differentiating it from *manilensis.*

TIMULLA (TROGASPIDIA) PROSERPINA subsp. PROSERPINA (Smith).

1858. *Mutilla proserpina* SMITH, Journ. Proc. Linn. Soc., Zool. 2: 85. female.

1897. *Mutilla proserpina* DALLE TORRE, Cat. Hymen. 8: 74, female.

1903. .... *proserpina* ANDRÉ, Gen. Ins. 1, fasc. 11: 71, female.

Holotype.—Female, Borneo, in Saunders's collection, University of Oxford, England.

Specimens examined.—PANAY, female, northwestern part (*Baker*). SIARGAO, female, Dapa. MINDANAO, 5 females, Surigao (*Baker*); female, Surigao; 6 females, Tangkulan, Bukidnon (*Baker*); 11 females, Iligan (*Baker*); 6 females, Kolambugan (*Baker*); 5 females, Dapitan (*Baker*); 2 females, Mumungan. BASILAN, 5 females (*Baker*).

The above specimens have been compared with specimens of *proserpina* from Borneo and found to be the same. These specimens, as well as Borneo specimens, vary in the extent of the ferruginous color on the first abdominal segment, some having that segment almost entirely ferruginous, others largely black; there is also some variation in the degree of development of the thin, apical fringe at the margin of the second tergite; most specimens have the fringe very thin and inconspicuous, but a few have the fringe well developed and distinct; the length of specimens varies from 4 to 8 millimeters.

TIMULLA (TROGASPIDIA) PROSERPINA subsp. TIBIATA subsp. nov.

Female.—Head, abdomen, tips of femora, tibiæ and tarsi entirely, all black; antennal tubercles, scape, mandibles except the tips, thorax entirely, coxæ, trochanters, and femora except the tips, all ferruginous; scutellar scale present; second tergite with a pair of small, round, basal spots, and a thin, inconspicuous, apical fringe of pale pubescence; third tergite with a broad band of dense, appressed, pale pubescence; last tergite anteriorly and laterally with sparse, erect, pale pubescence; pygidial area entirely glabrous, unsculptured. Length, 6.5 millimeters.

Holotype.—Female, catalogue No. 49344, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, female, Los Baños, March, 1917 (*F. X. Williams*); female, Los Baños, March–June, 1925 (*Pemberton*); female, Los Baños, July–August, 1917 (*F. X. Williams*); female, Los Baños, August, 1916 (*F. X. Williams*); female, Los Baños, September, 1917 (*F. X. Williams*); 10 females, Los Baños (*Baker*); 16 females, Mount Maquiling (*Baker*); 2 females, Mount Banahao (*Baker*); female, Malinao, Tayabas (*Baker*); female, Bulbulan. SAMAR, female, (*Baker*). MINDANAO, female, Kolambugan, 1914 (*C. S. Banks*).

Timulla proserpina subsp. *tibiata* is practically the same as the subspecies *proserpina* except that the antennal tubercles and scape are a darker ferruginous, the first abdominal segment is entirely black, and the tips of the femora as well as the tibiæ and tarsi entirely are also black. When the male is discovered this may prove to be a distinct species. It is probable that the specimen labeled "Kolambugan, Mindanao" is incorrectly labeled. Other specimens from Kolambugan are the subspecies *proserpina.*

TIMULLA (TROGASPIDIA) PROSERPINA subsp. SIBUYANENSIS subsp. nov.

Female.—Head and abdomen black; antennal tubercles, scape, flagellum beneath, mandibles except the tips, thorax entirely, coxæ, trochanters, and femora except the tips all pale ferruginous; tips of femora, tibiæ, and tarsi dark ferruginous; scutellar scale present; second tergite with a pair of linear spots extending from the anterior margin to the middle of the tergite, and a narrow apical margin of pale pubescence; third tergite with a broad band of dense, appressed, pale pubescence; last tergite anteriorly and laterally with sparse, erect, pale pubescence; pygidial area entirely glabrous, unsculptured. Length, 5.5 millimeters.

Holotype.—Female, catalogue No. 49345, United States National Museum, SIBUYAN (*Baker*).

Paratype.—SIBUYAN, female (*Baker*).

Very similar to *proserpina* but the tips of femora, tibiæ, and tarsi are darker than in the typical subspecies, but not as black as in the subspecies *tibiata;* also very distinct in the linear spots and narrow, apical, pale pubescent margin of the second tergite.

SPECIES KNOWN ONLY IN THE MALE

The following species and subspecies are known only in the male sex. They differ from the foregoing males in having the scutellum evenly convex, not conically elevated; in having the hypopygium flat and plain, without any indication of ridges or tubercles; and in having the genitalia of the males bilaterally symmetrical. There is practically no variation in the male genitalia of the various species and subspecies.

TIMULLA (TROGASPIDIA) IRA subsp. PALAWANA subsp. nov.

Male.—Head, thorax, last four abdominal segments, and legs black; first three abdominal segments ferruginous; median area of clypeus subtriangular, with a pair of obscure, submarginal tubercles near the anterolateral angles, clothed with sparse, pale pubescence; scutellum evenly convex, not at all elevated; tegulæ microreticulate; last abdominal tergite with a median, narrow, longitudinal, glabrous area on the posterior three-fourths; hypopygium unarmed; wings subfuscous. Length, 14 millimeters.

Head entirely black, clothed with sparse, erect and recumbent, pale pubescence, somewhat thicker on the front; mandibles deeply excised beneath, thus forming a tooth near the base beneath; median area of clypeus very slightly concave, glabrous, and as described above; scape strongly bicarinate beneath, with small, close punctures and sparse, pale pubescence; first segment of flagellum equal in length to the second; antennal scrobes carinate above; front, vertex, and genæ with moderate, dense, confluent punctures; relative widths of head and thorax including the tegulæ, 4.5 : 4.9.

Thorax entirely black; pronotum with moderately large, dense, confluent punctures, clothed with sparse, erect and appressed, pale pubescence; mesonotum with moderately large, close, distinct punctures, clothed with sparse, erect, dark fuscous pubescence, the parapsidal furrows present and distinct only on the posterior half; scutellum evenly, slightly convex, not at all elevated, with moderately large, dense, deep, confluent punctures, and clothed with sparse, erect, pale fuscous pubescence; dorsum and posterior face of propodeum rounded into one another, reticulate, clothed with sparse, erect, pale pubescence, and the dorsum with sparse, obscure, appressed, pale pubescence; inclosed space on dorsum of propodeum elongate, subtriangular, about one and one-half times as long as broad at the base, and with a very large reticulation each side at the base; lateral margins of dorsum of propodeum rounded into the sides; propleuræ micropunctate and micropubescent, the anterior margin defined by a carina; mesopleuræ medially with moderate, dense, confluent punctures, clothed with sparse, erect, and dense, appressed, pale pubescence, the anterior and posterior marginal areas micropunctate and micropubescent; metapleuræ micropunctate and micropubescent except ventrally a few scattered, moderate punctures; sides of propodeum micropunctate and micropubescent anteriorly, shallowly reticulate posteriorly; tegulæ large, convex, microreticulate throughout, and obscurely rugose, the anterior and inner margins punctate and pale pubescent.

First three abdominal segments ferruginous; remainder of abdomen black; first five abdominal segments clothed with very sparse, erect, very pale fulvous pubescence; last two abdominal segments clothed with sparse, black pubescence; first tergite with moderate punctures, scattered medially, close laterally; median area of second tergite with very sparse, small punctures, the lateral areas with moderate, distinct, somewhat close punctures; tergites three to six with moderately small, distinct, somewhat close punctures, except a narrow, median, longitudinal area on the posterior three-fourths glabrous, impunctate; first sternite with a median, longitudinal carina on the anterior two-thirds, not noticeably elevated posteriorly; second sternite with a median gibbosity on the anterior half, with sparse, moderate, distinct punctures throughout; remaining sternites and hypopygium with sparse, moderately small punctures.

Wings subfuscous; cell 2d $R_1 + R_2$ obliquely truncate at the tip, a little less than three times as long as broad, only slightly longer than cell R + 1st R_1; cell R_5 receiving vein M_{3+4} at about two-thirds the distance from base to apex; cell R_4 present but less distinct than R_5 and receiving vein M_2 slightly beyond the middle.

Legs black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49346, United States National Museum, PALAWAN, Puerto Princesa (*Baker*).

This subspecies differs from typical *ira* Cameron in the distinctly paler wings, ferruginous third abdominal segment and less-dense puncturation of the mesonotum. Specimens of the subspecies *palawana* have been compared with specimens of *ira* from Borneo. The two are alike except for the above differences. Thirty-two specimens of *ira* are before me from Borneo, all of which have distinctly darker wings and denser punctuation than the Palawan specimens. The genitalia of the two are apparently the same.

TIMULLA (TROGASPIDIA) TEMERARIA sp. nov.

Male.—Head, thorax, last five abdominal segments, and legs black; first two abdominal segments ferruginous; first segment of flagellum slightly shorter than the second; pronotum with moderate, close, somewhat confluent punctures; scutellum evenly, slightly convex, not elevated; tegulæ with small punctures and sparse, pale pubescence throughout; first five abdominal segments clothed with sparse, pale pubescence, except the fifth with the thin, apical fringe black; cell R_4 of wings practically obsolete. Length, 13 millimeters.

Head entirely black, clothed throughout with sparse, erect, pale pubescence except the front medially with thick, appressed, pale pubescence, and the genæ with short, sparse, thick, pale pubescence; mandibles deeply excised beneath, thus with a strong tooth beneath near the base, slender, edentate at the tips and with a small tooth within near the tips; clypeus without a distinct median area, bluntly elevated along the median line and with a small, transverse concavity medially between the anterior margin and the anterior terminus of the ridge; apical half of median clypeal ridge glabrous, bare, the median, apical concavity glabrous and very sparsely pubescent, the remainder of clypeus finely punctate and pale pubescent; scape with a single, strong carina beneath, with small, close punctures and sparse, pale pubescence; first segment of flagellum slightly shorter than the second; antennal scrobes carinate above; front with moderate, close, confluent punctures, the vertex with moderate, separated punctures, the genæ with small, shallow, well-separated punctures; relative widths of head and thorax at the tegulæ, 4.2: 4.4.

Thorax entirely black; pronotum with moderate, dense, confluent punctures, clothed with sparse, erect, pale pubescence, the posterior margin with thick, appressed, pale pubescence; mesonotum with moderate punctures in part separated, in part close and confluent, clothed with sparse, erect, black pubescence; scutellum evenly, slightly convex, not elevated, with moderate, dense, confluent punctures and sparse, erect, pale pubescence; dorsum of propodeum rounded into the posterior face, both reticulate throughout, the reticulations larger on the dorsum, clothed with sparse, erect, pale pubescence, the dorsum also with short, recumbent, obscure, pale pubescence; inclosed space of dorsum of propodeum elongate, about three times as long as broad, the sides sinuate; dorsum of propodeum rounded laterally into the sides of propodeum; posterior face of propodeum with a median, longitudinal carina its entire length; propleuræ with small, scattered punctures and also micropunctate and micropubescent, the anterior margin defined by a carina; ventral and dorsal areas of mesopleuræ evenly convex, separated by an oblique furrow, with moderate, close, shallow punctures and thick, appressed as well as sparse, erect, pale pubescence; anterior and posterior marginal areas of mesopleuræ micropunctate and micropubescent, the posterior area also with scattered, small, shallow punctures; metapleuræ micropunctate and micropubescent, ventrally with a very few, moderate punctures; posterior three-fifths of sides of propodeum reticulate, the anterior two-fifths micropunctate and micropubescent; tegulæ with sparse, small punctures throughout, the punctures closer towards the anterior and inner margins, clothed with sparse, recumbent, pale pubescence.

First two abdominal segments ferruginous, the remainder of the abdomen black; the first five abdominal segments clothed with sparse, suberect, pale pubescence, the last two segments clothed with black pubescence; first tergite with sparse, moderate punctures throughout; second tergite with moderate punctures, somewhat sparse medially, close laterally, and becoming small at the posterior margin; tergites three to six with moderate, well-separated punctures on the third and more separated medially than laterally, becoming smaller and sparser until the sixth with small, sparse punctures; last tergite with small, close, distinct punctures, and with a narrow, almost obsolete, median, longitudinal ridge on the anterior two-thirds, only very slightly elevated posteriorly; second sternite with moderate, distinct, close punctures throughout; sternites three to six with small, close, distinct punctures posteriorly on three and four, with small, sparse, distinct punctures on five and six; hypopygium with small punctures, some close to one another, others sparse.

Wings subfuscous; cell 2d $R_1 + R_2$ distinctly longer than cell R + 1st R_1, the former about two and one-half times its greatest breadth, narrowly, obliquely truncate at the apex; cell R_5 receiving vein M_{3+4} distinctly beyond the middle; cell R_4 practically obsolete.

Legs entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49347, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, male, Los Baños, July–August, 1917 (*F. X. Williams*); male, Los Baños, 1916 (*F. X. Williams*); male, Los Baños, March–June, 1925 (*Pemberton*); 3 males, Los Baños (*G. Villegas*); 28 males, Los Baños (*Baker*); 47 males, Mount Maquiling (*Baker*); 6 males, Mount Banahao (*Baker*); male, Bangui, Ilocos Norte, May 15, 1911 (*C. S. Banks*); male.

The paratypes vary in length from 7 to 13 millimeters. Easily recognized by the characters indicated in the key. Some of the paratypes have the anterior portion of the first abdominal segment tinged with black.

TIMULLA (TROGASPIDIA) FORTUITA sp. nov.

Male.—Black, except the first three abdominal segments ferruginous; pronotum and mesonotum with small, sparse, shallow punctures; scutellum with moderate, shallow, separated punctures; abdominal tergites one to five clothed with pale pubescence, the remaining abdominal segments with black pubescence; outer, posterior fourth of tegulæ glabrous, impunctate. Length, 10 millimeters.

Head entirely black, the front medially with thick, appressed and sparse, erect, pale pubescence, the front laterally, the vertex and the genæ, all with sparse, erect, pale pubescence, except the genæ at the posterior margin of the eyes also with thick, appressed, pale pubescence; mandibles deeply excised beneath forming a distinct tooth beneath near the base, edentate at the apex and with a small tooth within near the apex; subtriangular median area of clypeus moderately elevated, and with an obscure, median, longitudinal ridge on the posterior half, the latter also pale pubescent, the anterior half mostly glabrous, bare; scape strongly bicarinate beneath, elsewhere with fine, separated punctures and sparse, pale pubescence; first segment of flagellum slightly but distinctly shorter than the second; antennal scrobes distinctly carinate above; front with moderate, shallow, separated punctures; vertex with moderately small, shallow, sparse punctures; genæ with small, shallow, sparse, obscure punctures; relative widths of head and thorax including the tegulæ, 3.5: 3.7.

Thorax entirely black; pronotum with small, sparse, shallow punctures, clothed with sparse, pale pubescence, the latter thick and appressed at the posterior margin; mesonotum with moderately small, sparse punctures, clothed with sparse, dark fuscous, almost black, pubescence; parapsidal furrows distinct on the posterior half of mesonotum; scutellum convex, with moderate, shallow, separated but close punctures, clothed with sparse, erect, pale pubescence; dorsum and posterior face of propodeum rounded into one another, shallowly reticulate, clothed with sparse, erect, pale pubescence, the dorsum also with sparse, short, appressed, pale pubescence; lateral margins of dorsum of propodeum not defined, the median inclosed space triangular, elongate, three times as long as broad at the base, not elevated at the apex; propleuræ micropunctate and micropubescent, the anterior margin defined by a weak carina; mesopleuræ convex, the median area from venter to dorsum with moderate, separated, shallow punctures and clothed with sparse, erect, and thick, appressed, pale pubescence, the anterior and posterior areas micropunctate and micropubescent; metapleuræ micropunctate and micropubescent, with a few, moderate, punctures ventrally; sides of propodeum micropunctate and micropubescent on the anterior half, the posterior half shallowly reticulate; tegulæ convex, the inner half and anterior margin punctate and pale pubescent, the outer, posterior fourth glabrous, impunctate.

First three abdominal segments ferruginous, remainder of abdomen black; first five abdominal segments with sparse, erect, pale pubescence, the remainder with sparse, erect, black pubescence; first tergite with moderately small, shallow punctures; second tergite with fine, very sparse punctures, except the anterolateral areas with small, distinct punctures; tergites three to six with small, sparse punctures, the punctures on the anterior tergites of this somewhat larger than those on the posterior tergites; last tergite with small, sparse punctures and a median, longitudinal, glabrous, obscurely elevated ridge on the posterior half; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina not elevated posteriorly; second sternite with moderate, sparse punctures; sternites three to six with moderately small, sparse punctures; hypopygium with small, sparse punctures.

Wings subfuscous; cell 2d $R_1 + R_2$ distinctly longer than cell R + 1st R_1, the former very slightly more than twice as long as broad, almost squarely truncate at the apex; cell R_5 receiving vein M_{3+4} slightly beyond the middle; cell R_4 practically obsolete.

Legs entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49348, United States National Museum, MINDANAO, Tangkulan, Bukidnon (*Baker*).

Paratypes.—SIBUYAN, 4 males (*Baker*). NEGROS, 3 males, Cuernos Mountains (*Baker*). MINDANAO, male, Butuan (*Baker*); 51 males, Tangkulan, Bukidnon (*Baker*); 8 males, Iligan (*Baker*); 2 males, Kolambugan, 1914 (*C. S. Banks*); 8 males, Kolambugan (*Baker*); 13 males, Dapitan (*Baker*); 9 males, Davao (*Baker*); 3 males, Zamboanga (*Baker*). BASILAN, 6 males (*Baker*). PALAWAN, male, Puerto Princesa (*Baker*).

This species is closely related to *temeraria* but differs in so many respects externally that I regard it as a distinct species. The paratypes vary in length from 7 to 13 millimeters. There is also some variation in the color of the third abdominal segment. Most specimens have the third segment entirely ferruginous but a few have the posterior third or the posterior half blackish, and one or two specimens have the third segment entirely blackish. In all cases, however, the puncturation of the pronotum and mesonotum is small and sparse, and the outer, posterior fourth of the tegulæ is glabrous, impunctate.

TIMULLA (TROGASPIDIA) NIGERRIMA sp. nov.

Male.—Entirely black; mandibles excised beneath; pronotum and mesonotum with moderate, shallow, sparse punctures; scutellum evenly convex, with moderate, shallow, close punctures; first five abdominal segments with sparse, pale pubescence; hypopygium plain without elevated ridges; outer, posterior fourth of tegulæ glabrous, impunctate. Length, 13 millimeters.

Head entirely black, the front medially with sparse, erect and thick, appressed, pale pubescence, the vertex and genæ with sparse, erect, pale pubescence, except the genæ with thick, appressed, pale pubescence adjoining the posterior eye margins; mandibles excised beneath forming a distinct tooth beneath near the base, edentate at the apex and with a small, distinct tooth within near the apex; median, subtriangular area of clypeus elevated, the posterior half with a median, longitudinal, obscurely elevated ridge and with pale pubescence, the anterior half mostly glabrous, impunctate; scape obscurely bicarinate beneath, the anterior carina almost obsolete, elsewhere with small, close punctures and sparse, pale pubescence; first segment of flagellum slightly but distinctly shorter than the second; antennal scrobes carinate above; front with moderate, shallow, close, more or less confluent punctures interspersed medially with small, distinct punctures; vertex with moderately small, sparse punctures; genæ with small, sparse punctures; relative widths of head and thorax at the tegulæ, 4.3 : 4.7.

Thorax entirely black; pronotum with moderate, close, shallow punctures, clothed with sparse, erect and appressed, pale pubescence, except the appressed, pale pubescence thick at the posterior margin; mesonotum with moderate, distinct, sparse punctures, clothed with sparse, dark fuscous, almost black pubescence, except the anterior fifth with sparse, pale pubescence; parapsidal furrows distinct on posterior half of mesonotum; scutellum evenly convex, with moderately large, close, shallow punctures, clothed with sparse, erect, pale pubescence; dorsum, posterior face, and sides of propodeum all rounded into one another, the dorsum and posterior face distinctly reticulate, and clothed with sparse, long, erect, pale pubescence, the dorsum also with somewhat thick, short, appressed, pale pubescence; inclosed space of dorsum of propodeum elongate, subtriangular, about three times as broad as long; posterior face with a median carina extending from the apex of the inclosed area to the posterior margin; propleuræ defined anteriorly by a carina, micropunctate and micropubescent, and with a few, scattered, small punctures; mesopleuræ convex, the median area from ventral to dorsal margin with moderate, shallow, close punctures and somewhat thick, erect and appressed, pale pubescence; anterior and posterior areas of mesopleuræ micropunctate and micropubescent; metapleuræ micropunctate and micropubescent throughout, except moderately large, shallow punctures ventrally; anterior half of sides of propodeum micropunctate and micropubescent, the posterior half shallowly reticulate; tegulæ punctate and pale pubescent, except the outer, posterior fourth glabrous, impunctate, bare.

Abdomen entirely black, the first five segments with sparse, pale pubescence, the remainder with black pubescence; first tergite with sparse, small, shallow punctures, the latter becoming somewhat closer and more distinct posteriorly; second tergite with small, very sparse punctures, except the anterolateral areas with the punctures larger and closer though still well separated, and the posterior margin with the punctures closer; tergites three to six with small, sparse punctures; last tergite with small, distinct punctures, and with an obscure, median, longitudinal, glabrous ridge on the posterior half; first sternite with a median, longitudinal carina on the anterior two-thirds, only very slightly higher posteriorly than medially; second sternite with moderate sparse punctures; sternites three to six with moderate, distinct, separated punctures; hypopygium with small, separated punctures.

Wings fuscous with faint violet reflections; cell 2d $R_1 + R_2$ one and one-third times as long as cell R + 1st R_1, the former two and two-thirds times as long as broad; cell R_5 receiving vein M_{3+4} distinctly beyond the middle; cell R_4 practically obsolete.

Legs entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49349, United States National Museum, MINDANAO, Surigao (*Baker*).

Paratypes.—LUZON, male, Malinao, Tayabas (*Baker*). SAMAR, 10 males (*Baker*). BILIRAN, male, (*Baker*). MINDANAO, 18 males, Surigao (*Baker*); 2 males, Surigao; 3 males, Butuan (*Baker*).

Closely related to *fortuita* but differs in the puncturation of the body, in color, in the darker wings and its distinctly larger average size. The paratypes vary in length from 9 to 15 millimeters with most of them about 12 to 13 millimeters. The only other entirely black member of this genus likely to be confused with *nigerrima* is *sticticornis* subsp. *nigridia,* which may be recognized at once by the first segment of the flagellum being yellowish beneath. *Timulla philippinensis* subsp. *itambusa* is, of coarse, entirely black, but it is a much larger species in which the mandibles are not excised beneath.

TIMULLA (TROGASPIDIA) STICTICORNIS subsp. STICTICORNIS sp. et subsp. nov.

Male.—Black, except the second abdominal segment almost entirely ferruginous, and the first two flagellar segments yellowish beneath; first segment of flagellum distinctly shorter than the second; scutellum evenly convex; first five abdominal segments clothed with sparse, pale pubescence, remainder of abdomen with black pubescence; wings subfuscous. Length, 12 millimeters.

Head black, the front clothed with sparse, erect, pale pubescence and medially with short, appressed, pale pubescence, the vertex with sparse, erect, pale pubescence, and the genæ with sparse, erect, pale pubescence as well as short, sparse, appressed, pale pubescence adjoining the posterior eye margins; mandibles deeply excised beneath forming a tooth beneath near the base, edentate at the tip and with a small tooth within near the apex; subtriangular median area of clypeus moderately elevated, the posterior half with a median, elevated ridge terminating anteriorly in a blunt tubercle, the median area largely glabrous, impunctate and bare, but punctate and pale pubescent laterally; scape obscurely bicarinate beneath, the anterior carina sharp and well developed, the posterior one almost obsolete, the scape elsewhere with small, close punctures and sparse, pale pubescence; first segment of flagellum distinctly shorter than the second, the ventral surface entirely yellowish; second flagellar segment with the proximal fourth of the ventral surface yellowish; antennal scrobes carinate above; front with moderately large, dense, shallow, confluent punctures; vertex with moderate, distinct, separated punctures; genæ with small, shallow, sparse punctures; relative widths of head and thorax at the tegulæ, 4.6 : 4.9.

Thorax entirely black; pronotum with moderate, close, shallow punctures, clothed with sparse, erect and appressed, pale pubescence, the posterior margin with the appressed pubescence thick; mesonotum with moderate, distinct, separated punctures, clothed with sparse, erect, dark fuscous pubescence, except anteriorly the pubescence pale; parapsidal furrows distinct on posterior three-fifths of mesonotum; scutellum evenly convex, with large, dense, confluent punctures, clothed with sparse, erect, pale pubescence; dorsum, posterior face, and sides of propodeum rounded into one another, the dorsum and posterior face distinctly reticulate and clothed with long, sparse, erect, pale pubescence, the dorsum also with sparse, appressed, short, pale pubescence; inclosed space of dorsum of propodeum triangular, about two and two-fifths times as long as broad at the base; posterior face with a median, longitudinal carina extending from the apex of the inclosed space almost to the posterior margin; propleuræ micropunctate and with scattered, small punctures, clothed with short, appressed, pale pubescence, the anterior margins not well defined by a carina; median area of mesopleuræ from ventral to dorsal margins with moderate, close, more or less confluent punctures, clothed with somewhat thick, erect and appressed, pale pubescence, the anterior and posterior areas of mesopleuræ micropunctate and micropubescent; metapleuræ micropunctate and micropubescent, except a few, moderate punctures ventrally; anterior half of sides of propodeum micropunctate and micropubescent, the posterior half reticulate; tegulæ with scattered punctures and pale pubescence, except the outer, posterior fourth glabrous, impunctate, and the posterior, marginal area faintly transversely rugose.

Abdomen black, except the second abdominal segment mostly ferruginous, the median, posterior fourth of the second tergite also blackish; first five abdominal segments clothed with sparse, erect, pale pubescence, the remainder of the tergites with sparse, black pubescence, the remainder of the sternites with pale fuscous pubescence; first tergite with very sparse, shallow, small punctures becoming closer and more distinct posteriorly and laterally; second tergite with very sparse, fine punctures medially, becoming small and sparse laterally, and the anterolateral areas with moderately small, distinct, separated punctures; tergites three to six with small, sparse punctures; last tergite with moderate, close, somewhat confluent punctures, except a narrow, median, elongate area on the posterior half glabrous, impunctate; first sternite with a distinct carina on the anterior two-thirds, the carina only slightly higher posteriorly than anteriorly; second sternite with moderately large, sparse punctures; sternites three to six with moderate punctures, close and almost confluent on the third and fourth, separated and somewhat sparse on the fifth and sixth, but very sparse at the midline on all four sternites; hypopygium with moderate, sparse punctures anteriorly, small, close punctures medially, and glabrous, impunctate posteriorly.

Wings subfuscous; cell 2d $R_1 + R_2$ about one and one-third times as long as cell R + 1st R_1, the former three times as long as broad, truncate at the apex; cell R_5 receiving vein M_{3+4} distinctly beyond the middle; cell R_4 present but very indistinct, receiving vein M_2 two-thirds the distance from base to apex.

Legs entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49350, United States National Museum, MINDANAO, Kolambugan (*Baker*).

Paratypes.—SAMAR, 3 males (*Baker*). MINDANAO, male, Surigao; 2 males, Iligan (*Baker*); 3 males, Kolambugan (*Baker*); male, Dapitan (*Baker*).

There is a great amount of variation in the extent of the ferruginous area of the abdomen among the paratypes. At one extreme is a specimen from Samar which has the abdomen black, except the lateral thirds of the second tergite, and the second sternite entirely, ferruginous; another from Samar has in addition to this the lateral thirds of the first tergite ferruginous; several specimens are like the type in having the second tergite entirely ferruginous except a posterior, median, transverse spot, black; other specimens have the second segment entirely ferruginous; and one specimen from Iligan has the first, second, and almost all of the third segments ferruginous. The puncturation of the body and the color of the first flagellar segments are the same in all specimens.

TIMULLA (TROGASPIDIA) STICTICORNIS subsp. NIGRIDIA subsp. nov.

Male.—Entirely black, except the first flagellar segment beneath yellowish; first flagellar segment distinctly shorter than the second; front with moderately large, dense, confluent punctures as in *sticticornis;* mandibles excised beneath and with a small tooth near the base beneath; scutellum evenly convex; first five abdominal segments clothed with sparse, erect, pale pubescence, the remaining tergites with black pubescence, the remaining sternites with pale fuscous pubescence. Wings subfuscous. Length, 14 millimeters. Otherwise like the subspecies *sticticornis.*

Holotype.—Male, catalogue No. 49351, United States National Museum, MINDANAO, Iligan (*Baker*).

Paratypes.—MINDANAO, 9 males, Iligan (*Baker*); 5 males, Kolambugan (*Baker*); male, Dapitan (*Baker*); male, Zamboanga (*Baker*).

This subspecies is exactly like the subsp. *sticticornis* except that the body is entirely black and the yellow of the flagellum is restricted to the first segment. All other characters are the same as in the type subspecies. The length of the paratypes varies from 10 to 15 millimeters.

Genus SMICROMYRME Thomson

Key to the species.

MALES

1. Thorax largely ferruginous, the pleural areas and propodeum in part black; abdomen steel blue to black.... *ilerda* subsp. *sparsilis* subsp. nov.
   Thorax entirely black; abdomen entirely black, entirely metallic blue, or black and ferruginous.......... 2.
2. Mandibles distinctly or deeply emarginate beneath, and with a large, prominent, broad process, or a distinct tooth at the base beneath.... 5.
   Mandibles with the ventral margin straight, not at all emarginate, and without a tooth or process beneath at the base.......... 3.
3. Wings subhyaline; all the abdominal segments clothed with sparse, pale pubescence; first segment of flagellum only one-fourth the length of the second; body unicolorous, bright metallic blue.... *caerulea* sp. nov.
   Wings subfuscous; last two abdominal segments clothed with sparse, black pubescence; first segment of flagellum one-third of the length of the second; if body unicolorous, then black with obscure metallic blue reflections .... 4.
4. Abdomen with the second abdominal segment entirely, and the third segment in part or entirely, ferruginous.
   viriata subsp. *viriata* sp. et subsp. nov.
   Body unicolorous, black with obscure metallic blue reflections.
   viriata subsp. *nitela* subsp. nov.
5. Mandibles with a large, prominent, broad process at the base beneath; clypeus distinctly depressed below the dorsal margin of the mandibles. 6.
   Mandibles without a large, prominent, broad process beneath, at the most with a distinct tooth proximad of the excision; clypeus not depressed below the dorsal margin of the mandibles.......... 8.
6. Mandibles very broad at the apex, tridentate.......... *fluctuata* (Smith).
   Mandibles narrow at the apex, bidentate.......... 7.
7. Mandibles with a high carina on the proximal half of the dorsal surface, the small tooth within subapical; clypeus without a median, longitudinal, sharp ridge .... *palawanensis* sp. nov.
   Mandibles without a high carina on the proximal half of the dorsal surface, the inner tooth remote from the apex; clypeus with a median, longitudinal, sharp ridge.......... *zebina* (Smith).
8. Inner margin of hind coxæ armed its full length with a sharp carina, posteriorly the coxæ squarely truncate, thus the posterior-inner angle

of coxæ sharply angulate; second abdominal tergite with moderate to large punctures .... 9.

Posterior half of inner margin of hind coxæ not armed with a carina, the posterior margin of the coxæ not truncate, thus the posterior-inner angle of hind coxæ rounded; second abdominal tergite with very sparse, small punctures .... 11.

9. Tegulæ with small, dense punctures; wings subfuscous; second abdominal tergite with moderately large, distinct, separated punctures.. 10.

Tegulæ with small, well-separated, shallow punctures; wings subhyaline; second abdominal tergite with moderate, sparse punctures. *bakeri* sp. nov.

10. First two abdominal segments ferruginous. *semperi* subsp. *semperi* (Ashmead).

Abdomen entirely black........ *semperi* subsp. *melanogastra* subsp. nov.

11. First two or first three abdominal segments more or less ferruginous. *lavinia* subsp. *lavinia* sp. et subsp. nov.

Body unicolorous, entirely black........ *lavinia* subsp. *atrata* subsp. nov.

FEMALES

1. Second abdominal tergite with a single, median, anterior spot of pale pubescence .... 2.

Second abdominal tergite with three anterior spots of pale pubescence, one median and two lateral........ 7.

2. Abdomen dark metallic blue; third abdominal tergite clothed entirely with black pubescence .... *hyale* sp. nov.

Abdomen black; third abdominal tergite maculated with pale pubescence. 3.

3. Third abdominal tergite with a large, median, transverse spot of pale pubescence .... 4.

Third abdominal tergite clothed entirely with pale, appressed pubescence. 5.

4. Scape, coxæ, trochanters and femora except the tips, ferruginous, the femoral tips, tibiæ, and tarsi blackish. *fura* subsp. *fura* sp. et subsp. nov.

Scape and legs entirely black........ *fura* subsp. *anthracipes* subsp. nov.

5. Scutellar scale present .... 6.

Scutellar scale absent; scape, coxæ, trochanters and femora except tips, ferruginous .... *parva* (Brown).

6. Scape, legs, and first abdominal segment entirely ferruginous. *basalis* subsp. *basalis* (Smith).

Scape and legs black; first abdominal segment largely black. *basalis* subsp. *annularis* subsp. nov.

7. Second abdominal tergite with a narrow, apical fringe of pale pubescence; posterior fourth of pygidium glabrous, the striæ not extending to the posterior margin........ *autonoe* sp. nov.

Second abdominal tergite entirely black pubescent except for the three anterior, pale pubescent spots; pygidium longitudinally striate throughout .... 8.

8. Pale pubescent spots of second tergite in a transverse row; third and fourth abdominal tergites entirely pale pubescent........ *zebina* (Smith).

Median, anterior, pale pubescent spot of second tergite distinctly anterior to the lateral spots; only the third abdominal tergite entirely pale pubescent, the fourth with pale pubescence laterally.
semperi subsp. *semperi* (Ashmead).

SMICROMYRME ILERDA subsp. SPARSILIS subsp. nov.

Male.—Head, ventral plate of metapleuræ, sides and posterior face of propodeum, and legs all black; remainder of thorax pale ferruginous; abdomen dark metallic blue; pronotum with large, close but distinctly separated punctures; second and third abdominal tergites each with an apical band of dense, appressed, pale pubescence. Wings fuscous. Length, 14 millimeters.

Head entirely black, the front with thick, suberect, pale fulvous pubescence; except the genæ also with thick, short, appressed, pale pubescence adjacent to the posterior eye margins; mandibles moderately excised beneath, forming a small blunt tooth beneath near the base; clypeus without an elevated median area, with a median, longitudinal, low ridge, finely punctate and clothed with appressed, pale fulvous pubescence; scape distinctly bicarinate beneath, elsewhere with small, close punctures and sparse, pale fulvous pubescence; first flagellar segment about one-third the length of the second; proximal flagellar segments more or less ferruginous beneath; antennal scrobes in part carinate above, the carina extending half the distance between the antennal tubercles and the eyes; front with moderate, close, confluent punctures merging into the longitudinally striate-punctate vertex; genæ with small, close, more or less confluent punctures; relative widths of head and thorax including the tegulæ, 4.2 : 5.0.

Thorax ferruginous, except the posteroventral angle of mesopleuræ, the ventral plate of the metapleuræ, the sides and the posterior face of propodeum, all blackish; pronotum and mesonotum with moderately large, close but distinct punctures, clothed with sparse, erect, fulvous pubescence; parapsidal furrows present on the posterior two-thirds of mesonotum, but shallow; scutellum evenly convex, with moderately large, dense, confluent punctures and sparse, erect, fulvous pubescence; dorsum, posterior face and sides of propodeum all rounded into one another, the dorsum and posterior face distinctly reticulate and clothed with sparse, erect, pale fulvous pubescence, the dorsum also with somewhat thick, short, obscure, pale pubescence; median inclosed area of dorsum of propodeum subtriangular, the sides sinuate, about two and one-half times as long as broad at the base; posterior face of propodeum with a median, longitudinal, sinuate carina extending from the apex of the median inclosed area to the posterior margin; propleuræ defined anteriorly by a distinct carina, micropunctate and micropubescent, and with a very few, small, scattered punctures; mesopleuræ with moderately large, close, more or less confluent punctures becoming sparse on the anterior area, the latter micropunctate and micropubescent, the mesopleuræ elsewhere with sparse, erect, and short, sparse, appressed, pale pubescence; metapleuræ micropunctate and micropubescent, except for moderately large, close, shallow punctures ventrally; sides of propodeum reticulate, the reticulations smaller than on the posterior face; tegulæ large, extending one-third their length behind the posterior margin of mesonotum, entirely ferruginous, with sparse, small punctures, and sparse, recumbent, fulvous pubescence throughout.

Abdomen dark metallic blue, the first four segments with sparse, erect, pale pubescence, the second and third also with broad, apical bands of dense, appressed and sparse, erect, pale pubescence; remaining abdominal segments with sparse, erect, black pubescence; first tergite with sparse, moderate punctures becoming close laterally, and smaller but still sparse posteriorly; second tergite with moderate, distinct punctures, well separated medially, becoming close laterally; tergites three to six with small, sparse punctures, those on the anterior half (that part telescoping into the adjacent anterior segment) with the punctures more regular and the pubescence very short, the posterior half with the pubescence long; last tergite with small, close punctures throughout, except a weakly defined subtriangular area adjoining the posterior margin, glabrous, impunctate; first sternite with a distinct, median, longitudinal carina, the latter distinctly higher posteriorly than anteriorly; second sternite with moderately large, close, slightly confluent punctures throughout; sternites three to six with moderately small punctures, becoming close at the posterior margin of each; hypopygium with small, distinct, separated punctures.

Wings fuscous with violet reflections; cells 2d $R_1 + R_2$ and $R +$ 1st R_1 equal in length, the former acute at the apex; cell R_5 narrow, elongate, receiving vein M_{3+4} slightly before the middle; cell R_4 present but less distinct than R_5 and receiving vein M_2 two-thirds the distance from base to apex.

Legs black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49352, United States National Museum, MINDANAO, Dapitan (*Baker*).

Paratypes.—MINDANAO, 5 males, Butuan (*Baker*); male, Tangkulan, Bukidnon (*Baker*); 2 males, Iligan (*Baker*); male, Kolambugan (*Baker*); 9 males, Dapitan (*Baker*); male, Davao (*Baker*).

These specimens have been compared with the holotype of *ilerda* Cameron. They differ from the latter only in having the punctures of the pronotum more separated and distinct and in having the punctures of the second tergite larger, closer, and stronger. This species is the only one of this genus recorded from the Philippine Islands having a ferruginous thorax and metallic blue abdomen.

SMICROMYRME HYALE sp. nov.

Female.—Head and flagellum black; antennal tubercles, scape, thorax, and legs ferruginous; abdomen dark steel blue; thorax without a scutellar scale, slightly narrower posteriorly than anteriorly; second tergite with a median, elongate spot adjoining the anterior margin, and a broad, apical band of pale, appressed pubescence; tergites three to five black pubescent; pygidial area distinct, glabrous, unsculptured. Length, 8 millimeters.

Head black, except the antennal tubercles and scape, ferruginous; flagellum beneath and mandibles medially tinged with ferruginous; mandibles edentate at the tip and with a small tooth within near the apex; clypeus elevated, forming a transverse, arcuate, elevated margin posteriorly, the area anterior to the elevated margin transversely concave and glabrous, posterior to the elevated margin densely punctate; scape with small, close punctures and sparse, pale pubescence; first segment of flagellum slightly but distinctly longer than the second; antennal scrobes distinctly carinate above; front, vertex, and genæ with moderate, dense, confluent punctures, clothed with very sparse, recumbent, pale pubescence, the front and vertex also with scattered, erect, blackish hairs; front with a median, longitudinal, obscure carina; relative widths of head and thorax, 3.0: 2.6.

Thorax entirely ferruginous, the dorsum clothed with sparse, recumbent, fulvous pubescence and scattered, erect, dark fulvous hairs; lateral margins of dorsum of thorax somewhat crenulate, straight, slightly converging posteriorly, relative widths of the thorax at the pronotal region and propodeal region, 2.6: 2.3; humeral angles angulate; dorsum with moderate, dense, confluent punctures, becoming reticulate on the dorsum of propodeum; scutellar scale absent; posterior face of propodeum incompletely reticulate anteriorly, becoming glabrous, sparsely punctate on the posterior half; propleuræ defined anteriorly by a carina; all the pleural areas including the sides of propodeum micropunctate and micropubescent, the propleuræ also with a few, scattered, small, shallow punctures, and the mesopleuræ with moderate, close, shallow punctures posteroventrally.

Abdomen dark metallic blue, except the first sternite tinged with ferruginous; first tergite with small, sparse punctures, except the narrow, apical margin glabrous, impunctate, clothed with sparse, erect, pale pubescence; second tergite with small, dense, confluent punctures, the latter becoming slightly larger and sparse laterally, clothed with sparse, short, recumbent, and scattered, erect, black pubescence, the lateral areas with only scattered, erect, pale pubescence, and also an elongate, median spot adjoining the anterior margin, as well as a broad, apical band of dense, appressed, pale pubescence; tergites three to five with small, close punctures and clothed with sparse, short, recumbent and scattered, erect, black pubescence, except the third tergite anteriorly with scattered, recumbent, pale hairs, the fifth tergite posterolaterally with erect, pale hairs, and each of the tergites at the lateral margins with a few pale hairs; last tergite with small, close punctures, and sparse, erect, pale pubescence laterally, the pygidial area well defined, glabrous, unsculptured; first sternite with a high, sharp, straight carina on the anterior four-fifths, not at all higher posteriorly than anteriorly; second tergite with moderate, close, distinct punctures throughout, clothed with very sparse, pale pubescence, and with a thin, apical fringe of pale hairs; sternites three to five finely, transversely striate anteriorly and with small, separated, distinct punctures posteriorly, each with a thin, apical fringe of pale hairs; hypopygium striate anteriorly and punctate posteriorly like sternites three to five, the punctate area with sparse, erect, pale pubescence.

Legs ferruginous, except the basal third of the tibiæ and all of the tarsi infuscated, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49353, United States National Museum, MINDANAO, Iligan (*Baker*).

Paratype.—MINDANAO, female, Kolambugan (*Baker*).

Related to *calliope* Smith from Borneo but differs in having the third tergite entirely black pubescent, and in having the scape and legs ferruginous. The paratype differs from the holotype in being smaller (length, 6 millimeters) and in having the head a little less coarsely punctured. This may be the female of *ilerda* subsp. *sparsilis*.

SMICROMYRME VIRIATA subsp. VIRIATA sp. et subsp. nov.

Male.—Black, except the second abdominal segment entirely and the third segment in part, ferruginous; mandibles not at all excised beneath and without a tooth beneath near the base; anterior margin of clypeus broadly and very shallowly emarginate; first segment of flagellum about one-third the length of the second; pronotum very sparsely pale pubescent; first five abdominal segments with sparse, pale pubescence; wings subfuscous. Length, 12 millimeters.

Head entirely black, clothed with pale pubescence, scattered and erect on the vertex, thicker and both erect and appressed on the front and genæ; mandibles not at all excised beneath nor with a tooth beneath near the base, edentate at the tip and with a small tooth within near the apex; clypeus almost flat, slightly elevated along the median, longitudinal line, the anterior margin medially broadly and shallowly emarginate, with small, close punctures and sparse, thick, pale pubescence; scape distinctly bicarinate beneath, with small, close punctures elsewhere, and with sparse, pale pubescence; first segment of flagellum about one-third the length of the second; antennal scrobes with a carina above extending posteriorly from the antennal tubercles and about half way to the eye margins; front with moderately small, close, confluent punctures anteriorly merging into the longitudinally striate-punctate area of the front and vertex, the front also with a median, longitudinal furrow extending anteriorly from the median ocellus; genæ with small, close, shallow punctures; relative widths of head and thorax including the tegulæ, 3.8: 4.2.

Thorax entirely black; pronotum with moderately large, close, distinct punctures, clothed with very sparse, pale pubescence, except the extreme narrow, posterior margin with a line of dense, appressed pubescence; mesonotum with moderately large, distinct punctures, clothed with sparse, erect, black pubescence; parapsidal furrows shallow but present the entire length of mesonotum; scutellum comparatively flat, with moderate, dense, confluent punctures and sparse, erect, pale pubescence; dorsum, posterior face and sides of propodeum rounded into one another, the dorsum and posterior face distinctly reticulated and with very sparse, erect, pale pubescence, the dorsum also with short, recumbent, somewhat thick, obscure, pale pubescence; median area of dorsum of propodeum elongate, the sides straight, almost parallel, about two and one-half times as long as broad, acute at the tip; posterior face of propodeum without a median, longitudinal carina; propleuræ defined anteriorly by a carina, micropunctate and with moderate, shallow, close, obscure punctures, clothed with sparse, pale pubescence; mesopleuræ with moderate, distinct punctures medially becoming sparse and scattered anteriorly and posteriorly, the anterior and posterior areas also micropunctate and micropubescent, the median area clothed with thick, appressed, and sparse, erect, pale pubescence; metapleuræ micropunctate and micropubescent, except ventrally with moderate, sparse punctures; sides of propodeum shallowly reticulate; tegulæ large, extending behind the posterior margin of mesonotum a little less than one-third their length, with small, sparse punctures, and sparse, recumbent pubescence, black on the disk, pale at the margins.

Abdomen black with very obscure, metallic blue reflections, except the second segment entirely and the third segment in part, ferruginous; first five abdominal segments with sparse, pale pubescence, the terminal segments with sparse, black pubescence; first tergite with moderate, sparse punctures, becoming small and close at the lateral and posterior margins; second tergite with moderately small, sparse punctures throughout; tergites three to six with small, sparse punctures; last tergite with moderate punctures, close and distinct laterally, sparse, shallow, and obscure medially; first sternite with a median, longitudinal carina on the anterior two-thirds, only slightly higher posteriorly than anteriorly; second sternite with moderate, distinct, separated punctures throughout; sternites three to six with small, sparse punctures becoming closer towards the posterior margin; hypopygium with moderate, close punctures.

Wings subfuscous with faint violet reflections; cell 2d $R_1 + R_2$ slightly but distinctly shorter than cell R + 1st R_1, the former acute at the tip; cell R_5 long and narrow, receiving vein M_{3+4} slightly beyond the middle; cell R_4 present but less distinct than R_5, receiving vein M_2 about three-fifths the distance from base to apex.

Legs entirely black, clothed with sparse, pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49354, United States National Museum, MINDANAO, Iligan (*Baker*).

Paratypes.—LUZON, male, Los Baños, August, 1916 (*F. X. Williams*); 3 males, Los Baños, 1917 (*F. X. Williams*); 3 males, Los Baños (*Baker*); male, Manila, February, 1919 (*R. C. McGregor*); male, Manila (*Robert Brown*); male, Mount Maquiling (*G. Villegas*); 4 males, Mount Maquiling (*Baker*); 3 males, Baguio, Benguet (*Baker*). SAMAR, 3 males (*Baker*). SIBUYAN, 4 males (*Baker*). PANAY, male, northwestern part (*Baker*). BILIRAN, male (*Baker*). MINDANAO, 2 males, Surigao; male, Butuan (*Baker*); 13 males, Tangkulan, Bukidnon (*Baker*); 8 males, Iligan (*Baker*); 3 males, Kolambugan (*Baker*); 3 males, Dapitan (*Baker*); 4 males, Davao (*Baker*); male, Zamboanga (*Baker*).

The paratypes range in length from 5 to 13 millimeters. The second abdominal tergite is entirely ferruginous in all the specimens examined; the third segment has the sternite entirely ferruginous, and in most specimens the anterior half of the tergite is ferruginous, the posterior half black; a few specimens have the third tergite entirely ferruginous, and one from Baguio, Benguet, also has the fourth segment entirely ferruginous; in most specimens the black areas of the abdomen have obscure, metallic blue reflections, and in a few the metallic blue reflections are obvious not only on the abdomen but also on the thorax. The smaller specimens have the pubescence of the tegulæ entirely pale, the larger ones have the pubescence of this area as described for the holotype. None of these variations are correlated with the geographic distribution of the species but occur in specimens taken in the same locality. *Smicromyrme viriata* is related to *annexa* Cameron from Borneo but the latter species has the mandibles slightly excised beneath, has the first and second abdominal segments ferruginous, the tegulæ brownish, and the antennal tubercles ferruginous. *Smicromyrme fura* may be the female of *viriata.*

SMICROMYRME VIRIATA subsp. NITELA subsp. nov.

1895. *Mutilla nigra* BINGHAM, Ann. & Mag. Nat. Hist. VI 16: 440, male (nec Smith).

Male.—Entirely black with obscure metallic blue reflections; mandibles not at all excised beneath and without a tooth beneath near the base; clypeus with the anterior margin broadly, shallowly emarginate medially; first segment of flagellum one-third the length of the second; wings subfuscous. Exactly like the subsp. *viriata* except the color, and larger average size. Length, 13.5 millimeters.

Holotype.—Male, catalogue No. 49355, United States National Museum, LUZON, Mount Maquiling (*Baker*).

Paratypes.—LUZON, male, Los Baños (*Baker*); 4 males, Mount Maquiling (*Baker*); male, Lamao, March–June, 1911 (*C. V. Piper*); male, Cape Engaño (*Whitehead*); male, Malinao, Tayabas (*Baker*); male, Montalban. SAMAR, male, Catbalogan, 8 males (*Baker*). NEGROS, male, Cuernos Mountains (*Baker*). MINDANAO, male, Surigao (*Baker*); male, Iligan (*Baker*).

The paratypes vary in length from 8.5 to 14 millimeters. Some of the specimens have not only the pubescence of the tegulæ entirely pale but also that of the mesonotum is pale. This variation occurs in the larger specimens as well as in the smaller ones. There is also a variation in the intensity of the metallic blue reflections of the body, some specimens being almost without such reflections. The specimen listed above from Cape Engaño (*Whitehead*) is the specimen recorded by Bingham as *Mutilla nigra.* An examination of this specimen revealed that it was a specimen of this subspecies. Smith's *nigra* is not a *Smicromyrme* but belongs to the genus *Timulla* subgenus *Trogaspidia.*

SMICROMYRME FURA subsp. FURA sp. et subsp. nov.

Female.—Head, abdomen, tips of middle and hind femora, middle and hind tibiæ, and all the tarsi, black; antennal tubercles, scape, thorax, coxæ, trochanters, front femora and tibiæ, and middle and hind femora except the tips, all ferruginous; scutellar scale present and distinct; second tergite with a median, elongate-ovate, anterior spot and an apical band of pale pubescence, the anterior spot in a shallow, longitudinal depression; third tergite with a large, median, transverse spot of pale pubescence; pygidial area longitudinally striate on the anterior five-sixths, the posterior sixth glabrous. Length, 6 millimeters.

Head black, except the mandibles medially, the antennal tubercles and scape, ferruginous; flagellum slightly tinged with ferruginous beneath; mandibles slender, edentate at the tips and with a small tooth within near the apex; clypeus elevated along the median, transverse line into a sharp, sinuate, transverse ridge, the clypeal area anterior to the ridge glabrous, impunctate, posterior to the ridge finely, closely punctate and with a small, median tubercle, the ridge itself with a thin fringe of pale hairs; scape with small, sparse punctures and sparse, pale pubescence; first segment of flagellum about one and one-fourth times longer than the second; antennal scrobes carinate above;

front, vertex, and genæ with moderate, dense, confluent punctures, clothed with sparse, recumbent, obscure, pale pubescence, and scattered, erect, dark hairs, the posterior region of the vertex with an obscure, transverse band of appressed, pale pubescence; posterior margin of genæ defined by an obscure carina; relative widths of head and thorax, 2.55 : 2.0.

Thorax entirely ferruginous, the dorsum clothed with sparse, short, recumbent, fulvous pubescence, and sparse, erect, dark fulvous hairs, the posterior face of propodeum with sparse, erect, pale pubescence; humeral angles angulate; thorax broadest at the anterior spiracles; mesonotal area slightly narrower than the pronotal and propodeal areas; lateral margins of dorsum of thorax somewhat crenulate; scutellar scale present and distinct; dorsum of thorax with moderate, dense, confluent punctures merging into reticulate on the dorsum of propodeum, the reticulation extending onto the anterior area of the posterior face of propodeum, the remainder of the latter sparsely punctate; lateral margins of dorsum of propodeum faintly denticulate; propleuræ defined anteriorly by a carina; posteroventral area of mesopleuræ with a few, moderate, shallow punctures; remainder of pleural areas including sides of propodeum, micropunctate and micropubescent.

Abdomen entirely black; first tergite with small, sparse punctures, the latter becoming close at the posterior margin, and clothed with sparse, erect, pale pubescence; second tergite with small, dense, confluent punctures, except the lateral areas with moderate, distinct, close punctures; median area of second tergite with short, appressed, black pubescence, and sparse, erect, dark hairs, the lateral areas with sparse, erect, pale hairs, except an anterior, median, elongate ovate spot, and an apical band of dense, appressed, pale pubescence; anterior pale spot of second tergite in a shallow, longitudinal depression; tergites three to five with very small, close punctures, clothed with sparse, erect, black pubescence, except the third tergite with a large, median, transverse spot of dense, appressed, pale pubescence, and each of the tergites with a few, erect, pale hairs at their lateral margins; last tergite with small, close punctures and sparse, erect, pale pubescence laterally; pygidial area distinct, the anterior five-sixths longitudinally striate, the posterior sixth glabrous, impunctate; first sternite with a high, sharp, median, longitudinal carina on the anterior two-thirds; second tergite with moderate, distinct, separated punctures throughout, clothed with sparse, erect, pale pubescence, and a thin, apical fringe of pale hairs; sternites three to five finely, transversely striate anteriorly, with small punctures posteriorly, becoming close at the posterior margin, and each with a thin, apical fringe of pale hairs; hypopygium with small, close punctures and sparse, pale pubescence.

Coxæ, trochanters, front femora and tibiæ, and middle and hind femora except the tips, ferruginous; remainder of legs blackish; clothed throughout with sparse, pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49356, United States National Museum, MINDANAO, Tangkulan, Bukidnon (*Baker*).

Paratypes.—LUZON, 2 females, Mount Maquiling (*Baker*); female, Paete. SAMAR, female (*Baker*). SIBUYAN, 3 females (*Baker*). PANAY, female, northwestern part (*Baker*). MINDANAO, 2 females, Surigao; 4 females, Tangkulan, Bukidnon (*Baker*); 2 females, Iligan (*Baker*); female, Kolambugan (*Baker*); female, Davao (*Baker*); female, Zamboanga (*Baker*). BASILAN, 2 females (*Baker*).

The specimens from the southern islands exhibit a tendency for the pale spot on the third tergite to become smaller, and the middle and hind tibiæ to become ferruginous. The female from Zamboanga has the tibiæ almost entirely ferruginous. The paratypes vary in length from 4.5 to 9 millimeters. This may be the female sex of subsp. *viriata.*

SMICROMYRME FURA subsp. ANTHRACIPES subsp. nov.

Female.—Head, abdomen, and legs black; thorax entirely ferruginous; antennal tubercles dull ferruginous; scutellar scale present and distinct; second tergite with a median, elongate-ovate, anterior spot and an apical band of pale pubescence, the anterior spot in a shallow, longitudinal depression; third tergite with a large, median, transverse spot of pale pubescence; pygidial area longitudinally striate, except the apical sixth granulate. Length, 10 millimeters.

Holotype.—Female, catalogue No. 49357, United States National Museum, LUZON, Baguio, Benguet (*Baker*).

Paratype.—LUZON, female, Mount Arayat, Pampanga, March 15, 1923 (*R. C. McGregor*).

Exactly like subsp. *fura* except the scape and legs entirely black, the pygidium granulate apically, and the size larger.

SMICROMYRME CAERULEA sp. nov.

Male.—Body unicolorous, bright metallic blue, clothed throughout with pale pubescence; mandibles not excised beneath and without a tooth near the base beneath; first segment of flagellum only one-fourth the length of the second; mesonotum with moderate, close punctures throughout; anterior half of second tergite sparsely punctate, the posterior half with moderate, distinct punctures, less than their own diameter apart; wings subhyaline. Length, 13 millimeters.

Head bright metallic blue, the antennæ black; mandibles slender, not excised beneath, without a tooth beneath near the base, edentate at the tips and with a small tooth within near the apex; clypeus almost flat, with fine, close punctures and moderately thick, appressed, pale pubescence, the anterior margin not emarginate; scape bicarinate beneath, with small, sparse punctures and sparse, pale pubescence; first segment of flagellum about one-fourth the length of the second; antennal scrobes above with a carina extending posteriorly from the antennal tubercles and only reaching half the distance to the margin of the eyes; front and vertex longitudinally striate-punctate throughout, the front with a median, longitudinal furrow extending anteriorly from the median ocellus; genæ with moderately small, close punctures; front, vertex, and genæ with sparse, pale pubescence, except the front medially and the genæ adjacent to the eye margins with the pubescence thick; relative widths of head and thorax including the tegulæ, 3.6 : 4.5.

Thorax bright metallic blue, clothed throughout with sparse, pale pubescence, except the posterior margin of the pronotum with a line of thick pubescence, and the mesopleuræ with the pubescence thick; pronotum with moderately large, close, slightly confluent punctures; mesonotum with moderate, close punctures; parapsidal furrows present but shallow and indistinct; scutellum moderately convex, with moderate, close, somewhat confluent punctures; dorsum, posterior face and sides of propodeum rounded into one another; dorsum and posterior face of propodeum reticulate; median area of dorsum of propodeum elongate, about two and one-half times as long as broad, the sides sinuate; posterior face of propodeum with a median, longitudinal, slightly sinuate carina extending from the apex of the median area to the posterior margin; propleuræ defined anteriorly by a distinct carina, with moderate, shallow, close punctures; mesopleuræ with moderate, distinct punctures medially, becoming sparse and shallow anteriorly and posteriorly; metapleuræ micropunctate and micropubescent, except ventrally with moderate, close punctures; sides of propodeum reticulate; tegulæ moderate in size, extending behind the posterior margin of mesonotum about one-fifth their length, punctate and pubescent throughout, the punctures smaller and closer towards the outer margin.

Abdomen bright metallic violet-blue, clothed throughout with sparse, pale pubescence; first tergite with scattered, moderate, shallow punctures, except at the posterior margin with moderate, close, distinct punctures; second tergite with moderate punctures, sparse and shallow on the anterior half, closer and more distinct on the posterior half; tergites three to six with moderately small, separated, shallow punctures; last tergite with small, distinct punctures, except an apical, median, subtriangular area glabrous, impunctate; first sternite with a median, longitudinal, high carina on the anterior two-thirds, not higher posteriorly than anteriorly; second sternite with moderate, distinct, separated punctures becoming sparse at the median longitudinal line; sternites three to six with moderately small punctures, becoming close at the posterior margin of each; hypopygium with moderately small, distinct punctures.

Wings subhyaline; cells 2d $R_1 + R_2$ and R + 1st R_1 approximately equal in length, the former acute at the apex; cell R_5 long and narrow, receiving vein M_{3+4} slightly before the middle; cell R_4 present but less distinct than R_5, receiving vein M_2 slightly beyond the middle.

Legs metallic blue, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49358, United States National Museum, SAMAR (*Baker*).

Related to *viriata* but differs in the length of the first antennal segment, the form of the clypeus, puncturation of body, as well as color of the body and the pubescence.

SMICROMYRME BASALIS subsp. BASALIS (Smith).

1879. *Mutilla basalis* SMITH, Descr. New Species Hymen. 200, female.
1897. *Mutilla basalis* DALLE TORRE, Cat. Hymen. 8: 15, female.
1903. *Mutilla basalis* ANDRÉ, Gen. Ins. 1, fasc. 11: 38, female.

Holotype.—Female, Sarawak, Borneo, in British Museum of Natural History.

Specimens examined.—MINDANAO, female, Surigao; 4 females, Iligan (*Baker*).

Smith's type of this species has been examined and Borneo specimens compared with the type are before me. The Philippine specimens placed here are indistinguishable from the Borneo specimens. The species resembles *fura* in some respects but differs in that the anterior pale pubescent spot of the second tergite is not in a depression, and the third tergite has a broad, complete band of pale pubescence.

SMICROMYRME BASALIS subsp. ANNULARIS subsp. nov.

Female.—Head, abdomen, and legs black; thorax entirely ferruginous; scutellar scale present; second tergite with an anterior, median, ovate spot, and a narrow, apical band, of dense, appressed, pale pubescence, the anterior spot not situated in a depression; third tergite with a broad, complete band of dense, appressed, pale pubescence; pygidium longitudinally striate, the striæ not reaching the apical margin. Length, 6.5 millimeters.

Holotype.—Female, catalogue No. 49359, United States National Museum, LUZON, Baguio, Benguet (*Baker*).

Paratype.—LUZON, 3 females, Mount Maquiling (*Baker*).

Exactly like the subsp. *basalis* Smith, except that the scape, legs, and first abdominal segment are entirely black.

SMICROMYRME PARVA (Brown).

1906. *Mutilla parva* BROWN, Philip. Journ. Sci. 1: 685, female.

Type.—Female, Manila. Location of type unknown.

Specimens examined.—LUZON, female, Los Baños, August, 1916 (*F. X. Williams*); female, Los Baños (*Baker*); female, Manila, July, 1907 (*W. Schultze*); female, Mount Maquiling (*Baker*). MINDANAO, female, Surigao (*Baker*).

I have not been able to examine Brown's type of this species. The specimen listed above from Manila has been determined as *parva* by Mr. C. S. Banks. All of the above specimens agree with the original description with the exception of the last sentence of the latter. I have never seen any female mutillid with the "third and fourth ventral segments strongly longitudinally carinate." The original type was so small (4.5 millimeters in length) that I am doubtful if this statement can be taken literally. In fact, I am convinced that the above specimens are representatives of Brown's species *parva,* since they agree with all other points in the original description, and are the only ones among the large number of specimens from the Philippine Islands which I have studied that do satisfy the requirements of the original description.

The specimens examined vary from 4.5 to 6.5 millimeters in length. The pygidium is glabrous, almost unsculptured, but very feebly, longitudinally striate. The thorax lacks a scutellar scale.

SMICROMYRME FLUCTUATA (Smith).

1865. *Mutilla fluctuata* SMITH, Journ. Proc. Linnean Soc. London 8: 80, male.

1897. *Mutilla fluctuata* DALLE TORRE, Cat. Hymen. 8: 41, male.

1903. .... *fluctuata* ANDRÉ, Gen. Ins. 1, fasc. 11: 70, male.

Holotype.—Male, Morty Island, in Saunders's collection, Oxford University, England.

Specimens examined.—SAMAR, male (*Baker*). NEGROS, male, Cuernos Mountains (*Baker*). MINDANAO, male, Iligan (*Baker*); male, Dapitan (*Baker*); male, Davao (*Baker*).

These specimens have been compared with Smith's type and found to be identical with it. The species is characterized by much more robust mandibles than those of previous males; mandibles tridentate at the apex, deeply and broadly excised beneath forming a broad process between the excision and the base of the mandibles; clypeus depressed below the margin of the mandibles; first segment of flagellum about one-half the length of the second; tegulæ glabrous, impunctate on the outer, posterior fourth.

SMICROMYRME ZEBINA (Smith).

1860. *Mutilla zebina* SMITH, Journ. Proc. Linnean Soc. London, Zool. suppl. 5: 115, female.

1897. *Mutilla zebina* DALLE TORRE, Cat. Hymen. 8: 99, female.

1903. *Mutilla zebina* ANDRÉ, Gen. Ins. 1, fasc. 11: 41, female.

Holotype.—Female, Bachian, in Saunders's collection, Oxford University, England.

The description of the male, heretofore unpublished, is as follows:

Male.—Entirely black, clothed with sparse, pale pubescence, except the front, pronotum and mesopleuræ with thick, appressed, pale pubescence; mandibles robust, bidentate at the apex, the inner tooth somewhat remote from the apex, deeply excised beneath forming a prominent blunt tooth beneath near the base; clypeus only very slightly depressed below the dorsal margin of the mandibles, with a distinct, median, longitudinal sharp ridge; first and second abdominal segments with a thick, apical fringe of pale pubescence; wings subhyaline. Length, 8.5 millimeters.

Head entirely black, clothed with sparse, pale pubescence, except the clypeus and front with thick, appressed, pale pubescence; mandibles and clypeus as described above, except the median ridge of clypeus abruptly higher posteriorly between the antennal tubercles; scape distinctly bicarinate beneath, with small, close punctures and sparse, pale pubescence; first segment of flagellum about half the length of the second; front with small, dense, confluent punctures merging into the striate-punctate vertex, the front also with a median, longitudinal furrow extending anteriorly from the median ocellus; genæ with very small, close punctures, the interspaces micropunctate; relative widths of head and thorax including the tegulæ, 3.0 : 3.4.

Thorax entirely black, clothed with sparse, erect, pale pubescence, except the pronotum and mesopleuræ with thick, appressed, pale pubescence; pronotum with moderately small, sparse punctures interspersed with fine, close punctures; mesonotum with moderate, close, somewhat confluent punctures; parapsidal furrows distinct; scutellum with moderately small, dense, confluent punctures; dorsum, posterior face and sides of propodeum rounded into one another, moderately reticulate; median, inclosed area of dorsum of propodeum subtriangular, the apex rounded, about twice as long as broad at the base; propleuræ defined anteriorly by a distinct carina, finely, longitudinally striate; mesopleuræ with small, dense, confluent punctures medially, the latter becoming sparse anteriorly and posteriorly; metapleuræ glabrous, micropunctate and micropubescent, except a few, moderate, shallow punctures ventrally; sides of propodeum reticulate, the reticulation becoming obsolete towards the anterior margin; tegulæ with a small, median area glabrous, impunctate, otherwise sparsely punctured and pale pubescent, the outer and posterior margins translucent.

Abdomen entirely black, clothed with sparse, erect, pale pubescence, except the posterior half of the sixth segment and all of the second segment black pubescent, and the first and second segments each with a thick, apical fringe of pale pubescence; first tergite with moderately large, close punctures; second tergite with moderate, sparse punctures, closer laterally than medially; tergites three to six with small, sparse punctures; last tergite with moderately small, dense, confluent punctures laterally, becoming sparse at the longitudinal midline; first sternite with a low, median, longitudinal carina on the anterior two-thirds; second sternite with moderate, distinct, separated punctures; sternites three to six with small punctures becoming close at the posterior margin; hypopygium with small, close distinct punctures.

Wings subhyaline; cell R + 1st R_1 distinctly longer than 2d $R_1 + R_2$, the latter acute at the apex; cell R_5 narrow, elongate, receiving vein M_{3+4} about two-fifths the distance from base to apex; cell R_4 much less distinct than R_5, receiving vein M_2 slightly beyond the middle.

Legs entirely black, sparsely clothed with pale pubescence; calcaria pale.

Allotype.—LUZON, male, Los Baños, 1916 (*F. X. Williams*), mounted on the same pin with a female, and presumably taken in coitu, in collection of University of Minnesota. Females conspecific with this specimen have been compared with Smith's type of *zebina* and found to be identical with it.

Specimens examined.—LUZON, female, Los Baños, June, 1916 (*F. X. Williams*); female, Los Baños, August, 1916 (*F. X. Williams*); female, Limay, Bataan, October, 1913 (*W. Schultze*); female, Manila, January 16, 1906 (*C. S. Banks*); female, Montalban Gorge, Rizal, March, 1906 (*C. S. Banks*); female, Olongapo, Zambales, June 3, 1907 (*C. S. Banks*); female (*C. S. Banks*). CEBU, female, 1917 (*F. X. Williams*). MINDANAO, female, Surigao; 2 females, Dapitan (*Baker*); female, Davao (*Baker*).

The female may be recognized by the third and fourth tergites being entirely pale pubescent except the fourth subinterrupted medially, the second tergite without a pale, apical band or fringe, and the three pale pubescent spots of the second tergite arranged in a transverse straight line; the pygidium is longitudinally striate. The Luzon specimens vary with respect to the pale pubescence of the fourth tergite. The specimen taken with the allotype has the pubescence of the fourth tergite distinctly interrupted medially, while the remaining specimens have the pale band complete; the specimens from Cebu and Mindanao have this same band distinctly interrupted.

The male is related to *fluctuata*, from which it differs by the bidentate mandibles and the less-depressed clypeus, and to *palawanensis*, from which it differs by the form of the mandibles and the ridged clypeus.

SMICROMYRME PALAWANENSIS sp. nov.

Male.—Entirely black, clothed with pale pubescence, except the last two abdominal segments clothed with black pubescence;

mandibles robust, the proximal half of the dorsal surface with a high carina, deeply excised beneath forming a large, blunt tooth beneath near the base, bidentate at the apex, the inner tooth subapical; clypeus flat, without a median, longitudinal ridge; first segment of flagellum about one-half the length of the second; front, pronotum, and mesopleuræ with thick, appressed, pale pubescence; first and second abdominal segments with a thick, apical fringe of pale pubescence; wings subhyaline. Length, 10 millimeters.

Head entirely black, clothed with sparse, pale pubescence, except the clypeus and front with thick, appressed, pale pubescence; mandibles as described above; clypeus noticeably depressed below the dorsal surface of the mandibles, not emarginate medially at the anterior margin and without a median longitudinal ridge; scape distinctly bicarinate beneath, with small, close punctures and sparse, pale pubescence; first flagellar segment as above; antennal scrobes not carinate above, with only a small tubercle midway between the antennal tubercles and the eye margins; front with moderate, dense, confluent punctures merging into the longitudinally striate-punctate vertex, and with a median furrow extending anteriorly from the median ocellus; genæ with small, close, distinct punctures; relative widths of head and thorax including the tegulæ, 3.6 : 3.9.

Thorax entirely black, clothed with sparse, pale pubescence, except the pronotum and mesopleuræ with thick, appressed, pale pubescence, and the mesonotum with the pubescence slightly darker than elsewhere; pronotum with sparse, moderate punctures interpersed with fine, close punctures; mesonotum with moderate close punctures, slightly confluent; parapsidal furrows distinct; scutellum with moderate, very close, confluent punctures; dorsum, posterior face, and sides of propodeum rounded into one another, the dorsum and posterior face moderately reticulate; median, inclosed space on dorsum of propodeum subtriangular, the apex somewhat rounded, slightly less than twice as long as broad at the base; propleuræ with the anterior margin defined by a distinct carina, longitudinally, finely striate; mesopleuræ with moderate, dense, confluent punctures medially becoming separated and sparse anteriorly and posteriorly; metapleuræ micropuntate and micropubescent, with a few moderate, shallow, scattered punctures ventrally; sides of propodeum distinctly reticulate posteriorly, the reticulations becoming obsolete anteriorly; tegulæ glabrous, impunctate, except the anterior and inner margins, and the posterior half, punctate and pale pubescent, the outer and posterior halves also translucent.

Abdomen entirely black, the first five segments, as well as the anterior and lateral areas of the sixth, clothed with sparse, pale pubescence, the first and second segments also with a thick, apical fringe of pale pubescence; remainder of sixth segment and the last segment, with black pubescence; first tergite with moderate, sparse punctures medially, the latter becoming smaller and close posteriorly and laterally; second tergite with moderate, distinct, separated punctures throughout, the punctures somewhat closer on the anterolateral areas; tergites three to six with moderately small, sparse punctures; last tergite with moderately small, close, confluent punctures becoming sparse medially, thus an obscure, narrow, median, longitudinal area almost impunctate; first sternite with a low, median, longitudinal carina on the anterior two-thirds, the posterior terminus of the carina slightly elevated; second sternite with moderate, distinct, separated punctures; sternites three to six with small, close punctures posteriorly; hypopygium with small, distinct, separated punctures.

Wings subhyaline; cell $R + 1st\ R_1$ distinctly longer than $2d\ R_1 + R_2$; cell R_5 narrow, elongate, receiving vein M_{3+4} distinctly before the middle; cell R_4 present but much less distinct than R_5 and receiving vein M_2 slightly beyond the middle.

Legs entirely black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—Male, catalogue No. 49360, United States National Museum, PALAWAN, Puerto Princesa (*Baker*).

Paratype.—PALAWAN, male, Puerto Princesa (*Baker*).

Related to *fluctuata* and *zebina.* Differs from the former in having bidentate mandibles and in lacking a clypeal median ridge, as well as minor differences in the sculpture of the body. It differs from *zebina* in having the prominent carina on the dorsal surface of the mandibles, the inner tooth of the mandibles much nearer the apex, the clypeus more deeply depressed beneath the margin of the mandibles, and in lacking the clypeal median ridge.

SMICROMYRME AUTONOE sp. nov.

Female.—Head, abdomen, and legs black, thorax ferruginous; second abdominal tergite maculated with three pale pubescent spots, and with a very narrow, apical band of pale pubescence; median spot of the second tergite large, conspicuous, the two lateral spots small, almost obsolete; third abdominal tergite entirely pale pubescent; tergites four and five black pubescent; posterior fifth of pygidium glabrous, unsculptured, the remainder longitudinally striate. Length, 4.5 millimeters.

Head entirely black, except the mandibles medially and the antennal tubercles ferruginous; front and vertex clothed with sparse blackish pubescence, genæ with sparse, pale pubescence; mandibles slender, edentate at the apex, and with a very small obscure tooth within near the apex; clypeus elevated along the transverse, median line, the elevation arcuate; scape with small, sparse punctures and sparse, pale pubescence; first segment of flagellum approximately equal in length to the second; antennal scrobes obscurely carinate above; front and vertex with moderate, dense, somewhat confluent punctures, the genæ with small, dense punctures; relative widths of head and thorax, 2.0: 1.6.

Thorax entirely ferruginous, the dorsum clothed with sparse, erect and suberect, dark fulvous pubescence, the posterior face of propodeum with sparse, long, erect, pale pubescence; humeral angles subangulate; lateral margins of dorsum subparallel, the mesonotal area only very slightly constricted; dorsum with moderate, dense, confluent punctures merging with the reticulations of the propodeum; scutellar scale present and distinct, immediately preceded by an indistinct, transverse groove the width of the thorax; posterior face of propodeum precipitate, almost at right angles to the dorsum, the anterior area reticulate, the posterior area not visible in the type; pleural areas, including sides of propodeum, for the most part glabrous, micropunctate and micropubescent.

Abdomen entirely black; first tergite with sparse, erect, pale pubescence; second tergite with small, dense, confluent punctures, the latter becoming separated and sparse at the sides; clothed with sparse, erect, and short, appressed, black pubescence, except the lateral areas with sparse, erect, pale pubescence, a very narrow, apical band of thick, pale pubescence, and three anterior pale pubescent spots arranged in a transverse line, the median one large and conspicuous, the lateral ones small, almost obsolete; third tergite clothed entirely with sparse, erect and appressed, pale pubescence; fourth and fifth tergites with sparse, black pubescence, except a few pale hairs at the lateral margins; lateral areas of last tergite with sparse, pale fuscous pubescence; posterior fifth of pygidial area glabrous, unsculptured, the remainder longitudinally striate; first sternite with a distinct carina on the anterior two-thirds; second sternite with moderate, distinct punctures, clothed with very sparse, pale pubescence, and with a very thin, apical fringe of pale pubescence; sternites three to five with very small, close punctures towards the posterior margin, and each with a very thin, apical fringe of pale pubescence; hypopygium with very small, close punctures and sparse, pale pubescence.

Legs black, sparsely clothed with pale pubescence; calcaria pale.

Holotype.—Female, catalogue No. 49361, United States National Museum, PALAWAN, Puerto Princesa (*Baker*).

Paratype.—PALAWAN, female, Puerto Princesa (*Baker*).

Easily recognized by the narrow apical band of the second tergite, and the reduced lateral, pale spots of the same tergite. This may be the female of *palawanensis*.

SMICROMYRME SEMPERI subsp. SEMPERI (Ashmead).

1904. *Mutilla semperi* ASHMEAD, Proc. U. S. Nat. Mus. **28**: 135, male.
1906. *Mutilla semperi* BROWN, Philip. Journ. Sci. **1**: 689, male.

Holotype.—Male, Manila, in United States National Museum.

The description of the female, heretofore undescribed, is as follows:

Female.—Head, abdomen, and legs entirely black, the thorax entirely ferruginous; mesonotal area of thorax slightly but distinctly narrower than the pronotal and propodeal areas; second abdominal tergite with three pale pubescent spots arranged in a transverse row, the median one slightly but distinctly anterior to the lateral ones and in a slightly depressed area; third tergite entirely pale pubescent; pygidial area striate, the striæ not extending to the posterior margin. Length, 4.5 millimeters.

Head black, except the mandibles medially ferruginous; mandibles slender, edentate at the apex and with a very small tooth within near the apex; clypeus elevated along the transverse, median line forming an arcuate carina, the area anterior to the carina glabrous, impunctate; scape with small, sparse punctures and sparse, pale pubescence; first segment of flagellum approximately equal to the second in length; antennal scrobes not carinate above; front, vertex, and genæ with small, dense, more or less confluent punctures, clothed with sparse, pale pubescence, the front also with short, sparse, intermixed, dark pubescence; relative widths of head and thorax, 2.0: 1.6.

Thorax entirely ferruginous, the dorsum clothed with sparse, erect and suberect, dark fulvous pubescence, the posterior face of propodeum with sparse, long, erect pubescence; humeral angles rounded; mesonotal area slightly but distinctly narrower than the pronotal and propodeal areas; dorsum with moderate, dense, confluent punctures; scutellar scale present and distinct, immediately preceded by a transverse groove the width of the thorax; dorsum of propodeum longitudinally rugose, the rugæ irregular in height thus giving the dorsum of propodeum an asperated appearance; pleural areas, including sides of propodeum, finely, closely, shallowly punctate.

Abdomen entirely black; first tergite with sparse, erect, pale pubescence; second tergite with small, dense, confluent punctures becoming separated and sparse at the sides, clothed with sparse, erect and recumbent, black pubescence, except laterally with sparse, erect, pale pubescence, and the three anterior, pale pubescent spots arranged in a transverse row, the median one slightly anterior to the lateral ones and in a slight but distinct depression; third tergite entirely pale pubescent; fourth and fifth tergites black pubescent except laterally with scattered, pale, erect hairs; lateral areas of last tergite with sparse, erect, pale hairs; pygidial area striate, except the posterior fifth glabrous, unsculptured; first sternite with a median, longitudinal carina on the anterior two-thirds, the carina slightly elevated at its posterior terminus; second sternite with moderate, close, distinct punctures, clothed with very sparse, pale pubescence and with a thin, apical fringe of pale hairs; sternites three to six with small, dense punctures at the posterior margin and each with a thin, apical fringe of pale hairs; hypopygium with small, dense punctures and sparse, pale, erect pubescence.

Legs entirely black, sparsely clothed with pale pubescence; calcaria pale.

Allotype.—LUZON, female, Los Baños, 1916 (*F. X. Williams*), mounted on the same pin with a male of *semperi* Ashmead and presumably taken in coitu; in the collection of the University of Minnesota.

Specimens examined.—LUZON, male, Los Baños, March, 1917 (*F. X. Williams*); 2 males, Los Baños, July, 1916 (*F. Muir*); 2 males, Los Baños, July–August, 1917 (*F. X. Williams*); male, 4 females, Los Baños, August, 1916 (*F. X. Williams*); female, Los Baños, September 23, 1916 (*F. X. Williams*); male, Los Baños, September, 1915 (*F. Muir*); 4 males, 4 females, Los Baños, September, 1917 (*F. X. Williams*); 3 males, female, Los Baños, 1916 (*F. X. Williams*); 24 males, 4 females, Los Baños, 1917 (*F. X. Williams*); female, Los Baños (*F. X. Williams*);

30 males, female, Los Baños (*Baker*); 17 males, female, Mount Maquiling (*Baker*); 2 males, 2 females, Mount Banahao (*Baker*); 2 males, Manila, February, 1919 (*R. C. McGregor*); male, Manila, August, 1923 (*R. C. McGregor*); male, Manila (*Robert Brown*); male, Montalban Gorge, Rizal, March, 1906; female, Montalban (*W. Schultze*); 3 females, Olongapo, Zambales, June 8, 1907 (*C. S. Banks*); 2 males, female, Baguio, June, 1917 (*F. X. Williams*); 4 males, Baguio, Benguet (*Baker*); female, Bangui, Ilocos Norte, June 3, 1913 (*C. S. Banks*); 8 males, female, Malinao, Tayabas (*Baker*). PANAY, male, female, Culasi, June (*R. C. McGregor*); male, northwestern part (*Baker*). NEGROS, 19 males, 3 females, Cuernos Mountains (*Baker*).

The males vary in length from 7 to 11 millimeters, the females from 4 to 6.5 millimeters. The male is easily recognized by the ferruginous first two abdominal segments and the densely punctured tegulæ. The male is related to *hageni* Zavattari from Formosa but differs in having the scutellum sparsely pubescent and in the ferruginous color of the abdomen.

SMICROMYRME SEMPERI subsp. NIGROGASTRA subsp. nov.

Male.—Entirely black, clothed with sparse, erect, pale pubescence, except the front, pronotum, mesopleuræ, transverse band at anterior margin of dorsum of propodeum, and apical bands on first and second abdominal segments, all with dense, appressed, pale pubescence; mandibles excised beneath and with a distinct tooth beneath near the base; clypeus not depressed below the dorsal margin of mandibles; first segment of flagellum about half the length of the second; tegulæ with small, dense punctures and sparse, pale pubescence; second tergite with moderately large, distinct, separated punctures, except the apical margin with very small, close punctures. Wings subfuscous. Length, 10 millimeters.

Holotype.—Male, catalogue No. 49362, United States National Museum, LUZON, Zambales Province (*Baker*).

Exactly like the subsp. *semperi* except entirely black. Has much the appearance of *hageni* Zavattari since both are entirely black, but *hageni* has the scutellum thickly clothed with appressed, pale pubescence, while subsp. *nigrogastra* has the scutellum with sparse, erect pubescence.

SMICROMYRME BAKERI sp. nov.

Male.—Entirely black, clothed with sparse, erect, pale pubescence, except the clypeus, front, mesopleuræ, band at anterior margin of dorsum of propodeum, apical bands of first and second abdominal segments, all with thick, appressed, pale pubescence, and last two abdominal segments with sparse, black pubescence; mandibles excised beneath and with a small tooth beneath near the base; first segment of flagellum about one-half the length of the second; tegulæ with small, well-separated, shallow punctures; second abdominal segment with moderate, sparse punctures; posterior inner angle of hind coxæ sharply angulate. Wings subhyaline. Length, 8 millimeters.

Head entirely black, clothed with sparse, erect, pale pubescence except the clypeus and the front with thick, appressed, pale pubescence, and the vertex also with scattered, erect, dark hairs; mandibles excised beneath and with a tooth beneath near the base, edentate at the apex and with a small tooth within near the apex; clypeus not depressed below the dorsal margin of the mandibles, the anterior margin not emarginate, and slightly elevated along the median, longitudinal line; scape bicarinate beneath, with small, dense punctures and sparse, pale pubescence; flagellum as mentioned above; antennal scrobes carinate above; front with small, dense, confluent punctures merging into the longitudinally striate-punctate vertex, and with a median, longitudinal furrow extending anteriorly from the median ocellus; genæ with small, close, distinct punctures; relative widths of head and thorax including the tegulæ, 2.55 : 2.9.

Thorax entirely black, clothed with sparse, erect, pale pubescence, except the pronotum with sparse, appressed, pale pubescence, the dorsum of propodeum with a narrow band of dense, appressed, pale pubescence at the anterior margin, and the mesonotum with sparse, suberect, black pubescence; pronotum and mesonotum with moderately small, distinct punctures, well separated on the pronotum, somewhat close on the mesonotum; parapsidal furrows present and distinct; scutellum with moderately small, dense, confluent punctures; dorsum, posterior face, and sides of propodeum rounded into one another, the dorsum and posterior face reticulate; median inclosed space of dorsum of propodeum long, almost three times as long as broad at the base, the sides sinuate, the apex rounded; propleuræ with the anterior margin defined by a carina, very obscurely, obliquely rugose-punctate; mesopleuræ with moderately small, close punctures medially, the anterior and posterior areas almost entirely glabrous, impunctate; metapleuræ glabrous, micropunctate and micropubescent, except for a few, small, shallow punctures ventrally; sides of propodeum reticulate, the reticulations obsolete anteriorly; tegulæ with small, shallow, well-separated punctures, and sparse, pale pubescence throughout.

Abdomen entirely black, clothed with sparse, erect, pale pubescence, except the first and second segments with narrow bands of thick, appressed, pale pubescence, and the last two segments with sparse, erect, black pubescence; first tergite with sparse, moderate punctures becoming close posteriorly and laterally; second tergite with sparse, moderate punctures, the latter closer on the anterolateral areas; tergites three to six with small, sparse punctures; last tergite with small, close, somewhat confluent punctures, sparsely, almost impunctate medially; first sternite with a distinct, median, longitudinal carina on the anterior three-fourths, the posterior terminus of the carina slightly elevated and forming a small tooth; second sternite with moderately small, distinct, well-separated punctures; sternites three to six with small, sparse punctures; hypopygium with small, distinct, close punctures.

Wings subhyaline; cell R + 1st R_1 slightly longer than 2d $R_1 + R_2$, the latter acute at the apex; cell R_5 receiving vein M_{3+4} at about the middle; cell R_4 much less distinct than R_5 and receiving vein M_2 at two-thirds the distance from base to apex.

Legs entirely black, sparsely clothed with pale pubescence; inner margin of hind coxæ armed with a sharp, prominent carina their full length, the hind margin of the coxæ squarely truncate, thus the posterior inner angle of hind coxæ prominently angulate; calcaria pale.

Holotype.—Male, catalogue No. 49363, United States National Museum, PALAWAN, Puerto Princesa (*Baker*).

Very similar in appearance to *semperi* subsp. *nigrogastra* but the tegulæ are much less distinctly punctate, the wings paler, and the body less coarsely punctate.

SMICROMYRME LAVINIA subsp. LAVINIA sp. et subsp. nov.

Male.—Head, thorax, posterior margin of second abdominal tergite, last five abdominal segments, and legs black; first and most of second abdominal segments ferruginous; mandibles excised beneath and with a tooth beneath near the base; clypeus narrowly, distinctly emarginate at the median, anterior margin; first segment of flagellum about half the length of the second; second abdominal tergite with very sparse, small punctures; tegulæ with small, sparse punctures and sparse, pale pubescence; carina of inner margin of hind coxæ not extending to the posterior margin, thus the posterior inner angle of hind coxæ not angulate. Wings subfuscous. Length, 12.5 millimeters.

Head entirely black, clothed with sparse, erect, pale pubescence, except the clypeus, front, and genæ adjacent to posterior eye margins, with thick, appressed, pale pubescence; mandibles excised beneath and with a tooth beneath near the base, edentate at the apex and with a small tooth within near the apex; clypeus almost flat, the anterior margin with a narrow emargination; scape bicarinate beneath, with small, close punctures and sparse, pale pubescence; first segment of flagellum about one-half the length of the second; antennal scrobes not distinctly carinate above; front with moderate, dense, confluent punctures merging into the longitudinally striate-punctate vertex, and with a median, longitudinal furrow extending anteriorly from the median ocellus; genæ with small, distinct, close punctures; relative widths of head and thorax including the tegulæ, 3.9: 4.7.

Thorax entirely black, clothed with sparse, erect, pale pubescence, except the pronotum and dorsum of propodeum with sparse, appressed, pale pubescence, the mesopleuræ with thick, appressed, pale pubescence, and the mesonotum with sparse, erect, dark fuscous pubescence; pronotum and mesonotum with moderate, somewhat confluent punctures; parapsidal furrows distinct on the posterior two-thirds of mesonotum; scutellum with moderate, dense, confluent punctures; dorsum, posterior face, and sides of propodeum all rounded into one another, the dorsum and posterior face reticulate; median, inclosed area of dorsum of propodeum elongate, almost three times as long as broad at the base, the sides sinuate; propleuræ defined anteriorly by a carina, micropunctate and micropubescent, and with a few, shallow, moderate punctures dorsally; mesopleuræ with moderate, close punctures medially, the anterior and posterior areas glabrous, micropunctate and micropubescent, except moderate, shallow punctures ventrally; sides of propodeum reticulate, the reticulations obsolete at the anterior margin; tegulæ with small, sparse punctures and sparse, pale pubescence, the broad outer and posterior margins translucent.

Abdomen black, except the first segment entirely and the second excepting the black posterior margin, both ferruginous, clothed throughout with sparse, erect, pale pubescence, except the last two segments with sparse, erect, black pubescence; first tergite with small punctures, very sparse medially, close laterally and posteriorly; second tergite with small punctures, very sparse medially, closer laterally; tergites three to six with small, sparse punctures; last tergite with moderately small, dense, confluent punctures except a subapical, subtriangular area almost impunctate; first sternite with a distinct carina on the anterior three-fourths, the posterior terminus of the carina slightly elevated; second sternite with moderate, distinct, sparse punctures; sternites three to six with small, close, distinct punctures towards the posterior margin; hypopygium with small, distinct close punctures.

Wings subfuscous; cells R + 1st R_1 and 2d R_1 + R_2 equal in length, the latter subtruncate at the apex; cell R_5 long and narrow, receiving vein M_{3+4} slightly beyond the middle; cell R_4 much less distinct than R_5 and receiving vein M_2 at the middle.

Legs black, sparsely clothed with pale pubescence; carina on inner margin of hind coxæ not extending to the posterior margin, thus the posterior, inner angle not prominent nor angulate; calcaria pale.

Holotype.—Male, catalogue No. 49364, United States National Museum, LUZON, Mount Banahao (*Baker*).

Paratypes.—LUZON, male, Mount Banahao (*Baker*); male, Mount Maquiling (*Baker*); male, Montalban. MINDANAO, 2 males, Iligan (*Baker*).

The paratypes vary in length from 7.5 to 12.5 millimeters. The paratype from Mount Banahao and the two from Iligan have the first, second, and third tergites entirely ferruginous. The emarginate clypeus, sparsely punctate second abdominal tergite, and only partially carinate hind coxæ will aid in the recognition of this species. It is related to *caecina* Cameron from Borneo.

SMICROMYRME LAVINIA subsp. ATRATA subsp. nov.

Male.—Entirely black, clothed with sparse, erect, pale pubescence, except the clypeus, front, and mesopleuræ with thick appressed, pale pubescence, the pronotum and dorsum of propodeum with sparse, appressed, pale pubescence, and the mesonotum and last two abdominal segments with sparse, black pubescence; mandibles excised beneath and with a tooth beneath near the base; anterior margin of clypeus with a narrow, median emargination; first segment of flagellum about half the length of the second; tegulæ with small, sparse punctures and sparse, pale pubescence, the broad outer and posterior margins translucent; second abdominal tergite with very small, very sparse punctures, becoming closer and slightly larger laterally. Wings subfuscous. Length, 10 millimeters.

Holotype.—Male, catalogue No. 49365, United States National Museum, SAMAR (*Baker*).

Exactly like the subsp. *lavinia* except the body entirely black.

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ILLUSTRATION

PLATE 1

FIG. 1. *Squamulotilla imparilis* sp. nov., wing.

2. *Squamulotilla teuta* subsp. *teuta* sp. et subsp. nov., wing.
3. *Timulla* (*Trogaspidia*) *minor* subsp. *minor* (Ashmead); uncus, lateral view and dorsal view; squama, lateral view.
4. *Timulla* (*Trogaspidia*) *minor* subsp. *whiteheadi* subsp. nov.; uncus, lateral view and dorsal view; squama, lateral view.
5. *Timulla* (*Trogaspidia*) *minor* subsp. *tayabasensis* subsp. nov.; uncus, lateral view and dorsal view; squama, lateral view.
6. *Timulla* (*Trogaspidia*) *minor* subsp. *visayensis* subsp. nov.; uncus, lateral view and dorsal view; squama, lateral view.
7. *Timulla* (*Trogaspidia*) *minor* subsp. *islandica* subsp. nov.; uncus, lateral view and dorsal view; squama, lateral view.
8. *Timulla* (*Trogaspidia*) *minor* subsp. *princesa* subsp. nov.; uncus, lateral view and dorsal view; squama, lateral view.
9. *Timulla* (*Trogaspidia*) *luzonica* subsp. *luzonica* (Rads.); uncus, lateral view and dorsal view; squama, lateral view.
10. *Timulla* (*Trogaspidia*) *luzonica* subsp. *panayensis* subsp. nov.; uncus, lateral view and dorsal view; squama, lateral view.

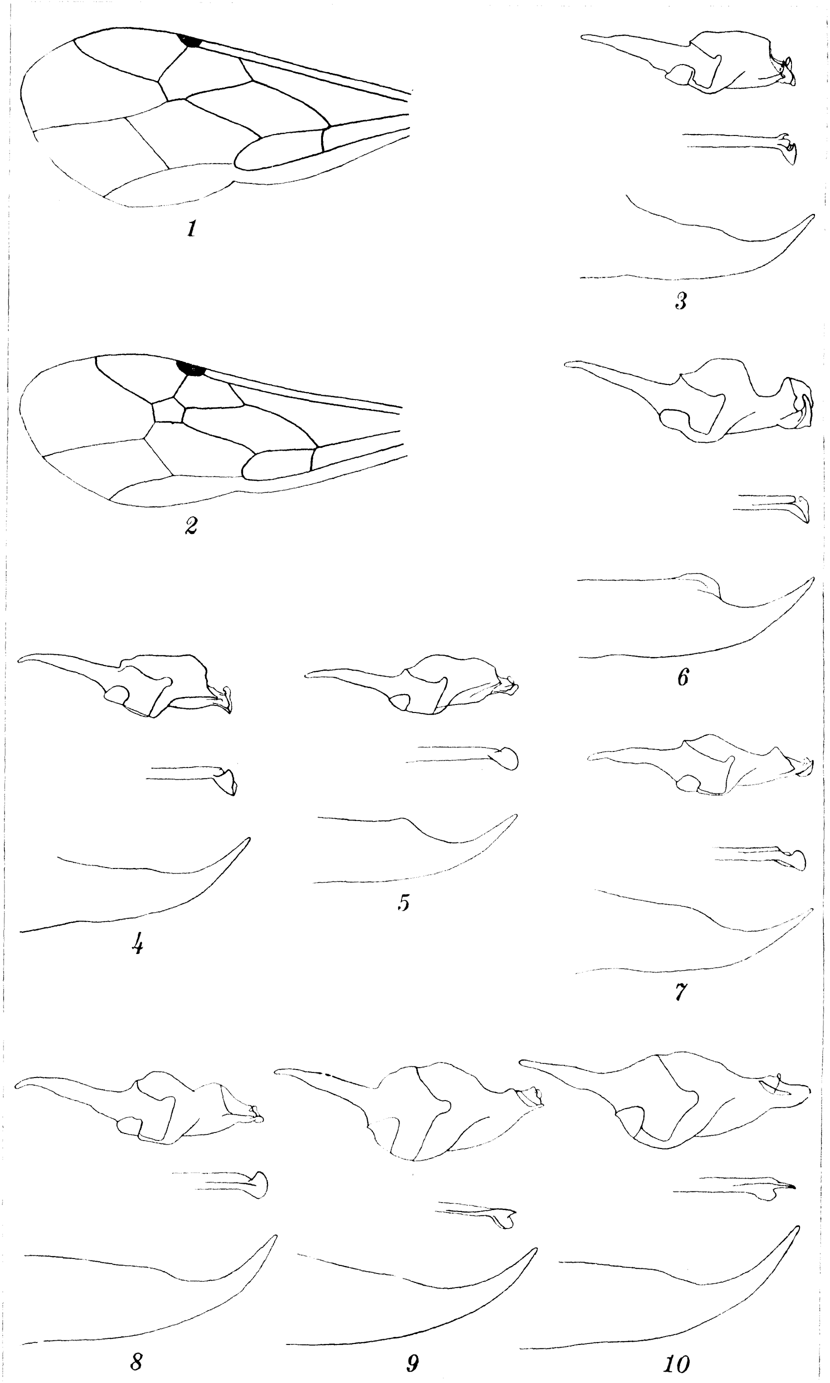

PLATE 1.

THE PHILIPPINE JOURNAL OF SCIENCE

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AMERICAN PLANTS IN PHILIPPINE ETHNOBOTANY

By ROBERT M. ZINGG

Research Associate, Department of Anthropology, University of Chicago Chicago

This study forms an element in the much larger and more complex problem of the ethnobotany of the Philippines, a large topic because of the rich tropical flora available to the inhabitants of the Philippines, and because of the clever uses to which they have put that flora.

A discussion of the American plants in the culture of the Philippines should have value, since it was by way of the Philippines that many American plants entered Asia; the subject thus ties up with the larger problem of American plant migration.

I must acknowledge special indebtedness to Dr. E. D. Merrill, of the New York Botanical Garden, whose work in the botany of the Philippines reduced chaos to order and furnishes the foundation for research in Philippine ethnobotany. I am further indebted to him for correspondence and suggestions in the preparation of this paper. I have also had the advantage of the interest of Dr. Paul C. Standley, of the Field Museum of Natural History, from whose encyclopædic work, The Trees and Shrubs of Mexico, I have often quoted. He was kind enough also to go over this paper and has made many valuable suggestions with reference to the botany involved. Prof. Robert Redfield, of the University of Chicago, has given me many suggestions regarding plants in Mexican culture.

THE AGRICULTURAL COMPLEX IN THE PHILIPPINES

Technic.—There is an almost world-wide, primitive, tropical, agricultural technic, consisting in simply cutting down the trees and clearing the land by burning the dried remains. This gives a temporary clearing sufficient to snatch a crop before the land is reclaimed by wild vegetation.

Cook,(28, p. 2) in an excellent discussion of this technic in tropical America, terms it the *milpa* system and shows how, with even the crudest stone implements and the use of fire, man is enabled to steal a march on Nature and secure a subsistence without the necessity of plowing, hoeing, and weeding. In parts of Central America planting is still done with only the use of a charred stick. This represents about the simplest possible agricultural technic.

The same author points out a great advance in American agriculture when specialized and permanent systems of terrace agriculture were developed for the cultivation of maize in Peru and Central America. Nor does he fail to note similar systems of terracing used for the cultivation of rice and other crops in eastern Asia. In both areas the advanced groups practicing this technic are surrounded by marginal neighbors who use the milpa system.

In the Philippines, the area under discussion in this paper, both systems are practiced. Here there can be no doubt that similar natural conditions of a tropical country and a people with a primitive culture have produced a counterpart of the milpa system, here called the *kaiñgin* system. This primitive system is typical among the Negritos everywhere; the Ilongots of the eastern Cordillera of northern Luzon; and throughout the mountains of Mindanao, as described among the Subanuns of Zamboanga Peninsula;(6, p. 46) and the Bagobos of Davao Gulf, (26, p. 132) who only use the digging stick.(1, p. 6) In general, the kaiñgin system is used to the exclusion of other technics by the peripheral groups in the Philippines.

Corresponding to the more-advanced terrace system of America, the tribes of the mountains of Luzon use a rice-paddy system which permits the cultivation of lowland rice. In these mountains this rice-paddy technic has developed into the most magnificent system of terraces in the world.(23, pl. 20, p. 160) Jenks, in discussing these terraces, flirts with the idea of a trait introduction from China, but decides that it is an early trait, "which spread from the nest of the primitive Malayan culture." (12, p. 88)

To the writer, however, it seems simpler and more in keeping with the facts to recognize that these terraces are essentially rice paddies that have been constructed to fit the topography of the mountainous terraine. So as population outgrew the small areas available in the sloping valleys, the people were forced to hang their paddies on the mountain sides, by the "invention" of terraces, which we see after all invented themselves as an adaptation of the old trait (the rice paddy) to a new condition.

Content of the agricultural complex.—In the terrace only lowland rice is produced and the groups that use the terrace also make use of the kaiñgin system for producing more than half of their food supply.

Rice is the prized and esteemed food to which the ceremony and ritual and prestige attach.

From the kaiñgin, however, the agricultural complex is completed with gabi (*Colocasia antiquorum*), ubi (*Dioscorea* sp.), and the American plants camote and corn. The essential native fruits are bananas, mangoes, and coconuts. Bamboo is everywhere of great importance.

Important in the ethnobotanical configuration is the betel nut, or *buyo*, complex, which enters the agricultural complex as the vine *Piper betle*, which produces the leaf, and the palm *Areca catechu*, which furnishes the nut.

The betel-nut complex in Philippine culture.—An understanding of the buyo (or betel-nut) complex is pertinent in this paper because of the fact that the American plant tobacco attached itself integrally to it, modified it, and has tended to displace it.

The buyo complex is one very closely integrated into the culture of this part of the world. This striking habit was noted by Pigafetta upon the discovery of the Philippines, and is thus well described by de Morga, 1609: (2, 16: 97–99)

The ordinary dainty throughout these Islands and in many kingdoms of the mainland is *buyo*. This is made from a climber [Piper betle] whose leaf is shaped like a mulberry; and from a palm [Areca catechu] is secured a fruit which resembles an oak acorn. This fruit, which is called *bonga*, is cut lengthwise into strips and each strip is wrapped in an envelope made from the leaf. With the *bonga* is thrown in a powder of lime.

This compound is placed in the mouth and chewed. It is so strong a mixture, and burns so much that it induces sleep and intoxication. The saliva and all the mouth is made as red as blood. It does not taste bad.

They consider it very beneficial, whatever quantity goes into the stomach for strengthening it, and for various diseases. It strengthens and preserves the teeth and gums from all inflammations, decay and aches.

Even the Spaniards took it up, and served it on trays like chocolate in New Spain (Mexico).

The natives (especially the chiefs), whenever they leave their houses, take for show and entertainment their boxes of *buyos* which they call *buccetas*. These are often handsome, being made of metal and other materials. They also carry a scissors and other tools for making *buyo* with cleanliness and neatness. Wherever they may stop they make and use their *buyo*. (2, 16: 97–99)

The carrying of the elaborate buccetas is no longer seen in Luzon, but is still characteristic in Mindanao among the Moros where the buyo complex has been much less influenced by tobacco. Among them still, as throughout the Philippines in pre-Spanish days, the amenities of friendship and hospitality are expressed in a ceremonial chewing of the betel nut.

The betel nut entered in death ceremonies and burial preparation. Chirino in 1604 records: (2, 12: 302–303; 40: 80)

The dead body is anointed with aromatic balsams which prevent corruptions, especially *buyo*. For the living it is a notable stimulant and the Indians carry it in their mouths as they use the coca [Erythroxylon coca] in Piru. With the juice of this plant they anointed the body, and so injected it through the mouth that it penetrated the whole body.

This is also recorded by Colin in 1663. (9)

The ceremonial use of betel as an offering to the *anitos* (spirits) was everywhere a commonplace and is still characteristic of the mountain peoples, though more prominent in Mindanao. (1, p. 104)

TOBACCO IN THE ETHNOBOTANY OF THE PHILIPPINES

Into this elaborate betel-nut complex of use, ceremony, offering, and social custom the American plant, tobacco (*Nicotiana tabacum*), promptly became integrated.

Stafford in an excellent account of the place of tobacco in the ethnobotany of North America says: (38, p. 389)

Tobacco was regarded by the Mexicans as a sacred or magic herb. It was used in their ceremonies and religious rites in the form of incense. They also inhaled its smoke and chewed its leaves together with lime.

Its use for chewing with lime is a striking convergence with the betel complex with which it integrated in the Philippines.

So widely spread was tobacco at the time of the discovery of America that although a plant of sub-tropical origin it was found in cultivation as far north as the St. Lawrence River.

At meetings of ambassadors, councils of nations, treaties of peace, and the reception of visitors, the calumet, or pipe of peace was invariably circulated. (38, p. 391)

Upon its introduction into the Philippines it was bodily taken out of this context yet promptly joined itself closely into the ritualistic and social complex of buyo. It was first chewed but soon came to be smoked and has displaced buyo in most parts of the Philippines as the common token of hospitality and friendship, except in Mindanao.

Tobacco was introduced into the Philippines by the missionaries in the last quarter of the sixteenth century, (2, 38: 28) and met with remarkable popularity as elsewhere in the world. Many references to it show how quickly "it became the most acceptable gift and a thing the Filipinos esteem highly," to quote Navarette. (2, 38: 28)

In Mindanao the social implications of the betel-tobacco complex is thus interestingly described in the dashing account by the English buccaneer Dampier who spent the year 1686–87 in the Philippines, attracted thither by the annual treasure galleon. Under the heading, A Comical Custom at Mindanao, (2, 39: 25) he says:

There is one kind of begging custom at Mindanao that I have not met elsewhere in my Travels. When Strangers arrive there, the Mindanao Men will come aboard and invite them to their houses, and inquire who has a *Comrade* (which word, I believe, they have heard from the Spaniards) or a Pagally, and who has not. A *Comrade* is a familiar Male-friend; a Pagally [Dyke word for kinsmen, comrade or fellow, also *panggal*, pillow, and *panggan*, bedstead. The Moro word for sweetheart is babay a magan pangaluman. B. and R. note.] is an innocent Platonick Friend of the other Sex.

All strangers are in a manner obliged to accept this Acquaintance and Familiarity, which must first be purchased with a small Present, and afterwards confirmed with some gift or other to continue the Acquaintance. And as often as the Stranger goes ashore he is welcome at his *Comrade* or Pagally's house where he may be entertained for his Money to Eat, Drink or Sleep; and is complimented as often as he comes ashore with Tobacco and Betel-nut, which is all the Entertainment he must expect *Gratis*.

The richest Men's wives are allowed the freedom to converse with her Pagally in public or may receive Presents from him. Even Sultan's or Generals' Wives, who are always cooped up, will yet look out of their Cages, when a stranger passeth by; and demand of him if he wants a Pagally; and to invite him to their friendship, will send a Present of Tobacco and Betel-nut to him by their Servants.

Though the "Pagally" custom has disappeared, in Mindanao up to the present time this betel-tobacco complex has been but little modified; and among the pagans of the interior Finley's description of the Subanuns of Zamboanga Peninsula is characteristic.

The entire chewing quid is composed of a small leaf of tobacco, a section of betel-nut, one *buyo* leaf and a small quantity of paste made from shell lime; together with ginger a local variant of the complex sometimes mixed with cocoanut oil or water. Women generally omit the tobacco; but Moros and pagans use it in this combination.

This remarkable combination for chewing is placed in a betel-nut box which may be suspended from the shoulder, carried in a bag at the side, or in a belt or sash at the waist. (8, p. 20)

The smoking of tobacco has made some headway among this group, for he continues:

Subanu are very fond of smoking a sort of cigarette made of native leaf-tobacco, and the soft inner husk of the corn. The tobacco is wrapped within this husk, and the whole is so folded as to take the shape of a cornucopia. (8, p. 20)

Tobacco, having attached itself to the betel complex in chewing, ritual, social custom, etc., soon became used for smoking, and thus to a large degree displanted the chewing of betel.

In 1751, Padre Delgado writes of the Visayans:

Everywhere it is prized by the natives, like their daily food, and just as they cannot live without bread, they cannot pass through life without tobacco. There is not a meal of rich or poor that is not finished with a cigar. (7, p. 578)

On Luzon the same thing is true to-day. The immense cigars, often 2 inches in diameter and 18 inches long, smoked all day by men, women, and even children in the Ilocano provinces, still attract attention. Among them tobacco is an important economic crop for local use and export.

The Tinguians, which are a marginal group between the Ilocanos and the more-primitive mountain people, show tobacco actually displanting betel. Cole thus describes the old importance of the buyo complex still preserved in conservative tradition:

Today betel-nut is less common, but the leaf (Piper betle) and the areca palm still play an important part in all ceremonies. According to tradition, it was possible in the old times to tell the fate of an absent friend by noting the condition of the vine planted by him prior to his departure. (25, p. 406)

Beyond this peripheral Tinguian area, in the higher mountains, are the Ifugaos. More secure in isolation the buyo complex has not been so greatly affected by tobacco. Here, Barton says, "betle-nut chewing ranks second to drinking in religious importance, and first in social and economic importance as a luxury." (22, p. 407)

The Bontoc area, situated on the Rio Chico, a tributary of Cagayan River permitting communication with Cagayan Valley where tobacco is the principal crop, has been more affected by tobacco. Here it is a definite trait linked with a folk-manufacture of brass pipes for smoking. One seldom sees a Bontoc without a pipe in his mouth, or tucked in his peculiar little cap, hung on the back of his head.

Across the Cordillera in the valley of Cagayan River tobacco comes into its own. In the lower provinces it is the only economic crop, and from here comes the best and most of the Philippine tobacco. Here, since the Spaniards came, a civilization has been built on the basis of two American plants, corn and tobacco. The rough terraine swept by typhoons and plagued by locusts was not suitable for rice; and the missionaries introduced corn, which is the staple food, but tobacco is even more important.

The great Cagayan River, the longest river in the Philippines, overflows annually and deposits a rich alluvium. In the little pockets of land so affected is raised the tobacco par excellence of the Philippines.

Tobacco is much used by the people; and here, I am reliably informed, they hang a gigantic cigar by a string from the ceiling from which each member of the family smokes in turn.

By 1781, this plant had become so profitable that Governor Basco y Vargas established a government monopoly in order to support the colonial government, which up to that time had been largely supported by an annual subsidy from Mexico. The next year the income was established, and by 1808 the net profit was half a million dollars. (4, 1: 173, 438–9)

Of the American plants introduced into the Philippines, tobacco is the most important in export and world trade from which arose the largest business organization in the Islands, the Compañía General de Tabacos de Filipinas, founded in 1886; (9, p. 266) which is the locally well-known Tabacalera and employs more men than the Insular Government.

Tobacco is universally known in the Philippines by its Spanish name, *tabaco;* varying only in Sulu to *tábaku.* (15, 3: 431)

STAPLE FOOD PLANTS INTRODUCED FROM AMERICA

IPOMOEA BATATAS (Linnæus) Poiret. Sweet potato; batata; camote.

Arguments for both an Old and New World origin of this plant have been put forth, though an American origin is now accepted. De Candolle reviews "powerful arguments in favor of an American origin of this plant under its early name, *batata*, which later refers by mistaken transfer to the potato (*Solanum tuberosum*); and later the now common term camote (Nahuatl, *camotl*)." He then summarizes the argument for an Asiatic origin.(5, p. 54)

Laufer(31, pp. 239–51) disposes of the early Chinese mention of Bretschneider.(5, p. 54) Rumphius says that this plant was introduced into the Malay Peninsula from Manila.(5, p. 54)

As is the case with many other New World plants, the Philippines was the center of dispersal into Asia and consequently forms an important link in the chain, meriting a close examination.

Strangely enough the first reference to batatas in the Philippines comes from the first writer to have seen it. Pigafetta in 1521 mentions batatas near Cagayan Sulu Island.(2, 33: 207) Laufer shows the real likelihood that Pigafetta mistook another species like *Ipomoea mammosa*, a convolvuluslike plant with an edible root but of distinct botanical character, or more likely a yam, *Dioscorea*.(31, pp. 239–51)

Camotes were likely introduced into the Philippines by the Villalobos expedition of exploration in 1541, that we know planted corn. The natives attached special importance to everything the Europeans gave them, as attested by Legaspi's finding the Santo Niño at Cebu, which had been left by Magellan upon the conquest in 1571. The camote would be more highly prized.

That later observers are more particular in observing plants in the Philippines is shown by a reference in 1573, the time of the conquest of the Philippines. Captain Arieta notes, "certain roots resembling sweet potatoes (Ipomoea mammosa?), called oropsia, as well as yams (yuñames) and camotes."(2, 3: 202)

By 1582 camotes were recognized in Cebu as an American plant by Loarca, who notes, "roots resembling the potatoes of Santo Domingo, and called by the natives camotes."(2, 5: 45) This reference clinches the matter, since the writer's knowledge of the plant in the New World removes the doubt of a mistake in the identification; and more important, that the natives of Cebu at that early date called the plant *camote*, which is a Nahuatl name. To-day, as well, no other name is commonly used in the Philippines, although *lapni* (If.); *panggi-bagun* (Sulu); *tigsi* (Bic.); *tugi* (Bon.) are names for it in isolated tribes where Spanish contact was slight.(15, 3: 364)

By 1599 camotes were of sufficient importance, as a product, to merit mention by the governor to the Spanish king: "The land abounds in rice, fish and camotes."(22, 10: 262) Thirty years after the conquest, the agricultural complex of the Philippines had assumed its characteristic form. So we see that the camote spread with the greatest rapidity. Indeed the camote reached the mountains before the Spanish were attracted by Igorote gold. In 1623 the characteristic cultivation of the camote under the kaiñgin system was seen by the first explorers among them. (2, 20: 80)

In 1609 de Morga mentions "camotes (which are sweet-potatoes)."(2, 16: 80) In 1640 Bobadilla mentions "camotes which are the potatoes of New Spain" (Mexico).(2, 29: 298) In 1649 a Relation of the early Franciscan Missions states, "The Spanish brought . . . camotes, or potatoes, which have resulted very well, and are a cause of great support to this kingdom."(2, 35:302) In 1763 Mozo says that the root and the name of camotes were brought from Mexico;(2, 48: 91) this statement is repeated by Blanco in 1837.(3, 1: 129)

This American plant soon came to be of paramount importance to the people of the Philippines. It figures only second to rice in the diet and livelihood of the people. It is not only of vital importance as a catch-crop when frequent typhoons lay waste the rice paddies, but has become a staple food among the Filipinos.

Writing in 1751 Delgado suggests this importance when he says:

> When in the Visayas they have their camotihan (camote-field) they are all year assured of their bread for themselves and their families. It is planted from shoots or buds which soon extend long branches and soon reproduce. Thus they plant long rows, and by this simple operation assure their future.
>
> Though in America and Europe they need granaries to store up their crop, these natives have it always in the ground at the doors of their houses. (7, p. 766)

Blanco in 1837 adds this to our knowledge of the use of the camote:

> Its preparation for the kitchen is variable. It serves the Filipinos from soup to chocolate (by cutting it in fine slices and toasting it). It is also boiled and roasted in the skin.(3, 1: 139)

This plant is known as camote all over the Philippines, though there is a variety called *tigsi,* of which Blanco says: "In Camarines there is a species called Tigsi, which yields a camote of very large size."(3, 1: 139)

As a staple food this is the most valuable of the American plants; and it is so commonly grown and used in the Philippines both in the mountains and the lowlands that it is second only to rice, by reason of the simplicity of its cultivation, and the ease with which it can be used.

In the mountains it is especially valuable, as it is best adapted to the kaiñgin system in the steep mountain clearings, which are also easier to work as the worker does not have to stoop over so far. Barton says:

> The camote is the most important of all crops to the Ifugao. Nevertheless the Ifugao despises camotes. To say a man has only camotes to eat is to pronounce him poverty-stricken. Yet camotes are the chief food of more than half the people. (22, 399)

According to Jenks, (12, 213) however, their neighbors, the Bontocs, are more appreciative of the camote and honor its planting with the Loskod ceremony. The pueblo "priest" performs this ceremony by killing a chicken or pig and petitions Lumawig (the chief deity) as follows: "May there be so many camotes that the ground will crack and burst open."

ZEA MAYS Linnæus. Indian corn; maize.

In the Philippines maize is called *maiz* (Sp.-Fil.) and *borona,* (33, 193) presumably by transfer from an earlier foreign plant—millet. Among isolated people to whom the Spanish name did not carry, the names are: *gahilang* (If.); *lgi* (Bon.); *maït* (Iv.), *mangi* (Ibn.); *tigi* (Bon.). (15, 1: 29) It was first planted in the Islands in 1541 by members of the Villalobos expedition, which explored the Archipelago before its conquest under Legaspi thirty years later. (2, 3: 69) They had brought it from Mexico as food.

In 1751, Delgado says that the Filipinos do not make tortillas, but make gruel, or when it is not yet ripe the *elote* (Mex. a tender ear of corn) is roasted. (7, p. 707)

A century later Blanco says:

> It first became popular as a catch-crop since it matures in seven weeks whenever the rice is destroyed. This opened their eyes to its value as a staple. It is generally eaten boiled or roasted in the fire.
>
> Some parts of Cebu produce the largest ears, but on Luzon it does well enough. Animals eat the stalks when they are dry, though some clever Filipinos wet it for forage when there is no grass. (3, 3: 90)

To-day, as when Blanco wrote, besides being eaten as roasting ears, the kernels are cracked into "grits" and then cooked in the same manner as rice.

Corn enters folk medicine in the Philippines. De Tavera says:

> The tassels have been used from time immemorial in decoction as a diuretic. The native medicine-man also gives a decoction from the stalk for various diseases of the bladder and kidneys.(19, p. 240)

The American plant maize (*Zea mays*) in aboriginal North America, much as rice in southwestern Asia, is the prized food—the staff of life, about which so much of the ceremony and ritual centered. The cultivation of maize extended from the Plata Valley in South America through northern United States, being the staple cereal food in all these areas. The technic for its production and use varied; and so much more complex and diversified were the rites and ceremonies that centered about it that the discussion of these aspects of the ethnobotany of maize in the New World cannot be attempted within the limits of this paper. Sturtevant's monumental work, Notes on Edible Plants, gives an excellent review.(10, 608)

Among the primitive peoples of Mexico to-day it is still produced under the primitive milpa system. The technics adhering to the maize complex in Mexico to-day are described by Starr:(39, p. 3)

> The use of the *metate* for grinding maize is universal. This instrument is a flat slab of stone with three supporting legs cut from a single block; one support being shorter than the others, so that the flat upper surface slopes somewhat. A second, long and cylindrical, but somewhat tapering toward the ends, is used as a grinder. This is called the *metlapilli* (child of the *metate*).
>
> The grains of maize are soaked in lye water and then rubbed to a dough with the metlapilli. This dough is slapped from hand to hand, being turned around and around until it is shaped into a thin, flat round cake, which is baked on an earthen griddle, the *comalli,* into the national *tortilla* (Sp. omelet for Nahuatl *tlazcal,* bread). There are several kinds of tortillas, thin or flat. Some have a dark green or bluish color and contain an admixture of *frijoles* (beans).
>
> *Tamales* are a sort of dumpling made of corn meal wrapped in corn husks and boiled. They may be sweetened, or hot with chili, or lined with meat or the flesh of fowls.
>
> *Atole* is a thickish sweet gruel of corn which is drunk from jicaras (cups). *Champurado* is a mixture of *atole* with chocolate.
>
> *Mole* is a stew of meat with nuts, raisins, vegetables, etc. in a chili sauce. Two of these are favorities, *totomol,* (Sp. mole de guahalote—turkey mole) and *tlilmol* (Sp. mole prieto—black mole).

Indian corn was planted in the Philippines in 1541, thirty years before the conquest. It did not meet the instant approval of the natives as did tobacco and the camote, and was slow to take its present important place in the ethnobotany of the Philippines. As indicated by Blanco its utilitarian value as a catch-crop in case of need was recognized and used.

The Spanish missionaries were able to show its value, especially in regions where but little rice could be produced. To-day the people of Cebu (the most populous island) live largely on corn; and it has become the staple food of the lower Cagayan Valley in Luzon.

Upon its introduction into the Islands, it was completely taken out of its Mexican patterns, but unlike tobacco did not attach itself to local patterns to mold them. Corn left behind its complex of metate, metlapilli, and its products *tortillas* and *tamales,* though Delgado records its use in the Philippines as atole (gruel), though the word is not now in common use.

Instead of using the Mexican metate, the Filipino prepares corn by pounding the hard flinty kernels (these are the varieties prized) in a mortar with a pestle, the technic for husking rice, after which it is boiled and eaten like rice. Thus we see corn taken out of its Mexican context, and molded into the prevailing rice patterns.

A small mill of stone grinders, the upper of which revolves within the grooves of the lower is an improvement in technic that is sometimes seen. Elsewhere the corn is simply parched before being eaten, and commonly it is eaten green as "roasting ears."

Among the mountain people of Luzon, Cole reports that the common method of preparation of corn among the Tinguians is to place the grain on the large stone over which a smaller stone is rocked until a fine powder is produced. The stone disc mills before described have been introduced from the lowlands as well. (25, p. 405) Corn is raised in kaiñgins, and the terraces serve only for rice.

Farther into the mountains Jenks (12, p. 140) reports that in Bontoc the ears are husked, the silk is removed, and the corn is eaten from the cob without salt. Among the Ifugaos Barton (22, p. 405) reports that among the recent Silipan immigrants corn is the chief food supplementary to rice. This is explicable as an introduction from the adjacent Cagayan Valley, where corn is a staple food. Among the Ifugaos it is prepared for food by being parched or by being pounded into a meal in a rice mortar and made into corn pone.

In the mountains of Mindanao corn is raised in the kaiñgin with upland rice and the camote as staple foods among the Bagobos (1, p. 6) and the Subanuns (8, p. 18) yet the ceremonies are given only in rice culture. (6, p. 86)

Contrasting with the elaborate ritual and ceremony connected with corn in the New World, in the Philippines such ritual is conspicuous by its absence. This did not escape so keen an observer as Cole, who says,

> Despite the fact that it is one of the most important crops, it has never gathered to itself ceremonial procedure, nor has it acquired a place in the folklore. (25, p. 405)

The explanation of this is not far to seek. In southeastern Asia, throughout an area as large as the indigenous corn culture area in America, rice occupies the key position, and about it attaches all the ceremony and ritual. It is the esteemed food and has an enormous importance in the lives and thoughts of the people. They not only prefer its taste to all other foods but among the primitive groups, in deference to rice, teeth are filed; and a multitude of ceremonies are carried out in connection with the planting, harvesting, and storing of rice.

Other foods are not so prized. Among the mountaineers a man maintains a status of wealth and greatness by eating rice three times a day. Other foods are for the poor and despised.

Among the more-advanced peoples of the lowlands, even on two of the most densely populated islands, the people have become corn eaters, since the natural conditions have forced this situation upon them. Yet corn is much less prized than rice, and the native attitude finds expression in apologies offered when corn in some form is set before a guest, the inference being that the host is tacitly admitting poverty in not offering rice. (30, p. 217)

Notwithstanding this prejudice, next to rice, corn has become the only important cereal in the Philippines. During 1915, 443,058 hectares were planted to corn with a yield worth over 8,000,000 dollars. The provinces that lead in the production are Cebu, Oriental Negros, Isabela, Leyte, Cagayan, and Bohol. (40, p. 167) In Cebu, the most populous province, with a million inhabitants, corn is the staple food.

LESS IMPORTANT NORTH AMERICAN FOOD PLANTS

The American plants, pumpkin and squash, we think of as associated with corn, but in the Philippines there is no such association. They are, however, important garden vegetables.

CUCURBITA MAXIMA Duch. Squash.

Despite de Candolle's doubts, this plant is now known definitely to be of American origin, and was generally cultivated by the Indians in their corn fields.

In the Philippines it is known to the Tagalogs as *kalabazang-bilog* (T.) and *calabazang-pula* (T.), which slight variation extended from north to south of the Archipelago, as well as: *kalabasi* (Su.), *karabasa* (Iko.), *kumbasa* (Bon.), obvious variations from calabaza (Sp.).(15, 3: 586)

It is now grown in all gardens throughout the Archipelago. It is one of the most important vegetables in the Islands and is eaten as a vegetable with meats.(40, p. 192) But squash escaped the American maize-squash complex, and in the Islands is cultivated alone.

LYCOPERSICUM ESCULENTUM Mill. Tomate (Sp.); tomato.

This common and important plant, probably native of Peru, was eaten by the aborigines of Mexico, and called *tomatl* among the Nahuatl nations,(10, p. 343) from which our name and the Spanish one derive. Mixed with chili it is commonly eaten as a sauce in Mexico.

It was introduced into the Philippines from Mexico at an early date and is there universally known by the Spanish name *tomates* or corruptions as: *kamatis* (B. M. T. S.), *kamates-bundok* (T.), and *kamates* (C.),(40, p. 369) while the isolated Ifugaos say *umli.*(15, 3: 586) It is now extensively cultivated and is also thoroughly naturalized throughout the Archipelago. The spontaneous form has evidently reverted, as the fruits are small and inferior.(32, p. 34) From fresh American seed, however, the fruit is large and excellent, but it rapidly deteriorates in succeeding crops in the Tropics.(15, 3: 586) Tarlac Province is now famous for its excellent tomatoes for the Manila market.

In 1751, Delgado says that they were little cultivated and were not used in cooking.(7, p. 773) To-day, however, they are one of the most important vegetables in the Philippines and are cultivated wherever there are people. The fruit forms part of almost all their meals as it supplies an important deficiency in their diet.

PHASEOLUS VULGARIS Linnæus. Kidney bean; haricot.

This is an American plant, though its cultivation has extended over the whole world. The mention of beans in Mexico is frequent. Sturtevant says of beans,

> The Olmecs had them before the times of the Toltecs and they were produced by the later Aztecs. The native Mexican word was *ayacolt,* though

they were the *etl* of the Aztecs, and when boiled in the pod were called *extol.*(10, p. 424) [Hispanicized as *ejotes*, string bean.]

To-day the bean, next to corn, is the most important food plant in Mexico; it is raised all over the country. No meal in Mexico is complete without beans, and many a meal consists of nothing else except corn(35, p. 212) but in the Philippines beans are not so prominent, being used mainly as string beans.

In the Philippines this species is known by the same names as *P. lunatus, habas* and *habichuelas* (Sp.-Fil.), *beríngi* (T.), and *butingi* (T. PV.). In isolated Bontoc the term *mula* appears.(15, 2: 319)

At the present time this annual herb is commonly grown for its tender pods, which are picked and eaten immature as "string beans," although it has been shown that they can be successfully grown and dried in the dry season,(40, p. 161) as they are in Mexico.

PHASEOLUS LUNATUS Linnæus. Lima bean.

The lima bean is unquestionably of American origin and de Candolle assigns its origin to Brazil,(10, p. 418) from where it was disseminated in earliest times by cultivation and has become naturalized in Peru and tropical America. It was probably introduced into Africa through the slave trade.(5, p. 345)

In the Philippines it has a variety of names which are freely applied also to the kidney bean (*P. vulgaris*) : *haba, zabache,* and *habichuela*(15, 2: 319) are Spanish terms often used. The most prominent name is *patani*(15, 2:319) used by the Tagalogs, Bicols, Visayans, and Ilocanos. The Tagalogs sometimes say *bulai-patani, buringi,* or *butingi.*(15, 2: 319) The Ilocanos of northern Luzon say *palpalai, parda,* or *percoles.*(15, 2: 319) The Ibanags of Cagayan Valley use the term *gulipatán.*(15, 2: 319)

The non-Christians of northern Luzon use these terms: *kilkilang, kutakut,* and *kopani,*(15, 2: 319) the last is a possible derivative from the common term patani; all are reported for the Bontocs. The Igorots of Benguet say *puida.* The non-Christian Bagobos of Mindanao call this plant *buni.*(15, 2: 319)

The nomenclature of this American plant shows a strong tendency to use the Spanish terms or patani among all the Christian people in close cultural contact, but varies widely among the marginal groups, where contacts were much less frequent.

Here it is of wide distribution and common cultivation and at the present time it is thoroughly naturalized in many parts of the Philippines. There are at least seven distinct forms, of which the white-seeded varieties are best for culinary purposes. The colored or variegated beans should be boiled and the water changed two or three times to make them wholesome. (40, p. 176)

In 1751 Delgado writes:

In Visayas the red beans are more abundant, while in Luzon the grey beans produce more. The *habas* are not native to the Philippines or of China. The annual galleon from Mexico brings habas and frijoles and from these the plants do not die unless destroyed by typhoons. (7, p. 730)

There is a similarly ambiguous reference to this species in Blanco, who says:

The seeds are eaten, also the pod is little longer than two inches. It is not as much appreciated as *patani* (P. vulgaris?). The seeds are white with red and yellow spots. (3, 2: 270)

CAPSICUM FRUTESCENS Linnæus. Chile picante (Sp.); chili pepper.

An herbaceous plant, with small red fruits which have a very pungent taste, universally cultivated and used as a condiment. (33, p. 133)

De Candolle says that no *Capsicum* appears to be indigenous in the Old World, while its ancient and extensive distribution in South America indicates that it is indigenous there. (5, p. 345) Irish, who has carefully worked over the whole problem of *Capsicum*, says:

Its use as a condiment is universal throughout the Tropics. When mixed with turmeric and spice it forms Curry powder. Cayenne pepper is the fruit of these small pungent varieties ground to a powder. Paprika is made from the fruit by grinding after removing the seeds, so is much less pungent. Soaked in strong brine or vinegar it makes Tobasco sauce. In Mexico Chili-con-carne makes use of these small peppers finely ground, and they also form an important ingredient in tamales.

The rapidity with which the plants spread in tropical countries together with the increased commercial trade following the discovery of America caused a wide dissemination into the Old World tropics.

The first explorers to the New World found it commonly used as a condiment and in Spain and India as early as the 16th century it was used in dressing meats; and supposed to be valuable in dyeing. (29, pp. 54ff)

This plant is the *ajo* or *uchu* seen by Creza de Leon in 1532–50 in Peru; (10, p. 136) and it is called *aji* in Cuba and Porto Rico. (19, p. 178) In 1570 it was found by Legaspi upon the conquest of the Philippines; he recorded that in the river of Bato (Cotabato) were found green peppers growing on trees as small as shrubs with their clusters like *agias.* (2, 3: 77) This indicates with what great rapidity this plant was disseminated, since only Magellan and Villalobos had visited the Islands prior to this time.

At the present time Merrill says of the distribution of this plant that it is "throughout the Philippines planted here and there about dwellings but also thoroughly naturalized in open waste-places in the settled areas." (15, 3: 424) Since its early introduction, this plant has assumed some little importance in Philippine culture as evidenced by the fact that it has carried modifications of its Spanish name into the languages of the regions where Spanish influence was strong.

The Spanish term *chile* is not uncommon, but is more often varied to *sili* in most dialects. The Tagalogs vary it to *chileng-búndok, siling labúyo,* or *siling pálai.* One Tagalog term, *pasitas,* escapes the Spanish pattern.

The Ilocano term *silit-diablo,* "chile of the devil," expresses an interesting folk reaction to its pungent taste.

The Bicols, of southern Luzon, in addition to *sili* have *rimo-rímo* and *lada.* The latter appears to have carried to Sulu, where it is used or varied to *lara.*

Among the Visayans local terms are *kilikot* and *katumbal,* although the hispanic form *sili* is common.

This latter term does not appear to have reached more-marginal peoples. The Ifugaos of northern Luzon use *paktiu;* while among the isolated Magindanaos of Cotabato on Mindanao the term is *kasira.* (15, 3: 424)

Thus we see an American plant of general distribution, but of only minor importance, able to carry its Spanish name only within considerable variations to the regions of strongest Spanish contact. Even here local names have arisen, while among the peoples outside the area of Spanish influence, the plant left its name behind.

In the Philippines it is commonly used as a condiment and as a native herb medicine. Pardo de Tavera says of it:

> As a tonic and a stimulant it is a useful article of food in hot countries where the digestive functions become sluggish. When used in moderation it is thought to prevent dyspepsia and consequent diarrhea and as a gargle for hoarseness. (19, p. 178)

Blanco records that the Filipinos cook the leaves with alum to get a good fast yellow dye. Also he has seen them apply the crushed leaves to the wounds made by mad dogs. (3, 1: 174)

CAPSICUM ANNUM Linnæus. Pimiento (Sp.); bell pepper.

This plant is definitely of American origin, probably from Brazil, though common in Mexico and the West Indies before the conquest. (5, p. 289)

This chile pepper, common and characteristic in the Mexican food as a condiment, is an herb or shrub of which many varieties have had a wide distribution.

In Mexico many kinds are used both in the seasoning of food and in making chile sauce. The sauce is made by crushing the red peppers (usually the long red one) with ripe tomatoes on a metate or sometimes the crushing is done in a clay dish with a pestle, or more often in the stone mortar *molcajete*. It is used with almost all kinds of food, especially with beans and meats. (35, p. 21)

This plant is of sufficient importance in Philippine culture to have been able to carry a slight variation of its Spanish name throughout the regions where Spanish contacts were strong. Among the Tagalogs, Ilocanos, and Bicols, the plant is known as *sili,* (15, 3: 424) a term also applied to *C. frutescens*. However, beyond the contact of the missionaries, the non-Christians have local terms exemplified by Bontoc where it is known as *kalubengan* or *kalubsengan.* (15, 3: 424)

UNIMPORTANT SOUTH AMERICAN FOOD PLANTS

It is worthy of note that the American plants of greatest utility in the Philippines are those from Mexico. This would show, were other evidence of a historical nature not available, that the plants, together with some lore of their possibilities, uses, values, and technics were brought over by the Spaniards. The Spanish friars not only brought the Filipinos "under the bells," but also through their organization, the Mission, taught them either new or improved ways of meeting their every-day problems. Until 1828, when the Acapulco galleon trade was stopped by the independence of Mexico, the Philippines were administered as a subcolony of New Spain. The friars all came through Mexico and were familiar to some extent with Mexican plants. This continuous contact and communication with Mexico is shown in the uses of American plants in the Philippines.

Of the South American plants only the pineapple (which was introduced from China) found an important place in Philippine culture. The peanut and the potato were in use in aboriginal Mexico, and consequently assume a more important place in the Philippines than arrowroot and cassava.

These are potentially very valuable plants, the latter being especially valuable to the natives of Central and South America; but in the Philippines they made very little impression, although the North American camote almost immediately superseded *gabe* and *ubi,* native root crops, still common but everywhere yielding first place to the camote.

SOLANUM TUBEROSUM Linnæus. Potato.

The potato is a South American plant from the highlands of Peru and Chile where it is known as *papas.*(10, p. 545)

In Mexico the potato has degenerated to the size of a cherry or somewhat larger and is added to soups and stews along with raisins, olives, *nancas,* etc. There is a wild potato common in the mountains.(35, p. 227)

In the Philippines it is known as *papas* and *patatas,* which are the common Spanish names.(33, p. 185) As early as 1650 Navarrete found potatoes, sweet potatoes, and yams in the mountains of Mindoro.(2, 38: 28) Blanco records that the potato does not do well in the lowlands, though in parts of Pangasinan and the mountains of Benguet the inhabitants succeed in getting a good crop. From Chinese seed the roots are half as big as the fist.(3, 1: 179)

To-day, as a hundred years ago, the tubers are small and of inferior quality. They must be planted within the elevation limits of 600 to 1,200 meters.(40, p. 177)

They are still commonly planted among the Igorots of Benguet, but even at that altitude, my observation was that they degenerated to little larger than marbles. Nowhere do they form an important source of food, and are used much as in Mexico.

MARANTA ARUNDINACEA Linnæus. Arrowroot.

The arrowroot is a plant native to South and Central America.(10, p. 354) It is an herbaceous plant introduced into the Philippines from Singapore, probably in the last quarter of the nineteenth century, of fairly general distribution, but rarely cultivated and of little commercial importance,(40, p. 160) although it is grown as a source of starch in Camarines Sur, but in general rice starch is used.

Its Philippine names, *ararao* (T.) and *araro* (V. and P.) would appear to be corruptions of the English;(32, p. 29) but in 1887 *aroru* is mentioned as cultivated in Mindanao (probably in Surigao).(2, 43: 269) The Ilocanos and Bicols say *sagu* and in Batanes the name is *bai* (Iv.), while the non-Christian Bontoc term is *galamáka.*(15, 1: 250)

MANIHOT UTILISSIMA Pohl. Cassava; tapioca.

Cassava is an erect, frutescent plant from large tuberous roots.(33, p. 165) In the Amazon jungle region of South America, this plant is the staff of life to the numerous tribes of Indians. It has been well named *utilissima*. About it Standley says:

Cassava (Haitian *Cacabi*, bread, from the root *yuca*), is one of the valuable food plants of the world. Two well marked varieties occur, one that may be used without special treatment (yuca dulce), while the other has a very poisonous juice made harmless by heat. Meal, starch, and cassava or tapioca are prepared from the roots. Meal is prepared by peeling the root, which must also be heated in case of the poisonous variety. Starch is obtained by a precipitation from an infusion of the grated roots. Tapioca is prepared by roasting the starch grains.

It is a native of Brazil but is cultivated in most tropical regions. It was cultivated in southern Mexico in pre-Columbian times, and in some places has escaped from cultivation. It was called by the Aztecs *quauhcamotl* (tree-potato).(21, p. 644)

Strangely enough it is most commonly known in the Philippines by the local equivalent of the same name: *camoting-cahoy* (tree-potato), other names being: *balangay* (V.), *kamote de Moro* (potato of the Moros) (Il.).(40, p. 253) The last name has basis in fact. The plants are cultivated and used as a common article of food only among the Yakan, the natives in the interior of Basilan Island, which is the largest of the Sulu Archipelago. Here it enters with rice and corn, ubi and camotes in the fundamental food complex.(20, pp. 14, 15) It is extensively used in Jolo. More isolated tribes call it: *malambóñga* (Tagb.), *padpádi* (Bon.), *panggi-kahui* (Su.).(15, 2: 450)

Though it is of universal distribution, it is otherwise very little used and of comparatively slight importance.(40, p. 253) A few foreigners' plantations in Mindanao produce it as a profitable commercial crop for its high content of starch (25 per cent), but it is still unimportant.

ARACHIS HYPOGAEA Linnæus. Peanut; mani (Sp.-Amer.); cacahuate (Mex.).

De Candolle, in a classic analysis of authority, decides that this plant is of Brazilian origin, where it is known as *mandubi;* from there it was introduced into Africa by the slave trade, and into southern Asia by the Portuguese at the end of the fifteenth century.(5, pp. 411–13)

This useful plant had a wide dispersal in America before the arrival of the Spaniards. In Peru it was known as *anchic.* Acosta in 1598 mentions the American name *maní,* which was adopted by the Spaniards. In Mexico after its introduction it was called *tlalcacahuate* because of its resemblance to the chocolate bean.

In the Philippines it is known by the Spanish name *mani,* and *cacahuate,* which is the best evidence that it was introduced by the Spaniards from Mexico. The plant left behind its Spanish name before getting to Sulu, where Spanish influence was very slight. Here it is called *batung-china,* which shows a folk recognition of its exotic introduction. (15, 2: 283)

It is extensively grown but is chiefly utilized for forage at the present time, although the nuts are commonly eaten by the people and are often seen for sale in the markets. Blanco, writing in 1837, says, (3, 2: 303)

> They give it to their horses after it has dried some time, although the nuts are eaten. It is well known that the natives do not use all of its (utilidades) values.

AMERICAN FIBER PLANTS

The flora of the Philippines is astonishingly rich in fiber plants, and rattan, bamboo, abacá, cotton, etc., are cleverly utilized in many ways by the Filipinos.

America had little to offer the Philippines in fibers. Abacá (*Musa textilis*) is a fiber plant par excellence, which yields only in the Islands though it also grows in Sumatra. It furnishes a fiber 4 feet long, and, I am told, stronger by weight than steel. This fiber furnished the fabric for the native costume in pre-Spanish Philippines. These fabrics were woven on the back-strap or semigirdle loom, which is distributed among all the primitive peoples of the Philippines to-day. Roth's study in primitive looms shows their general distribution in northwestern India, among the Tibetans, Chinese, Burmese, Assamese, Sea Dykes, Japanese and Ainu, Koreans (in Asia), among the Santa Cruz Islanders and Caroline Islanders (in Oceania), and among the ancient Aztecs and modern Mexican tribes. (36, p. 294)

I suppose this extraordinary distribution has not been overlooked by the extreme "diffusionists," and it certainly offers a fascinating problem for the study of prehistoric contacts between the New and the Old World.

The Spaniards found the Ilocanos spinning cotton and with a considerable cotton industry for trade with the Chinese. The industry persists to-day among the Tinguians, that fascinating marginal people, much as it was described by the early Spanish writers to have been practiced by the more-advanced Ilocanos.

It was among the Ilocanos particularly that the fiber of the *agave* met with favor and still persists as an important money crop. In the Visayan Islands, especially in Panay, which since prehistoric times has been a commercial and export center for fabrics, the agave was substituted for abacá in making the gauzy fabrics called *nipis,* now unknown. Later they found that the pineapple gave a more silky fiber; and now agave is no longer used, a complete substitution of the pineapple fiber having been made. So far as I can find out, it is only in the Philippines that the pineapple plant is of greater value for its fiber than for its fruit.

Though costume in the Philippines would be a study beyond this paper, it may be pertinent to say that the first Spanish accounts show that most of the Filipinos wore a costume of abacá similar to that still worn by the Bagobos of Mindanao, which is thick and heavily woven.

A thin and loosely woven fabric of abacá is still made. It is known as "sinamay," but is less prized than "piña." The characteristic Philippine costume to-day is an interesting adaptation of a forgotten Spanish influence. In contrast to the other Malays, who commonly wear the sarong, the Filipino men when they dress in native style wear "calzones," or trousers, with a "camisa," or shirt, hanging over them, as do the Mexicans; either is the adaptation of the Spanish costume to a hot climate. The camisa is often made from piña fiber, and is thin, airy, and gauzy.

The women of the Philippines wear a peculiar costume, the charm of which is attested by every writer on the Philippines. The long skirt with its stately train is a heritage of a forgotten Spanish style. The train is sometimes tucked in at the waist or pinned up revealing a considerable portion of beautifully embroidered or lacy petticoat, often of silk. Over the skirt is worn a "tapis," a sort of apron, often very fancy. The woman's "camisa" is of this gauzy piña, or other sheer material, under which is worn a chemise. Its most noteworthy characteristic is the balloon-sleeve effect, the sleeve being carefully pressed upward. About the neck is a curiously folded neckerchief, of the same stuff. This characteristic and charming costume is becoming more a dress and ceremonial costume, as the camisa must be taken to pieces when it is washed and its use entails a great deal of care and trouble. However, the older women even among the poor, still wear it considerably. Among the Ilocanos there is a common variation in the use of the voluminous plain skirt. The slack is often drawn between the legs and tucked into the waist behind, giving a short-trouser effect, very practical for crossing streams and for the rough work that the poor women are constantly about.

AGAVE CANTALA Roxb. Maguey; century plant.

This American plant (5, p. 153) was first seen by white men in Yucatan. (10, p. 27) This peculiar and extraordinary plant, which is so important in its many variations in the life of Mexico, is known in the United States as the "century plant."

In Mexico the national drink *pulque* is fermented from the exuded sap of the large leaf maguey. (21, p. 107) A large cavity or bowl is hollowed out of the center of the pulque maguey, by taking out the core or bud; and into this cavity the sap oozes and is gathered twice a day. When fermented it furnishes the Mexican beer, *pulque*. The distilled drink *mescal*, or now more commonly *tequila*, is made from the small thin-leaf species. The Indians and Mexicans of the mountains use wild species, whereas on the mesa, these magueys are cultivated in large plantations. (35, p. 224)

An excellent and useful fiber, called *ixtle*, is made from the leaves. (21, p. 107) This fiber is spun into thread and rope by the Mexicans. The fiber not spun is used in washing. In pre-Spanish Mexico this fiber furnished the material for Indian garb.

This hardy xerophytic plant was early introduced into the Philippines, and it is mentioned in 1609. (2, 16: 184) This species does best in a tropical climate only in certain drier regions, especially in the Ilocano Provinces, Iloilo, and Negros. In the dry and sandy soil of the Ilocano Provinces it furnishes one of the most important economic crops and is extensively cultivated. The fiber is stripped only after the leaves have decomposed in the sea. The fiber is similar to sisal or henequen of Central America.

In the Philippines it is known as: *maguey* (Sp.-Fil.); *magai* (V.), an obvious corruption; and *nipis* and *pita* (Cebu), a name often used in Central America for the plants and their fiber, (33, p. 121) words of Spanish introduction descriptive of the cloth made from it. Padre Navarrete in 1650 mentioned its use as a hedge. It is never used to furnish alcoholic drink in the Philippines.

This plant was used to furnish a fabric for clothing until pineapple cloth took its place in general esteem. Padre Delgado in 1751 described *nipis*, woven of *maguey*, and made into light waists, airy and suitable for the Tropics. (7, p. 741)

The characteristic part of the dress of the Filipinos, both men and women, was then made of agave fiber but has since been woven of the fiber of another American plant, the pineapple (*Ananas comosus*), which is more highly prized for its fineness and glossy texture. This art, as the preceding, still centers in the Visayas, especially in Iloilo and Jaro.

The maguey fiber is still commonly used for rope. Blanco (3, 1: 322) also tells us that the folk doctors use this plant in medicine by mashing the prickly leaves and applying it to cancer.

AMERICAN FRUITS IN THE PHILIPPINES

Edible fruits abound in the Philippines, and some of them are the best in the world, offering an attraction to life in the Tropics. Most of these fruits are not native, but introduced, including both mango and mangosteen.

Some of the American fruits, like the guayava and the papaya, are of general distribution and in constant use everywhere, being so common that the casual traveler would think them native to the Islands.

Certainly not least among the Spanish contributions to the culture of the Philippines was its enrichment with many of the most delicious fruits now in use.

ANANAS COMOSUS (Linnæus) Merrill. Piña (Sp.); pineapple.

This is an American plant (5, p. 311) propagated by slips or buds; wild plants capable of producing seed are found only in South America. (10, p. 47) The Brazilian (Tupi) name, *nana*, was changed by the Portuguese to *ananas*, from which its scientific name, and many common names of Africa, India, Malaysia, and Europe derive; only the Spaniards called it *piña* because of the resemblance of its fruit to a pine cone. (31, p. 247) Kircher says that the Chinese cultivated it in the seventeenth century, but it was believed to have been brought from Peru. (5, p. 311)

Although we commonly find that American plants were introduced to the mainland of Asia from the Philippines, in this case the reverse seems to be the case. In 1586 Bishop Salazar reports pineapples among the fruits imported to the Philippines from China. (2, 7: 34) Laufer shows that the Portuguese introduced this Brazilian plant, and the name *ananas*, into Saint Helena in 1502, into India and Malacca by 1550, and into China soon after through Macao. Chinese records of it exist from the beginning of the seventeenth century. (31, p. 247) Thus we see how this American plant traveled eastward and was introduced from China into the Philippines only sixty-five years after its discovery.

In 1667, Padre Navarrete finds the pineapples of Mexico and Manila the same, and is familiar with the *ananases* of Malacca. (2, 38: 50)

In the Philippines this plant preserves its Spanish nomenclature: *pita* (Il.), and *piña* (Sp.-Fil.), except in isolated regions of little Spanish contact as Bontoc: *apangdán* or *pangdán.*(15, 1: 194) It grows well everywhere and is widely distributed, being esteemed for its delicious fruit and even more for its fiber from which the beautiful gauze fabrics of the national costume are made. These are mostly manufactured in Iloilo and Jaro, whence there is a wide interisland commerce.

PSIDIUM GUAYAVA Linnæus. Guayaba (Sp.); guava.

A shrub or small tree bearing a fruit from which the well-known guava jelly is made. This is an American plant apparently distributed throughout tropical America before the Europeans came.(5, p. 244) Standley gives us this account of its folk-uses in Mexico:

> In Mexico the bark is sometimes used in tanning and a decoction of the buds is a local Mexican remedy for diarrhea. The leaves are reputed to be a remedy for the itch and a decoction of the astringent bark is applied to ulcers and taken internally for pains of the stomach.
>
> It is known generally as *guayava,* a name of Antillean origin.(21, p. 1036)

By 1609 the plant was common enough to merit mention by de Morga;(2, 16: 87) and by 1650 Navarrete says that it was spreading so fast that it was destroying the pasturage due to the fact that the seed is dropped by birds which have eaten the fruit.(2, 16: 87) It is now very common everywhere in the Archipelago; the fruit is commonly made into jelly.

The Filipinos took over some of the Mexican medicinal uses and found or fancied they found others. Delgado writes:

> Eaten green it is an astringent, but very ripe it is a laxative and encourages body worms. The cooked leaves are beneficial for obstructions of the spleen; and for swollen legs when used as a bath. Dried and powdered leaves cure wounds. There is no doubt that the tree has medicinal values yet unknown.(7, p. 515)

Blanco records that the juice of the tender shoots is used to clear up clouds from the corners of the eyes.(3, 2: 178) Tavera vouches for it only by saying that the bark is strongly astringent and a decoction of it is used for diarrhœa and as a wash for ulcers.(19, p. 114)

The nomenclature of this common plant of minor use is valuable for this study, since the value of the tree enables it to carry its Antillean name, *guayaba,* everywhere in the Archipelago. The wide variation of the terms within the pattern indicates a minor importance, but still considerable.

Only the Tagalogs call it *guayába,*(15, 3: 155) as they are near the center of diffusion, but they vary it as far as *kalimbahin,*(15, 3:155) which may be a descriptive term, unlike another term, *tayábas.* (15, 3:155)

Among other Tagalogs, the Visayans of Cebu, Ilocanos, and Ibanags (of the Cagayan Valley) it is called *bayábas.* (15, 3: 155) The Bicols of southern Luzon call it *bayáuas,* (15, 3: 155) a variation greater than another Ilocano term *guyábas.* (15, 3: 155)

Among the non-Christians of northern Luzon, the Ilocano term *bayábas* (15, 3: 155) becomes *bagábas* (15, 3: 155) among the Igorots (of Benguet). Among the Bontocs the term *geyábas* (15, 3: 155) seems to build on the other Ilocano term *guyábas.* (15, 3: 155) Farther off, in Ifugao, it passes along *gaiyábat* (15, 3: 155) or *gaiyábit.* (15, 3: 155)

The pattern carries to the southernmost part of the Philippines, being termed *baibas* (15, 3: 155) in Sulu.

CARICA PAPAYA Linnæus. Papaya (Sp.); papaw.

All species of this family are American. This one seems to have been cultivated from Brazil to the West Indies before the arrival of the Europeans. Papaya derives from the Carib word *abibai.* (5, pp. 293, 94)

The ripe fruit is smooth and yellow, and the inside resembles that of a muskmelon. It is deservedly one of the most popular of tropical fruits and resembles the muskmelon in taste and texture, although sweeter.

It is an extraordinary plant because the fruit and other parts of the plant contain an abundant milky juice containing an enzyme, papain, resembling animal pepsin in its digestive action. (21, p. 582) The strong digestive properties of this plant were known to the ancient as to the modern Mexicans, and upon its introduction into the Philippines the peoples there soon learned them.

The papaya was early brought to the Islands by the Spaniards since it is mentioned by Chirino in 1604. (2, 13: 141) It has deservedly become one of the commonest and most popular fruits in the Islands.

The green fruit is cooked with meat in order to make it tender—a trick every Filipino cook is familiar with. Too much of the fruit will cause the meat to fall into shreds. Some go to the length of saying that it is only necessary to hang meat in a papaya tree in order to soften it. (19, p. 123)

The Filipinos use a cold infusion of the leaves to wash clothes spotted with blood and the spots disappear immediately by virtue of the ferment, papain, which digests the fibrin. The infusion is useful as a wash for sores and gangrenous ulcers. Small pieces of the green fruit are used to remove freckles.(19, p. 123) The leaves are excellent for the treatment of rheumatism if applied to the afflicted members. Blanco,(3, 3: 212) however, observed that the cure was not permanent.

The leaves serve the washerwoman in place of soap. The crushed leaves will bleach new cloth and clean dirty linen, promptly taking out all stains.(3, 3: 212)

Delgado in 1751 notes the general distribution and the above uses and goes on to observe that "from the shoots of the leaves, which are hollow, the boys make trumpets which sound very pretty,"(7, pp. 520, 21) a note not without ethnobotanical interest.

The nomenclature of this plant in the Philippines patterns very closely around the Spanish word *papaya* as a nucleus, even in isolated regions where Spanish contact was slight, showing the ability of a new trait to carry its foreign name beyond the limits of organized diffusion.

The somewhat isolated Samar and Leyte Visayans vary the term to *kapaya,*(15, 3: 118) which term is carried as far south as Sulu, where it is also varied to *papaye.*(15, 3: 118) The Bicol term is *tapayas,*(15, 3: 118) which is closer to the original, as would be expected nearer to Manila. Even among the non-Christian Bontocs the term does not escape the Spanish pattern in their word *lapaya;*(15, 3: 118) while the non-Christian Subanuns of Mindanao retain the pattern in varying the Sulu term *papaye* to *payyas,*(15, 3: 118)

ACHRAS ZAPOTA Linnæus. Chico zapote (Sp.); sapodilla.

This is a tall tree with wide-spreading branches. The sap produces the chicle of commerce, and the fruits are universally liked. The tree is found wild in the forests of southern Mexico and eastern Guatemala and no one doubts its American origin. (5, p. 286)

Standley, writing of the trees and shrubs of Mexico, says:

> Its name, *chico zapote* derives from the Nahuatl *tzicozapotl* (gum-zapote). The ancient Aztecs were well acquainted with chicle gum which was chewed by the women and children. Figures were also moulded in it. The wood is hard and durable, and is found in the Maya ruins of Yucatan.
>
> The bark is said to produce an alkaloid, sapotine, which is employed in Mexico as a folk remedy for fevers.
>
> This plant has a wide distribution through the tropics and is common in South India and Ceylon.(21, p. 1119)

In the Philippines, it is commonly known as *chico,* also *sico,* (V.) and *tsicu* (T.), obvious corruptions of the Spanish *chico,* which is the general term in use in the Islands. (33, p. 120) It is cultivated in the Philippines to a considerable extent for its edible fruit. There is a large local production of this fruit near Manila for the Manila market. (40, p. 216) It is commonly seen in the markets and sold by women who meet the passing trains.

The use of the gum—an ethnic complex taken over in toto from the ancient Mexicans by the Americans of the United States—is unknown in the Philippines; although the coming of the American régime brought with it the gum-chewing complex, and in every little Chinese tienda neat packages of American chewing gum are for sale. American chewing gum also has a common sale in Mexico, where it is called *chicles.* This is really carrying coals to Newcastle, or in anthropological terms, reintroducing an old trait in modified form.

By 1751 the plant was common around Manila but not in the Visayas. (7, p. 517) At present it is of general distribution in the Archipelago (40, p. 216) and is a favorite dessert fruit.

ANONA SQUAMOSA Linnæus. Ates (Sp.); sugar apple; sweet sop.

This is a tree 4.5 to 6 meters in height with grayish bark. The fruit, the size of an orange, is heart-shaped with a tuberculate surface. The pulp is yellowish white, creamy, custard-like, sweet, and pleasantly flavored. (21, p. 283)

De Candolle gives a scholarly review of the evidence for its American origin in the West Indies or the neighboring part of North America. (5, pp. 168–73) Cogolludo, in his history of Yucatan, quotes an early source to the effect that the first Montijo expedition (1527) found *anonas* growing in Yucatan. Sturtevant thinks that Mexico or the Amazon Valley is the home of this tree. (10, p. 53) It is widely cultivated in Mexico, where it is known by a variety of names. In southern Mexico it is known as *ahate,* from which is derived the Spanish term *ate.* (21, p. 283)

In the Philippines it is known by variations of this Spanish name: *atis, ates,* or *yates.* (15, 3: 177) It was introduced by the Spaniards at an early date, as stated by Chirino in 1604. (2, 12: 216) In 1667, Navarrete writes of *ates,* "which for odor and taste I consider superior to all fruits, which God has created." (2, 38: 50)

By 1751 the tree had become so common on Luzon and Panay that Delgado thought it indigenous. (7, p. 519)

It is universally prized in the Philippines for its edible fruit, but it is commoner in Luzon than in the Visayas, Iloilo excepted. (40, p. 247)

The roots of the tree are sometimes boiled with lye to obtain a faint red coloring. (3, 2: 241)

ANONA RETICULATA Linnæus. Anonas (Sp.); bullock's heart; custard apple.

A small semideciduous tree from 5 to 7 meters high with a brownish yellow, heart-shaped fruit with a pulp that is sweetish, insipid, and tallowlike. It is cultivated in Mexico, and in some places doubtless native. (21, p. 284) It occurs wild in the West Indies and in Central America. (5, p. 174) It is certainly of tropical American origin. (10, p. 52)

In Mexico it is said to have astringent and tonic properties which are used in remedies. (21, p. 284) The young branches have a useful fiber.

In the Philippines it is known only by its Spanish name *anonas*, except in Sulu where it is called *sarikaya*. (15, 3: 177) It was brought from Mexico in the eighteenth century. Delgado writes: (7, p. 518)

> It produces well in Luzon and Visayas, but it is rare, having been brought from New Spain. It has no market value, since only a few foreigners are willing to pay for fruits, except in Manila where there are many Spaniards; so the Chinese purchase the fruit for re-sale.

The fruit in the Philippines has a cream-colored, juicy pulp inferior to *A. squamosa*. (40, p. 221) It is common in Luzon, but scarce in the Visayas and Mindanao.

In some parts of the Philippines a curious superstition still persists about the anonas. In cases of sickness, the local folk doctor ties up the toes and fingers of the patient with anonas bark to drive out the *mangkukulam*, or evil spirits. (2, 43: 314, 15)

ANONA MURICATA Linnæus. Guanabano (Sp.); sour sop.

This tree grows wild in the West Indies, and was early cultivated throughout tropical America; (10, p. 52) and is sometimes naturalized on the continent of South America near dwellings. (5, p. 173) Standley, writing on the tree in Mexico, says: (21, p. 280)

> It is widely cultivated in Mexico where it is called *guanabano*, the West Indian name. The fruit of the sour sop is highly esteemed in tropical regions. It is eaten fresh, used in the preparation of beverages, and made into jelly. Sometimes, in Mexico, it is fermented to produce an intoxicating drink.
>
> There also the seeds, and green fruit, being astringent, are used as a remedy for dysentery.

The tree is valued in the Philippines for its fruit, which is eaten fresh or made into preserves. It is the most widely cultivated species of the genus.(40, p. 225) The very large green fruit is covered with long soft spines. The flesh is white, rather fibrous, juicy, pleasantly acid, and of good flavor.

The medicinal properties of this plant did not escape the Filipinos. Here the unripe fruit is also used to treat dysentery, though the ripe fruit is used for diseases of the liver.(19, p. 22) Blanco says,(3, 2: 242) "Dr. Chevalier assures us that there is no better cure in Europe for diarrhœa and dysentery than this *anona*."

The roots are boiled with lime by the natives to secure a faint red dye.(3, p. 242)

In the Philippines it is known by variations of its Antillean name, *guanabano*, introduced with the plant by the Spaniards. The Tagalogs use the true term *guanábano* (15, 2: 177) and vary it to *guayábano, guyábana*, or *guiábano*.(15, 2: 177) The last term carries to the Zambales.

The name failed to carry to all the Ibanags of Cagayan Valley for they call it *attí*,(15, 2: 177) a variation of the common term for the similar *A. squamosa*. Some of them, however, use the Ilocano term *gayubáno*,(15, 2: 177) which is evidence of early cultural contact, now so prominent between these two peoples. Another Ilocano term is *bayubána*.(15, 2: 177)

When the term leaves Luzon, it becomes more and more mutilated. On Panay it is corrupted to *babána*,(15, 2: 177) and another Visayan term is *llabanos* (15, 2: 177) (yabanos).

In Sulu this Visayan word, like a battered coin still showing traces of its mintage, *guanabano* becomes *labanus*.(15, 2: 177) This variation of the Visayan word is valid testimony of a great deal of history. Most of the contacts of the Mohammedan Moros of Sulu with the rest of the Philippines have been slave and piratical forays so that *bisayan* in Sulu is a word meaning slave. Since the introduction of steam gunboats by the Spaniards in the nineteenth century, this has changed, and the contact is now Moro trading vintas, which are still seen in Cebu and Iloilo. Hence it is not surprising that the Sulu word for this *anona* is varied from the Visayan.

PITHECOLOBIUM DULCE (Roxburg) Bentham. Quamuchil (Mex.-Sp.).

This is an American tree native on the west coast of Mexico and Central America, whence it was introduced into the Philippines, and from there into India where its fruits are known as Manila tamarinds.

Its seeds are considerably used by the natives of the west coast of Mexico, where it is sometimes planted for its fruit. It is found throughout tropical Mexico, where it is apparently native. The men and boys gather the pods by the basketful. The large fleshy aril which surrounds and hides the seeds is eaten raw, being crisp, sweetish, and very palatable. (35, p. 216)

The bark yields a yellow dye and is also useful in tanning, and has local medicinal use because of its astringent properties. The gum exuding from the bark makes good mucilage. In Mexico the plant is called *huamuchil* or *guamachil* from the Nathuatl *quamuchitl.* (21, p. 392)

In the Philippines, where it was early introduced, the fleshy aril surrounding the seed is everywhere eaten, as in Mexico; (33, p. 176) and the bark is extensively used in tanning leather. The wood is commonly burned to make charcoal.

Among the Tagalogs near Manila the Aztec word *quamochitl* is retained with a slight variation, though considerable variation would be expected upon introducing so foreign a name as Aztec into Philippine linguistic patterns. Tagalog words for this plant are: *kamachíle, kamachílis, kamasíli kamarsílis, kamatséle,* and *kamonsíles.* (15, 2: 2243)

At some distance from Manila, in contact with the Tagalogs in southern Luzon, the Bicols use a Tagalog variation, *kamachíli.* (15, 2: 243) The term, in reaching Cagayan Valley in north-central Luzon, among the Ibanags takes on a *ra* infix, becoming *ka-ra-mansíli.* (15, 2: 243)

The Ilocano word *kamantiris,* having substituted a "t" for "s" from the Tagalog, becomes a fertile nuclear word which was dispersed into northwestern Luzon. Among the non-Christians of the western cordillera, Ilocano linguistic influence is very strong due to trade between the mountains and the Ilocano coast. This influence is seen in the Tinguian group—a geographical intermediary between the Ilocanos and the Igorots. Here the plant is called *komóntos,* a close variation from the Ilocano *kamantiris.* (15, 2: 243) The Igorots of Benguet miss it farther in saying *chamúltis,* and it varies still more in *damúlkis* of the Bontocs. (15, 2: 243) This is a direct geographic and linguistic chain from Aztec *quamochitl* to faraway Bontoc *damúlkis.*

When the Tagalog word *kamansíle* leaves Luzon it changes on Panay (Visayan) to *komonsíli* and *kamúnsil,* (33, p. 176) in keeping with the strong cultural interchange we know existed between these two islands. Another Visayan word, *kamonsil,* (15, 2: 243) still falls within the pattern.

This extraordinary diversification in nomenclature in the Philippines for this Mexican plant is very illuminating to the student of culture because of the relative unimportance of the plant. While the fleshy aril surrounding the seed is everywhere eaten in both Mexico and the Philippines, this use is only casual and nowhere becomes important. The uses of the plant as a dye, for tanning, and as a medicine are minor.

Thus it shows not only an interesting philologic variation, but shows also the inability of an unimportant plant to carry a new name unmodified into new patterns in contrast to the unmodified American nomenclature of important plants like the camote, tobacco, corn, etc.

CALOCARPUM SAPOTA (Jacquenot) Merrill. Chico mamey (Sp.); marmalade plum.

This tree is found wild in southern Mexico, Central America, and on the banks of the Orinoco, and is cultivated in the West Indies and in tropical America generally. (15, p. 286) Sturtevant gives its origin as the West Indies and South America where it is known as *mammee.* (10, p. 340) Standley writes: (21, pp. 1120–22)

> It is a tree cultivated for its edible fruit. It is widely distributed in the warmer parts of Mexico and its fruit is highly esteemed by the Mexicans, though others must cultivate a taste for it. The fruit is often made into jelly. The handsome seeds known in Mexico as "pizle" or "pixtle" are in some places mixed with cacao and parched corn in the preparation of a beverage called "choue" by the Indians. There is a common belief in Mexico that the oil from these seeds will restore fallen hair and the Aztecs used it in hairdressing.
>
> In southern Mexico it is called "tezon-zapote" (lava zapote) from Nahuatl *tezontzapotl.* In this language *tzapotl* (Sp. zapote) is a general term for sweet fruits, while *xocotl* (sp. jocote) is used for sour.

The plant is known in the Philippines by an introduced Spanish name *chiko-mamei* or *mamei.* (15, 3: 284) It was introduced rather late in the Spanish régime, for by 1751 it was still rare in the Visayas; (7, p. 516) however, a century later it was so common around Manila that Blanco thought it indigenous. (32, p. 34) To-day it is seen only occasionally planted in Luzon—in Cavite and Laguna, etc., near Manila, the center of diffusion of the American plants.

The fruit is similar to the chico (*Achras zapota*) but about 5 inches long. (32, p. 34) It is like a very large oblong chico in appearance. The pulp somewhat resembles thick reddish brown marmalade, and is sweetish and aromatic. It is now cultivated mainly in Cavite and Laguna, (40, p. 216) but is not a common fruit throughout the Archipelago.

SPONDIAS PURPUREA Linnæus. Ciruelo (Sp.); hog plum.

A small spreading deciduous tree about 6 meters high, cultivated for its edible fruit, the size of a small plum, a little longer than broad. It contains a large seed, but the fruit is of good flavor and is eaten as a dessert fruit in the Philippines.(40, p. 217) It is widely distributed in Mexico and tropical America, where it is native.(21, p. 656) It is called *ciruela* (Sp. plum) in Mexico.

In Mexico large quantities of the fruit are eaten raw or cooked. It is also used for beverages and intoxicating liquors. The fruit is reputed to have diuretic and antispasmodic properties. (21, p. 656)

In the Philippines it is universally known by corruptions of the Spanish name. The Tagalogs keep closest to the Spanish word *ciruéla* when they say *sirihuélas*,(15, 2: 471) which the nearby Bicols take over as *siriguélas*.(15, 2: 471) Another Tagalog term is *sineguélas*.(15, 2: 471) In Ilocos the term gets farther from the prototype in *saguélas* and *sarguélas*.(15, 2: 471) This last may have influenced the Ibanag *saraguelas*,(15, 2: 471) especially in view of the ecclesiastical organization of Ilocos and Cagayan Valley as the bishopric of Nueva Segovia.

According to F. Villar,(32, p. 22) it was introduced into the Philippines in the eighteenth century.

Blanco tells us that the fruit, though astringent, is eaten, and used medicinally in treatment of dysentery. The nut, he reports, is poisonous.(3, 1: 143)

DIOSPYROS EBENASTER Retzius. Sapote negro; persimmon.

A large, wide-spreading tree producing a rather large smooth fruit, the pulp of which is black and soft.(21, p. 1128) This plant is now known to grow wild in Central America. It is mentioned in Mexico by the older writers, and Merrill states that it was carried to the Philippines from Mexico during the early colonial period.(15, 3:291)

The tree was described in Mexico by Hernandez, under the Nahuatl name *tliltzapotl* (black zapote) and used by the Indians as a remedy for leprosy, ringworm, and itch, as well as for killing fish in streams.(21, p. 1128)

Its Nahuatl name is hispanicized in southern Mexico into *zapote negro*, by which name it is known in the Philippines,(7, pp. 517, 18) or simply as *sapote*.(40, p. 252)

The natives of the Philippines rarely cultivate it for its edible but inferior fruit. It is one of the rarest fruits in the Islands; hence, the paucity in nomenclature.

The green fruit is used to poison fish. The leaves, and even more so the bark, serve as a caustic.(3, 2: 29) The wood is one of the ebonies.

AMERICAN MEDICINAL PLANTS IN THE PHILIPPINES

A discussion of the important subject of folk medicine in the Philippines is not within the scope of this paper. Suffice it to say that there is no Philippine village without its *curadero*.

In connection with the rites and ceremonies used by some of these curaderos they often have a considerable practical knowledge of the properties of medicinal plants, which they often use to advantage. In Binondo Square in Manila there long has been a market for native drugs.

It will be obvious to the reader that, in general, the Filipinos use the American medicinal plants in much the same way, and for much the same purposes, as they are used in Mexico. Nor is the reason far to seek. From the writings of Blanco, Delgado, and other friars, it is clear that many of these plants were definitely introduced as medicinal plants and that the properties known in Mexico were taught to the Filipinos.

JATROPHA CURCAS Linnæus. Sangre grado (Sp.); physic nut (West Indies).

Of this plant in Mexico, Standley says:(21, p. 640)

> A shrub or tree from 1 to 6 meters high with greenish yellow flowers. It is commonly cultivated in Mexico as a hedge plant since the branches take root quickly and stock does not eat it. It is reported that it gives a purple dye. The seeds contain from 25 to 40 per cent of an inodorous oil, easily extracted by pressure. It has been employed in Mexico as an illuminant in soap-making, lubrication and in paints. The seeds possess drastic purgative properties.

It is one of the commonest fence plants on the west coast of Mexico, where it is used as a physic.(35, p. 229) Hence it is easy to see why it was introduced into the Philippines, with all its uses, since Philippine commercial relations were with the west coast of Mexico.

In the Philippines it is one of the most widely distributed American plants and commonly cultivated as a hedge.(33, p. 160) The milky sap of the stem and leaves, as well as the seeds, yield a drastic purgative;(32, p. 27) indeed, too drastic for safety.(19, p. 215) The seeds yield 25 to 40 per cent of a yellowish oil, more active than castor oil. Mixed with water it is used as a wash for atonic sores. Up to 1890 the oil was exported to Europe for purposes of illumination and adulterating soaps, and for candles. (19, p. 215) The roasted seeds are good to eat.

Blanco (3, 3: 159) in 1837 records its use as a hedge, and its abundant oil extracted for use in lighting, especially in Ilocos, as it lasts longer than coconut oil. A decoction of the leaves is used in fixing the red or blue dye in thread.

Blanco gives another interesting use of this plant. The children stir up the oil until it is foamy, and then blow bubbles through small reeds, as youngsters in Europe do with pipes, soap, and water. This is a simple, naïve, but excellent example of what the anthropologists mean by "parallel development."

Despite the general distribution, and the past use and importance of this plant, its nomenclature shows no trace of American influence. Its general name *tuba,* which has a wide distribution in the Visayas, and among the Tagalogs, Ilocanos, and Igorots, is derived from its property of stupefying fish in ponds and sluggish streams.

The plant carries a variety of other names. The Tagalogs use: *kirisól*; (15, 2:449) *taba-tabá, tañgan-tañgan-túba,* and *tubang-bakód.* In nearby Pampanga the dialectic term is *galumbam,* which varies to *tagumbáu* among the Ilocanos, and *takumbau* among the Zambals. Other Ilocano terms are *tagumbau nga puraú* and *tauuá.* The Ilocano term *taua-tauá* is reported from the Igorots, which is not surprising in view of the contacts we know exist between them. Another term for Visayan dialects is *kasla.*

CASSIA ALATA Linnæus.

This is a small shrub with yellow flowers and angular winged pods. Though cosmopolitan in the Tropics, this plant was probably introduced from Mexico and is extensively used in the practice of folk medicine.

Cassia alata provides one of the most popular native remedies and its usefulness is vouched for by physicians. It is a cure for herpes when the juice of the plant is applied locally to the affected part. (19, p. 103) It is commonly used for this purpose and is called *gamot sa buni* (remedy for herpes), which is a common tropical skin disease. (3, 2: 77) It also has the virtue, and is commonly used, to cure itch and ringworm as Delgado proved to himself by application of the leaves well crushed. (7, p. 617)

The American origin of this plant, and even its port of departure for the Philippines is preserved in a common Philippine name for this plant: *akapúlko,* or corrupted to *kapúrko.* In nearby Pampanga the reference is less correct, *pakayomkom-kastíla,* while farther away in the Visayas the geography is badly off, *palo-china* (Chinese stick); yet both terms show the nomenclature indicating the foreign origin of the plant.

The value of this plant as a folk cure for herpes did not prevent its assuming a local nomenclature in many regions. The Tagalogs call it: *bayabásin, bikas-bíkas,* as well as *gamót-sa-búni* (cure for herpes), *katánda, pakagonkin,* and *soonting.* This term varies in the Visayas to *sunting.* In the Bicol region of southern Luzon the term *kasítas* is used.(15, 2: 262)

In Sulu the term *andalan* is reported, although the Spanish *aka-pulko* was also introduced. The Subanuns of Mindanao say *kapis,* while the Bogobos say *buni-buni.*

The Ilocano term influences the nomenclature of the non-Christians of Luzon, commerce having made that dialect a sort of lingua franca in that region. Ilocano terms are: *andadási, andadási-a-dadakkel,* and *andadasi nga bugbugtóng.* The Tinguians who are situated between the Ilocano coast and the mountains use the first words *andadasi,* while the Igorots beyond say *ancharási.*

CHENOPODIUM AMBROSIODES Linnæus. Alpasotes (Sp.); ezapote (Mex.).

This is an aromatic herb introduced to the Philippines from Mexico,(33, p. 135) where it is called *ezapote*(10, p. 160) from the Nahuatl, *epazotl,* meaning skunk, since it has an extremely nauseating odor. This *epazotl del zorrillo* (*zorrillo* is the Spanish word for skunk, giving this term the meaning "skunk of skunks") is a folk medicine in general use among the Mexicans, being taken in the form of tea to cure colic, pneumonia, and other ills.

It is an official drug of the United States Pharmacopoeia for expelling intestinal parasites, and has lately found important use in treating hookworm. The plant is a common weed in many parts of the United States.

Of its use in the Philippines, Padre Mercado(19, p. 202) records:

When the seeds are taken with wine, sensation is so dulled that the drinker may be whipped without feeling the lashes and even when put to the torture does not feel it.

Under the Spanish régime the Filipinos had considerable opportunity for testing this property of the plant which the Spaniards were thoughtful enough to provide.

Blanco (3, 1:253) adds to our knowledge of the use of this plant in recording that the Filipinos eat it when cooked. The whole plant causes sweating, urination and menstruation, and is very useful in asthma and pulmonary catarrah. The cooked root is said to cure fever when taken two or three times. It has a *very strong odor that first pleases and then tires.* It is said to preserve books from maggots—if so it should be much appreciated in these Islands.

In the Philippines it is known by various corruptions of its Spanish name *alpasótes: aposótis, apasóte, aposótis, pasótis,* and *parsótis* are reported (15, 2: 125) for all the Christian peoples. With historical data lacking this would indicate that this valuable medicinal plant was actively diffused by the Spanish missionaries who were especially interested in folk medicine, since they had but little other available. Such an inference is clearly verified by the divergent nomenclature among the groups which were never brought under the bells: *libug* in Ifugao; *adlabón* among the Igorots, presumably of Benguet; and *bulbúla* in Bontoc. (15, 2: 125) All of these groups are in geographic contiguity, but are peculiarly isolated from cultural contact due to head-hunting in past times.

EUPATORIUM TRIPLINERVE Vahl.

An aromatic herbaceous plant, native of Brazil. (33, p. 253) Standley says of its use in Mexico: (21, p. 1433)

It is of little economic importance, but some species are used in folk medicine. At least one species is aromatic and used in flavoring tobacco.

Shortly before 1837 this species was introduced into the Philippines because of its reputation for medicinal properties in the treatment of bites of insects and snakes; according to Blanco: (3, 3: 8)

This marvelous plant has been talked about so much in the last few years and has marvelous virtues for a multitude of ills. It is said that its crushed leaves applied to the bites of snakes and insects will immediately cure. For bites they also drink a decoction of the leaves to induce sweat. Over the wound are placed the crushed leaves covering all with a cloth, well moistened with the decoction of the plant. This can be drunk with no unpleasant effects.

It propagates rapidly in this climate, and is cultivated by the curious.

In 1898 a more-competent scientist, the Filipino scholar, Pardo de Tavera, says: (19, p. 150)

Its infusion has an agreeable, bitter taste and is a good stimulant, disphoretic and tonic. It is used internally and locally for the bites of venomous snakes and insects. Although its virtues have been greatly exaggerated, it has in general fallen into unmerited neglect.

At present it is planted occasionally for medicinal purposes but is nowhere spontaneous.(15, 3: 598) The plant is known by variants of its Brazilian name, *apána* or *ayupána,* among the Tagalogs,(15, 3: 598) and *inpana* among the Ilocanos.(15, 3: 598) Its limited use and distribution probably accounts for the paucity of nomenclature.

ASCLEPIAS CURASSAVICA Linnæus.

An herb, a member of the milkweed family, with milky sap, red and yellow flowers, introduced to the Philippines from America, and common in the Islands.(33, p. 126) It is one of the abundant and generally distributed weeds of tropical America.

Standléy gives this information about the plant in Mexico:(21, p. 1168)

> Numerous herbaceous species of the milkweed occur in Mexico, where the juice is used locally as a drastic purgative, but it is dangerous. Palmer reports that in Durango, the leaves are applied to the temples to relieve headache.

Merrill(15, 3: 341) says that this plant is found "throughout the Philippines in the settled areas, and in open waste places in and about settlements, ascending to at least 1,500 meters."

The Philippine nomenclature is considerable, and one suspects largely descriptive. Tagalog incorrectly indicates its foreign origin by *bulak-kastíla,* Spanish cotton (apparently because of the cottonlike appendages to the seeds); while the term in nearby Pangasinan shows a more-confused geography, *kapös de francia* (*kapos* or *kapok* for tree cotton, *Ceiba pentranda,* of France).

From these terms the local nomenclature varies into a complexity of forms without any American pattern. The Tagalogs also use these terms: *kala láuan; bubuyan; bulak-bulákan; bulak-damó; bukitkit; kamantíging ligaú;* and *kapol-kapol.* The Bicols use *koronítas.* In Panay the Visayan term is *ligurias.* The Ilocanos use *sabsabrong;* and the nearby non-Christian terms show no relation to it, *anibung* and *pasanglai* in Bontoc; and in Ifugao *balihig.* The Subanun non-Christians near Zamboanga say *kambang-datu. Punganen* and *dadal* are terms reported from the Ivatan, at the other extremity of the Archipelago in the Batanes.(15, 3: 341)

The medicinal uses of this plant were taken up in the Philippines where it was known that the juice that escapes from the slightest abrasion is a drastic purgative. It is also used by local medicine men to cure dropsy. Packed in the cavities of teeth it relieves toothache and is locally applied for skin diseases and syphilis, and is used as a depilatory.(19, p. 168)

ARGEMONE MEXICANA Linnæus.

This member of the poppy family is an herb with large yellow flowers, spiny leaves, and no yellow sap. It was introduced from Mexico to the Philippines. (33, p. 125) In Mexico there are several species known by the vernacular names *chicalote* and *cardo-santo*. (21, p. 299)

The flowers are narcotic by virtue of a principle resembling morphine, and are used by the Filipinos in treating scratched eyes, according to Blanco. (19, p. 168)

About this plant Merrill says it is found, "in and about towns, a weed in waste places, widely distributed in the Philippines." (15, 2: 207) It is known by its Mexican name *chicalote;* but among the Tagalogs has usurped the name *diluáriu,* (15, 2: 207) because of the similarity of its leaves to *Acanthus ilicifolius.* Among the Ilocanos it has usurped another name, being called *kachúmba,* (15, 2: 207) a Sanskrit name carried to the Philippines from India by the plant *Carthamus tinctorius,* the leaves of which resemble those of the American plant under discussion. Another Ilocano word is *kasúbang-áso.* (15, 2: 207) On Panay we find the Visayan word *kagang-kágang.* (15, 2: 207) In the Batanes Ivatan gives this plant the name *baruás.* (15, 2: 207)

Here we see a common weed of general distribution and some folk-value carrying with it its American name, but soon losing it for descriptive terms. Because of the similarities of the leaves of this plant to other plants, it has usurped their names, one of which is a Sanskrit word brought from India.

AMERICAN MONEY CROPS IN THE PHILIPPINES

INDIGOFERA SUFFRUTICOSA Miller. Indigo.

Standley gives this account of this plant in America: (21, p. 440)

> A shrub occurring nearly throughout Mexico; widely dispersed in tropical America; and adventive in the Old World. It is generally known in Spanish America as *anil* or *Jiquelite* from the Nahuatl *xiu-quilitl* (turquiose herb). The use of this plant for a dye was known to the aboriginal inhabitants of Mexico. In addition, the plant was much used in domestic medicine.

It was introduced into the Philippines from Mexico in the eighteenth century and is known there as: *tagum-tagum* (V.); *tayum* (T.); and *anil.* (33, p. 159) In 1751 Delgado records that the women dye cotton and abacá (hemp) cloth. A little fine lime fixes it so well that it cannot be washed out. (7, p. 733)

In the next century it became an important plantation product and a considerable native industry was based upon it. In 1837, Blanco(3, 2: 292) gives us this account of the native industry:

> The natives plow the soil twice and plant the seed in November when there is little rain. They harvest at the end of July, taking off the fruit as it ripens. The plants regerminate promptly and reproduce four times without a new planting.
>
> To extract the blue dye they prepare a tub or vat of wood about 7 feet high, which is filled with cold water. The plants and leaves are put in in the morning and are left until the following day until the water becomes apple-green. Then they take out the plants.
>
> Then they put in a quantity of lime and stir the water until it takes the desired color, which requires about half an hour. Then it is allowed to rest until it settles and becomes clear.
>
> Then the vat is tapped and the liquid run off. The sediment is then taken out and put in a small pit and the water disappears from it immediately. It is then put in clay vessels and each is sold at from three to eight pesos. This is the method that the Indians use to make *lodo* or tintarón. It has good sale in the Islands and in China.

With the appearance of coal-tar dyes the industry disappeared here as elsewhere.

THEOBROMA CACAO Linnæus. Cacao.

This well-known plant is wild in the forests of southern Mexico and Central America. It was cultivated in the warmer parts of Mexico in preconquest times and is now distributed over all tropical lands.(21, pp. 805–8) In Mexico, Cortez was given chocolate by Montezuma, and the beans were used as money among the Aztecs.(10, p. 569)

The words *cacao, cocoa,* and *chocolate* derive from the Nahuatl word *cacahuatl.* The name also is applied to the peanut in Mexico because of an evident resemblance to the cacao bean; the peanut was a pre-Columbian introduction into Mexico that lost its Brazilian name, *madubi,* en route.

Standley gives an excellent account of the uses in ancient Mexico of this important plant, to which the curious reader should refer, since within the scope of this paper the writer can excerpt only a paragraph.(21, pp. 805–8)

> The original inhabitants of Mexico sometimes ate the seeds either green or dry; but the seeds were used chiefly for the preparation of a drink known as "xocoatl," this being the word from which our word chocolate derives. The word signifies "sour water," the unsweetened decoction of the seeds being unpleasantly bitter. The drink as prepared by the Mexicans was different from the chocolate as now usually prepared. It consisted of a strong decoction of the seeds flavored with chile, maize, honey, ceiba seeds, and many other substances, and the beverage was beaten into a foam

which dissolved almost imperceptibly upon the tongue. It was often colored with *Bixa orellana*"—(this plant was also introduced into the Philippines, but this use is not recorded there.)

It was the favorite drink of the Mexican nobility, who consumed immense quantities of it. It was a favorite also of the emperor, for whom almost incredible quantities were prepared every day.

A drink still much used in some parts of Mexico is "chilate," in Nahuatl *chilatl,* (chile-water, or *chilcacohuatl*) which is made from cacao, chile and water. Similar drinks are also prepared by the addition of other substances.

This plant made a great impression on the excited minds of Renaissance Europe and its use became the fashion. Guilds of chocolate mixers grew up, that often mixed it with peanuts. To the Philippines the Spaniards brought considerable lore with the plant. However, the Filipinos promptly mixed toasted rice or coffee with the cacao in preparing the beverage.

In the Philippines it is known only as *cacao.* (33, p. 35) It was introduced into the Islands about 1670, though there are two different accounts for the event. Delgado quotes Murillo Valverde who says that it was introduced in 1665 from Mexico by Governor Diego Salcedo at the instance of the Jesuit Juan de Avila. (7, p. 564) Blanco cites Gaspar de San Agustin, who says that it was brought by a pilot from Acapulco in 1670. (3, 2: 401–3) He says:

The plant was cultivated in Lipa, Batangas, in 1674, and in this province the best plants were raised up to 1830 despite the earthquakes and violent storms.

The natives plant the seeds in a small plot of ground or also in the leaves of trees, doubling each leaf into the form of a funnel with a little earth inside, which is watered from time to time, until it sprouts even in the house. Then they transplant the plants to the desired place, opening for each plant a hole a handsbreadth in depth. They also took care to plant also bananas or *achiote* (Bixa orellana) to shade and protect the cacao. They water the new plants from time to time and in three years they bear fruits. The seeds are planted 6 feet apart and the ground is kept clear of weeds.

The fruits are picked before they are ripe.

The natives have already made great use of the cacao for many of them drink chocolate. For this they mix one-eighth part of toasted rice or more and prepare a chocolate that is very palatable. Others add toasted coffee.

The plant had an extraordinarily wide and rapid diffusion in the Philippines. Writing in 1751, Delgado says: (7, p. 564)

The plant has done well in these islands and we no longer have to send to Mexico for it. Almost all the Visayans plant it and in Mindanao the Moros bring it to Dapitan to sell because there is much of it around Lake Malanao (Lanao). The Subanos (river people) who inhabit the rivers of

Mindanao gather much cacao and transport it to Manila where it finds a ready market.

Although the quality produced is good, even at the present time the cultivation is primitive with little or no attention paid to the fungus and insect pests to which the plants are susceptible. (32, p. 35) By 1915 the cultivation had dwindled to 1,169 hectares. (40, p. 21)

GLIRICIDIA SEPIUM (Jacquenot) Steud. Madre de cacao.

This is a tree distributed throughout Mexico where it is called *cacahuanano* from the Nahuatl *cacahua-nantli* (cacao-mother). It is a favorite shade tree for coffee and cacao. (21, p. 482)

It was introduced into the Philippines in the eighteenth century for the same purpose and for which it is still used, being cultivated in many cacao plantations. It has become spontaneous in many localities and is of general distribution. (32, p. 31)

In the Philippines this plant bears the same name as the Mexican word for peanut, *kakauati,* an interchange of terms that involves a great deal of history and historical reconstruction.

The Philippine nomenclature of this plant, the humble handmaiden to the "Drink of the Gods," the Mexican *cacao,* embalms much pre-Columbian history in far-away America, which is here briefly recapitulated.

In ancient Indian Mexico *cacao* was of such importance as to have firmly patterned its nomenclature about the Aztec word *kakahuá,* or *kakauáti.* (15, 2: 281) When that useful plant the peanut arrived in Mexico its resemblance to the cacao caused the Aztecs to call it *tlalkakauatl,* and as *cacahuate* (Mex.) the peanut is known all over Mexico.

In the conquest of America the Spaniards encountered the peanut elsewhere, obviously at some point where, in its migration from Brazil, it has modified its Brazilian name *mandubi* (5, pp. 411–13) to *mani,* which term the Spaniards took up, rather than the Mexican term *cacahuate.*

Upon the introduction of the peanut into the Philippines by the Spaniards it carried its Spanish name *mani,* (4, 2: 283) which is still the commonest term. However, due to the constant contact with Mexico, the Mexican term, *cacahuate,* could not be kept out. Still it is less common than the Spanish term *mani* in Philippine nomenclature.

When the key plant, the cacao (*Theobroma cacao*), was introduced into the Philippines by the Spaniards, it dropped its

Aztec word *kakahuatl* completely; and now it is known by its hispanicized form *cacao* everywhere in the Islands.

However, for the handmaid of the great cacao, the "mother of cacao" under discussion, the original word for cacao trails along and appears as *kakahuati*(15, 2: 281) in the Philippines, which is also the less common name for the peanut.

This explanation of the stealing of the Aztec term for cacao by both the peanut and the "mother of cacao" in the Philippines illustrates the conservatism of plant nomenclature in cases when an introduced plant is culturally important in its new habitat, and shows the utility of plant nomenclature as a tool for historical reconstructions to bridge over gaps where better data are missing.

Let us examine what happened to our Aztec word, *kakauati*, upon introduction into the Philippines and applied to the "mother of cacao" instead of her famous daughter. The plant is commonly called from the Spanish *madre de cacao*,(15, 2: 281) but the Tagalogs keep the original Aztec in *kakauati*. They seem possibly to have mixed and combined the terms in *marikakáu* (15, 2: 281) (*Maria*, Mary, and *cacao* Sp.).

This term proves especially conservative, for it carries as far north as isolated Bontoc as *kakaoati*,(15, 2: 281) possibly as an important shade tree for coffee which is common at that altitude. The term carries its cacao element as far south as Sulu in *mandiri-kakaú*. (15, 2: 281)

Only once is a local term reported for this plant; among the Tagalogs it is also called *balok-balok*,(33, p. 153) a transfer of names from the remotely similar plant *Pongamia pinnata*.

HEVEA BRASILIENSIS (HBK.) Muell.-Arg. Para rubber.

Rubber is undoubtedly the most useful nonfood vegetable substance in modern civilization. Apparently its use and properties were unknown to white men until the discovery of America brought to their attention its use among the Indians, which is a cultural contribution of capital importance.

So valuable has the substance become that a world-wide search of the Tropics for plants that bear this latex has revealed many kinds of latex-giving vines and trees; but none yields so excellent a product as *Hevea brasiliensis*, although other American species are also common.

Columbus found that the natives of Haiti possessed among other amusements a game of ball. "The balls were of the gum of a tree, and although large were lighter and bounced better than the wind balls of Castille."(13, p. 3)

The latex-producing tree (*Castilloa elastica*) was described by Juan de Torquemada in Central America where it was called *ulequahuital.* It was held in high esteem by the natives, the latex being allowed to coagulate in calabashes or simply smeared over the bodies of the collectors. The rubber so prepared was used in making balls or for shoes for tumblers or jesters whose antics it assisted. A medicinal oil was extracted from it. The Spaniards used the latex to waterproof their cloaks.(13, p. 3)

The first accurate account of Para rubber (*Hevea braziliensis*) was given by G. M. de La Condamine, who visited the Amazon country in 1735. He describes various uses of rubber among the Omaguas Indians, including that of making syringes or squirts which had an important place in social gatherings and religious festivals.(13, p. 3)

Erland Nordenskiold(17, p. 184) gives the classic references to syringes in South American culture and shows that the aborigines also invented the use of the enema, which was adopted by the Portuguese, who carried its use to Europe and Asia. The Indians used the enema-syringe not only as a medicine but also as a mode of taking an opiate *parica* from the seeds of *Piptadenia.* So taken it produces the blissful intoxication of opium and may have been used as an anæsthetic in trepanning.

To the present time the native workers among the wild rubber trees of Brazil are called *serigueros.*

In England, Priestly, the discoverer of oxygen, found that the gum would erase pencil marks, hence its common name, rubber. (18, p, 5)

The first English patent was for its use as waterproofing, taken out in 1791. In 1839 an American, Nelson Goodyear, discovered the process of vulcanization by combining rubber with sulphur. Since then it has come to play its important rôle in modern civilization.

Sherman, in an excellent monograph,(37, p. 1) shows that in parts of the Philippines there occur vines [*Parameria barbata* (Bl.) K. Schum., and others] that produce a good grade of rubber. The people of Tawitawi (southeast of Jolo) know its commercial value and collect it for sale in Borneo.

In Mindoro the vine is known as *ductung ahas,* apparently *ductung,* to cut, and *ahas,* snake; arising from the curious belief that if a snake is cut in two and smeared with the latex, it will recover.

The only so-called rubber trees in the Philippines prior to the American occupation was the beautiful India rubber tree (*Ficus* *elastica*), which was introduced throughout the Archipelago by the Spaniards as ornamental shade trees rather than as rubber producers.

Realizing the economic value of rubber, the Government of the Philippine Islands sent Dr. P. L. Sherman to the rubber-producing countries of Malaysia in 1902. He introduced *Hevea brasiliensis* in the Philippines where it was found to grow with great success. Researches since that time have shown that Mindanao offers ideal natural conditions for the production of rubber on a large scale. On the nearby island of Basilan there have been rubber plantations in production for many years.

MISCELLANEOUS USEFUL AMERICAN PLANTS

BIXA ORELLANA Linnæus.

A shrub or small tree, 2 to 9 meters high, having a prickly pod containing numerous seeds with a fleshy, bright orange covering. From its fruit is obtained the *annatto* of commerce for coloring cheese and butter and silk. It was introduced from America and is common in the Islands but has no commercial value.

It is indigenous in tropical America, where it is used for coloring cooked rice, and was one of the first plants transplanted to southern Asia and Africa. (5, p. 401)

Standley gives us this information about the plant: (21, pp. 835, 36)

> The name *Bixa* comes from the native name *bija*, or *bixa* in Panama, while the specific name *orellana* was given in honor of Don Francisco Orellana, the disloyal but famous captain of Pizarro, who achieved one of the most remarkable explorations in history in the descent of the Amazon from its headwaters.
>
> The plant has had wide usages among primitive peoples. It was used extensively by the Indians of Mexico, Central America and the West Indies for painting their bodies, partly for ornament and also for protection against mosquitoes and other insects. It was early introduced into the Pacific islands where the natives soon learned to use the dye in the same way.

In the Philippines a less picturesque and much less primitive use was made of this dye. Pardo de Tavera, (19, p. 32) at the end of the nineteenth century, writes: "Everyone knows the yellow color that Filipino cooks impart to almost all their dishes by this plant." Even this use has largely disappeared.

The Tagalogs still preserve the Mexican word closely in *achóte*, (15, 3: 103) but vary it considerably in *atseuéte* and *asuíti*. (15, 3: 103) The commonest word in the Archipelago is *achuéte*, which extends to the Tagalogs, Bicols, Zambals, Ilocanos, and the Panay Visayans, keeping close to the original name.

In the Visayan islands this general term did not reach Cebu, where *sótis* (15, 3: 103) represents a new variation from the original. In more isolated Samar and Leyte this becomes *chótes*, (15, 3: 103) due to contacts with Cebu, their nearest Visayan neighbor.

In Sulu it is possible that *chotes* is the prototype for the local word *chanang*, which varies to janang. (15, 3: 103) These words are quite unrecognizable from their Mexican original.

Nearer Manila the Mexican word is carried with little variation to the Tagbanuas of the interior of Palawan where it is known as *achoéte*.

This extraordinary variability of nomenclature clustering around the Mexican name *achiote*, means something interesting to the student of culture. Historic and ethnographic data are quite lacking. What reconstruction may properly be attempted, with the little botanical and comparative material available?

Merrill says of this plant that it occurs "in and about towns throughout the Philippines, usually planted, but at least persisting after cultivation has been abandoned." (15, 3: 103) This shows that the plant had sufficient folk-use to have been distributed everywhere by man, a usage important enough to cause the plant to keep its American name within great variation.

The only historic material available about the Philippines comes at the end of the nineteenth century, when Pardo de Tavera writes of its use for coloring food. Even this use has largely disappeared.

Plenty of comparative materials have been summed up by Standley in the quotation on the preceding page, and in view of this indirect evidence, the patterns of nomenclature for this plant in the Philippines force the conclusion that these varied uses once played a part in Philippine culture.

ANACARDIUM OCCIDENTALE Linnæus. Cashew.

A small tree cultivated for its edible fruits, the seeds of which yield a valuable oil, (33, p. 125) or are eaten roasted. (40, p. 215) De Candolle reaches the opinion that this tree is of American origin and quotes Ernst that it is indigenous in the Amazon basin, (5, p. 199) although Sturtevant thinks that it is indigenous in the West Indies, Central America, and South America. (10, p. 47) It grows wild generally in dryer parts of Mexico and Central America. The Portuguese introduced it into India and the Malay Peninsula. (5, p. 199)

In the Philippines it is of wide dissemination, but not extensively cultivated. (40, p. 215) It has these native names: *casoy* (T. and V.); *casuy* (T.); *bollogo* (Il.); and *balubad* (T.).

The fruit and receptacle are the most important products of the tree. The enlarged basal part, receptacle, is red or yellow, pear-shaped, and very fleshy and spongy. It is astringent when green, but when ripe has a pleasantly acid flavor. The pericarp of the fruit contains an oil, cardol, which is acrid and caustic. The roasted kernels are edible, having a pleasant milky flavor.

The gum resin contains 90 per cent of anacardic acid, and 10 per cent cardol. In the Philippines, wood soaked in it is preserved from the ravages of white ants, for which purpose it is also used by bookbinders. (19, p. 85)

The nomenclature for this plant in the Philippines shows considerable local development. The most constant term of widest diffusion is *kasúi;* enough like the English word *cashew* to allow us more than a suspicion that both are derived from an unknown American word.

The Tagalogs use the term *kasúi* which carried unmodified also to the Ilocanos in northern Luzon. It carried to the Ibanags of Cagayan Valley as *kasói,* and among the Igorots as *kosing.* To the southernmost Sulu the term went as *kasul.* (15, 2: 469)

There is also much variation in terminology in the different dialects. *Kasui* varies to *kachuí* among the Tagalogs, among whom a whole cluster of terms arose: *balúban, balúbat, balúbar, balumbang, balúbad.* (15, 2: 469) From Ilocano a wide variation is also reported: *kológo, balógo, balúgo,* and the odd term, *sambalduke.* (15, 2: 469)

Thus we see the terminology of this relatively unimportant plant widely diffusing on the form *kasui;* but also showing a strong tendency to dialectic patterning on local words.

FRAGRANT FLOWERING PLANTS

CESTRUM NOCTURUM Linnæus. Dama de noche (lady of the night).

A shrub with small tubular flowers which fill the air at night with a delightful fragrance. It was early introduced into the Philippines, for we find mention of it by Mercado writing in 1650. (3, 4: 3, 59) It is known everywhere among the Filipinos by its Spanish name, *dama de noche,* which indicates a high value or extraordinary esteem on their part and merits the ethnologist's attention.

The Filipinos from time immemorial have loved fragrant smells and in Philippine culture perfumes have entered deeply. The Spaniards found them using perfumes which they got from the *ilang-ilang* (*Canangium odoratum*) and civet cats, as well as perfumes they got in trade with Chinese.

In many dialects to kiss and to smell is the same word, for the old, and still to a greater or less degree prevalent, custom was to kiss by smelling. Jagor noted lovers smelling if not their beloved, then some article belonging to the sweetheart, commonly a handkerchief. (11, p. 132) Another foreigner, even more conversant with the Philippines, Foreman, says that they do not kiss, but smell each other, placing the nose and lip on the cheek and drawing a long breath. (9, p. 181)

In Nueva Vizcaya the author learned an interesting origin myth of that region, about the pine tree. The pine tree was an ugly girl who prayed the gods to be changed into a form that everyone would love. She was changed into a pine tree, which all men kiss. This story was quite unintelligible until it was explained that before the tree is cut down the woodsman gashes the tree, and smells it to ascertain if it contains enough pitch for good firewood. Thus, since kissing and smelling were synonymous in their ideology, the girl had had her petition granted.

Jagor's footnote [1] reports the identical custom from India.

This plant is planted around the houses in every town and barrio in the Philippines. Indeed, one of the charms of night in the Islands is the cool night breeze, strongly scented with its delicate fragrance.

In other countries it is known by similarly descriptive names, according to Standley. (2, p. 1282)

> *Huella de noche* (smells at night) in Puebla, Coahuilla, and southern Mexico; *galan de tarde* (gallant of evening) in Oaxaca; *galan de noche* (gallant of the night) in Guatemala and Cuba; *reina de noche* (queen of the night) in Guatemala.
>
> Though it is poisonous, an extract of the plant is employed as an antispasmodic, especially in epilepsy in Mexico.

This use of the plant did not penetrate into Philippine culture.

[1] "Lewin (Chittangong Hill tracts 1869, S.46) erzählt von den dortigen Bergvölkern: 'Ihre Art zu küssen ist sonderbar: statt Lippe an Lippe zu pressen, legen sie Mund und Nase auf die Wange, und ziehn den Atem stark ein. In ihrer Sprache heisst es nicht: Gieb mir einen Kuss, sondern; rieche mich.' " Reisen in den Philippinen (1873) 132.

PLUMIERA ACUMINATA Ait. Temple flower.

The temple flower is an American plant very common in Mexico from where it was introduced into the Philippines. It is a tree with very fragrant white or yellowish flowers, and is extensively planted in the Philippines. When in bloom the tree is covered with the blossoms, which children and girls thread on strings to wear, much as the Hawaiian *leis*, which is often made of the same flower. In the Philippines this use is by no means as important as the Hawaiian use of the leis.

The trees are commonly planted in the plazas of Philippine towns, but they are esteemed less than the brilliant red-flowered flame tree (*Delonix regia*) which, though a native of Madagascar, is called *caballero* or *arbol de fuego*, indicating Spanish introduction into the Islands.

The temple flower carried its Aztec name *kalachúche* into all dialects of the Philippines where the Spanish influence was strong. The Tagalogs use *kalachúche, kalasúsi, kalatsútsi, kalasási, karachúcha*, and *karatúche*.(15, 3: 321) The first of these names carries to the Bicols of southern Luzon.

The Ilocanos of the north say *kalanúche* or *kalonóche*. Among the Visayans of Panay the term gets varied to *kachúchi*.

SUMMARY

The diffusion of American plants in the ethnobotany of the Philippines was aided by one of the strongest forms of organized diffusion, missionary zeal. The great mission establishments that Spain had planted over most of America had their counterpart in the Philippines, where they dominated everything. These missions were great educational establishments that not only Christianized the natives and taught them "right manners and good conduct," but also educated them in the use of domestic animals, improved agricultural technics, better household arts, etc. New plants were introduced, and their cultivation was taught to the natives.(2, vol. 1, Introduction)

Despite this organized aid, some of the American plants—camotes and tobacco—extended to many parts of the Archipelago before the missions were established, while others, especially American fruits, lagged despite the best efforts of the missionaries.

Tobacco had the greatest effect on primitive cultures of the Philippines. It first promptly attached itself to the buyo complex, and then like the ungrateful camel in the Arab's tent, largely displaced betel nut in the ceremonial, social, and everyday life of the people. Smoking tobacco, rather than chewing, is the commonest form of narcotic pleasure in the Islands. Tobacco carried its foreign name even to groups isolated from Spanish contact.

No American plant furnished alcoholic beverages. The pulque complex was not introduced with the agave, since the native people of the Islands had a plentiful supply of liquor from the coco palm (*tuba,* an excellent drink) in Mindanao and Visayas, and *basi* from sugar cane in the north, as well as rice wine everywhere. All Spanish accounts, even that of sympathetic de Morga, agree that the natives drank a great deal, and to excess at all ceremonials, as most primitive people still do. The friars stamped out this practice almost completely, and nowadays the sight of an intoxicated Filipino is rare indeed.

Turning from vices, which in cultural contacts seem to spread faster than other traits, we see that, though the camote spread with amazing swiftness, it failed to integrate as well as tobacco into the culture, and is still thought of as a food fit only for the poor. Corn has the same status in the psychology of the Filipinos and its spread was slower, as it had to compete with an elaborate rice complex. Corn serves only as a catch-crop, though it is a staple where rice does not grow to advantage. In Cebu and in Cagayan Valley it replaced rice for a population in excess of a million. In the utilization of corn, it was taken completely out of its characteristic Mexican complex and fitted into the prevailing rice patterns. Squashes and tomatoes have long been important vegetables in the Philippines because they supplied deficiencies in the local diet. Beans and chiles, like corn, escaped completely from their Mexican contexts, beans being used mostly as a vegetable, string beans.

The prominence of Mexican plants in the American element of the ethnobotany of the Philippines is noteworthy. This resulted from the continuous contacts of the Islands and Mexico in the long trade monopoly between Acapulco and Manila from about 1600 to 1820. The South American plants, potatoes, peanuts, and cassava, were common in Mexico before the Spaniards came. Some other South American plants of the Amazon Valley found a diffusion across the Atlantic into Europe and thence into Asia, but these diffusions were on the whole more recent. We have seen how one of these plants, the pineapple, thus travelled from west to east and entered the Philippines from China. For this plant the Filipinos found an extraordinary use, in extracting the fiber for use in weaving their most highly esteemed fabric, piña cloth. Like silk in China and Japan, piña cloth in the Philippines furnishes the material for clothes of prestige, social ritual, and ceremony.

The American fruits were, in general, slow to spread, except the guava, which soon came to grow wild everywhere from the seeds dropped by birds. The papaya was so useful that its culture became common. Most of the American fruits, however, are even now commoner around Manila, the center of diffusion, than elsewhere. The reason for this slow diffusion is obvious; the Filipinos are already bountifully supplied with a considerable variety of excellent fruits of pre-hispanic introduction.

The American medicinal plants represent a cultural migration in which the lore and technic as well as the plants were introduced. The early Spanish missionaries were keenly interested in medicinal plants and in folk medicine, and having none other, often used them on themselves. The first work on Philippine botany is Fr. Mercado's notes on medicinal plants written in 1650. Another friar, some centuries ago, naïvely informs us of the *Indios*, "But it is in their superstition that they most show their savagery. They think that disease is caused by the flight of the spirit, whereas all intelligent men know that sickness is caused by fluctuations of the humors." To-day his ideas are as strange as those he criticized.

Among the American plants were some which became important money crops in trade with China and Mexico, and which were finally given great impetus with the opening of the Suez Canal in the nineteenth century. The first of these plants was tobacco and then cacao. Both immediately became popular, and considerable interisland trade grew up. The cacao business flourished for two centuries and then died out because of fungous disease and lack of care of the delicate plants. There are a few cacao plants in Lipa, Batangas, once a great center of this industry, but now these are a curiosity. In spite of the poor farming methods, the tobacco business is still important. A century after the introduction of cacao, indigo was introduced from America and an important business in this dye grew up with China. This lasted until the artificial dyes became cheaper. The other great American profit crop, greater in potentialities than actualities, however, is rubber, the spread and development of which is one of the most fascinating chapters of modern industry.

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APLOCHEILUS LUZONENSIS, A NEW PHILIPPINE CYPRINODONT [1]

By ALBERT W. HERRE
Of Stanford University, California
and
GUILLERMO L. ABLAN
Of the Fish and Game Administration, Manila

ONE PLATE

APLOCHEILUS LUZONENSIS Herre and Ablan sp. nov. Plate 1.

Dorsal 5 to 7; anal 15 to 18; 30 to 35 scales in a longitudinal, 10 in a transverse series; 19 to 21 predorsal scales to the large scale on the occiput.

Body laterally compressed, head flattened above; depth 4 to 4.3 times, head 3.4 to 4.25, and caudal about 4 in length; the circular eye 2.7 in head, much longer than snout, and a little less than the width of the interorbital space; origin of the dorsal above the 12th anal ray; longest dorsal and anal rays equal, 4.7 to 5 in length; least depth of caudal peduncle twice in head; anal origin approximately midway between pupil and caudal base; ventral origin halfway between tip of snout and posterior angle of anal base; pectoral a little shorter than head; the truncate caudal has square corners.

Color in life gray, with a yellow sheen above and a silvery luster along the sides; a dusky stripe extends from upper angle of opercle to caudal base, most evident posteriorly; some specimens have black spots scattered over the sides posteriorly, and on the caudal base; dorsal, anal, ventrals, and upper and lower portions of caudal are usually yellow or yellowish, but may be colorless; sometimes there are one or two cross rows of black spots in the central part of the basal half of caudal; pectorals colorless.

Color in alcohol varies from pale gray to blackish, often with black specks on the caudal peduncle; a very narrow blackish lateral line is usually present; a blackish line runs along the

[1] Contribution No. 5 from the Fish and Game Administration, Manila.

middle of the back from head to dorsal fin; sometimes there is a blackish line above the anal base; the fins are usually colorless, but all of them may be black or blackish; the caudal often has one or two rows of black spots basally.

Type: No. 41062, Fish and Game Administration collection, 30 mm in length, and 29 cotypes from 24 to 30 mm in length, collected by the junior author from a creek and from rice fields at Solsona, Ilocos Norte, Luzon, October, 1933.

Over 500 living specimens collected at the same time were placed in the Manila Aquarium, Fish and Game Administration, and are under observation at the time of writing, December 20, 1933. More than 500 alcoholic specimens, 9 to 30 mm in length, from the same locality, are also in the collection. A few cotypes and other specimens are also in the collection of Stanford University, California.

The present new species is very close to *Aplocheilus celebensis* from which it differs in having a slenderer body, fewer predorsal scales, and a smaller transverse scale count. It is very distinct from all other species of the genus in having a truncate caudal fin.

We append a comparison of the number of fin rays and scales in the species of *Aplocheilus* occurring from India to Japan.

Species.	Country.	Fin rays.		Scales in lateral line.
		Dorsal.	Anal.	
A. luzonensis	Luzon	5–7	15–18	30–35
A. celebensis	Celebes	7–9	17–21	30–32
A. javanicus	Java	7	21–23	29–30
A. latipes	Japan	6	19–20	29
A. melanostigma	India	6–7	20–24	27
A. timorensis	Timor	9	17–19	31–34

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ILLUSTRATION

PLATE 1. *Aplocheilus luzonensis* sp. nov.; from the type. (Drawing by Antonio Verzosa.)

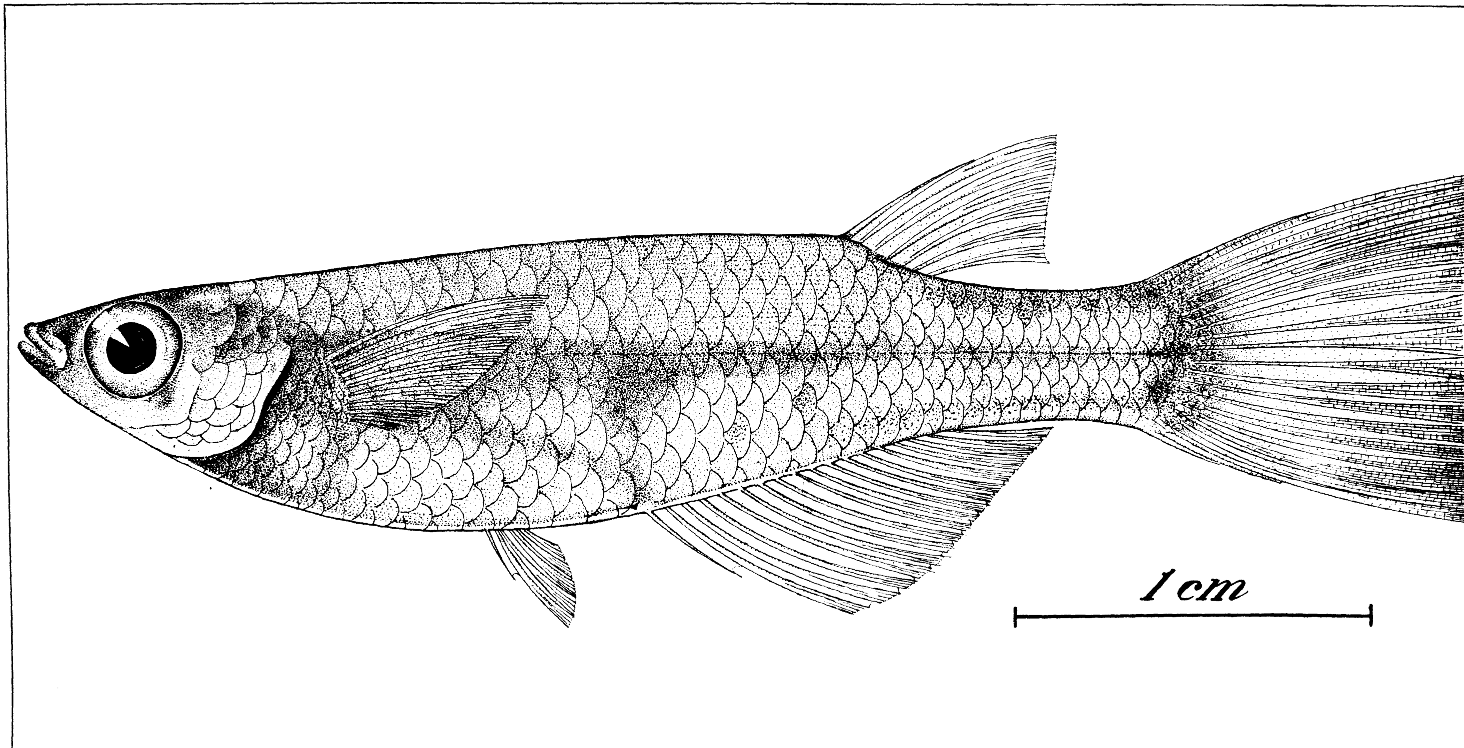

PLATE 1. APLOCHEILUS LUZONENSIS SP. NOV.; FROM THE TYPE.

NEW AND LITTLE-KNOWN PHILIPPINE COLEOPTERA

By K. M. Heller

Zoölogical Museum, Dresden, Germany

ONE PLATE AND FOUR TEXT FIGURES

In this paper I have given descriptions of some new species, and supplementary and correcting notes on earlier species some of which were based on single specimens. The studies of which this paper is the result were facilitated by material collected by the late C. F. Baker, the late G. Boettcher, the late O. Schütze, Mr. F. C. Hadden, of the Hawaiian Sugar Planters' Association and at one time resident at the College of Agriculture, Los Baños, Luzon, and Mr. W. Jark, of Hamburg. Owing to Mr. J. D. Alfken, custodian of the Bremen Museum, and to Mr. H. Gebien, of Hamburg, typical specimens of all species herein described are represented in the Dresden Museum. The museum, moreover, has other important material, obtained through the kindness of the late J. Moser and, by acquisition, through Staudinger and Bang-Haas.

In the following list only new species have been supplied with numbers; upon the remaining items only supplementary and synonymic remarks are given.

DYTISCIDÆ

1. *Sandracottus angulifer* sp. nov.

CERAMBYCIDÆ

LAMIINÆ

Cereopsius mindanaoensis (W. Schultze).

2. *Cereopsius marmoratus* sp. nov.
3. *Agelasta basimaculata* sp. nov.
4. *Enispia samarana* sp. nov.

Atelais (*Sybra?*) *roseolata* Heller.

Atelais (*Sybra?*) *bifasciata* Heller.

5. *Epaphra minor* sp. nov.
6. *Glenea vestalis* sp. nov.
7. *Glenea pistrix* sp. nov.

Glenea dido Aurivillius and other species.

CURCULIONIDÆ

SITONINI

8. *Catachaenus sulcifrons* sp. nov.

PACHYRRHYNCHINI

9. *Pachyrrhynchus stellulifer abranus* subsp. nov.
10. *Pachyrrhynchus orbifer murinus* subsp. nov.

Exnothapocyrtus lixoides Heller.

11. *Metapocyrtus currani* sp. nov.

CELEUTHETINI

12. *Pseudottistira subtuberculata* g. et sp. nov.
13. *Eupyrgops maquilingi* sp. nov.
14. *Neopyrgops prasina* sp. nov.

HYLOBIINI

15. *Styanax inconspicuus* sp. nov.
16. *Orthorrhinus rugosus philippinus* subsp. nov.
17. *Orthorrhinus brevirostris* sp. nov.

ALCIDINI

18. *Alcides alfkeni* sp. nov.
19. *Alcides haddeni* sp. nov.
20. *Alcides mimus* sp. nov.
    Alcides dipterocarpi G. A. K. Marshall.

MENEMACHINI

21. *Acicnemis haddeni* sp. nov.

CAMPTORRHININI

22. *Pachyonix inversa* sp. nov.

CRYPTORRHYNCHINÆ

TYLODINI

23. *Tragopus* (?) *sexpunctatus* sp. nov.

CRYPTORRHYNCHINI

24. *Sclerolips reducta* sp. nov.

ZYGOPINI

25. *Nauphaeus alboplagiatus* sp. nov.

CALENDRINÆ

26. *Anathymus lineatocollis* sp. nov.

SPHENOPHORINI

27. *Cosmopolitus pruinosus* sp. nov.
    Cosmopolitus sordidus Germar.
28. *Sphenophorus octomaculatus* sp. nov.
29. *Eugithopus bilineatus* sp. nov.
    Eugithopus interruptolineatus (Heller).
    Eugithopus flavoplagiatus (Heller).

CRYPTODERMINÆ

30. *Cryptoderma fractisignum* sp. nov.

SCARABÆIDÆ

CETONIINI

Podopogonus boettcheri Moser.

LUCANINI

Gnaphaloryx opacus Burm.
Metallactulus parvulus Hope.

FIGULINI

Nigidius montanus Heller.

DYTISCIDÆ

1. SANDRACOTTUS ANGULIFER sp. nov. Male. Plate 1, fig. 1.

Ellipticus, niger, elytris maculis obscure aurantiacis (vel luridis) macula subsuturali, postmedia, subsuturali angulata ornatis; capite lurido, fronte inter oculos ante fascia obtusangulata, post altera, sed medio interrupta, a präecedente aeque distante, nigris; prothorace nigro, lateribus late lurido-marginato, medio, juxta marginem, macula minuta lurida; elytris seriis tribus (exterioribus vix observandis) perremote punctatis, margine laterali, triente apicali excepto, ut ramo brevi, post humerum oblique reflexo, fascia media, brevi undosa oblique promota, aurantiacis, praeterea, eadem colore; utrinque maculis tribus, in margine basali, harum media minima, intima, maiore, circulari, extrema vittiforme, altera lineola, subapicali, marginali, obliqua, altera punctiforme, suturali, apicali. Long. 14.5, lat. 8.5 mm.

MINDANAO, Davao (ex coll. C. F. Baker 7251).

An easily discernible, black, exactly elliptic species; head, margin of the prothorax, elytra with the exception of the apical third, and diverse spots on the elytra dull orange-yellow. These spots are best shown in the figure on Plate 1, which has the characteristic obtuse, angulate, subsutural marks medially.

It differs from *S. bakeri* Régimb. and its variety *ornatus* Sharp especially by the black prothorax, bordered with yellowish laterally.[1]

CERAMBYCIDÆ

CEREOPSIUS MINDANAOENSIS (W. Schultze).

Pharsalia mindanaoensis W. Schultze[2] must be transferred to the genus *Cereopsius*. It is closely related to *C. varius* m., from Celebes,[3] and to the following new species from Mindanao.

2. CEREOPSIUS MARMORATUS sp. nov. Male. Text fig. 1.

C. mindanaoensis W. Schultze affinis, sed niger, subtilissime griseo-, in elytris albo-nigroque marmorato-pubescens; prothorace longitudine latitudini fere aequali, spinis lateralibus minus acuminatis; antennis concoloribus nigris, opacis, scapo remote punctulato; elytris latitudine humerali plus duplo longioribus, eodem modo irregulariter remoteque, post sensim subtilius punctatis; corpore subter subtilissime, mesepisternis densissime albido-pubescentibus. Long. 22, lat. 7 mm.

MINDANAO, Davao (ex coll. C. F. Baker).

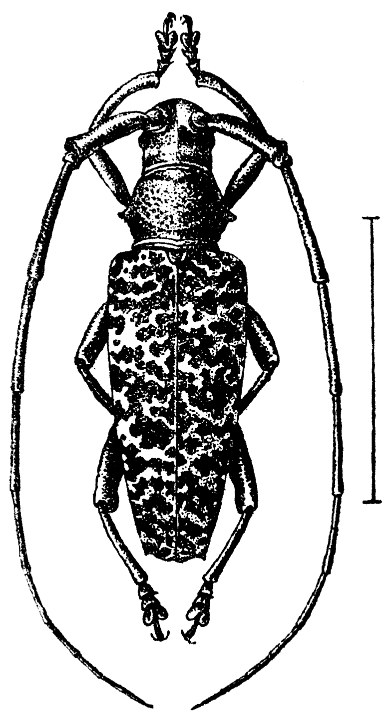

FIG. 1. *Cereopsius marmoratus* sp. nov., male.

Very close to *C. mindanaoensis* W. Schultze, but the body and antennæ entirely black, and the pubescence, instead of ochraceous, whitish throughout. Pro-

[1] Ann. Soc. Ent. France 68 (1894) 338.
[2] Philip. Journ. Sci. 16 (1920) 197, pl. 1, fig. 7.
[3] Abh. Ber. Mus. Dresden No. 3 (1898) 35, pl. ——, fig. 10.

thorax distinctly longer, its subapical and subbasal furrow less impressed, the lateral tooth less acute. Underside delicately, the mesepisterna densely, whitish pubescent. The related *C. varius* m. has a much broader prothorax than either species mentioned, and a double carina in front of it.

Another allied species, which I know only by description, is *Cereopsius guttulatus* Auriv.[4] from Kina Balu, Borneo, but it differs from all similar species in that the prothorax has two transverse carinæ medially, each carina bearing three tubercles.

3. **AGELASTA BASIMACULATA** sp. nov. Plate 1, fig. 6.

Niger, cretaceo-tomentosa, corpore lateribus, fronte, elytris fasciis duabus, latis, per suturam interruptis parteque apicali parum lutescentibus, omnino punctatione nigro-glabra, dispersa, partim vermiculoso-confluente, humeris tuberoso-productis ut macula parva, transversa, utrinque ad scutellum, altera longitudinali, post acuminata, intra humeros, nigro-glabris; antennis subter nigro-fimbriatis, articulis, duobus basalibus griseis atque quinque nigris apicalibus exceptis, lutescentibus, apicem versus nigricantibus. Long. 18.5, lat. hum. 8.5 mm. LUZON, Tayabas, 14. IX. 1930 (ex coll. F. C. Hadden).

According to the synopsis[5] this species must be placed near *basispreta* m., which likewise has the shoulders produced, but which may easily be distinguished by the different color of the toment. Front faintly yellowish, dispersely and finely punctate, each point circled in black, vertex whitish. Antennæ gray with the three basal joints yellowish brown, on the apex blackish, the six apical joints entirely black, the whole antennæ fringed with black beneath. Prothorax also white tomentose and black vermiculosely punctate, a small transverse dot on either side of the disk impunctate. Scutellum rectangular, transverse, white. Elytra not quite twice as long as broad, with a shining black humeral cone, basal margin on either side of the scutellum with a small transverse spot; inward from the shoulders with a greater, oblong-triangular, black spot and an indistinct oblique-arcuate band beginning on the base of the suture and running to the middle of the metapisterna; furthermore, posteromedially a similar, but nearly straight, band, like the apical part, yellowish. Legs and tibiæ gray, dotted with black, the latter blackish towards the apex. Front legs elongate, tarsi gray.

[4] Ark. för Zool. Stockholm Nr. 5 15 (1923) 22.
[5] Ent. Mitt. Berlin (1923) 207.

4. ENISPIA SAMARANA sp. nov. Plate 1, fig. 10.

E. venosa Pasc.[6] simillima, sed aliter colorata atque signata, praesertim capite albido, antennis unicoloribus fulvis; prothorace maculis punctiformibus, subobscure aurantiacis, octo ornatis, nam altera utrinque in margine antico posticoque, altera utrimque in disco et post medium; elytris fascia subbasali, in primo quinto, undata, eodem colore aurantiaca atque in sutura post breviter producta, altera in secundo triente, fortiter undata atque una subapicali transversa, ut parte apicali plus minusve, tibiisque, apice excepto, albidis. Long. 8, lat. 3.2 mm.

Insula Samar (ex coll. C. F. Baker 22752).

Very similar to *E. venosa* Pasc.[7] The pubescence of the head, however, is whitish, and that of the antennæ is uniform reddish brown; prothorax with eight dull orange dots, one pair on either side of the disk, one each on the anterior and posterior margins, and one behind the middle, somewhat nearer to the lateral margin than to the median line. Elytra on either side of the scutellum with a transverse black spot, in the fifth basal part a waved rusty band which is shortly produced posteriorly along the suture, in the second third another rusty band, more waved, bounded by black spots; behind these a short transverse band more or less whitish pubescent as are the tibiæ, except for the black tips.

Atelais (*Sybra?*) *roseolata* Heller, from Mount Maquiling, and *bifasciata* Heller, from Mount Banahao [8] must be transferred to the genus *Epilista* and come under the synonyms of *Epilista guttulata* Auriv. and *bifasciata* Auriv.,[9] which have priority. My description of *roseolata,* moreover, failed to mention that it is represented on pl. 2, fig. 5.

5. EPAPHRA MINOR sp. nov. Male, female. Plate 1, fig. 8.

E. valga New. similis, sed minor, supra violaceo-nigra atque fortius punctata; prothorace minime longitudine latitudini aequali, vitta lateromarginali ut in *valga;* elytris maculis stramineo-tomentosis aliter dispositis atque formatis, nam: singulis, una, minuta, oblonga, basali in medio, altera, fere circulari, in primo quinto, altera minore subsuturali, ante medium atque vitta, medio interrupta, in triente apicali; corpore subter inpube, metaepisternis in dimidia parte anteriore, metasterno solum macula oblonga, obliqua in angulis externis, posticis,

[6] Trans. Ent. Soc. London II 5 (1864) 51, pl. 1, fig. 1.

[7] Loc. cit.

[8] Ent. Mitt. Berlin-Dahlem 13 (1924) 211.

[9] Ark. för Zoolog. Stockholm No. 25 15 (1923) 23.

abdomine seriis duabus, altera submediana, e maculis minoribus, altera, marginali, e maculis maioribus formatis, stramineo-tomentosis. Long. 9 ad 14 mm.

LUZON, Prov. Laguna, Pañgil, prope Paete, F. C. Hadden legit (ex coll. Dr. Reinh. Meyer, Darmstadt) in Mus. Dresden.

Smaller than *E. valga* New., puncture of the upperside coarser, the underside, except for the yellowish spots, shining smooth, prothorax and elytra black with an intense violet shimmer, the straw-colored spots different in form and arrangement; namely, each elytron has a small oblong spot in the middle near the base, in the first fifth another nearly circular spot, nearly of the size of the middle coxæ, a point anteromedially, near the suture, and a stripe in the apical third, interrupted in the half and its two parts acuminate at the ends. The straw-yellow tomentose parts of the brownish underside are also different, and in the anterior half of metaepisterna consist only of a small stripelike spot at the posterior edges of the metasternum and two rows of spots on the abdomen, one along the sides, the other consisting of smaller spots on either side of the middle line.

I have before me several identical specimens of the typical *E. valga* New.[10] collected by the late Prof. C. F. Baker and by Mr. Jark (ex Mus. Hamburg) at Baguio, Luzon, and a half dozen of *E. minor*, collected by Mr. F. C. Hadden at Pañgil, Laguna Province. As these two localities are separated by a distance of about 250 kilometers and neither form of *Epaphra* shows any inclination to individual variation, I am convinced of the specific value of *E. minor*.

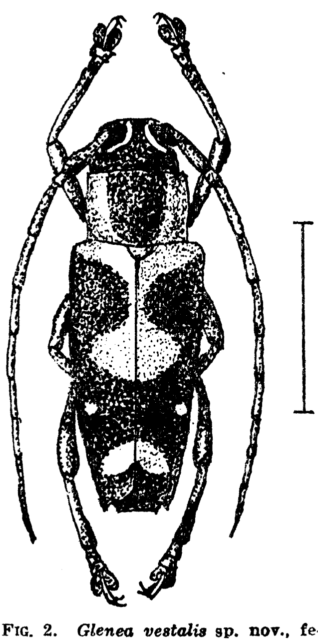

FIG. 2. *Glenea vestalis* sp. nov., female.

6. GLENEA VESTALIS sp. nov. Female. Text fig. 2.

G. vestae Pasc. affinis, sed obscure fuliginosa aliterque sulfureo-signata; antennis articulis duobus basalibus nigris, reliquis ferrugineis, ab sexto pallidioribus; vertice lineis duabus sulfureis, ante convergentibus; prothorace vitta media lata, basi paulo attenuata, in dimidia parte anteriore parallela; elytris macula basali haud

[10] Figured in Lacordaire, Gen. Coleop., Atlas, pl. 106, fig. 1.

semicirculari, sed post acuminata atque per suturam cum macula rhomboidali, suturali, media conjuncta, macula subapicali transversa, margine antico convexo-rotundato, margine postico obtusangulato-concavo; inter hanc et praecedentem, utrisque aequedistante, macula punctiforme sulfurea; corpore subter sulfureotomentoso, prosterno medio, mesosterno, epimeris sufureis exceptis, toto, metaepisternis in parte anteriore abdomineque ventrito primo ultimoque, fuliginosis. Long. 13, lat. 4.5 mm.

Insula Masbate, Aroroy, G. Boettcher legit (a Dr. Staudinger et Bang-Haas acquisita).

In 1857 Fr. Pascoe [11] described *pulchella* sp. nov., from Malacca; in 1866 [12] he gave a colored drawing, and changed the name *pulchella* to *vesta;* finally, in 1867,[13] he gave a more-detailed description and added the localities Singapore, Sarawak, Mysol, and Ceram. With the exception of one from the Philippines, I have no specimen before me from any of these localities, but I believe that the design alone of the latter is different enough to warrant a new name. Indeed, Pascoe says: "One of my specimens has the praeapical patch somewhat in the form of the letter X with a small spot on either side near the upper lines of the patch," but he does not say from where this specimen came. The new Philippine form also has a small supernumerary dot on either side of the elytra, between the mesal and subapical sutural spot and equidistant from both. The form of the mesal vitta on the prothorax and the basal patch connected along the suture with the mesal patch, moreover, at least speak for a distinct local race.

7. **GLENEA PISTRIX** sp. nov. Female.

Niger, subter densius, albido-pilosa, vertice vitta tenui nigra; antennis nigris; prothorace vittis duabus, discalibus, basin apicemque attingentibus, altera tenui utrinque inframarginali, basi abbreviata, nigris; scutello transverso, fere semicirculari, cretaceo; elytris vitta media nigricante, vix tomentosa, apice cum vitta tenui, humerali, glabra, conjuncta, margine laterali tenuiter nigro-marginato; pedibus nigris, femoribus subrufescentibus; tarsorum posticorum articulo primo duobus sequentibus unitis paulo breviore. Long. 11, lat. 3 mm.

[11] Trans. Ent. Soc. London II 4 (1857) 260.
[12] Proc. Zool. Soc. London (1866) 260, pl. 28, fig. 3.
[13] Trans. Ent. Soc. London III 3 (1867) 411.

MINDANAO, Davao (ex coll. C. F. Baker).

According to the key of Chr. Aurivillius (1926), this species must be placed near *cinerea* Thoms., although it has no black spots on the elytra.

Derm black, covered all over with a whitish toment, which is very dense on the underside, a fine medial stripe on the vertex, two broader ones on the disk of the prothorax, touching the front and basal margin, and a finer one, abbreviated behind, black, beneath the lateral margin. Elytra with a slightly tomentose blackish discal stripe, jointed before the apex with a fine barred humeral stripe, a fine marginal stripe in the basal third of the suture, and another, black, along the lateral margin. Legs black, femora more or less dark reddish. First joint of the hind tarsi less than three times longer than broad.

GLENEA DIDO Aurivillius. Male.

Chr. Aurivillius was acquainted with a female specimen only when he published [14] this species and therefore the characters were not quite complete. As usual, the male is much slenderer, and has longer hind femora, than the female; moreover, the black barred mesal stripe on the elytra is not dilated in such a manner on the apex as to be confluent with the black subhumeral stripe. After a male and a female specimen from Zamboanga, Mindanao (ex coll. C. F. Baker).

The same author has given [15] a key of the Philippine species of *Glenea* of which three supposedly Philippine species could not be placed, as they still were not interpretable; namely, *lineella, stellata,* and *varifascia* Thoms.

The following notices on observed additional localities of the occurrence of some species may be useful: *astarte* Thoms., Luzon, Pañgil (legit F. C. Hadden); *dido* Auriv., Mindanao, Zamboanga (legit C. F. Baker 7179); *minerva* Auriv., Dinagat and Malinao (legit C. F. Baker 5521); *cylindropomoides* Thoms.; *fissiauda* and *tritoleuca* Auriv., Mindanao, Zamboanga (Baker 7180–7184); *comixta* Auriv., Luzon, Mount Maquiling; *referens* Auriv., Luzon, Mount Limay; *Macroglenea kraatzi* Thoms., Luzon, Mount Maquiling and Pañgil (legit F. C. Hadden).

[14] Philip. Journ. Sci. 30 (1926) 101. [15] Tome cit. 92–98.

CURCULIONIDÆ

8. **CATACHAENUS**[16] **SULCIFRONS** sp. nov. Male, female.

Niger, squamulis griseis, plus minusve ellipticis, partim margaritaceo- aut aeneo-micantibus, in prothorace elongato-trigonis, sat dense tectus; rostro latitudine vix longiore, dorso ad latera haud angulatim declivi; fronte sulco medio, tenui, diametro oculari, transverso, distincte latiore, oculis modice convexis, subelongato-ovatis; antennis nigris, funiculo sex-articulato, articulo primo incrassato, latitudine vix longiore, articulo secundo multo tenuiore, primo aequali, quatuor sequentibus transversis, septimo conico, clava agnata, hac crassitudine plus sesqui longiore (9 : 25); prothorace transverso (9 : 11), lateribus paulo rotundatis, linea media pallida; scutellum punctiforme, vix squamoso; elytra deciens seriato-punctatis, punctis elongatis, praecise definitis, post, interdum atque ante medium, utrinque intra striam sextam et octavam fascia, obsoleta, pallidiore, margaritaceo-micante; sutura apice (in femina, tuberculo minutissimo). Long. 6 ad 7, lat. 2 ad 3 mm.

LUZON, Subprov. Benguet, Monte Santo Tomas, G. Boettcher legit (a Staudinger et Bang-Haas acquisitus).

Black, covered with minute, gray, apple-kernellike (not hairlike) tolerably dense scales, glittering more or less, metallic or pearly, along the middle of the front and of the prothorax and on one or two bands of the elytra. Antennæ black, scape reaching to the middle of the eye, funicle with the first joint scarcely longer but thicker than the second, fifth to seventh transverse. Prothorax broader than long (11 : 9), sides slightly rounded, base not margined. Elytra with ten rows of oblong punctures, intervals flat, without granules; in the second, sometimes also in the first third, between the sixth and eighth striæ with an indistinct, paler, glittering, metallic band. Legs black, without teeth.

[16] Deutsch. Ent. Zeitschr. Berlin (1925) 210–223. Mr. Eduard Voss gives therein the difference between *Eugnathus* Schönh. (1834) and *Catachaenus* Schönh. (1840); in consequence of this *sulcifrons* m., with a transverse thorax and without a lateral ridge, dorsally upon the rostrum, must be placed with *Catachaenus;* however, the broader front and the more (even as in the genotype, *E. viridanus* Schönh.) flattened and longer eyes are in contradiction to *Catachaenus*. I doubt, therefore, whether *Catachaenus* can stand as a valid genus.

9. PACHYRRHYNCHUS STELLULIFER ABRANUS subsp. nov. Plate 1, fig. 4.

A specie typica differt: statura minore, squamositate albida, generaliter vermiculatim discerpta atque multo expansa, in prothorace crucem formante, in elytris, distinctius seriato-punctatis, fascia basali cum fascia media, lata, ad suturam haud interrupta ut cum parteapicali, fere toto vermiculatim vermiculato-squamosa, per spatium secundum atque per vittam marginalem plus minusve conjuncta. Long. 9.5, lat. 4.5 mm.

LUZON, Prov. Abra (ex coll. O. Schütze). Quatuor specimina aequalia in Mus. Dresden et Bremen.

I hesitate to consider this form a "species," although the differences from *stellulifer* might justify doing so. Probably, however, there exist still other intermediate forms from other localities. The principal mark of *abranus* is the more-extended and vermiculose-scratched whitish scaling which on the prothorax assumes the appearance of a cruciform figure, and on the elytra appears as a large median band connected by a lateromarginal stripe and, on the second interspace, by a more or less interrupted dorsal stripe, with the basal band and the apical part of the elytra.

10. PACHYRRHYNCHUS ORBIFER MURINUS subsp. nov. Plate 1, fig. 3.

Subchalybaeo-niger, squamositate cinerea sat dense obsitus; prothorace maculis nigro-glabris ut in *P. orbifero*, sed in elytris multo reductis; nam inter striam tertiam atque sextam, in primo secundoque tertio, macula transversa, altera rhomboidali, basali, altera inverso-cordiforme, in secundo triente, utrisque, ut macula minuta apicali, suturalibus; femoribus ante et post tumorem griseo-anulatis. Long. 12, lat. 5.9 mm.

LUZON, Prov. Ilocos Sur, Cabugao (lat. septentrionali 17° 48′), specimina dua aequalia, O. Schütze legit (in Mus. Dresden et Hamburg).

W. Schultze [17] illustrated a series of *Pachyrrhynchus orbifer* varieties from Ilocos Norte. The form given by him on pl. 6, fig. 7, seems to come close to *murinus*, but the sutural spots of the latter are widely distant from each other and of different form, so that a subspecific name seems recommendable.

Exnothapocyrtys lixoides Heller.—Since I described [18] this species from a single male, I obtained from the Museum at Hamburg a female, collected by Mr. W. Jark at "Bokod" (certainly

[17] Philip. Journ. Sci. 23 (1923) 640–641.
[18] Wien. Ent. Zeit. (1929).

a mistaken spelling of "Bokos"), near Mount Polis, Ifugao Subprovince, Luzon. As was to be expected, the sexes differ considerably. The elytra of the female slope gently at the posterior end and the apex of the suture is abbreviated, forming a rectangularly truncate apical margin; the lateral margin of the slightly impressed anal sternite shows a tubercle in the middle, and, as usual, the female is larger.

The female of *Ex. basimaculatus* may be distinguished, inter alia, by a deep furrow around the free margin of the anal sternite.

In the female of *Ex. subpilosulus* m. the anal sternite is impressed in the apical half and this impression is prolonged on either side to the base in the form of a furrow, circumscribing a semicircular callosity.

11. METAPOCYRTUS CURRANI sp. nov. Plate 1, fig. 12.

Rufo-castaneus, dense, laete viridi-micate squamosus, prothorace vitta lata, triente media occupante atque in elytris usque ad apicem continuata, nitido glabra; rostro latitudine tertia parte longiore, planiusculo, subruguloso-punctato, sulco medio indistincto; antennis, clava nigra excepta, rufis; fronte concava, margine supraorbitali elevato; prothorace latitudine longitudini aequali, lateribus paulo rotundatis, vitta media, glabra, subtilissime remoteque punctata; elytris seriis punctatis per squamositatem occultis, solum pone vittam suturalem, ante dilatatam, observandis, apice parce subtiliterque albo-pilosis; corpore subter nigro, pedibus rufis, femoribus apice nigris. Long. 7, lat. 3 mm.

LUZON, Subprov. Benguet, Haight's Place, H. M. Curran et O. Schütze legerunt (in Mus. Dresden et Bremen).

This species, by its verdigris-colored scaling, suggests *repandicauda* m.,[19] but its elytra are of ordinary form and the large, shining, smooth, chestnut-brown stripe along the middle of the thorax and the suture makes it easily distinguishable from all other species.

Genus PSEUDOTTISTIRA g. nov. abnorme

Rostrum breve, sulco transverso, basali, nullo, apice abrupte declivi, scrobibus lateralibus, brevibus, feveolatis. Oculi pla-

[19] Philip. Journ. Sci. § D 7 (1912) 356.

niusculis, in fronte approximatis. Mandibulae cicatrice instructae, submentum pedunculo transverso, distincto. Antennae geniculatae, scapo prothoracis marginem anticum superante, funiculo septem articulato, clava oblonga fusiforme. Prothorax modice convexus, basi truncatus. Elytra oblong-ovata, ad basin thoracis basi haud latiora, margine basali elevato, deciens striata, in femina parte apicali fortiter declivi. Scutellum nullum. Femora inermia, clavata. Tibiae posticae corbiculis cavernosis. Tarsi articulo tertio transverso, bilobato. Unguiculi liberi. Coxæ anticae coniventes, posticae valde distantes, marginem elytrorum tangentes. Mesepimera lata haud adscendentia. Mesosternum processu intercoxali, oblongo, truncato. Metepisterna angusta. Ventrita in mare quinque, intermedia brevissima, in femina duo, intermedia perfecto connata.

This new genus belongs to the aberrant "adelongnath cyclophthalm" Curculionidæ of Lacordaire, which shows, like *Cratopus*, *Elytrodon*, and others, a scar on the mandibles, a distinct transverse peduncle on the submentum, but a short, in front abruptly and obliquely truncate, rostrum without a transverse basal furrow, a lacunous antennal furrow, the anterior coxæ connate, the posterior coxæ widely distant, touching the lateral margin of the elytra, the corbles of the hind tibiæ cavernous, the claws free, and other characters which indicate its systematic position to be near *Celeuthetes*. It has some superficial resemblance to *Ottistira* but is in other respects a very aberrant genus.

12. **PSEUDOTTISTIRA SUBTUBERCULATA** sp. nov. Male, female. Plate 1, fig. 5; text fig. 3.

Niger, squamulis perminutis, luteis, plus minusve rosaceo-micantibus, obsita; antennis obscure rufis, scapo prothoracis marginem anticum distincte superante, funiculo (clava haud computata) scapo longiore, articulo secundo primo fere duplo longiore, sequentibus tribus oblongis, sexto septimoque subnodosis, clava nigra, crassitudine fere triplo longiore, rostro longitudine capitis aequali, dorso late vageque impresso, margine supraorbitale carinulato; oculis planiusculis, rude granosis; prothorace longitudine latitudini aequali, in dimidia basali fere parallelo, in dimidia parte apicali paulo rotundato-ampliato, rude rugoso-punctato, ante medium callositate punctiformi, glabra; elytris oblongo-ovatis, margine basali sat late elevato, fortiter punctato-striatis, sutura, spatio secundo quartoque costatis, his praesertim ad declivitatem tuberculato-interruptis, tuberculis squamulis longioribus, setiformibus obsitis; femoribus posticis elytra vix superantibus, ut reliquis modice dense setoso-squamosis, tibiis margine interno subtiliter albo-fimbriatis. Long. 4.5 ad 5, lat. 1.8 ad 2 mm.

LUZON, Benguet, Monte Santo Tomas et Baguio, G. Boettcher legit (a Dr. Staudinger et Bang-Haas acquisita).

Blackish, covered with drab, mostly reddish, pearly glittering, partly ovate, partly setiform, scales; punctures of prothorax and elytra each beset with a fine bristle, transversely directed in the former. Antennæ dark reddish, club fusiform, and nearly as long as the four preceding joints of the funicle, the second joint of the latter distinctly longer than the first, the following

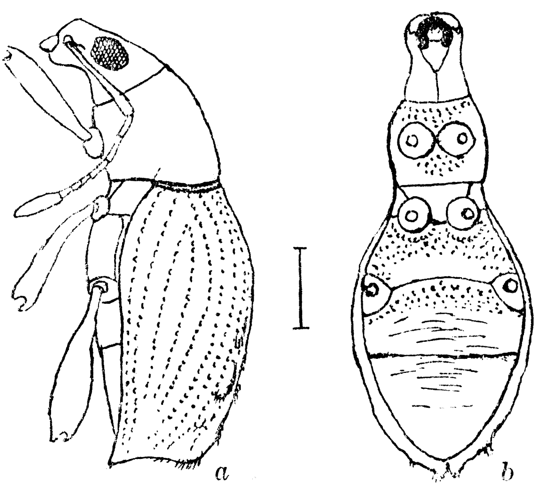

FIG. 3. *Pseudottistira subtuberculata* g. et sp. nov.; *a*, lateral aspect; *b*, ventral aspect.

gradually decreasing, but even the last still longer than broad. Prothorax with coarse punctures, disk on the front with a minute oblong callosity. Elytra ovate, punctate-striate, basal margin rather broadly elevated and smooth; suture, the second and fourth intervals elevated, and, especially on the declivity forming tubercles, beset with longer setiform scales. Hind femora unarmed, not extended beyond the elytra. Tibiæ finely whitish setose within.

13. EUPYRGOPS MAQUILINGI sp. nov. Male and female.

E. granulato Faust subsimilis sed longior atque nitido-niger, prothorace basi utrinque in medio macula parva, elytris maculis punctiformibus irregulariter dispersis ut femoribus basi apiceque, vitta supracoxali in prosterno atque in lateribus metasterni cobaltino-squamosis; antennis funiculo tenuiore, articulo tertio duobusque apicalibus crassitudine sesqui longioribus;

rostro area trapezoidali, dorsali, sulcis rectelineatis determinata; prothorace basi apiceque fortius atennuato sat dense dupliciterque punctato, spatiis inter punctis haud rogosis; elytris indistincte granulosis, spatiis transverse subrugosis. Long. 13, lat. 5 mm.

LUZON, Monte Maquiling, F. C. Hadden legit, 8. VI. 1931.

Eupyrgops granulatus Faust, without statement of an exact locality, has a dull granulate upper side, densely covered between the granules with very minute luteous squamules; *E. semperi* has nowhere a granulation and the disk of prothorax is impunctate. The new species is more elongate, with a shining upper side. Prothorax in front and at the base more attenuate, without granules, but with a double punctuation, a very fine, a coarser, and, in the middle of the base two cobalt blue squamous spots; of the same color are the dispersed punctiform spots on the elytra, a stripe above the front coxæ, the sides of meso- and metasternum, the base, and an apical spot on the legs. Two females from Mount Banahao, with dispersed punctiform bluish or whitish spots on the elytra, I do not venture to take for females of *maquilingi*.

I have also stated that *banahaonis* is the female of *semperi* Faust and extremely variable as is proved by the figure given of a female with an extraordinarily rich, extended, pale design on Plate 1, fig. 2.

14. NEOPYRGOPS PRASINA sp. nov. Female.

Nigra, omnino squamulis prasinis, metallicis, sat dense tectus; elytris erecte nigro-setulosis, macula laterali, postmedia, nigrodenudata; rostro longitudine latitudini aequali, dorso bicarinato; antennis multo gracilioribus quam in *granosa* Boh., funiculo articulo tertio, ut clava, crassitudine duplo longioribus; prothorace longtitudine paulo latiore (4 : 4.6), crebre nigro-granoso, disco vitta media, brevi, levi; elytris in spatiis seriato-granosis, granulis in parte anteriore multo maioribus adque deplanatis quam in parte declivi, in spatiis lateralibus minimis atque remotius seriatis; femoribus minus quam in *granosa* clavatis. Long. 10.5, lat. 5 mm.

LUZON, Laguna, Paete, W. Jark legit.

This species is closely related to *granosa* Boh. but of larger size and uniformly covered with moderately dense brassy green scaling; only the elytra on the sides, like *granosa*, have a bare, transverse, black patch.

The following key will facilitate ready discrimination among the known species of that genus:

1 (4) Prothorax without scaled stripes or spots, elytra behind the middle on the sides with a transverse, bare, black patch.
2 (3) Scaling of body luteous, granules of the elytra not very different in size. (Luzon.) .... *C. granosa* Boh.[20]
3 (2) Scaling of body brassy green, granules on the anterior part of the elytra flattened and much larger than in the other half. (Luzon.) *C. prasina* sp. nov.
4 (1) Prothorax with pale scaled stripes or spots, elytra without a bare black patch on the sides behind the middle.
5 (6) Prothorax between the two scaled dorsal stripes with coarse puncture, elytra on the base and before and behind the middle with small bands and along the suture with a stripe of golden scales. (Negros.) .... *C. banksi* Heller.[21]
6 (5) Prothorax granulate all over.
7 (8) Prothorax with flattened granules intermixed with coarse puncture, on either side of the disk with a whitish scale-stripe, elytra with irregular whitish scale-spots. (Mindoro.) *C. albovarius* Heller.[22]
8 (7) Prothorax with sharp and dense granules without intermixed puncture and scale stripes, but at the front and hind margins with a greenish scale spot. (Luzon.) .... *C. dives* Heller.[23]

15. **STYANAX INCONSPICUUS** sp. nov.

Niger, parce subtiliterque lutescenti-setosus, capite corporeque subter densius lutescenti-setoso-squamosis; antennis funiculo, ab articulo tertio, articulis transversis, clava subcylindrica, crassitudine paulo longiore, apice obtusata; prothorace subtransverso, granuloso, margine basali ferrugineo-setoso; elytris latitudine duplo longioribus, apice conjunctim rotundatis, solum spatio secundo callo, oblongo, basali, granuloso; striis rude punctatis, punctis cicatricosis, ad latera praesertim maioribus, rectangularibus, inter se anguste separatis atque spatiis dorsalibus vix ad latera multo latioribus; spatiis convexiusculis, aequaliter seriato-granulosis, granulis planiusculis, setuligeris; pedibus brevibus, femoribus anticis prothorace vix longioribus, posticis ex sternito abdominali, tertio vix extantibus; tarsis coactis. Long. 12, lat. 4.5 mm.

LUZON, Prov. Laguna, San Antonio (ex coll. O. Schütze).

As the femora of this new species are armed as in *anthracinus* m.,[24] it must be placed, according to the key, near the latter, al-

[20] *Isomerinthus granosus* Boh., Schönh. Gen. Curc. 7 (1843) 249, W. Schultze, Cat. Philip. Coleop. (1915) 140; *Coptorrhynchus granosus* Boh.

[21] Philip. Journ. Sci. § D 7 (1912) 382.

[22] Op. cit. 383.

[23] Deutsche Ent. Zeitschr. Berlin (1916) 929.

[24] Cf. Ent. Mitt. Berlin-Dahlem 9 (1920) 85.

though it differs from all other species [25] by the absence of remarkable protuberances except for a granulate callosity along the base of the second interspace, of the elytra and by the apex which is neither produced nor singly rounded. The punctures of the stripes are coarse, squamigerous on the ground, and, on the sides, rectangularly oblong, separated from each other by a small bridge. Legs short, the posterior legs extended but little beyond the third ventral sternite.

16. **ORTHORRHINUS RUGOSUS PHILIPPINUS** subsp. nov. Male and female.

A specie typica differt: prothorace margine antico tuberis anticis perobsoletis haud nigro-penicillatis; scutello distincte transverse.

MINDANAO, Davao, mas (ex coll. C. F. Baker) in Mus. Dresden; Zamboanga, femina (ex coll. C. F. Baker) in British Mus.

In the Dresden Museum is a specimen of *O. rugosus* Montr., from Woodlark, collected by Montrouzier, which is extraordinarily similar to the form from Mindanao, but in the latter the two black dusted gibbosities are wanting and the white pubescent scutellum is distinctly transverse.

17. **ORTHORRHINUS BREVIROSTRIS** sp. nov. Male.

O. granosparso Fairm.[26] affinis sed rostro prothorace breviore, niger, subtiliter lutescenti, elytris in parte ante media quartaque parte apicali plus minusve albido-marmorato-squamosis, fascia post media, lata, marginem lateralem attingente, nigro-denudata; rostro crebre ruguloso-punctato, in parte basali obsolete quadricarinulato; antennis obscure sanguineis, funiculo articulo primo secundo crassiore atque longiore, sequentibus subtransverse moniliformibus, clavam versus gradatim crescentibus, clava crassitudine vix duplo longiore; prothorace longitudine sexta parte latiore, granulis glabris, oblongis dense obsito, disco carinula brevi; elytris subcyilindricis, sutura spaciisque minute seriato-granulosis; tibiis posticis vix arcuatis; maris tarsis anticis haud longe fimbriatis. Long. 10, lat. 4 mm.

LUZON, Monte Maquiling, et insula SIBUYAN (ex coll. C. F. Baker).

The two males before me, one from Luzon, the other from Sibuyan, are similar to small specimens of *granosparsus* Fairm., from Viti, but unlike these, both have a short rostrum and unfringed front tarsi; on the other hand they are not quite identi-

[25] I have also described, Ent. Mitt. Berlin-Dahlem 11 (1922) 213, *Styanax overbeckianus*, from Java.

[26] Ann. Soc. Ent. France VI 1 (1881) 314 and Pet. Nouv. (1877) 287.

cal with each other. The specimen from Mount Maquiling shows on the prothorax oblong rough glabrous granules and on the disk a short carinula; elytra cylindrical, in the apical fourth and in the basal half the scaling covered with a white exudation, the former bounded behind by a blackish band, as broad as the combined lengths of the first and second ventrit, and extending to the lateral margin. The one from Sibuyan is a little larger, its scaling ocherous, the median band more black marbled, the granulation of the prothorax flattened and the short carinula on the disk wanting. I do not venture to name this form from a single specimen that perhaps represents a peculiar subspecies.

18. **ALCIDES ALFKENI** sp. nov. Male. Plate 1, fig. 13.

A. chalcomorpho m.[27] affinis, elytris fortius punctato-striatis, coeruleo-nigris, basin atque apicem versus virescentibus, singulis maculis, oblongis, octo, in fasciis tribus, una subbasali, altera postmediana, tertia subapicali, ordinatis; prothorace transverso, viridi-aeneo, prosterni margine basali cyaneo micante, dorso fortius quam in *chalcomorpho* punctato, in angulis anticis posticisque, ut in lobo scutellari, macula griseo tomentosa; corpore subter pedibusque obscure viridi-aeneo, femoribus apice coeruleis, dente, subdenticulato, armatis; tibiis anticis margine interno post medium angulatim dilatato. Long. 11, lat. 4.5 mm.

LUZON, Laguna, San Antonio (ex coll. O. Schütze) in Mus. Dresden et Bremen.

Allied to *A. chalcomorphus* m.;[28] elytra bluish black, towards the base and the apex changing to metallic green, with three transverse rows of gray-haired oblong-ovate, contiguous spots. First row near the base and the second behind the middle, formed by six, the third row before the apex formed by four spots, the inner spot of the first and the second spot on either side of the second transverse row removed between the first and sixth striæ to the front. Rostrum as long as the head and prothorax together, in the basal half a distinct dorsal furrow, on the sides coarser, on the back finer and somewhat rugously punctate. Antennæ black, second joint of funicle longer, the third shorter than the first, seventh conical and annexed to the club. Prothorax metallic green, formed and spotted like *chalcomorphus*, but more strongly punctate. Scutellum black, nearly quadrate, larger than in *chalcomorphus*, not inclosed by the suture in front. Elytra finely punctate-striate. Legs clavate, the hind leg extend-

[27] Philip. Journ. Sci. 19 (1921) 553.
[28] Loc. cit.

ing nearly to the apex of the elytra, its tooth denticulate on the distal edge.

19. **ALCIDES HADDENI** sp. nov. Male. Plate 1, fig. 14.

Praecedenti (*alfkeni*) valde affinis sed differt; rostro breviore, elytris convexioribus, striis, praesertim lateralibus, subtilioribus, spatiis levissime transverse subrugulosis, maculis auroviridibus, holosericeis, minoribus, aliter formatis ac dispositis, nam utrinque una humerali, in margine basali elytrorum introrsum continuata, una in quinta parte basali, subsuturali, rotundata, a praecedenti separata, una media, inter striam tertiam et sextam, una postmedia obliqua, inter striam tertiam et suturam, duabus marginalibus, in quinta et tertia parte anterioribus, posteriore fere rectangulare-transverso atque duabus apicalibus similiter utin *alfkeni* dispositis, praeterea parte tota apicali elytrorum auro-micante. Long. 11, lat. 5 mm.

LUZON, Monte Maquiling, 5. VI. 1931, F. C. Hadden legit (in Mus. Dresden).

This species is so nearly allied to *alfkeni* that at first I was of the opinion that, considering the longer rostrum of *alfkeni*, this form may be the female of *haddeni*, but anatomical examination proves that both specimens are males. The shorter rostrum, the fine transverse rugous interspaces, the finer striæ, and the different disposition of the spots in *haddeni*, speak for a distinct species.

20. **ALCIDES MIMUS** sp. nov.

A. dipterocarpo G. A. K. Marshall verisimilis, sed paulo longior, antennis articulo primo funiculari quinque sequentibus sumptis aequali, secundo, ut tertio, crassitudine longioribus; prothorace granulis maioribus, minus confertis, in dimidia basali sulco medio obsoleto, lobo scutellari acutangulo; scutello minore, haud transverso, sutura ante eum coarctata; elytris eodem modo humeris prominentibus, spatiis convexiusculis, per totam longitudinem manifeste granulatis; coxis anticis remotis; femoribus anticis intermediisque dente, lato, aciei distali denticulata, armatis, posticis dente minuto, sternitum abdominalem quartum distincte superantibus, tibiis anticis dente subapicali nullo, margine interno, in primo triente subdilatato, reliquis simplicibus; unguiculis fissis. Long. 9, lat. 5 mm.

MINDANAO, Surigao (ex coll. C. F. Baker).

In outline similar to *A. dipterocarpi* G. A. K. Marshall,[29] but a little longer. First joint of antennæ as long as the five following together, second and third longer than thick. Prothorax with acute scutellar lobe and an indistinct medial furrow in the basal half, the granulation less dense, the granules larger. Scutellum smaller, not transverse, confined in front by the suture. Shoulders of the elytra produced, interspaces moderately convex, at full length distinctly granulate. Anterior and intermediate femora with a large tooth, denticulate on the distal edge, posterior femora with small teeth and extending beyond the fourth ventral sternite. Front tibiæ enlarged in the basal half of their inner edge, without subapical teeth. Claws fissured. *Alcides morio* m., from Madras,[30] differs from *mimus*, inter alia, by the contiguous anterior coxæ and the nongranulate interspaces of the elytra.

21. **ACICNEMIS HADDENI** sp. nov. Female. Plate 1, fig. 15.

Ex affinitate *A. peduncularis* Pasc. (= *triangularis* Hubenth.), sed prothorace longitudine distincte latiore, similiter albido vittata, sed subter marginem lateralem vitta nigra, in elytrorum triente basali continuata atque hic latiore; scutello subtrigono, stramineo; elytris, ut prothorace reliquo, ferruginoso-fuscis, spatio quarto ad basin, septimo in tertio quarto nigro-vittatis, fascia media straminea per suturam lutescentem interrupta, ante plaga rectangulari, subtransversa, post utrinque, in spatio primo, puncto oblongo, in spatio secundo quartoque vitta nigro-velutinis detreminata; femoribus pallide lutescentibus, in dimidia parte basali atque puncto, interdum obsoleto, in parte tumida, albis; tibiis in margine interno haud subdilatatis; corpore subter squamositate fusca, sine squamulis setiformibus albis dispersis. Long. 9, lat. 3.7 mm.

LUZON, Monte Maquiling, F. C. Hadden legit 2. IX. 1931.

Similar to *A. peduncularis* Pasc., but the prothorax broader and the general color of the scaling more chocolate brown (instead of fuliginous) ; the postmedian whitish band of the elytra

[29] Bull. Ent. Research, London 12 (1921) 166, fig. 2; described from Dehra Dun, India, but occurs also in the Philippine Islands—Kolambugan and Butuan, Mindanao, and Cuernos Mountains, Negros (ex coll. C. F. Baker).

[30] Ent. Zeitung Stettin (1908) 171, pl. 1, fig. 4.

interrupted by the pale brownish suture; prothorax below the lateral margin, as also the elytra in the first quarter of lateral margin, on the base of fourth, and behind the middle of the seventh interspace, further, behind the white band, on the second and fourth interspace, with a velvet-black stripe and on the first interspace with a spot of the same color; before the white band, inside of the fifth punctate stripe on either side with a nearly square black patch. Legs pale hazel, in the basal half whitish, on the swollen part with an often indistinct whitish spot.

22. **PACHYONYX INVERSA** sp. nov. Male. Plate 1, fig. 17.

Nigra, prothorace dense, elytris, apice singulis rotundatis, maxima parte pilositate lutescentialba indutis, his intra striam tertiam plaga, basali, oblonga, in sutura continuata atque utrinque vitta, a humeris suturae mediam versus currente vittisque duabus, una laterali, ante abbreviata, altera in dimidia parte apicali, subsuturali, sed apicem haud attingente, subdenudato-nigricantibus; prothorace longitudine latiore (3 : 3.4), sulco medio, in impressione oblongo-ovata, utrinque ante subtuberculata, desinente, basi, utrinque in medio, vitta pallidiore, in elytris breviter conducta; scutello oblongo-trapezoidali; elytris latitudine plus duplo longioribus, striis spatiis, convexiusculis, latitudine aequalibus, callo subapicali nullo; corpore subter pollinoso. Long. 6, lat. 2.4 mm.

MINDANAO, Kolambugan (ex coll. C. F. Baker).

Black, densely luteously pilose, rostrum nearly cylindrical, about one-third shorter than the prothorax, at the base higher than broad and wider than in front, moderately densely punctate, sides in the basal half punctate-striate. Antennæ dark red, inserted before the middle of the rostrum, club spindle-shaped, longer than the funicle. Prothorax at the base a little broader than long, disk with an oblong-ovate impression. Scutellum oblong-trapezoidal. Elytra more than twice as long as broad, without a subapical callosity, singly rounded on the apex, only the first interspace distinctly convex; at the base, between the third striæ, a dark gray spot, prolonged along the suture; farther on either side a stripe running from the shoulders towards the middle of the suture; on the sides, another stripe, abbreviated at the base and a third stripe in the posterior half, near the suture, but not extending to the apical margin, of the same gray color. Underside densely yellowish pollinose. This is the first known Philippine species of this widely spread genus.

23. TRAGOPUS (?) SEXPUNCTATUS sp. nov. Plate 1, fig. 11.

Niger, sat dense ochraceo-squamosus; rostro prothorace breviore, subdepresso, paulo arcuato, scrobibus lateralibus; antennis in secundo triente rostri insertis, scapo oculum attingente, funiculo septem-articulato; prothorace longitudine latiore, maxima latitudine ante medium, basi recte truncato, fortiter denseque punctato; elytris latitudine quarta parte longiore, basi utrinque subsinuatis quam thoracis basi paulo latioribus eius angulis posticis amplectentibus, inter striam tertiam fascia pallidiore lutescenti, spatio, secundo maculis minutis, tribus, nigris, nam una prope ante, altera post fasciam, tertia ad declivitatem; spatiis convexiusculis atque remote, exterioribus dense fortiusque seriato-granulatis; femoribus subter haud sulcatis, posticis elytrorum apicem vix attingentibus; tarsis supra albido-pilosis. Long. 6.5, lat. 3.5 mm.

MINDANAO, Surigao (ex coll. C. F. Baker).

Derm black, hidden by moderately dense, dull yellow ocher scaling; prothorax on the posterior angles with a triangular spot, elytra between the third striæ just before the middle with slightly curved band of pale ocher, three oblong dots on the third interval, one close before, another behind the pale band, the third, on the beginning of the declivity, black. Rostrum dorsally with three carinæ, abbreviated in front. Front granulate punctate, with a carinula above the eye. Antennæ with the funicle seven-jointed. Prothorax transverse, broadest before the middle, lightly vaulted, densely and, especially along the base, very coarsely punctate, interstices of the puncture minutely granulate. Elytra ovate, narrowed in the apical fourth, one and one-fourth as long as broad, broadest before the middle, on either side of the base gently sinuate and embracing the hind edges of the prothorax; striæ fine, remotely and coarsely punctate; intervals slightly convex and remotely, the externals sharper and more densely, granulate. Legs stout, femora unarmed, without a furrow beneath, hind pair hardly reaching to the apex of the elytra. Tarsi whitish pilose above.

I have described this species preliminarily as a *Tragopus*, giving an illustration of it which will exclude all doubt as to the validity of that species, though it is certainly as little a *Tragopus* as some other species described.

24. SCLEROLIPS REDUCTA sp. nov.

S. ochrodisco m. valde affinis, sed minor, prothorace plus transverso, margine antico haud pro-producto, in dimidia parte basali, in loco macula, vitta media, interdum fere evanescente, lutescenti; elytris spatiis in triente basali haud seriato-granulatis. Long. 5 ad 6 mm.

MINDANAO, Iligan et Kolambugan.

J. Faust established the genus *Sclerolips*[31] upon a species from Perak. Later I published a new species[32] from Cape Engaño, northern Luzon. W. Schultze[33] mentions Calayan, one of the Babuyan Islands, as the locality of its occurrence. I must call attention to this error because the single specimens from both localities mentioned are not quite identical, and under such circumstances it is doubtful that they represent local races. This matter can only be cleared up by means of copious material. The following key will illustrate this best.

1 (2) Prothorax on the disk before the middle with a tubercle beset with black bristles, elytra on the second quarter of the suture with a black brush. (Perak.) .... *S. sticticus* Faust.

2 (1) Prothorax without a black setose tubercle before the middle and the elytra without a black brush on the second quarter of the suture.

3 (4) Scutellum circular, elytra grayish setose, the alternate intervals and the suture with more erect, remotely seriate, short and thick setæ, prothorax with a transverse row of four black setose tubercles. (Formosa.) .... *S. horrida* Heller.

4 (5) Scutellum rectangular or oblong, prothorax without a transverse row of tubercles, elytra on the alternate intervals without short, thick, and more-erect setæ.

5 (6) Prothorax in the basal half along the middle with an ovate yellowish spot, elytra on the suture and intervals of the basal half with remotely seriate, minute shining granules. (Cape Engaño, Luzon.) .... *S. ochrodiscus* Heller (typicus).

6 (7) Prothorax in the basal half with a square, in front slightly rounded, yellowish spot; scutellum square, elytra without seriate shining granules on the intervals. (Calayan Island, Babuyanes.) *S. ochrodiscus* Heller var.?

7 (8) Prothorax more transverse, front margin less produced than in *ochrodiscus*, with two black setose spots, in the basal half with a yellowish line along the middle, elytra without seriate granulate intervals. (Iligan, Mindanao.) .... *S. reducta* sp. nov.

8 (9) Prothorax in the basal half, along the middle, with a yellowish stripe only twice as long as broad; without a black setose spot on the front margin. (Cuernos Mountains, Negros.) *S. reducta* Heller var.?

9 (8) Prothorax without a pale middle line in the basal half, upper edge of mesepimera without pale scaling. (Samar.) *S. reducta* var.?

[31] Ent. Zeit. Stettin (1895) 22.
[32] Philip. Journ. Sci. § D 7 (1913) 142.
[33] Cat. Philip. Coleop. (1915) 147.

25. NAUPHAEUS ALBOPLAGIATUS sp. nov. Male. Plate 1, fig. 16.

N. decorato m. affinis, sed aliter signatus; rostro latitudine fere triplo longiore (1 : 2.9), creberrime subtiliterque, longitudinaliter rugoso; antennis rufis, funiculo articulo tertio subtransverso, clava quadriarticulata; prothorace sulco medio tenui, vitta submarginali, lata, elytris fascia basali, intra striam sextam ac per vittam, in spatio primo, cum fascia antemedia conjuncta quartaque parte, apicali, ut corpore subter, cretaceo-squamosis, sutura ad basin callo elongato, granulis maioribus circiter quinque obsito. Long. 10.5, lat. 4.5 mm.

SAMAR (ex coll. C. F. Baker).

I have before me only one female of *decoratus* m.[34] and one male of the new species, and therefore it is possible that a few of the observed particularities of the latter are sexual differences. Superficially speaking, one may say that all the loop-like figures of *decoratus* appear filled up in *alboplagiatus* with white scaling. For the specific value of it speaks the convex and granulate base of the suture, the granules of which are larger than the rest of the elytra; the second interspace moreover is broader at the base than the third, while the contrary is true in *decoratus*. The suture in the latter species, at least before the declivity, is as broad as the second interspace, in *alboplagiatus* it is much narrower and the tenth stripe is continued to the apex, whereas in *decoratus* the tenth stripe extends only to the apex of metaepisterna.

26. ANATHYMUS LINEATOCOLLIS sp. nov. Male.

A. colorato Faust, ex Java, affinis, niger, pedibus, genubus nigris exceptis, segmentoque anali rufis; rostro nitido, sat remote punctato; antennis funiculo primo incrassato, longitudine latitudini aequali, secundo latitudine paulo longiore; prothorace latitudine sesque longiore, remotius guam in *colorato* punctato, lineis tribus ut macula in vertice atque scutello, vittiforme, luteopruinosis; elytris, inter striam sextam, plaga ovata, ultra secundum trientem extensa et per suturam divisa, rufa; pygidio luteopruinoso, utrinque pone carinam dorsalem vitta nigra, ad basim alteracum conjuncta. Long. 9, lat. 2 mm.

LUZON, Monte Maquiling, F. C. Hadden legit 17. IV. 1931.

Allied to *lineatocollis* Faust[35] but easily distinguished by the much longer prothorax with three pale luteous stripes and the luteous pygidium with a black stripe on either side of the middle

[34] Philip. Journ. Sci. 25 (1924) 299.
[35] Ent Zeit. Stettin 51 (1898) 208.

keel confluent to the base. Dorsal patch of the elytra ovate, laterally determined by the sixth stria, halved by the black suture. As this red patch is very variable in extent in *coloratus* Faust, it may also be so in *lineatocollis* of which I have only a single specimen before me.

27. COSMOPOLITES PRUINOSUS sp. nov. (=PRUINOSUS Faust in lit.)

C. (*Sphenophorus* olim) *sordido* Germ.[36] similliniger, luteo pruinosus, sed prothorace paulo longiore, ante minus abrupte coarctato; elytris brevioribus, subcordatis, sutura spatiisque planiusculis, uniseriatim punctatis striis punctatis multo latioribus. Long. 11, lat. 4 mm.

LUZON, Manila, legit Dr. O. F. v. Möllendorff; "Philippinen" legit W. Jark 1919; Nord Borneo, legit John Waterstradt.

Like *sordidus* Germ. black, incrusted with a waxlike exudation; prothorax a little longer, on the sides less rounded, less abruptly attenuate in front; elytra shorter, more cordiform, intervals flat, broader than the slightly impressed rows of somewhat remote and coarser punctures.

This species may possibly be confused in collections with *C. sordidus* Germ., a common and wide-spread species which also occurs in the Philippine Islands. In the Dresden Museum the following localities are represented by specimens: India or. (ex coll. Dohrn-Faust) ; Cambodia, Kampong Toul (Vitalis de Salvaza) ; Ceylon (Dr. W. Horn) ; Andaman Islands (Merkel) ; Malacca (Dr. Staudinger) ; Sumatra, Deli (Devrient) ; Java (H. Fruhstorfer) ; North Borneo (C. Wahnes, coll. W. Müller) ; Celebes, Makassar (C. Ribbe) ; Lombok, Sapit, 2000 (H. Fruhstorfer) ; Philippines, Mindanao (C. F. Baker) ; Aru (C. Ribbe) ; Neu Caledonia (Dr. F. Sarasin and Alex. Bau) ; Madagascar (Dohrn, Chevr. det.) ; Reumion (Chevr.) ; Fernando Po (ex coll. Dr. F. Zacher) ; Madeira (W. Schnuse) ; and because *striatus* Fahrs. falls under the synonym of *sordidus* Germ. also Brasilia (in coll. Faust).

28. SPHENOPHORUS OCTOMACULATUS sp. nov. Female.

Niger, corpore subter omnino cinereo-pruinoso, prothorace elytrisque subsanguineis, pustulis setuligeris, punctiformibus, dense adspersis, illo utrinque in disco, his ad humeros macula minore atque inter striam secundam et sextam macula maiore, anteme-

[36] On this occasion I should like to express my best thanks to Dr. J. Brüel, of the University Halle a/S, for enabling me to examine Germar's type specimen.

diana, ut subapicali, obliqua, elliptica, inter striam tertiam et nonam, nigro-velutinis. Long. 10, lat. 3.5 mm.

Insulae Philippinae, ex coll. O. Schütze.

Allied to *S. alfurus* m.[37] but larger and the gray toment of the dark blood-red upperside dispersed in moderately dense round dots with a very minute center bearing a short, often loose, bristle. Prothorax with an indistinct black stripe along the middle and a well-marked roundish black spot on each side of the disk. Elytra with similarly disposed but deep velvet black spots; namely, a small one on the shoulder, a larger one before the middle between the second and sixth stripe, and an oblong one before the apex between the fourth and tenth stripes.

29. EUGITHOPUS BILINEATUS sp. nov. Male. Plate 1, fig. 9.

Niger, prothorace elytrique similiter ut in *interruptolineato* m., lineis, sed albo-incrustatis ornatis, nam in prothorace utrinque una marginali, altera submarginali, una in elytris usque ad medium spatii secundi extensa, juxta apicem eius praeterea puncto in spatio primo, altera in spatii tertii triente apicali, cum altera marginali, ante abbreviata, in spatio sexto conjunctâ; scutello nigro, vittiforme; corpore subter pedibusque cinereis, prothorace vitta inframarginali, mesepimeris, metepisternis, metepimeris atque vitta marginali in abdomine albo-incrustatis; pygidio rude punctato, carina media. Long. 8.5, lat. 3 mm.

Insulae Philippinae (sine loco acurrato) ex coll. O. Schütze.

Prothorax and elytra as in *interruptolineatus* m.[38] but pure white striped, the former more attenuate in front and the white stripe, above the anterior coxae, equally curved upwards, inclosing a black elliptic space. Scutellum linear, a little broader at the base, acuminate at the top. The white incrusted stripe on the second interspace of the elytra surpassing the middle and continuing to the apical third part of the third interspace, that of the sixth interspace abbreviated in front and closely connected with the former at the apex. Pygidium parabolic, as long as broad, with moderately remote, ringed punctures. Prosternum white in the middle of the posterior margin, and thence upwards to the posterior angles of the prothorax.

Eugithopus bilineatus m., very closely allied to *interruptolineatus* m.,[39] I formerly took to be a female of the genus *Cercidocerus;* but it should be transferred to *Eugithopus,* because this

[37] Ent. Mitt. Berlin (1914) 313, pl. 5, fig. 7 and 7*a*.

[38] Ent. Zeitung Stettin (1908) 190.

[39] Loc. cit.

vicarious species from Borneo certainly has likewise an unenlarged club in the male. The same is true of *Cercidocerus flavoplagiatus* Heller,[40] which is at most a local variety of *Eugithopus elegans* Roelofs.[41] The former comes from Davao, on the southern coast of Mindanao, the first from Surigao, a province in northeastern Mindanao. It differs from the type species by the different shape of the pale spots on the elytra; namely, the subbasal spot is not pointed inward, but nearly rectangular transverse, the postmedian band is not prolonged, but sharply delimited behind, and the pale sutural stripe, in the front third, extends gradually towards the base to the first and second intervals.

30. CRYPTODERMA FRACTISIGNUM sp. nov. Male.

C. laterali (Boh.) affinis, sed aliter albosignatum; antennis articulo tertio duobus sequentibus sumptis breviore; prothorace latitudine linea alba dorsali aequali, dorso reticulato-, ad latera varioloso-punctato ut in laterali lineis albo-incrustatis tribus; elytris post minus attenuatis, sutura ante scutellum coarctata, margine basali intra striam quintam, lobis quatuor productis, linea alba submarginali, in primo triente ramum brevissimum intus imittente, sutura, in primo triente ut pictura angulata, communi, in suturae secundo triente incipiente atque callum, subapicalem versus currente, albo-incrustatis. Long. 11, lat. 4 mm.

Insula Panay (ex coll. C. F. Baker 20933).

This is one of the few species of the genus without a white cruciform design on the elytra, belonging near *lateralis* Boh. Antennæ with the third joint shorter than the two following combined, club barely twice as long as broad. Prothorax as broad as the middle line is long, coarsely reticulate; the sides more flattish and cicatrized-punctate. Scutellum oblong-ovate, inclosed by the suture. Elytra (of the male) with four denticles on the basal margin, towards the apex less attenuate than in *lateralis* Boh.; suture in the first third narrowly bordered with white; the white lateral stripe, on the fifth interspace, extends but a little beyond the first third of the elytra and forms there a short branch, extending inwards to the fourth interspace and then prolonged on the sixth stripe, away over the subapical callosity, to the apex of the first interspace. Suture in second third with an angular white band, the branches directed backward

[40] Philip. Journ. Sci. § D 8 (1913) 147, fig. 3.
[41] Notes Leyd. Mus. 13 (1891) 145, pl. 8, fig. 5.

and connecting the white lateral stripe. Hind border of the prosternum with sharp rectangular angles edges on the sides.

SCARABÆIDÆ

CETONIINI

PODOPOGONUS BOETTCHERI Moser. Male. Plate 1, fig. 7; text fig. 4.

This genus was described by J. Moser [42] from a single, supposedly male, specimen. A specimen before me, doubtlessly male, with only two anterior tibial teeth, collected by the late O. Schütze on Mount Critas near Montalban, Rizal Province, Luzon, shows that Moser's statement of the sex is erroneous in that he believed a female to be a male. The illustration (Plate 1, fig. 7) of the male specimen from Mount Critas, to which I add a text figure of the forceps, proves this, and also that both sexes of this genus have a broad median impression along the abdomen.

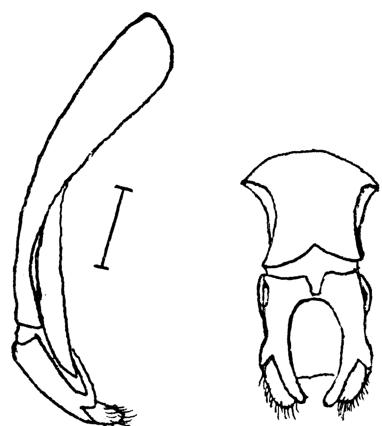

FIG. 4. *Podopogonus boettcheri* Moser, male; *a*, forceps, lateral aspect; *b*, forceps, view from behind.

LUCANINI

W. Schultze [43] makes no mention of the occurrence of *Gnaphaloryx opacus* Burm. in the following localities: LUZON, Tayabas, Malinao (C. F. Baker legit); MINDANAO, Zamboanga (F. C. Hadden legit).

To other known localities of *Metallactulus parvulus* Hope I can add PANAY (C. F. Baker); MINDANAO, Zamboanga and Kabasalan (F. C. Hadden); LUZON, Mount Maquiling (C. F. Baker).

FIGULINI

Copious material of *Nigidius*, collected by Mr. F. C. Hadden and kindly sent me for study, has convinced me that *Nigidius montanus* m.[44] is based upon large specimens and is *boneulli* Boileu [45] = *laevicollis* Jakowleff (nec Westw.),[46] and *N. taurus* Jak. = *laevicollis* Westw. *Nigidius bonneuli* Boil. has priority over *montanus* m.

[42] Deut. Ent. Zeitschr. Berlin (1917) 18.
[43] Cat. Philip. Coleop. (1915) 161.
[44] Ent. Mitt. Berlin-Dahlem 6 (1917) 171.
[45] Le Naturaliste 27 (1905) 18.
[46] Hor. Ent. Ross. 34 (1900) 642.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Sandracottus angulifer* sp. nov., male, Mindanao.
2. *Eupyrgops semperi* Faust (= *banahaonis* Heller), female, Luzon.
3. *Pachyrrhynchus orbifer murinus* subsp. nov., Luzon.
4. *Pachyrrhynchus stellulifer abranus* subsp. nov.
5. *Pseudottistira subtuberculata* g. et sp. nov., Luzon.
6. *Agelasta basimaculata* sp. nov., Luzon.
7. *Podopogonus boettcheri* Mos., male, Luzon.
8. *Epaphra minor* sp. nov., Luzon.
9. *Eugithopus bilineatus* sp. nov., Luzon.
10. *Enispia samarana* sp. nov., Samar.
11. *Tragopus* (?) *sexpunctatus* sp. nov., Mindanao.
12. *Metapocyrtus currani* sp. nov., Luzon.
13. *Alcides alfkeni* sp. nov., Luzon.
14. *Alcides haddeni* sp. nov., left elytron, Luzon.
15. *Acicnemis haddeni* sp. nov., Luzon.
16. *Alphaeus alboplagiatus* sp. nov., Samar.
17. *Pachyonyx inversa* sp. nov., Mindanao.

TEXT FIGURES

FIG. 1. *Cereopsius marmoratus* sp. nov., male.
2. *Glenea vestalis* sp. nov., female.
3. *Pseudottistira subtuberculata* g. et sp. nov.; *a*, lateral aspect; *b*, ventral aspect.
4. *Podopogonus boettcheri* Moser, male; *a*, forceps, lateral aspect; *b*, forceps, view from behind.

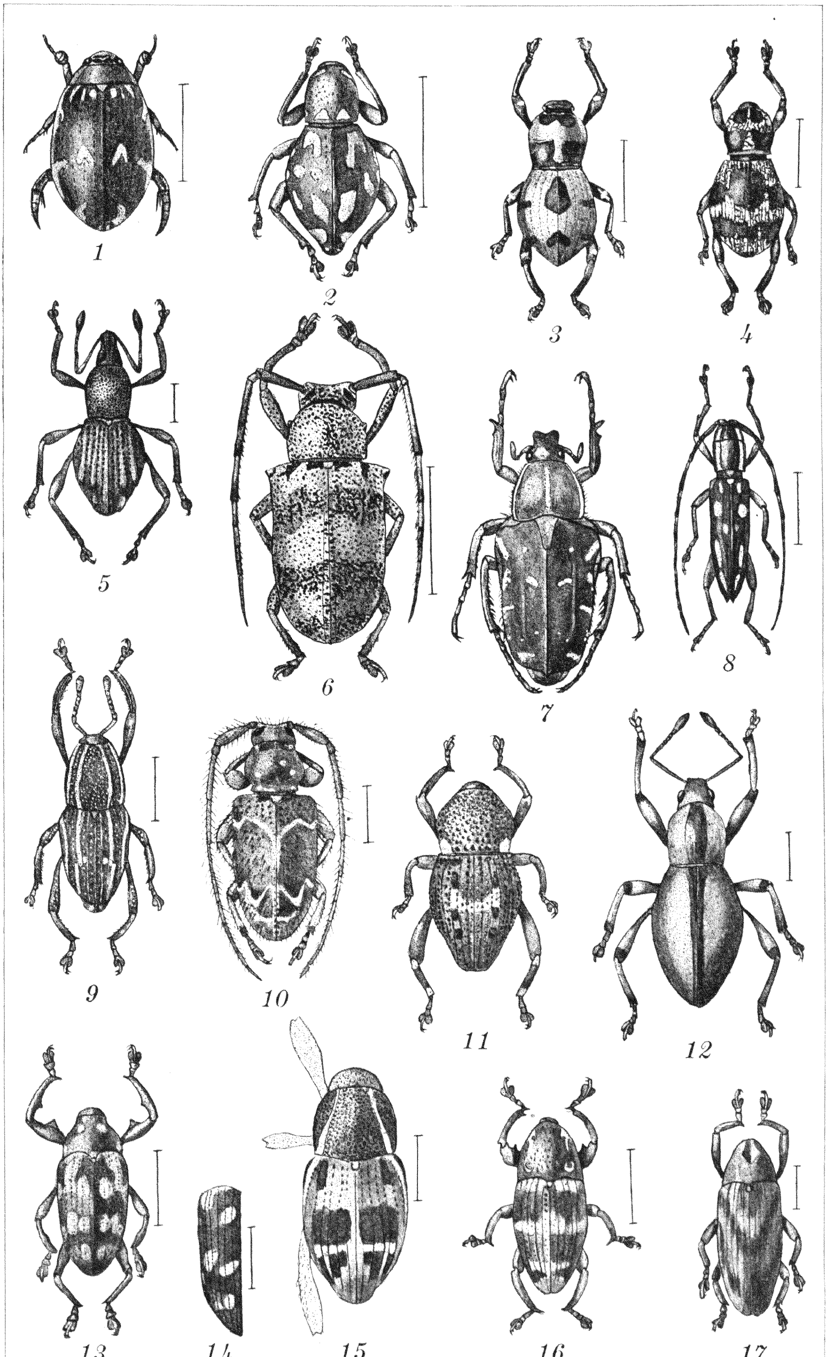

PLATE 1.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XIX [1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

THREE PLATES

The majority of the crane flies discussed at this time are from western China, mostly from Mount Omei, Szechwan, where they were taken by my friend the Reverend Mr. George M. Franck. A few others, preserved in the United States National Museum through the kindly interest of the collector, were taken in Sumatra by Mr. Edward Jacobson. A small number of species were taken on various islands to the east of Wallace's Line and so from the Australasian rather than the Oriental Region. Such specimens were taken in Celebes by my friend and former student Mr. Charles F. Clagg, and in New Caledonia, collected by Mr. Jean Risbec. Still further material, now contained in the Hungarian National Museum and received for study through the kindness of Dr. Z. Szilady, is from New Guinea. Except where stated otherwise, all types of novelties described at this time are in my own collection. I wish to extend my cordial thanks to all of the above-mentioned entomologists for this continued aid in the study of the Asiatic and Australian Tipulidæ.

TIPULINÆ

TIPULA (VESTIPLEX) DESERRATA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

Antennæ 12-segmented, unusually short; flagellum bicolorous; terminal two segments more or less fused; mesonotal præscutum gray with four grayish brown stripes that are narrowly bordered by dark brown; apices of knobs of halteres brightened; femora obscure yellow, the tips blackened; wings whitish to pale yellowish subhyaline, variegated by dark and pale brown; a large dark brown postarcular darkening; dark area in stigmal field interrupted by a pale spot at proximal end of stigma; male hypopygium with basistyle armed with a black spine; cerci of ovipositor slender, with smooth valves.

[1] Contribution from the entomological laboratory, Massachusetts State College.

Male.—Length, about 16 millimeters; wing, 19.

Female.—Length, about 18 to 20 millimeters; wing, 16.5 to 18.5.

Frontal prolongation of head reddish yellow, darker above; nasus elongate, brownish black; palpi dark brown, paler at incisures. Antennæ (male) short, less than the palpi; basal four segments yellow, the succeeding segments bicolorous, darkened basally, the remainder obscure yellow; only twelve antennal segments, the small apical one further partly fused with the penultimate; verticils considerably exceeding the segments in length. Head with front and orbits light yellow, the vertex infuscated.

Mesonotal præscutum gray, with four grayish brown stripes that are narrowly bordered by dark brown, the intermediate pair confluent at cephalic ends; each scutal lobe with two dark areas that are unmargined; median area of scutum pale; scutellum and mediotergite gray; a narrow, continuous, dark brown median line extending from scutum to base of abdomen. Pleura chiefly pale, the pleurotergite in front golden yellow. Halteres darkened, the apices of knobs narrowly yellow. Legs with the coxæ and trochanters yellow; femora obscure yellow, the tips narrowly and conspicuously blackened; tibiæ and tarsi brown to dark brown. Wings (Plate 1, fig. 1) with the ground color whitish to pale yellowish subhyaline, the disk chiefly covered by pale brown; prearcular cells light yellow, cells C and Sc more brownish yellow; darker brown markings, as follows: A large postarcular area in bases of cells R and M; origin of Rs; stigma, the last preceded by a conspicuous white spot in the center of a darkened cloud that extends from tip of Sc along outer end of Rs to stigma and thence along the anterior cord; posterior cord; a spot at near midlength of Cu and a seam at end of vein 2d A less distinctly darkened; the ground subhyaline areas include the subbasal portions of cells R and M; most of cell R_1 before the stigma; a broad fascia beyond the stigma, extending from costa into base of cell M_3; an area near outer end of cell M; white marginal spots in cells 1st A and 2d A (two areas in each cell); basal portions of cells Cu and 1st A variegated with whitish or pale yellow; veins brown. Veins R_3 and R_{4+5} with abundant macrotrichia. Venation: R_{1+2} entire but pale yellow, without trichia; Rs long, approximately three times m-cu, the latter somewhat variable in position, from just before to just beyond the fork of M_{3+4}.

Abdominal tergites obscure yellow, the basal segments in male with a very conspicuous brownish black median stripe; in female, the basal and intermediate tergites are reddish yellow, darker sublaterally, the borders narrowly grayish; subterminal segments and genital shield blackened. Male hypopygium with the tergite divided medially by pale membrane or very thin chitin, with a serrulate blackened plate on either side of midline. Basistyle (Plate 2, fig. 25, *b*) with a powerful black spine. Dististyles *id, od,* as figured. Ovipositor with the cerci entirely abnormal for the subgenus, almost as in the typical subgenus of *Tipula,* slender, not transverse, the margins without denticulations; hypovalvæ developed, extending caudad to end of genital shield.

Habitat.—China (Szechwan).

Holotype, male, Kwanhsien, altitude 3,500 feet, May 27, 1930 (*Franck*). Allotopotype, female. Paratopotype, female, in poor condition.

Of the two score species of *Vestiplex* now known from eastern Asia (including Siberia, Tibet, China, Japan, and Formosa, as well as the Himalayas) the present fly seems unquestionably to find its nearest ally in *Tipula* (*Vestiplex*) *asio* Alexander (Japan: Honshiu), which differs especially in the structure of the male hypopygium. The slender, nonserrate cerci of the ovipositor differ from those of all species of the subgenus known to me, but, unfortunately, the female sex of several species, including *asio,* is still undescribed.

TIPULA (VESTIPLEX) KWANHSIENANA sp. nov. Plate 1, fig. 2; Plate 2, fig. 26.

Mesonotal præscutum silvery, with four brown stripes that are narrowly bordered by darker brown, the intermediate pair with their anterior ends abruptly paler; femora obscure yellow, the tips blackened, preceded by a clearer yellow ring; wings pale yellow and brown, variegated with darker brown areas, including a conspicuous postarcular one; m-cu connecting with M_{3+4} at two-thirds the length; male hypopygium with caudal margin of tergite terminating in two widely separated rounded lobes; outer dististyle elongate, narrow, sinuous; basistyle unarmed.

Male.—Length, about 13 millimeters; wing, 15.6.

Frontal prolongation of head light yellow above, slightly infuscated laterally, nasus long and slender, black; palpi brownish black. Antennæ with scape and pedicel light yellow, flagellum black; flagellar segments subcylindrical, the basal enlargements feebly developed; longest verticils subequal in length to the segments; terminal segment reduced. Head yellow, the center of vertex darkened.

Ground color of mesonotal præscutum silvery on sides, the interspaces more yellowish, the disk with four brown stripes that are very narrowly bordered by darker brown; anterior ends of intermediate stripes abruptly paler, more olive; scutal lobes yellow pollinose, each with two dark brown areas; scutellum and mediotergite similar; a capillary brown vitta extends from the transverse suture to the abdomen. Pleura chiefly golden yellow. Halteres with base of stem and apex of knob yellow, the remainder of stem pale brown, the base of knob dark brown. Legs with coxæ light yellow pollinose; trochanters yellow; femora obscure yellow, the tips rather narrowly but conspicuously blackened, preceded by a slightly clearer yellow ring; tibiæ dark brown, the bases paler; tarsi brownish black. Wings (Plate 1, fig. 2) strongly narrowed at base; ground color pale yellow, the coloration chiefly concealed by an extensive grayish brown pattern that covers most of the disk, exposing the ground as follows: Prearcular region beyond the post-arcular darkening; a very tiny area before origin of Rs; cell R_1 before stigma almost entirely pale; post-stigmal crossband to cell 1st M_2; near outer end of cell M; posterior half of cell 1st M_2; in basal half of cell Cu; two spots in outer end of cell 1st A; both ends of cell 2d A; cell C chiefly pale; darker brown areas in bases of cells R and M; origin of Rs and along vein Cu in alignment with this; stigma; entire wing tip unvariegated by pale color; veins dark brown. Venation: m-cu connecting with M_{3+4} at two-thirds the length.

Abdominal segment one and basal ring of two light golden yellow, darkened medially; succeeding segments almost uniformly dark brown, the caudal borders of segments two to four faintly paler; basal sternites yellow, the outer segments dark, gray pruinose; outer segments, with hypopygium, dark brown. Male hypopygium (Plate 2, fig. 26) with the tergite separated from sternite by membrane; basistyle complete, with a triangular area partially delimited from sternite dorsad of tergite. Ninth tergite, *9t*, as viewed from above, with two flattened reddish lateral lobes, widely separated, clothed with delicate pale setæ; space between lobes truncate and blackened; dorsomedian area of tergite pale but not membranous, as is the case in several other species of *Vestiplex;* viewed laterally, there is seen to be a second lobe ventrad of the one described, the margin between the two with abundant pale setæ. Basistyle, *b*, and eighth sternite, *8s*, without spines. Outer dististyle, *od*, unusually long and slender, sinuous at near midlength, the basal half stouter than the outer half. Inner dististyle, *id*, with apical beak slender, blackened, separated from the subterminal lobe only by a linear curved split.

Habitat.—China (Szechwan).

Holotype, male, Kwanhsien, altitude 3,000 feet, August 16, 1930 (*Franck*).

The closest ally of the present fly is *Tipula* (*Vestiplex*) *arisanensis* Edwards (Formosa), which differs in the even smaller size, pale basal flagellar segments, unbordered præscutal stripes with the median one entire on anterior portion, and the details of wing pattern, such as the restriction of the yellow ground in bases of cells R and M, before the stigma and in base of cell 2d A, and its increase in amount before the origin of Rs. Both species show the uniformly darkened wing tip and the unusual position of m-cu before the fork of M_{3+4}. Unfortunately the male sex of *arisanensis* is still unknown.

TIPULA (ACUTIPULA) DICLADURA sp. nov. Plate 1, fig. 3; Plate 2, fig. 27.

Belongs to the *munda* group; allied to *biramosa;* mesonotal præscutum, scutum, and scutellum almost uniformly brownish gray; mediotergite light yellow, the center of the disk dark brown; pleura yellow; wings tinged with brown, the costal region and stigma darker; male hypopygium with the median lobe of tergite wide, depressed, the caudal margin deeply notched, each lobule densely set with small black spines; inner dististyle with a powerful curved blade and a slender axillary spine, additional to the usual beak.

Male.—Length, about 24 millimeters; wing, 27.5. Hind leg, femur, 20; tibia, 25; basitarsus, about 36.

Frontal prolongation of head dark reddish brown; nasus dark brown, elongate; palpi dark brown. Antennæ relatively short; scape brown, pedicel yellow; flagellar segments weakly bicolorous, the basal enlargement darkened, the apical portion obscure yellow; longest verticils more than one-half longer than the segments. Head brown, the posterior orbits narrowly yellowish.

Pronotum brownish yellow, the scutellum darker. Mesonotal præcutum, scutum, and scutellum almost uniformly dark brownish gray, the præscutum with very indistinct darker stripes, the lateral margins obscure brownish yellow; mediotergite light yellow, with a large brown area occupying much of disk. Pleura, including propleura and dorsopleural membrane, uniformly yellow. Halteres darkened, the apices of knobs obscure yellow.

Legs very long; coxæ and trochanters yellow; femora light brown, the tips rather narrowly blackened; tibiæ and tarsi dark brown. Wings (Plate 1, fig. 3) tinged with brown; cell C and especially cell Sc darker brown; stigma brown; obliterative areas before cord reduced in size, inconspicuous. Venation: Rs short, subequal to m-cu; petiole of cell M_1 subequal to m.

Abdominal tergites brownish yellow, the basal segments narrowly darkened sublaterally, the fifth and succeeding segments, including hypopygium, brownish black. Male hypopygium with the median lobe of tergite (Plate 2, fig. 27, *9t*) broad, depressed, the caudal margin with a deep U-shaped notch that has about the same general outline as that of the lobules, the latter densely set with blackened spinous points. Outer dististyle, *od*, broad on basal half, the apical portion somewhat narrower. Inner dististyle, *id*, with the outer portion a powerful flattened curved blade, glabrous, terminating in an acute point; in axil between this blade and the usual apical beak of style a slender needlelike rod, its tip subacute; apical beak compressed, the margin flattened.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 4,500 feet, August 8, 1931 (*Franck*).

The only other member of the group that has a hypopygium at all like that of the present fly is *Tipula* (*Acutipula*) *biramosa* Alexander, likewise from Szechwan. This species has the median lobe of the tergite narrow, only feebly notched, and with the inner dististyle of quite different conformation.

TIPULA (ACUTIPULA) PLATYCANTHA sp. nov. Plate 2, fig. 28.

Belongs to the *munda* group; allied to *oncerodes;* mesonotal præscutum, scutum, and scutellum dark gray; mediotergite darkened medially, bordered by yellow; pleura yellow; obliterative areas of wing inconspicuous; male hypopygium with the median lobe of tergite narrow, the tip simple; inner dististyle with a slender blackened beak, the outer lobe very broad and flattened, terminating in a small spine, with a second spine on outer margin before apex.

Male.—Length, about 20 to 25 millimeters; wing, 20.5 to 28.

Frontal prolongation of head yellowish brown, narrowly lined with darker; nasus elongate, blackened; palpi black. Antennæ with scape brownish yellow; pedicel obscure yellow; flagellum weakly bicolorous, the basal enlargement darkened, the remainder obscure yellow. Head brownish gray, the posterior orbits narrowly pale; anterior vertex relatively narrow, at narrowest point about twice the diameter of scape.

Mesonotum chiefly dark gray, the parascutella yellow; mediotergite dark medially, broadly margined with yellow. Pleura yellow. Halteres brown, the base of stem narrowly pale. Legs with coxæ and trochanters pale yellow; femora obscure yellow, the tips blackened; tibiæ brown, the tips brownish black; tarsi chiefly brownish yellow, the apices of the segments narrowly darkened. Wings with a strong brown tinge, the prearcular region, cells C and Sc, and the stigma darker brown; obliterative area distinct before stigma but only slightly evident before the cord, much less so than in *oncerodes*. Venation: Petiole of cell M_1 variable, subequal to or shorter than m; m-cu at or just before fork of M_{3+4}.

Abdomen with basal four segments reddish brown, the tergites narrowly margined laterally with yellow, lined internally with a faint dusky wash; segments five to nine brownish black. Male hypopygium with the median lobe of tergite (Plate 2, fig. 28, 9*t*) unusually slender, narrowed to a simple point that is densely set with abundant black spinous points. Outer dististyle, *od*, a flattened, long-oval lobe, the apex obtuse. Inner dististyle, *id*, with the beak unusually slender, blackened; outer lobe of style very broad and flattened, terminating in a small spine, with a second spine on outer margin before apex.

Habitat.—China (Szechwan).

Holotype, male, Kwanhsien, altitude 4,000 feet, August 17, 1930 (*Franck*). Paratopotype, male, August 19, 1930 (*Franck*). Paratypes, 2 males, Mount Omei, altitude, 4,500 feet, August 8, 1931 (*Franck*).

The only near ally, *Tipula* (*Acutipula*) *oncerodes* Alexander, is generally similar in appearance to the present fly, but the male hypopygium, especially in the structure of the inner dististyle, is quite different.

TIPULA BIPENDULA sp. nov. Plate 1, fig. 4; Plate 2, figs. 29 to 31.

Mesonotal præscutum brownish gray, with four darker brown stripes; pleura uniformly light yellow; antennæ (male) relatively long; flagellum beyond basal segment black; wings strongly tinged with brown, cells C and Sc conspicuously darker brown; cell 1st M_2 small; abdomen orange, the tergites with a median black vitta that is narrowly interrupted; male hypopygium with a single dististyle; eighth sternite bearing a large pale lobe that is profoundly divided medially.

Male.—Length, about 15 millimeters: wing, 19; antenna, about 6.

Frontal prolongation of head dark brown, shiny; nasus elongate; palpi brownish black. Antennæ (male) relatively elongate; scape and pedicel clear light yellow; first flagellar segment brownish yellow; remainder of flagellum black, the extensive tips of the individual segments a trifle brightened; basal enlargements of segments moderately developed; longest verticils subequal to the segment. Head chiefly dark brown, the front pale yellow.

Mesonotal præscutum brownish gray, with four dark brown stripes that are but little conspicuous against the ground, the intermediate pair saparated by a more blackish median vitta; posterior sclerites of notum concealed in the unique type. Pleura uniformly light yellow.

Halteres dark brown, the base of stem narrowly pale yellow. Legs with the coxæ and trochanters pale yellow; femora obscure yellow, the tips narrowly but conspicuously brownish black; remainder of legs darker brown; claws (male) toothed. Wings (Plate 1, fig. 4) strongly tinged with brown; cells C and Sc darker brown, the color not involving the radial field, a little darker than the stigma; paler areas in outer ends of cells R_3 and R_5; obliterative areas restricted; veins dark brown. Macrotrichia of veins abundant; squama naked. Venation: R_{1+2} entire, with trichia on basal portion; cell 1st M_2 unusually small, subpentagonal; cell M_1 about twice its petiole; cell 2d A relatively narrow.

Abdomen chiefly orange, the tergites with a median black vitta that is narrowly interrupted at caudal borders of segments; hypopygium chiefly darkened. Male hypopygium (Plate 2, fig. 29) with the tergite, 9*t*, sternite, 9*s*, and basistyle all entirely separate by sutures. Ninth tergite (Plate 2, fig. 31, 9*t*) with caudal border deeply trifid, the lateral lobes more darkened than the short obtuse median lobe; lateral lobes with very delicate setulæ. Ventral end of basistyle protuberant, provided with long setæ. A single dististyle (Plate 2, fig. 30), near its base produced into a long erect black spine; outer portion of style produced backward into a diaphanous membrane. Membrane of eighth sternite produced into a depressed pale structure, 8*s*, that is split almost to base, leaving two lobes that in a position of rest hang pendant (Plate 2, fig. 31).

Habitat.—China (Szechwan).

Holotype, male, Kwanhsien, altitude 2,500 feet, May 27, 1930 (*Franck*).

The structure of the male hypopygium readily serves to distinguish the present fly from all other members of the genus known to me. The wing pattern is somewhat like that of *Tipula brunnicosta* Brunetti (northern India), which is otherwise an entirely different fly.

LIMONIINÆ

LIMONIINI

LIMONIA (LIBNOTES) DIPHRAGMA sp. nov. Plate 1, fig. 5.

Mesonotal præscutum yellow with two darker intermediate stripes, the lateral borders darkened; antennal flagellum yellow; pronotum dark brown; wings pale yellow, with a restricted pale brown pattern; free tip of Sc_2 lying its own length before R_2; supernumerary crossveins in cells R_3 and R_5; abdominal tergites yellow, with a median brownish black stripe; ovipositor with small, weak cerci.

Female.—Length, about 10 millimeters; wing, 13 by 3.5.

Rostrum and palpi brownish black. Antennæ with basal segments dark; flagellum yellow. Head buffy yellow.

Pronotum yellow, dark brown laterally. Mesonotal præscutum with the ground color yellow, with two intermediate darker stripes that are separated only by a capillary pale vitta; lateral border of præscutum darkened; scutal lobes slightly darkened; scutellum pale yellow. Pleura pale yellow, with a conspicuous dorsopleural longitudinal stripe across the dorsal sclerites and pleural membranes; ventral pleurites not darkened. Halteres elongate, pale, the knobs dark brown. Legs with the coxæ and trochanters pale yellow; femora yellow, with a narrow brown subterminal ring; tibiæ and tarsi brownish yellow, the terminal tarsal segments darkened. Wings (Plate 1, fig. 5) relatively broad, as shown by the measurements; pale yellow, with a restricted pale brown pattern, distributed as spots and seams along the crossveins and deflections of longitudinal veins, and as longitudinal washes on veins R_3, M_{1+2}, and Cu; axillary region and posterior border of wing in medial and cubital fields darkened; veins pale yellow, darker in the clouded areas. Venation: Free tip of Sc_2 lying distinctly before the level of R_2, so that Sc_2 and R_1 are subequal; two supernumerary crossveins in outer radial field, one in cell R_3 about its own length proximad of R_2, the other in cell R_5, about its own length beyond the long, arcuated m; in addition to the above, both wings of the type show weak crossveins almost at the wing tip in outer ends of cells R_5 and 2d M_2; these are variable in length and position in the two wings of the type and are presumably adventitious (not shown in figure); m-cu at about one-third the length of cell 1st M_2.

Abdominal tergites yellow, with a conspicuous median brownish black stripe; sternites more uniformly yellow. Genital segment pale yellow. Ovipositor with very small and weak cerci.

Habitat.—China (Szechwan).

Holotype, female, Mount Omei, on mossy cliffs in river gorge, altitude 3,600 feet, July 27, 1932 (*Franck*).

The only other described *Libnotes* with two supernumerary crossveins in the wing is *Limonia* (*Libnotes*) *regalis* (Edwards) of the higher mountains of Formosa. Compared with the allotype female of this latter species in my collection, the present fly differs conspicuously in the diagnostic features listed above. The type is apparently slightly teneral but with the colorational pattern firmly indicated. If the outer adventitious crossveins at the wing tip should prove to be a constant feature, the present fly would be unique in this respect.

LIMONIA (LIBNOTES) CHRYSOPHÆA sp. nov. Plate 1, fig. 6.

General coloration of body orange; legs chiefly black, the femoral bases orange-yellow, tarsi paling to obscure yellow; wings golden yellow with about the outer tenth abruptly dark brown; free tip of Sc_2 some distance before the level of R_2; inner ends of cells 2d M_2 and M_3 about on a level; anal veins gently convergent at bases.

Male.—Length, about 11 millimeters; wing, 15.5.

Female.—Length, about 11 millimeters; wing, 15.5.

Rostrum and palpi brown. Antennæ brown; flagellar segments short-oval, the outer segments more elongate; terminal segment long, the outer two-fifths narrowed and pointed; verticils unilaterally arranged, the longest more than two times the segments. Head obscure fulvous, the front silvery white; anterior vertex of moderate width, subequal to the diameter of scape.

Thorax almost uniformly orange, the præscutum with indications of four more greenish stripes. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters obscure orange; femora orange-yellow basally, the tips very broadly blackened, on forelegs including nearly the outer three-fourths, on posterior legs including a little less than the outer half; tibiæ brownish black; tarsi paling to brownish yellow or obscure yellow. Wings (Plate 1, fig. 6) rich golden yellow, the extreme tip, including about the outer tenth, abruptly dark brown; stigmal region more saturated golden yellow; veins yellow, brown in the apical darkening. Venation: Sc_1 ending beyond level of r-m, Sc_2 close to its tip; Rs very gently arcuated; free tip of Sc_2 some distance beyond R_2, the latter evenly curved into R_1; inner ends of cells 2d M_2 and M_3 about on a level; m-cu at near one-third the length of cell 1st M_2; anal veins gently convergent at bases.

Abdomen orange throughout.

Habitat.—North Celebes (Minahassa).

Holotype, male, Roeroekan, altitude 4,000 feet, April 13, 1931 (*Clagg*). Allotopotype, female, April 17, 1931 (*Clagg*).

This striking crane fly needs no comparison with any other described species of the subgenus. The nature of the wing pattern is like certain species of the tipuline genus *Pselliophora* Osten Sacken, such as *compedita* (Wiedemann) but in the present fly the wing tip is even more narrowly darkened. By Edwards's key to the species of *Libnotes*,[2] the fly runs to couplet 28, disagreeing with all other species in the coloration of the body, wings, and legs.

LIMONIA (LIBNOTES) NIGERRIMA sp. nov. Plate 1, fig. 7.

Allied to *imponens;* coloration of entire body black; knobs of halteres blackened; wings narrow, the costal border infuscated; free tip of Sc_2 and R_2 in transverse alignment; vein 2d A strongly sinuous.

Male.—Length, about 11 millimeters; wing, 13 by 2.3.

Rostrum and palpi black. Antennæ brownish black, the scape more intensely so; flagellar segments oval; verticils relatively short. Head grayish brown; anterior vertex reduced to a linear silvery strip.

Thorax uniformly brownish black or black. Halteres dusky, the knobs brownish black. Legs with the coxæ black; trochanters brownish black; remainder of legs broken. Wings (Plate 1, fig. 7) narrow, weakly tinged with brown; prearcular region, cells C and Sc, and the elongate stigma darker brown, forming a narrow but continuous costal border; veins dark brown. Macrotrichia of vein C very small, especially near the wing base. Venation: Free tip of Sc_2 and R_2 in transverse alignment; all

[2] Journ. Fed. Malay States Mus. 14 (1928) 74–80.

radial and medial veins strongly decurved near margin; m long and arcuated, about one-third the total length of cell 1st M_2; m-cu at near one-fourth the length of cell; vein 2d A strongly sinuous.

Abdomen black; hypopygium obscure yellow. Male hypopygium of the typical form of *Libnotes,* with the tubercle of the ventral dististyle, together with its setæ, long and conspicuous; rostral spines long and slender.

Habitat.—North Celebes (Minahassa).

Holotype, male, Roeroekan, altitudes 4,000 feet, April 11, 1931 (*Clagg*).

By both Osten Sacken's [3] and Edwards's [4] keys to the species of *Libnotes,* the present fly runs directly to *Limonia* (*Libnotes*) *imponens* (Walker), of South Celebes. The latter differs in the ochraceous coloration of the thorax, together with the wings being unmarked except for the stigmal darkening.

LIMONIA (LIMONIA) COXITALIS sp. nov. Plate 1, fig. 8; Plate 2, fig. 32.

Mesonotal præscutum obscure yellow with a median brown stripe and with the lateral margins darkened; femora brown, the tips narrowly yellow; wings with a faint grayish tinge; stigma brown, subcircular; male hypopygium with the ventromesal lobe of basistyle stout, ending in a slender glabrous lobe; rostral prolongation of dististyle a long yellow blade, with a single small setalike spine on outer margin at near midlength; gonapophyses without corrugated ridges.

Male.—Length, about 7 to 8 millimeters; wing, 8.5 to 9.5.

Rostrum and the reduced palpi brownish black. Antennæ with the scape black; remainder of organ broken. Head dark gray; eyes contiguous on vertex.

Pronotum obscure yellow above, dark brown laterally. Mesonotal præscutum with the ground color obscure yellow, with a median dark brown stripe and with the extreme lateral portions of the sclerite broadly darkened; scutal lobes dark brown, the median region more testaceous; scutellum dark brown; mediotergite more yellowish brown. Pleura almost entirely covered by a broad dark brown stripe, the posterior portion of the sternopleurite and the dorsal portions of the pteropleurite and pleurotergite obscure yellow. Halteres with the stems yellow, knobs broken. Legs with the fore coxæ dark brown, the remaining

[3] Berlin. Ent. Zeitschr. 31 (1887) 182–183.

[4] Journ. Fed. Malay States Mus. 14 (1928) 74–80.

coxæ and all trochanters obscure yellow; femora brown, the bases narrowly yellow, the tips narrowly but very conspicuously paling to yellow; tibiæ and tarsi pale brown, the outer segments of the latter darker. Wings (Plate 1, fig. 8) with a faint grayish or sandy tinge, the costal region more brownish yellow; stigma brown, subcircular, conspicuous; wing tip weakly suffused with brown; veins brown. Venation: Sc relatively long, Sc_1 ending about opposite five-sixths the length of Rs, with Sc_2 at its tip; Rs leaving R at an acute angle, the central portion more arcuated; R_2 and free tip of Sc_2 in transverse alignment; m-cu close to fork of M.

Abdomen brownish black, the intermediate segments more bicolorous, their bases broadly obscure yellow. Male hypopygium (Plate 2, fig. 32) with the caudal margin of tergite, *9t*, evenly and convexly rounded. Basistyle, *b*, elongate, the ventromesal lobe stout, its apex narrowed into a slender glabrous lobe. A single dististyle, *d*, the body of which is a small oval mass, much smaller than the lobe of basistyle; rostral prolongation a long, pale yellow, gently curved blade, at near midlength on outer margin with small setalike spine. Gonapophyses, *g*, with the mesal-apical lobe long and narrow, the margin of the blade not transversely corrugated, as in members of the *pendleburyi* group.

Habitat.—China (Szechwan).

Holotype, male, Chengtu, altitude 1,800 feet, April 18, 1932 (*Franck*). Paratopotype, male, April 26, 1932 (*Franck*).

The general appearance of the present fly is much as in various members of the *pendleburyi* group of the subgenus, all of which have the surface of the gonapophyses with a delicate transverse corrugation, whereas in this insect the apophyses are quite smooth. The yellow femoral tips and the peculiar structure of the basistyle (coxite) will readily separate the present fly from all other regional members of *Limonia.*

LIMONIA (LIMONIA) QUANTILLA sp. nov. Plate 1, fig. 9; Plate 2, fig. 33.

General coloration of mesonotum reddish brown, the præscutum with a capillary dark brown median stripe; dorsal half of thoracic pleura darkened, the ventral portion suddenly light yellow; legs brownish black; wings tinged with brown; m-cu about one-third its length beyond fork of M; male hypopygium with the caudal margin of tergite truncated; basistyle slender, the ventromesal lobe basal in position; ventral dististyle with the rostral prolongation slender, without spines.

Male.—Length, about 3 millimeters; wing, 3.5.

Rostrum and palpi black. Antennæ brownish black throughout; flagellar segments oval. Head dark brown; anterior vertex reduced to a linear strip.

Pronotum pale brown. Mesonotal præscutum reddish brown, with a capillary darker brown stripe extending from the cephalic margin, a little widened behind on posterior third; scutal lobes reddish brown, their mesal edges narrowly darkened; scutellum infuscated; mediotergite reddish brown. Pleura with the dorsal portion darkened, the ventral half suddenly pale yellow. Halteres dusky, the base of stem very narrowly pale. Legs with the coxæ and trochanters light yellow; remainder of legs brownish black, only the femoral bases restrictedly brightened. Wings (Plate 1, fig. 9) rather strongly tinged with brown; stigma oval, slightly darker brown; veins and macrotrichia darker brown. Venation: Sc_1 ending about opposite five-sixths the length of Rs, Sc_2 at its tip; Rs only a little longer than R_{2+3}; free tip of Sc_2 and R_2 in transverse alignment; m-cu between one-third and one-half its length beyond the fork of M.

Abdominal tergites dark brown, the outer sternites more obscure yellow; hypopygium dark brown. Male hypopygium (Plate 2, fig. 33) with the tergite, *9t*, narrowed outwardly, the apex truncate, all setæ not far from margin. Basistyle, *b*, elongate, the cushionlike ventromesal lobe on basal half, provided with abundant erect setæ. Dorsal dististyle a powerful blade, the tip decurved. Ventral dististyle, *vd*, with the body of style an oval pale lobe, set with long erect setæ that are fully as long as the diameter of the lobe; rostral prolongation a long yellow curved rod, of blade, without evident spines. Gonapophyses, *g*, with the mesal-apical lobe ending bluntly but with the tip directed laterad into a point.

Habitat.—Sumatra (west coast).

Holotype, male, Fort de Kock, altitude 920 meters, 1926 (*Jacobson*).

Limonia (*Limonia*) *quantilla* is one of the smallest species of the subgenus so far made known. It is allied to the larger *L.* (*L.*) *flavohumeralis* Alexander and *L.* (*L.*) *melanopleura* Alexander, both of the Philippines, all three forms having the same general structure of the male hypopygium, but with the details different, especially in the tergite. The coloration of the body and position of m-cu further separate the present fly from the two species mentioned. The even smaller *L.* (*L.*) *infantula* Edwards (Borneo) belongs to a distinct group of the subgenus, the male hypopygium having lost the dorsal dististyle.

LIMONIA (DICRANOMYIA) RECTIDENS sp. nov. Plate 1, fig. 10; Plate 3, fig. 34.

Belongs to the *punctulata* group; a series of five or six brown clouds in cell C; male hypopygium with the ventral dististyle relatively small, the rostral prolongation long and slender, with two small straight spines placed on its lateral face near base; mesal-apical lobe of gonapophysis a simple acute blackened point.

Male.—Length, about 4 to 4.2 millimeters; wing, 4.8 to 5.

Female.—Length, about 5 to 5.5 millimeters; wing, 5.5 to 6.

Rostrum gray; palpi and antennæ black. Head dark gray. Mesonotum gray, the præscutum with a median dark brown stripe that is more or less constricted opposite the level of the humeri, in cases weakly split by a pale vitta; lateral stripes less distinctly indicated; median region of scutum and the scutellum more testaceous. Pleura dark gray. Halteres pale, the knobs infuscated. Legs with the coxæ dark brown; trochanters obscure yellow; femora brownish yellow, the tips broadly blackened; tibiæ and tarsi brown, the outer segments of the latter dark brown. Wings (Plate 1, fig. 10) grayish, with a sparse darker brownish gray pattern, arranged as in the *punctulata* group; a series of five or six brown clouds in cell C; veins brown. Costal fringe moderately long. Venation: Tip of R_{2+3} strongly upturned at outer end and here without trichia.

Abdomen, including hypopygium, brownish black. Male hypopygium (Plate 3, fig. 34) with the tergite, *9t*, notched medially, the caudal margin of the lobes thickened and provided with numerous setæ. Ventral dististyle, *vd*, small, as compared with *subpunctulata;* rostral prolongation long and slender, with two small straight spines that are inserted close together near the base of the prolongation and on its lateral aspect; inner spine a trifle longer than the outer; both spines shorter than the apex of the prolongation beyond the outer spine. Gonapophyses, *g*, with the mesal-apical lobe a short simple acute blackened point.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 4,200 feet, June 29, 1932 (*Franck*). Allotopotype, female, altitude 4,800 feet, July 4, 1932 (*Franck*). Paratopotypes, several males and females, altitude 3,500 feet, August 16, 1931; 4,200 feet, June 29 to July 2, 1932; 4,500 feet, July 29, 1929 (*Franck*). Paratypes, males, Kwanhsien, altitude 4,000 feet, August 16, 1930 (*Franck*).

Limonia (*Dicranomyia*) *rectidens* is most nearly allied to the Formosan *L.* (*D.*) *subpunctulata* Alexander, in the bispinous rostral prolongation of the male hypopygium, differing most evidently in the spotted costal cell of the wing, and the much smaller ventral dististyle of the male hypopygium. The status of *L.* (*D.*) *fascipennis* (Brunetti) has been discussed by the writer in another paper.[5]

LIMONIA (RHIPIDIA) FORMOSANA EXPANSIMACULA subsp. nov. Plate 1, fig. 11.

Male.—Length, about 3.3 to 3.8 millimeters; wing, 4 to 4.5.

Similar to typical *formosana* (Alexander), differing especially in the small size and details of the wing pattern.

Legs with the femora pale brown, the tips narrowly whitish, preceded by a broader subterminal ring. Wings (Plate 1, fig. 11) with the dark area at origin of Rs and tip of Sc_1 broadened behind, much wider in cell R than in the costal field, not quite reaching vein M.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 4,800 feet, July 4, 1932 (*Franck*). Paratopotype, male.

Limonia (*Rhipidia*) *formosana* (Alexander), first described as a variety of *rostrifera* (Edwards), is a valid species, with the dark area at midlength of cell Sc very restricted, not involving cells C or R, and without darkening at tip of vein 1st A.

HELIUS (RHAMPHOLIMNOBIA) PAPUANUS sp. nov. Plate 1, fig. 12; Plate 3, fig. 35.

Size small (wing, male, under 4.5 millimeters); mesonotal præscutum and scutum with orange or brownish orange stripes, the lateral borders and interspaces darker; r-m at or close to fork of Rs; m-cu strongly pointed at inner end; m-cu nearly its own length before fork of M; dark area in outer end of cell R in alignment with the m-cu crossvein, not connected with the broken crossband at midlength of cells R and M.

Male.—Length, excluding rostrum, about 4 millimeters; wing, 4 to 4.2; rostrum, alone, about 0.6.

Rostrum black; palpi whitish. Antennæ with scape and pedicel black; first flagellar segment pale, remainder of flagellum dark brown, somewhat darker outwardly. Head gray, the anterior vertex narrow, about equal in width to the diameter of scape.

Pronotum obscure yellow, darkened laterally. Cervical sclerites elongate, dark brown. Anterior lateral pretergites whitish.

[5] Philip. Journ. Sci. 46 (1931) 282.

Mesonotal præscutum with the disk largely covered by three orange or brownish orange stripes, the interspaces pale brown; lateral borders of sclerite narrowly dark brown; scutal lobes extensively orange or brownish orange, margined with brown; scutellum and mediotergite dark brown. Pleura traversed by a very broad dark brown stripe, the dorsopleural region and ventral sternopleurite more yellowish. Halteres pale, the knobs weakly darkened. Legs with the coxæ dark brown, the midcoxæ paler basally; trochanters dark brown; femora obscure yellow basally, passing into dark brown, immediately before tip with a very narrow yellow ring; tibiæ dark brown, the extreme base and tip pale; tarsi chiefly obscure yellow. Wings (Plate 1, fig. 12) whitish, the prearcular region, cells C and Sc, and the wing tip in cell R_3, light yellow; a restricted reticulate brown pattern, including the stigma, two larger areas in cell R, and narrow transverse spots in most of the cells, including two in each of cells R_5, 2d M_2 and M_3; m-cu and a spot in cell R above it narrowly brown; a wider, interrupted, brown crossband across cells R and M, terminating at end of vein 1st A; a brown spot at arculus and another in the axillary region of cell 2d A; most of the described brown spots and dots tend to form interrupted brown crossbands that lie more or less parallel with one another; veins pale brown, somewhat darker in the clouded areas. Costal fringe long and conspicuous; no macrotrichia on anterior branch of Rs or on anal veins. Venation: r-m at or just before fork of Rs; anterior branch of Rs diverging very strongly from R_{4+5}, cell R_3 at margin thus being very wide; inner end of cell 1st M_2 strongly pointed; m-cu nearly its own length before fork of M; cell 2d A relatively narrow.

Abdomen dark reddish brown, the caudal and lateral portions of the segments somewhat darker brown; hypopygium dark. Male hypopygium (Plate 3, fig. 35) with the outer dististyle, *od,* slender, its tip weakly dilated, the surface indistinctly roughened. Inner dististyle, *id,* longer, the apical third narrowed, the margin of style with conspicuous setigerous tubercles. Ædeagus, *a,* small. Gonapophyses, *g,* recurved, the tips acute.

Habitat.—New Guinea, New Britain.

Holotype, male, Laup, New Britain (*Dr. Hosking*); Macleay Collection, University of Sydney, through Mr. Frank H. Taylor. Paratype, male, Friedrich-Wilhelmshafen, New Guinea, June, 1896 (*Biró*); Hungarian National Museum.

Helius (*Rhampholimnobia*) *papuanus* is most nearly allied to the subgenotype, *H.* (*R.*) *reticularis* (Alexander), of Java, Borneo, Celebes, Mindanao, and Luzon, differing in the diagnostic features listed above, especially the small size, the less heavily reticulated wing pattern, and the venation. The paratype had been recorded earlier by Riedel [6] as *Geranomyia annulipes* Hutton, which is now known as *Limonia* (*Zelandoglochina*) *huttoni* (Edwards).

ORIMARGA (ORIMARGA) LATISSIMA sp. nov. Plate 1, fig. 13; Plate 3, fig. 36.

General coloration dark gray; halteres pale yellow throughout; legs black; wings unusually broad, brownish yellow; costal fringe (male) short; macrotrichia on outer end of vein R_3; R_{1+2} only a little short than R_{2+3+4}; male hypopygium with one pair of gonapophyses yellow, densely set with spinous points.

Male.—Length, about 7 millimeters; wing, 7 by 2.2.

Female.—Length, about 8 millimeters; wing, 7.3 by 2.2.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, the outer segments gradually smaller. Head dark gray.

Mesonotum and pleura uniformly dark gray. Halteres pale yellow throughout. Legs with the coxæ and trochanters dark blackish gray; remainder of legs black, the femoral bases somewhat paler. Wings (Plate 1, fig. 13) unusually broad, especially in male, widest just opposite or slightly beyond termination of vein 2d A; wings tinged with brownish yellow, cells C and Sc somewhat paler yellow; stigmal region vaguely darker; veins pale. Costal fringe abundant, short. Macrotrichia of veins relatively abundant, there being from ten to twenty on distal third or more of vein R_3. Venation: R_{1+2} elongate, only a little shorter than R_{2+3+4}; free tip of Sc_2 very vague, about its own length before R_2; cell 2d A very wide.

Abdomen, including hypopygium, black. Male hypopygium (Plate 3, fig. 36) with the phallosomic armature, *p*, conspicuous, consisting in part of a pair of spinous yellow lobes, united basally into a common stem, the entire outer end densely set with spinous points.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 3,600 feet, July 27, 1932 (*Franck*). Allotopotype, female, altitude 4,200 feet, June 29, 1932 (*Franck*). Paratopotype, male, altitude 4,800 feet, July 4, 1932 (*Franck*).

There are now seven species of *Orimarga* known from China, all of which have been taken at various altitudes on Mount

[6] Ann. Mus. Nat. Hungarici 18 (1921) 131.

Omei. The present fly differs from all members of the subgenus known to me by the unusual width of the wing, the increase in diameter being taken up chiefly by a widening of the anal cells.

Key to the Chinese species of Orimarga.

1. Vein R_2 of wings not more than its own length beyond fork of Rs........ 2.
   Vein R_2 of wings at least twice its length beyond fork of Rs (*seticosta*), usually fully four times this length.. 4.
2. Wings unusually narrow, especially on basal third; vein R_2 at end of of Rs and in transverse alignment with the basal section of R_5.
   cruciformis Alexander.
   Wings of normal width, vein R_2 about its own length beyond fork of Rs .... 3.
3. Wing veins unusually glabrous, R_3 without trichia; male hypopygium with elements of phallosome conspicuous.............. *nudivena* Alexander.
   Wing veins with abundant trichia, R_3 having a series over its entire length; male hypopygium with elements of phallosome inconspicuous.
   æquivena Alexander.
4. General coloration of thorax brownish gray, the pleura with a narrow black longitudinal stripe; costal fringe long and conspicuous in both sexes .... *seticosta* Alexander.
   General coloration of thorax dark gray, including at least the dorsal pleurites; costal fringe short in both sexes.. 5.
5. Wings unusually wide, especially the anal field; R_{1+2} only a little shorter than R_{2+3}; femora black, paler only at bases........ *latissima* sp. nov.
   Wings of normal width; R_{1+2} approximately one-half R_{2+3}; femora brown to yellowish brown .... 6.
6. Wings tinged with yellowish; male hypopygium with the outer dististyle gently arcuated; basistyle unarmed at base.
   omeina Alexander.
   Wings tinged with grayish brown; male hypopygium with outer dististyle bent beyond midlength at about a right angle; basistyle with a conspicuous lobe on mesal face at base......................... *basilobata* sp. nov.

ORIMARGA (ORIMARGA) BASILOBATA sp. nov. Plate 1, fig. 14; Plate 3, fig. 37.

General coloration gray, the sternopleurite more reddish yellow; wings with costal fringe short; macrotrichia of outer veins numerous; free tip of Sc_2 far before R_2; R_{1+2} a little more than one-half R_{2+3}; male hypopygium with the basistyle bearing a large setiferous lobe on cephalic end of mesal face; outer dististyle with the outer third bent at about a right angle into a long apical spine.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum light brown, gray pruinose; palpi brownish black. Antennæ black throughout; flagellar segments oval, with a short white pubescence and short verticils. Head gray, the anterior vertex silvery, at narrowest point nearly twice as wide as diameter of scape.

Mesonotum dark brownish gray. Dorsal pleurites dark brown, the sternopleurite and meral region light reddish yellow. Halteres pale, the knobs weakly infuscated. Legs with the coxæ yellowish testaceous, the fore coxæ a little darker; trochanters yellow; femora brown, the tips darker; remainder of legs dark brown. Wings (Plate 1, fig. 14) with a grayish brown tinge, the prearcular and costal regions paler, more whitish; veins pale brown. Costal fringe short; macrotrichia of veins beyond cord abundant and relatively long, on R_3 with about a score. Venation: Sc_1 ending shortly before fork of Rs; free tip of Sc_2 faint, far before R_2, at near mid-distance between the latter vein and tip of Sc_1; R_{1+2} a little more than one-half R_{2+3}; r-m and basal section of M_{1+2} both pale, nearly in transverse alignment; cell 2d A relatively narrow.

Abdomen brownish black; hypopygium a little brighter. Male hypopygium (Plate 3, fig. 37) with the mesal face of basistyle, *b*, at cephalic end with a large setiferous lobe. Outer dististyle at near two-thirds the length narrowed and bent at nearly a right angle into a long apical spine. Inner dististyle, *id*, with a single row of setæ along the face, additional to a small group on the inner margin at near midlength. Phallosome, *p*, with the ædeagus short, the gonapophyses appearing as slender, gently curved hooks.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 4,000 feet, July 14, 1931 (*Franck*).

The relations of this distinct species to the other described Chinese species of *Orimarga* are shown by the key accompanying the preceding species.

ORIMARGA (ORIMARGA) RISBECI sp. nov. Plate 1, fig. 15.

General coloration gray, the præscutum with three brown stripes; R_{1+2} ending opposite the fork of M_{3+4} and before midlength of the distance between end of Sc_1 and wing apex; m-cu at near one-third the length of Rs.

Female.—Length, about 4.8 millimeters; wing, 4.2.

Rostrum brown; palpi black. Antennæ black throughout; flagellar segments oval, terminal segment shorter than penultimate. Head gray.

Mesonotal præscutum gray, with three brown stripes, the broad median stripe slightly divided by a capillary gray vitta; scutal lobes with brown centers; posterior sclerites of mesonotum gray. Pleura gray, the ventral sternopleurite darker. Halteres pale, the knobs somewhat more yellow. Legs with the coxæ brownish yellow, the fore and middle coxæ more pruinose; remainder of legs yellowish brown, the outer tarsal segments darker. Wings (Plate 1, fig. 15) tinged with whitish, the prearcular and costal cells slightly more yellowish, the bases of the anal cells a little darkened; veins pale. Macrotrichia on almost the entire length of the veins beyond cord, there being more than 30 on R_2. Venation: Sc_1 ending beyond midlength of Rs; tip of R_{1+2} opposite fork of M_{3+4} and before midlength of distance between end of Sc_1 and apex of wing; Rs angulated at origin; R_{2+3} a little shorter than R_{1+2}, without trichia; R_2 a little longer than r-m; m-cu about opposite one-third to two-fifths the length of Rs.

Abdomen brownish black, the genital segment ocherous, the ovipositor horn yellow.

Habitat.—New Caledonia.

Holotype, female, Plum Farm, January, 1929 (*Risbec*).

I take great pleasure in naming this species in honor of the collector, Prof. Jean Risbec. The fly is closest to *Orimarga* (*Orimarga*) *inornata* Skuse (New South Wales), differing in the coloration of the thorax and the details of venation, especially the shorter R_{1+2} and the position of m-cu.

HEXATOMINI

HEXATOMA (ERIOCERA) MINENSIS sp. nov. Plate 1, fig. 16.

Belongs to the *verticalis* group; mesonotum brownish gray, the præscutum with three dark brown stripes; vertical tubercle yellow, its summit more polished brown; knobs of halteres blackened; femora brownish black on outer half; wings strongly tinged with yellowish brown; stigma oval, dark brown; longitudinal veins narrowly and vaguely seamed with darker; numerous macrotrichia on outer radial veins; abdominal tergites black, the shield of ovipositor bright orange.

Female.—Length, about 16 millimeters; wing, 13.

Rostrum short, brownish yellow; palpi black. Antennæ with the scape and pedicel yellow, flagellum broken. Head with vertex, including the vertical tubercle, yellow, the latter somewhat polished brown at summit; sides of vertex behind darker and sparsely pruinose.

Mesonotum brownish gray, the præscutum with three dark brown stripes, the middle one entire; scutellum more heavily dusted with light gray. Pleura dark brown, more or less pruinose. Halteres yellow basally, the knobs and outer ends of stems blackened. Legs with the coxæ brown, pruinose; trochanters yellow; femora brown on basal half, the outer half passing into brownish black; tibiæ brown, the tips a little darker; tarsi brownish black. Wings (Plate 1, fig. 16) strongly tinged with yellowish brown; cells C and Sc clearer light brown; stigma oval, usually small, dark brown; longitudinal veins narrowly and vaguely seamed with darker; veins brown, the outer radial veins and the cord darker brown. Costal fringe abundant, moderately long; abundant macrotrichia on outer radial veins, there being a series of about twenty-five on R_3. Venation: R_2 about one-half R_{1+2}, subequal to R_{2+3}; outer medial veins tending to become evanescent, as common in this genus; dark fold behind vein 2d A faint and little evident.

Abdominal tergites black; basal sternites a little paler. Ovipositor with its shield bright orange; cerci blackened at bases, more reddish on outer half; cerci of moderate length, slender.

Habitat.—China (Szechwan).

Holotype, female, Chengtu, along banks of Min River, altitude 1,700 feet, August 26, 1932 (*Franck*). Paratopotype, female.

Hexatoma (*Eriocera*) *minensis* is closest to *H.* (*E.*) *nipponensis* (Alexander), of Japan, differing most conspicuously in the wing pattern, presence of only three præscutal stripes, and the yellow vertical tubercle.

HEXATOMA (ERIOCERA) DIPLONEURA sp. nov. Plate 1, fig. 17.

Belongs to the *verticalis* group; size small (wing, female, under 8 millimeters); mesonotum almost uniformly dark brown, the præscutum with indications of three more blackish stripes; femora brownish yellow, the tips narrowly blackened; wings with a brownish tinge; no macrotrichia on outer branches of Rs, excepting a sparse series on R_5; cell M_1 lacking; a chitinized fold or weak spurious vein immediately behind and paralleling vein 2d A; valves of ovipositor unusually long and slender.

Female.—Length, about 7.5 to 9 millimeters; wing, 6 to 7.5.

Rostrum greatly reduced; palpi black. Antennæ with scape and pedicel obscure yellow to brownish yellow; flagellum broken. Head with vertical tubercle dark brown, entire; posterior portion of head dark gray pruinose.

Mesonotum almost uniformly dark brown, with indications of three more blackish stripes on præscutum. Pleura dark brown. Halteres obscure brownish yellow, the knobs brownish black. Legs with the coxæ dark brown; trochanters obscure yellow; femora brownish yellow, the tips narrowly blackened; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 17) with a brownish tinge, cells C and Sc slightly darker; stigma oval, slightly darker than the ground color; veins brown. Costal fringe abundant and relatively long; no macrotrichia on outer radial veins, excepting a sparse series on vein R_5. Venation: Cell M_1 lacking; a second vein or sclerotized fold lying immediately behind and parallel to vein 2d A.

Abdomen black. Ovipositor with the valves, especially the cerci, unusually long and slender, nearly straight; hypovalvæ extending to just beyond midlength of cerci, very slender.

Habitat.—China (Szechwan).

Holotype, female, Chengtu, along banks of Min River, altitude 1,700 feet, August 26, 1932 (*Franck*). Paratopotype, female.

Hexatoma (*Eriocera*) *diploneura* is readily told from *H.* (*E.*) *nipponensis* (Alexander) and other allied forms, by the diagnostic features listed above. The small size, glabrous outer radial veins, double vein 2d A, together with the unusually long and slender cerci, readily define the species.

GYNOPLISTIA (GYNOPLISTIA) NOVEM-PECTINATA sp. nov. Plate 1, fig. 18; Plate 3, fig. 38.

Belongs to the *jucunda* group; antennæ (male) 16-segmented, with nine branched segments, the branches elongate; head and thorax polished black; halteres uniformly blackened; wings whitish, with a restricted dark pattern; abdomen with segments one, seven, eight, and nine black, the remainder yellow, more darkened on their pleural portions; male hypopygium with a single dististyle that is tridentate at apex, the inner tooth a slender curved spine.

Male.—Length, about 8 millimeters; wing, 7.

Described from an alcoholic specimen.

Rostrum and palpi dark brown. Antennæ with scape and pedicel light yellow; axis of flagellum yellow, the branches and subapical portions of the axis of segments darkened, giving a bicolorous appearance to the individual segments, the ends being yellow, the central portion infuscated; apical simple segments darkened; flagellum with nine long branched segments, the antennal formula being $2 + 2 + 7 + 5$; first branch a trifle longer than the last branch, the latter about four times the segment; longest branch (about the fifth or sixth flagellar segment) about two-fifths as long as the entire flagellum. Head black.

Thorax polished black, the dorsopleural membrane paler; any pruinosity normally present destroyed by immersion. Halteres uniformly blackened. Legs with the coxæ black, clothed with very conspicuous elongate setæ; trochanters dark brown; remainder of legs broken. Wings (Plate 1, fig. 18) with the ground color whitish; cells C and Sc slightly more yellow; a restricted brown pattern, including small areas at arculus and origin of Rs, with a larger triangular area, including the stigma and anterior cord; a paler cloud in cells M, Cu, and 1st A at the level of Rs; posterior cord and outer end of cell 1st M_2 very narrowly seamed with brown; wing tip narrowly and very vaguely darkened; veins brown. Venation: Sc_1 ending opposite fork of Rs, Sc_2 at its tip; R_{2+3+4} subequal to r-m; R_{1+2} a little longer than R_2; cell M_1 lacking.

Abdomen with basal segment black; segments two to six light yellow, the lateral portions extensively darkened, becoming deeper and more clearly defined on outer segments; terminal segments uniformly blackened. Male hypopygium (Plate 3, fig. 38) with the dististyle, *d*, single, tridentate at tip, the inner spine long and slender, curved; surface of style with numerous microscopic punctures. Arms of phallosome, *p*, appearing as black slender structures, the outer margins microscopically roughened.

Habitat.—Central Celebes (Bontoe Batoe).

Holotype, alcoholic male, Latimodjong Mountains, altitude 4,500 to 6,000 feet, May 25, 1931 (*Clagg*).

The present species is most nearly allied to *Gynoplistia* (*Gynoplistia*) *jucunda* Osten Sacken and *G.* (*G.*) *octo-fasciata* Brunetti, both of South Celebes.

Key to the three Celebean species of the genus Gynoplistia.

1. Abdomen uniformly reddish yellow .... *jucunda* Osten Sacken.
   Abdomen variegated with black .... 2.
2. Abdomen with segments two to seven obscure yellow, the caudal margins broadly dark brown to produce a fasciate appearance; head gray; halteres bright orange-yellow .... *octo-fasciata* Brunetti.
   Abdomen with segments one, seven, eight and nine blackened, the intermediate sternites and tergites light yellow; head black; halteres uniformly blackened .... *novem-punctata* sp. nov.

All three members of the *jucunda* group discussed above have cell M_1 of the wings lacking and with a rather unusual number of simple terminal antennal segments in male, there being presumably eight in *jucunda* but only five in the present species. Antennal formula of *jucunda* male, $2 + 2 + 6 + ?$; of *novem-punctata* male, $2 + 2 + 7 + 5$; male of *octo-fasciata* unknown.

Elsewhere in the Australasian region half a dozen species of *Gynoplistia* occur in which cell M_1 is lacking (Papua, 1; southeastern Australia and Tasmania, 3; New Zealand, 2). These six species represent several distinct groups of the genus.

GYNOPLISTIA (GYNOPLISTIA) OCTO-FASCIATA Brunetti.

Gynoplistia 8-fasciata BRUNETTI, Rec. Indian Mus. 6 (1911) 307.

Described from a unique female specimen taken at Patunuang, South Celebes, January 1896 (*H. Fruhstorfer*). This type, in the Vienna Museum, was kindly loaned me for study by Dr. Hans Zerny in 1921. The following supplementary notes are given.

Female.—Length, 9 millimeters; wing, 7.7.

Dorsum of head densely covered with a microscopic appressed gray pubescence to appear like a heavy bloom. Antennæ apparently 16-segmented, the formula (female) being 2 + 2 + 4 + 8 or 2 + 6 + 8. Thoracic pleura with an appressed gray pubescence. Abdominal tergite one dark brown, tergites two to seven obscure yellow, with the caudal margin broadly, the lateral margins more narrowly dark brown; sternites similar, but the dark pattern much more extensive except on segments five and six, on sternites two to four including at least the posterior half of the segment. Genital segment and ovipositor yellowish horn color. Wings yellow, the pattern very much as in the female of *jucunda;* mark at origin of cells R and M distinct; band at level of origin of Rs interrupted in cell M.

The species differs from *jucunda* in the banded abdomen and in the gray coloration of the head.

ERIOPTERINI

GONOMYIA (LIPOPHLEPS) KERTÉSZIANA sp. nov. Plate 1, fig. 19; Plate 3, fig. 39.

General coloration dark brown; pleura with a yellowish white longitudinal stripe; wings grayish, sparsely variegated with bluish subhyaline areas; Sc ending just before origin of the strongly arcuated to feebly angulated Rs; abdomen, including hypopygium, dark brown; male hypopygium with three dististyles, the outer a long simple rod; phallosome without blackened hooks or spines.

Male.—Length, about 2.6 millimeters; wing, 3.

Rostrum and palpi black. Antennæ with the scape and pedicel black above, more yellowish beneath; flagellum brownish black, with the usual long verticils of this sex. Head pale yellow, the center of vertex shrunken, apparently darkened.

Pronotum and anterior lateral pretergites pale yellow. Mesonotum dark brown, the scutellum a very little brighter. Pleura blackish, with a yellowish white longitudinal stripe. Halteres dusky, the extreme apices of the knobs obscure yellow. Legs with the coxæ and trochanters obscure testaceous yellow;

remainder of legs broken. Wings (Plate 1, fig. 19) grayish, with bluish subhyaline areas in cells Cu, 1st M_2 and M_3; veins pale. Costal fringe long and conspicuous. Venation: Sc_1 ending just before origin of the strongly arcuated or angulated Rs; m-cu near fork of M.

Abdomen, including hypopygium, dark brown. Male hypopygium (Plate 3, fig. 39) with three dististyles, the outer, *od*, a simple glabrous rod; second style clavate, its outer surface densely set with recurved black spines; inner style, *id*, fleshy, with long setæ, including a group of three very powerful setæ on basal half of style. Phallosome without blackened hooks or spines.

Habitat.—New Guinea.

Holotype, male, Simbang, Huon Gulf, July, 1898 (*Biró*).

I take great pleasure in dedicating this fly to the memory of Dr. Koloman Kertész, former custodian of Diptera in the Hungarian National Museum, to whom I express my great personal indebtedness over a period of many years. By Edwards's key to the Oriental species of *Lipophleps*, the present species runs to *Gonomyia* (*Lipophleps*) *diffusa* (de Meijere), a very different species. As usual in this group of Tipulidæ, the structure of the male hypopygium furnishes the most important specific characters. The specimen had earlier been identified as being *Lipophleps brevivena* Skuse by Riedel (No. 25).

GONOMYIA (LIPOPHLEPS) AQUILA sp. nov. Plate 1, fig. 20; Plate 3, fig. 40.

Mesonotum dark brownish gray, the scutellum broadly margined with yellow; pleura striped longitudinally with yellowish white; femora yellow, with a broad black subterminal ring; wings whitish subhyaline and pale brown, the arcular and stigmal areas darker brown; abdominal segments dark brown, ringed caudally with yellow; male hypopygium with the outer dististyle blackened, forked at base into two arms, the outer one longer, glabrous, the inner arm terminating in an acute spine, the dilated apical portion with abundant setæ; phallosome depressed, each outer lateral angle produced into a blackened conical horn.

Male.—Length, about 3 millimeters; wing, 3.5.

Rostrum and palpi black. Antennæ with scape and pedicel dark beneath, yellow above; flagellum brownish black. Head yellow, the center of vertex with a dark area.

Pronotum and pretergites yellow. Mesonotal præscutum and scutum dark brownish gray, the latter with a small point on caudal-lateral portion; scutellum dark basally, broadly margined behind with yellow; mediotergite dark behind, variegated with yellow on cephalic-lateral angles, the coloration forming a more or less complete crossband at near midlength of the sclerite. Pleura dark, with a ventral longitudinal yellowish white stripe extending from the fore coxæ to base of abdomen. Halteres yellow, the bases of knobs darkened. Legs with fore coxæ whitened, remaining coxæ yellowish testaceous; trochanters yellow; femora yellow, with a broad black subterminal ring that is about two or three times as wide as the pale apex; tibiæ and tarsi obscure yellow, the outer tarsal segments darkened; in cases, the femora are more brownish yellow, the black ring preceded and followed by clearer yellow. Wings (Plate 1, fig. 20) relatively broad, the disk variegated with whitish subhyaline and pale brown; darker brown areas at arculus and stigma; the pale ground areas are arranged as more or less complete crossbands before the cord and at about one-third the length of the wings, in median field and as conspicuous pale areas before and beyond the stigma; veins pale, darker in the clouded areas. Venation: Sc short, Sc_1 ending a short distance before origin of Rs; m-cu close to fork of M.

Abdomen dark brown, the segments narrowly but conspicuously ringed caudally with yellow, most distinct on tergites; hypopygium reddish. Male hypopygium (Plate 3, fig. 40) with the outer dististyle, *od,* profoundly bifid, blackened, the outer arm slender, sinuous, glabrous; inner arm shorter, the outer half a little dilated, terminating in a long straight black spine, the dilated portion with numerous, long, pale, appressed setæ. Inner dististyle pale, terminating in the usual two fasciculate setæ, the apex and cephalic margin of style with long normal setæ. Phallosome, *p,* with each outer lateral angle terminating in a stout, curved, blackened horn.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 4,200 feet, July 2, 1932 (*Franck*). Paratopotypes, 2 males, altitude 4,800 feet, July 4, 1932 (*Franck*).

The nearest ally of the present fly is *Gonomyia* (*Lipophleps*) *angulifera* Alexander, likewise from Mount Omei, where it occurs at higher altitudes on the mountain. The details of the male hypopygia of the two flies are quite distinct.

GONOMYIA (LIPOPHLEPS) ANXIA sp. nov. Plate 1, fig. 21; Plate 3, fig. 41.

Belongs to the *skusei* group; pleural stripe broad and conspicuous, whitish; knobs of halteres obscure yellow; legs dark brown; wings with a strong brown tinge; male hypopygium with the dististyle subterminal in position, fleshy; phallosome terminating in two flattened plates.

Male.—Length, about 3 millimeters; wing, 3.6.

Female.—Length, about 4 to 4.5 millimeters; wing, 4 to 4.3.

Rostrum and palpi brownish black. Antennæ brownish black throughout. Head with front pale; posterior portion of head chiefly gray, the occipital region variegated by yellow.

Pronotum and anterior lateral pretergites light yellow. Mesonotal præscutum and scutal lobes almost uniformly medium brown, the former very sparsely pruinose; median region of scutum and posterior borders of scutal lobes obscure yellow; scutellum chiefly yellow, the median region at base more darkened; mediotergite darkened. Pleura light brown, with a broad and conspicuous whitish longitudinal stripe, extending from the propleura to base of abdomen, involving also much of pteropleurite and pleurotergite. Halteres dusky, the knobs obscure yellow. Legs with the coxæ brownish testaceous, the fore coxæ slightly darker; trochanters obscure yellow; remainder of legs dark brown, only the femoral bases somewhat paler. Wings (Plate 1, fig. 21) with a strong brown tinge, the stigma scarcely evident; veins brown. Venation: Sc_1 ending about opposite one-third the length of the long Rs, Sc_2 at near middistance between tip of Sc_1 and origin of Rs; m-cu shortly before the fork of M.

Abdominal tergites dark brown, paler laterally; sternites paler; hypopygium brownish yellow. Male hypopygium (Plate 3, fig. 41) with the single dististyle, *d*, fleshy, subequal in length and size to the outer lobe of basistyle, tipped with the usual fasciculate seta; a long modified seta on outer face beyond midlength. Phallosome, *p*, complex, in slide mounts constructed about as figured.

Habitat.—Sumatra (West Coast).

Holotype, male, Fort de Kock, altitude 920 meters, 1926 (*Jacobson*). Allotopotype, female. Paratopotypes, 2 females.

This is the first member of the *skusei* group of the subgenus to be described from the Dutch East Indian islands. It is most nearly allied to a group of three Philippine species, *acanthophallus* Alexander and *macilenta* Alexander, of Mindanao, and *longiradialis* Alexander, of Luzon. All four species agree in having a single fleshy dististyle to the male hypopygium, this with a single specially modified seta on outer margin before apex. These species differ among themselves chiefly in the construction of the phallosome. The other species of the group from eastern

Asia, *sagittifera* Alexander, of Mindanao, and *sauteri* Alexander, of Formosa and western China, are very distinct in the structure of the dististyles of the hypopygium.

GONOMYIA (GONOMYIA) LATILOBATA sp. nov. Plate 1, fig. 22; Plate 3, fig. 42.

Mesonotum and scutal lobes brown, scutellum broadly yellow behind; pleura extensively yellow, the ventral sternopleurite and anepisternum darkened; wings yellowish brown, the diffuse stigma slightly darker; Sc relatively long, Sc_1 extending to about opposite one-fourth the length of Rs; male hypopygium with the dististyle bearing a large flattened dark lobe on outer margin; phallosome with two slender black spines.

Male.—Length, about 3.8 to 4.2 millimeters; wing, 4.5 to 5.

Rostrum and palpi dark brown. Antennæ brownish black throughout; flagellar segments oval. Head above chiefly dark brown.

Pronotum and anterior lateral pretergites light yellow. Mesonotal præscutum and scutal lobes brown, the humeral and lateral portions of the former broadly yellow; pseudosutural foveæ elongate, reddish brown; median region of scutum obscure yellow; scutellum darkened basally, the apical border broadly yellow; mediotergite darkened, the cephalic lateral portions yellow. Pleura extensively yellow, the ventral sternopleurite and ventral anepisternum darkened. Halteres pale, the knobs dusky. Legs with the coxæ darkened; trochanters obscure yellow; remainder of legs brown. Wings (Plate 1, fig. 22) with a yellowish brown tinge, the diffuse stigma slightly darker; veins pale brown. Costal fringe relatively long and conspicuous. Venation: Sc relatively long, Sc_1 extending to opposite or just beyond one-fourth the length of Rs, Sc_2 faint, not far from its tip; R_3 oblique, relatively long; m-cu at fork of M.

Abdominal tergites brown, the sternites more obscure yellow; hypopygium more yellowish. Male hypopygium (Plate 3, fig. 42) with outer lobe of basistyle, *b*, slender, pale. Dististyle, *d*, with a conspicuous flattened dusky lobe on basal half of outer margin, this provided with a single conspicuous seta near base; apical lobe of style with outer margin slightly darkened, the apex with two fasciculate and other normal setæ. Phallosome, *p*, consisting of a compressed pale ædeagus and two subtending, slightly unequal apophyses, both slender, needlelike, blackened.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 3,500 feet, August 17, 1931 (*Franck*). Paratopotypes, 2 males.

Allied to *Gonomyia* (*Gonomyia*) *omeiensis* Alexander, likewise from Mount Omei, differing especially in the details of venation, as the longer Sc and more oblique R_3, and in the structure of the male hypopygium, especially of the dististyle and phallosome.

RHABDOMASTIX MINICOLA sp. nov. Plate 1, fig. 23.

General coloration light gray, the præscutum with indications of slightly darker stripes; antennæ dark brown; halteres pale yellow, the knobs almost white; femora brownish yellow, the tips narrowly infuscated; tibiæ and tarsi brown; wings grayish, the stigma slightly darker; no macrotrichia on veins beyond cord, excepting outer end of R_1 and R_{1+2}; vein R_3 suberect; cell 1st M_2 elongate, with m-cu before midlength; m longer than basal section of M_3.

Female.—Length, about 4.5 millimeters; wing, 4.5.

Rostrum gray; palpi dark brown. Antennæ dark brown throughout, relatively short; flagellar segments oval, with verticils that exceed the segments; terminal segments apparently broken; in the unique type it appears that the basal segment of the flagellum is a fused unit of more than a single segment. Head gray.

Mesonotum almost uniformly light gray, the præscutum with indications of slightly darker stripes; pseudosutural foveæ black. Pleura and sternum gray. Halteres pale yellow, the knobs almost white. Legs with the coxæ gray; trochanters obscure yellow; femora brownish yellow, the tips narrowly infuscated; tibiæ and tarsi brown. Wings (Plate 1, fig. 23) grayish, the prearcular and costal regions pale yellow; stigma pale brown, only a little darker than the ground; veins brown. No macrotrichia on Rs or its anterior branch; M and its branches without trichia; a sparse series along outer section of vein R_5. Venation: Sc_1 ends just beyond midlength of Rs, Sc_2 not evident; R_3 suberect, about equal to the distance along costa between R_{1+2} and R_3; R_4 and R_{2+3+4} subequal; m-cu short, before midlength of cell 1st M_2; m about twice as long as the basal section of M_3.

Abdomen dark brown. Ovipositor with the long cerci horn color.

Habitat.—China (Szechwan).

Holotype, female, Chekiang, on boat on Min River, May 3, 1933 (*Franck*).

Rhabdomastix minicola is very different from *Rhabdomastix* (*Palæogonomyia*) *omeina* Alexander (Mount Omei, Szechwan), differing especially in the venation and coloration of the legs. Because of the sex of the unique type of the present fly, I am unable to place it definitely as to subgenus, but believe it will be found to belong to *Sacandaga* Alexander, with the antennæ short in both sexes.

ERIOPTERA (ERIOPTERA) HAPLOSTYLA sp. nov. Plate 1, fig. 24; Plate 3, fig. 43.

Male.—Length, about 4.5 millimeters; wing, 5.

Very similar in general appearance to *Erioptera* (*Erioptera*) *luteicornis* Alexander, likewise from the mountains of western China, differing in the details of structure of the male hypopygium.

General coloration pale yellow; mesonotal præscutum light reddish brown, somewhat darker medially. Basal four or five antennal segments yellow, the remainder passing into brown. Knobs of halteres blackened. Legs yellow, the tips of femora scarcely darkened. Wings (Plate 1, fig. 24) very pale yellowish white; veins pale yellow; macrotrichia light brown. Venation: m-cu long and gently sinuous; vein 2d A strongly sinuous, cell 1st A at midlength nearly three times as wide as at the narrowest point just before outer end. Abdomen dark brown; hypopygium brownish yellow. Male hypopygium (Plate 3, fig. 43) with the outer dististyle, *od*, simple, darkened, quite glabrous, its outer third narrowed. Inner dististyle, *id*, a shorter sinuous rod, the obtuse dusky apex with a number of setigerous punctures; on outer margin just before midlength with a small pale fingerlike lobe that is tipped with a single small pale spine. Gonapophyses, *g*, appearing as nearly straight to gently curved darkened rods, the tips cultriform; each inner apophysis bearing at tip a small darkened peglike spine.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 7,000 feet, July 17, 1931 (*Franck*).

MOLOPHILUS TETRAGONUS sp. nov. Plate 3, fig. 44.

Belongs to the *gracilis* group and subgroup; general coloration of mesonotum light reddish yellow; antennæ (male) short; legs obscure yellow, wings light yellow; male hypopygium with two small spinous lobes at apex of each basistyle; outer dististyle with a dense brush of spinous setæ on outer half; inner dististyle slightly dilated at apex, further produced laterad into a small apical point.

Male.—Length, about 3 millimeters; wing, 4.

Rostrum pale brown; palpi brownish black. Antennæ (male) short; basal segments pale, the outer segments a little darker. Head discolored in type, chiefly dark.

Thoracic dorsum almost uniformly light reddish yellow, the humeral region of præscutum clearer yellow; mediotergite somewhat darker. Pleura with dorsal sclerites reddish brown, the ventral sclerites more yellow. Halteres pale, the knobs broken. Legs with the coxæ and trochanters light yellow; remainder of legs slightly more obscured yellow, the terminal tarsal segments darker. Wings light yellow, veins somewhat darker; macrotrichia dark brown. Venation: R_2 lying almost in transverse alignment with the basal section of R_5; petiole of cell M_3 about twice m-cu; vein 2d A ending just before level of caudal end of m-cu.

Abdominal tergites dark brown, the sternites somewhat more brightened; hypopygium light yellow. Male hypopygium (Plate 3, fig. 44) with the dorsal lobe of basistyle, *db*, setiferous on basal two-thirds, thence suddenly narrowed into a very slender acute spine that is darkened only on outer third; ventral lobe of basistyle a similar spine of almost the same length but a little stouter, glabrous to base. Two dististyles, the outer, *od*, a long, yellow, ribbonlike structure, the distal half blackened, narrowed to an acute point at apex, the blackened portion on inner or lower face densely provided with long spinous setæ that are arranged in at least two ranks. Inner style, *id*, nearly as long, yellow, the apex slightly dilated into a darkened head that is further produced laterad into an apiculate point; capitate portion of style with a series of ten to twelve microscopic punctures along outer margin before the point.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, altitude 4,200 feet, June 29, 1932 (*Franck*).

Molophilus tetragonus is quite distinct from the other Palæarctic species of the genus in the structure of the male hypopygium. The dense brush of setæ on the outer dististyle is somewhat suggestive of the condition in *M. triacanthus* Alexander (Japan), but all other characters are quite distinct.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *d*, dististyle; *db*, dorsal lobe of basistyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *mb*, mesal lobe of basistyle; *od*, outer dististyle; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Tipula* (*Vestiplex*) *deserrata* sp. nov.; venation.
2. *Tipula* (*Vestiplex*) *kwanhsienana* sp. nov.; venation.
3. *Tipula* (*Acutipula*) *dicladura* sp. nov.; venation.
4. *Tipula bipendula* sp. nov.; venation.
5. *Limonia* (*Libnotes*) *diphragma* sp. nov.; venation.
6. *Limonia* (*Libnotes*) *chrysophæa* sp. nov.; venation.
7. *Limonia* (*Libnotes*) *nigerrima* sp. nov.; venation.
8. *Limonia* (*Limonia*) *coxitalis* sp. nov.; venation.
9. *Limonia* (*Limonia*) *quantilla* sp. nov.; venation.
10. *Limonia* (*Dicranomyia*) *rectidens* sp. nov.; venation.
11. *Limonia* (*Rhipidia*) *formosana expansimacula* subsp. nov.; venation.
12. *Helius* (*Rhampholimnobia*) *papuanus* sp. nov.; venation.
13. *Orimarga* (*Orimarga*) *latissima* sp. nov.; venation.
14. *Orimarga* (*Orimarga*) *basilobata* sp. nov.; venation.
15. *Orimarga* (*Orimarga*) *risbeci* sp. nov.; venation.
16. *Hexatoma* (*Eriocera*) *minensis* sp. nov.; venation.
17. *Hexatoma* (*Eriocera*) *diploneura* sp. nov.; venation.
18. *Gynoplistia* (*Gynoplistia*) *novem-pectinata* sp. nov.; venation.
19. *Gonomyia* (*Lipophleps*) *kertésziana* sp. nov.; venation.
20. *Gonomyia* (*Lipophleps*) *aquila* sp. nov.; venation.
21. *Gonomyia* (*Lipophleps*) *anxia* sp. nov.; venation.
22. *Gonomyia* (*Gonomyia*) *latilobata* sp. nov.; venation.
23. *Rhabdomastix minicola* sp. nov.; venation.
24. *Erioptera* (*Erioptera*) *haplostyla* sp. nov.; venation.

PLATE 2

FIG. 25. *Tipula* (*Vestiplex*) *deserrata* sp. nov.; male hypopygium, details.
26. *Tipula* (*Vestiplex*) *kwanhsienana* sp. nov.; male hypopygium, details.
27. *Tipula* (*Acutipula*) *dicladura* sp. nov.; male hypopygium, details.
28. *Tipula* (*Acutipula*) *platycantha* sp. nov.; male hypopygium, details.
29. *Tipula bipendula* sp. nov.; male hypopygium, lateral aspect.
30. *Tipula bipendula* sp. nov.; male hypopygium, dististyle.
31. *Tipula bipendula* sp. nov.; male hypopygium, details.
32. *Limonia* (*Limonia*) *coxitalis* sp. nov.; male hypopygium.
33. *Limonia* (*Limonia*) *quantilla* sp. nov.; male hypopygium.

PLATE 3

FIG. 34. *Limonia* (*Dicranomyia*) *rectidens* sp. nov.; male hypopygium.
35. *Helius* (*Rhampholimnobia*) *papuanus* sp. nov.; male hypopygium.
36. *Orimarga* (*Orimarga*) *latissima* sp. nov.; male hypopygium.
37. *Orimarga* (*Orimarga*) *basilobata* sp. nov.; male hypopygium.
38. *Gynoplistia* (*Gynoplistia*) *novem-pectinata* sp. nov.; male hypopygium.
39. *Gonomyia* (*Lipophleps*) *kertésziana* sp. nov.; male hypopygium.
40. *Gonomyia* (*Lipophleps*) *aquila* sp. nov.; male hypopygium.
41. *Gonomyia* (*Lipophleps*) *anxia* sp. nov.; male hypopygium.
42. *Gonomyia* (*Gonomyia*) *latilobata* sp. nov.; male hypopygium.
43. *Erioptera* (*Erioptera*) *haplostyla* sp. nov.; male hypopygium.
44. *Molophilus tetragonus* sp. nov.; male hypopygium.

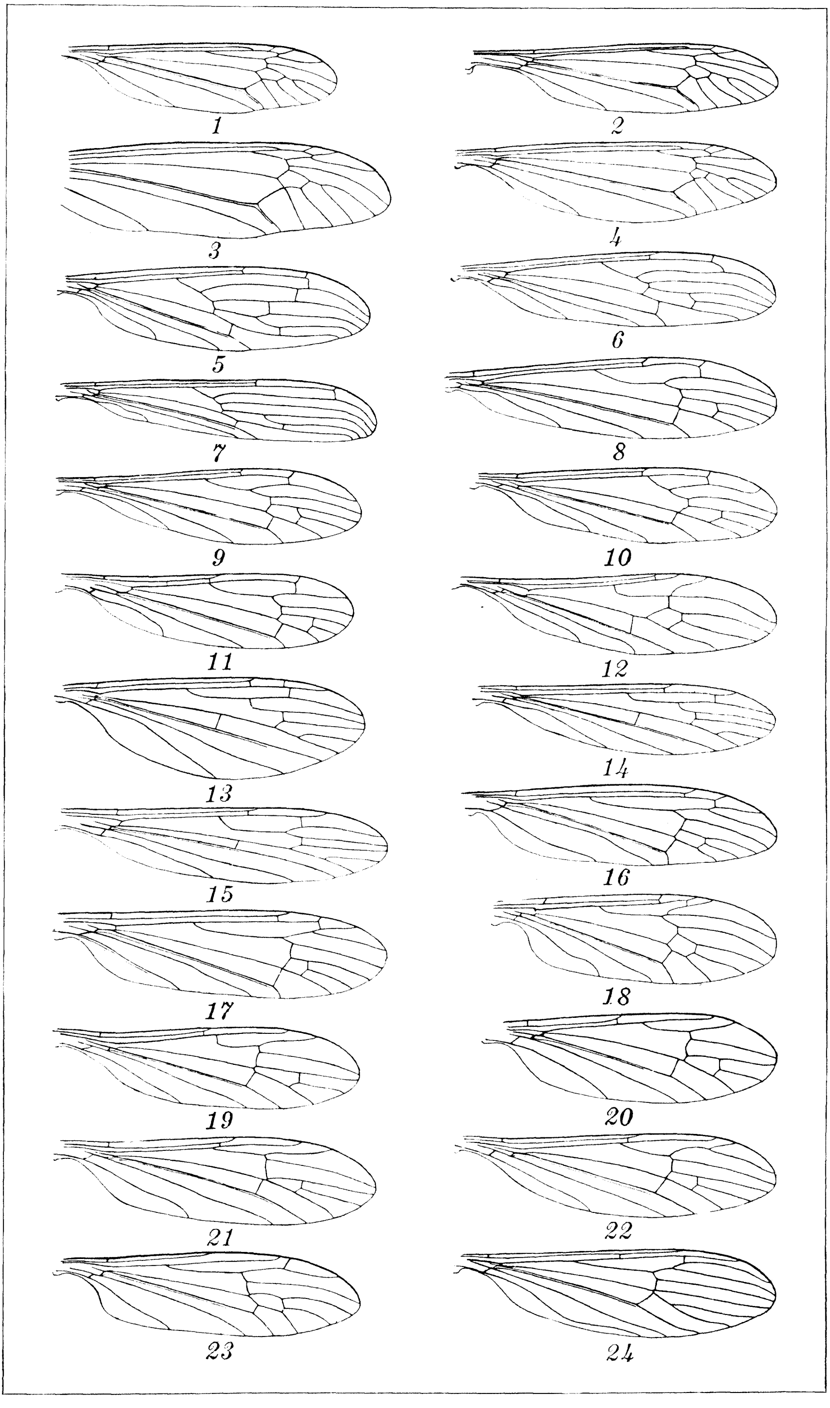

PLATE 1.

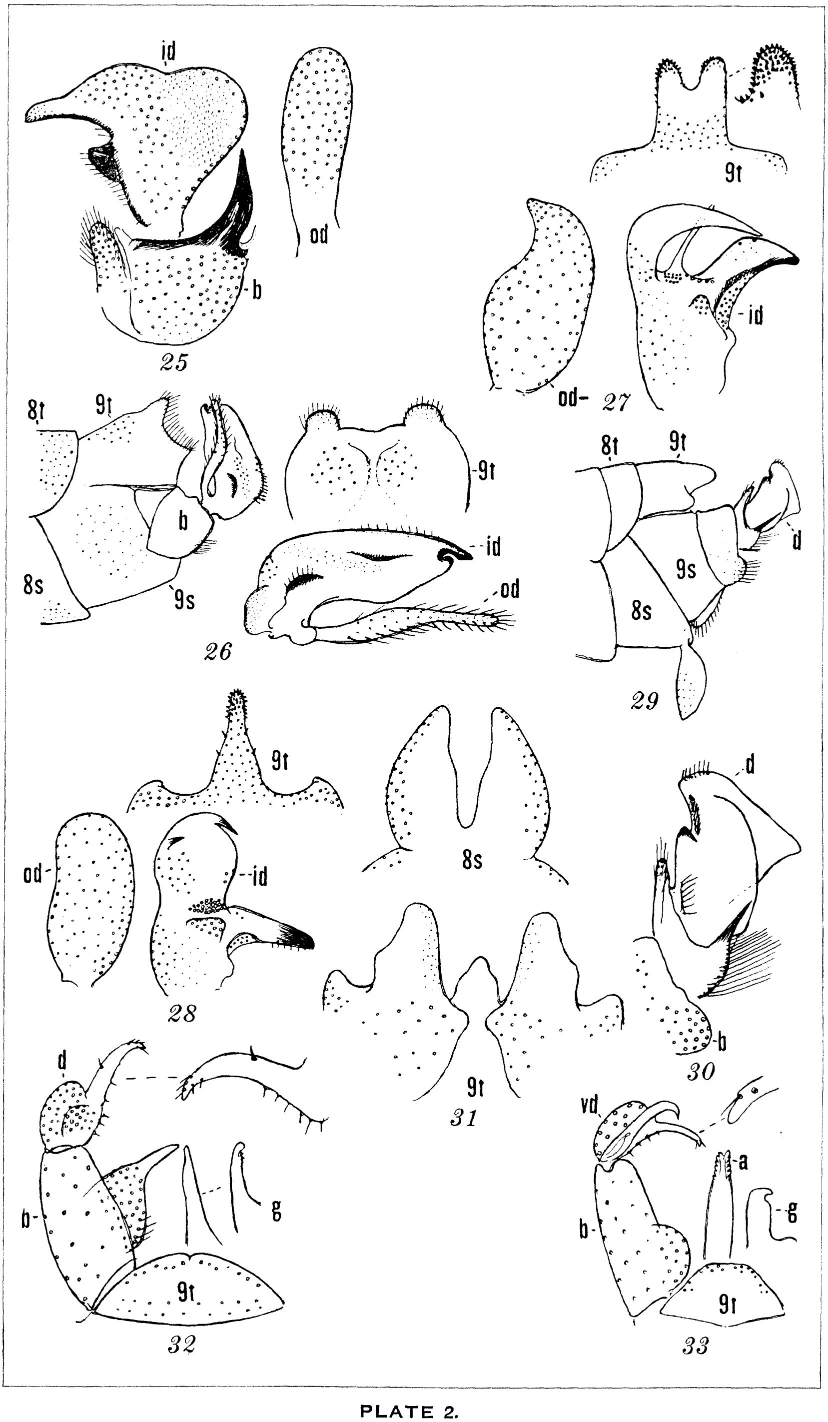
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PLATE 2.

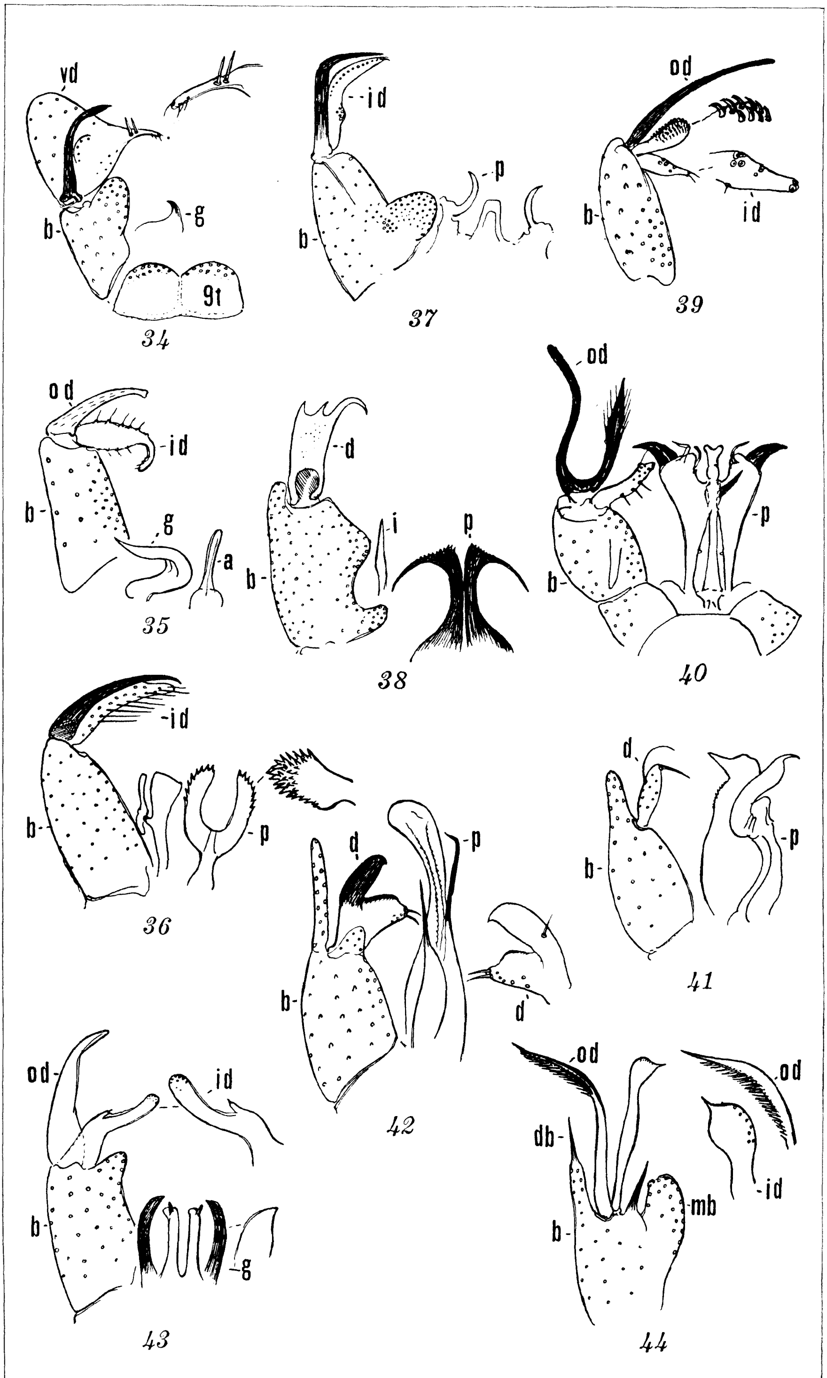
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PLATE 3.

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DOES CHAULMOOGRA TREATMENT INFLUENCE THE SHIFTING OF SEROLOGIC FINDINGS IN LEPERS AS OBTAINED BY THE WASSERMANN, KAHN, AND VERNES REACTIONS?

By CARLOS MONSERRAT
Of the Department of Pathology and Bacteriology, College of Medicine University of the Philippines, Manila

SIX TEXT FIGURES

INTRODUCTION

A great amount of evidence gathered by investigators indicates that sera of lepers frequently give positive Wassermann and Kahn reactions. In the Philippines, the Vernes test in leprosy has not been studied. It was, therefore, considered advisable to study the Philippine material and to arrange parallel tests with the Vernes on the one side and the Wassermann and Kahn tests on the other.

The Vernes test being a quantitative reaction, and the reading being made with a photometer, the information as to the amount of "reagin" present in the serum of lepers will become more clearly evident by this method.

It has been claimed by a majority of authors that strong positive Wassermann and Kahn reactions in lepers have the same significance as in nonlepers. This claim very likely is due to the observation made on serologic curves in lepers who had not received antisyphilitic drugs or who had not been repeatedly tested for a sufficiently long time by careful serologic, quantitative methods. Only recently B. T. Badger,[1] of the leper station

[1] Banger, L. F., Public Health Reports, issued by the U. S. Public Health Service 46 (April 24, 1931) No. 17.

in Hawaii, performed repeated examinations on a small group of lepers, using the quantitative Kahn test. He showed that variations in units of reagin may occur in the sera of lepers treated exclusively by chaulmoogra preparations. Therefore, these lepers received no antisyphilitic drugs whatsoever. It was our purpose to study in these investigations the effect upon the degree of serologic reaction of chaulmoogra treatment. For this purpose we have used the Vernes reaction, comparing the results obtained thereby with those shown by the Wassermann and the Kahn methods. It was hoped that by this arrangement such effect of chaulmoogra treatment as may be exerted upon the serologic reaction would be more evident and earlier perceptible by the more sensitive quantitative Vernes reaction than by the usual Wassermann and Kahn methods.

Whether or not the "reagin" present in the serum of lepers, as detectible by positive Wassermann, Vernes, and Kahn tests, is due to the infection by *M. lepræ* or caused by latent treponematous infection, has been considered in this investigation.

In lepers, in the Philippines as in any tropical country, who show positive Vernes, Wassermann, and Kahn reactions, we cannot exclude by clinical means or by history the possibility of a previous contamination by syphilis or particularly by yaws.

All the evidence gathered from clinical patients is burdened by the objection that syphilis and yaws may be, and no doubt are, just as prevalent among lepers as among nonlepers. However, it has been found that the serologic reactions in lepers decreased in degree when chaulmoogra treatment had been continued for some time in the same lepers. The chaulmoogra oil being considered specific for leprosy, these findings may lead to the conclusion that positive serologic reactions in lepers are due to the infection by *M. lepræ*. On the other hand, there is some evidence, both clinical and experimental, that militates against this explanation. To start with, there appears to be no quantitative relation between the extent of intensity of the leprous lesions in untreated lepers and the degree of the serologic reactions. Furthermore, in monkeys in which typical leprous lesions were produced by superinoculations with leprous material the serologic reaction remained negative (Wassermann and Kahn).[2]

Any further investigation along the above-mentioned lines will not rid the evidence of the objection that the patient may have

[2] Schöbl, Otto, Eloy V. Pineda, and Isao Miyao, Philip. Journ. Sci. 41 (1930) 233.

syphilis or yaws. We have attempted, therefore, to approach the problem experimentally from another angle. It appeared to us that the missing link in the chain of evidence presented in the literature, is the question whether or not chaulmoogra treatment affects the serologic reactions caused by treponematous infections.

Through the courtesy of Dr. Otto Schöbl, formerly of the Bureau of Science, five Philippine monkeys that had been inoculated by him years ago with syphilis and yaws were placed at my disposal. These animals still showed at the time of this experiment strongly positive Vernes, Wassermann, and Kahn reactions. Unfortunately four of the monkeys died during the experiment and only one survived. The monkey that survived received no antisyphilitic treatment whatsoever, and for the present experiment this monkey received a few injections of pure chaulmoogra oil. The effect of chaulmoogra treatment upon the positive Vernes, Wassermann, and Kahn reactions caused by syphilis and yaws in this monkey is shown in this paper.

TECHNIC

During this investigation the Wassermann test was performed by Dr. Onofre Garcia, of the biologic division, Bureau of Science. The technic for the Wassermann test was the same as that described by Schöbl and the writer;[3] that is, guinea-pig's complement, antimonkey hæmolytic system, and alcoholic and cholesterinized antigens. The results of the Wassermann test are expressed as follows: + + + + = 100 per cent hæmolysis, + + + = 75 per cent, + + = 25 per cent, + = 10 per cent, ± = 5 per cent, — = no hæmolysis.

The Kahn test and the Vernes test were performed by the writer. For the Kahn test, the technic followed was that described by Kahn.[4] Our antigen was prepared from bacto-beef heart and its sensitiveness complied with the requirements of an antigen control obtained directly from Kahn's laboratory. Our final results in the Kahn test are expressed as an average of the reactions in three tubes following the advice given by Kahn in his book.

The results of the Vernes test in our table are given in figures that represent the exact figures of the photometric readings of each sample of blood.

[3] Philip. Journ. Sci. § B 12 (1917) 249.
[4] The Kahn Test. A Practical Guide (1928).

The Vernes reaction was performed by following exactly Vernes's technic,[5] which the author of this paper learned in the laboratory of Professor Vernes at the Prophylactic Institute of Paris.

MATERIAL INVESTIGATED

Samples of blood obtained from eighty-four lepers were examined, and the results are here presented. All the patients were Filipinos except two Chinese and one native of Guam. There were fifty-seven males and twenty-seven females. The ages ranged from 6 to 67 years.

Forty-six of these patients received no treatment with injections of chaulmoogra preparations up to the time of this experiment.

There were thirty-three lepers who received previously chaulmoogra injections and only five patients who received besides chaulmoogra a certain amount of neosalvarsan.

In the total of eighty-four cases there were sixty-nine considered as active lepers showing both clinical and bacteriological positive findings of leprosy. In five cases the clinical manifestations of the disease were evident, but the lepra bacilli, though present in the lesions of these patients at the beginning of chaulmoogra treatment, disappeared during continuous treatment.

In ten cases the clinical signs of leprosy were clear, but these patients were found persistently negative for lepra bacilli before and after treatment. The patients of this last group were considered clinical lepers.

GROUP OF UNTREATED LEPERS

In this group of untreated lepers, composed of forty-six cases, the Vernes, Wassermann, and Kahn reactions were positive in twenty-five, giving a positive percentage of 54.3. In the rest, twenty-one cases, the three tests were all negative. There were seventeen males and eight females; the male to female ratio is 2.1:1. In this group all the cases were positive both clinically and bacteriologically except two cases (4 and 6, Table 1); these were considered as clinical lepers.

Among the twenty-five untreated lepers, the results of positive Vernes, Wassermann, and Kahn tests, as shown in Table 1, agree

[5] Travaux et publications de l'Institut Prophylactique. Fasc. 2, Maloine ed. (1923).

with each other in most respects. In case 5 the Wassermann reaction was 2 plus, while the Vernes and Kahn were negative. In cases 9 and 10 the Wassermann was negative and 1 plus, respectively, while the Vernes and Kahn were strongly positive. In case 13 the Vernes test showed a positive result of 10, while the Wassermann and Kahn tests were negative.

TABLE 1.—*Comparative results in the blood of 25 untreated lepers showing positive Vernes, Wassermann, or Kahn tests.*

No.	Name.	Nationality.	Sex.	Age.	Type.	Lepra bacillus.	Test.		
							Vernes.	Wassermann.	Kahn.
				Yrs.					
1	C. M.	Guam	F	44	M	+	10	....	++++
2	C. L.	Chinese	M	24	M	+	132	++++	+++
3	N. B.	Filipino	M	54	C	+	0	±	—
4	F. C.	do	M	51	N	[a]—	20	++	++++
5	C. C.	do	M	21	M	+	0	++	—
6	T. S.	do	M	15	M	[a]—	3	++	—
7	G. P.	do	M	21	M	+	4	+	—
8	M. L.	do	F	15	C	+	1	++	—
9	G. G.	do	F	30	M	+	23	—	++++
10	M. M.	do	M	28	M	+	21	+	++++
11	J. M.	do	M	37	M	+	0	+	—
12	L. B.	do	M	15	M	+	1	+	—
13	G. C.	do	M	21	M	+	10	—	—
14	F. G.	do	F	13	M	+	0	+	—
15	N. S.	do	F	19	M	+	0	+	—
16	H. V.	do	F	18	M	+	131	+++	++++
17	D. A.	do	M	35	M	+	113	++	++++
18	C. C.	do	M	47	M	+	121	++	+++
19	S. A.	do	M	21	M	+	0	±	—
20	A. V.	do	M	30	M	+	57	++	+++
21	L. M.	do	F	23	M	+	1	±	—
22	F. B.	do	F	50	M	+	39	++	++
23	P. U.	do	M	57	M	+	53	++	++
24	J. V.	do	M	28	M	+	8	+	++
25	A. D.	do	M	6	C	+	73	++	+ +++

[a] A clinical leper.

GROUP OF LEPERS TREATED WITH CHAULMOOGRA

This group consists of thirty-three cases. In ten of these cases the Vernes, Wassermann, and Kahn tests were found positive and in twenty-three negative. The positive percentage in this treated group was only 30.3. These positive cases were six males and four females, a ratio of 1.5 : 1.

All these cases were clinically and bacteriologically positive except Nos. 9 and 10, Table 2, which were considered as clinical lepers. In the group of ten treated lepers, shown in Table 2, with positive Vernes, Wassermann, and Kahn reactions, the general agreement of the three tests is also evident. In cases 1 and 3 the Wassermann was 2 plus while the Vernes and Kahn were negative. In case 5 the Vernes test showed a strength of 15 and the Wassermann and Kahn tests were only ±. In case 7 the Vernes test was 4 and the Wassermann and Kahn tests were negative.

TABLE 2.—*The results of the positive Vernes, Wassermann, or Kahn test in ten lepers treated with chaulmoogra.*

No.	Name.	Nationality.	Sex.	Age.	Type.	Lepra bacilli.	Test.		
							Vernes.	Wassermann.	Kahn.
				Yrs.					
1	C. C.	Filipino	M	21	M	+	0	++	—
2	R. D.	do	M	19	M	+	5	++	—
3	E. R.	do	F	24	M	+	0	++	—
4	C. G.	do	F	23	M	+	25	++	++++
5	M. B.	do	F	14	M	+	15	±	±
6	J. S.	do	F	14	M	+	0	+	—
7	J. C.	do	M	35	M	+	4	—	—
8	J. Q.	do	M	40	M	+	1	±	—
9	D. R.	do	M	67	C	[a] —	0	±	—
10	F. M.	do	M	53	C	[a] —	6	±	±

[a] A clinical leper.

GROUP OF LEPERS TREATED WITH CHAULMOOGRA AND NEOSALVARSAN

Only five cases are included in this group; four males and one female (Table 3).

Patient 1 received 45 cc of chaulmoogra during a period of two months. Blood tests at the end of this period (November 4, 1931) showed: Vernes reaction, 23; Wassermann reaction, + +; Kahn reaction, + + + +.

After these blood examinations, the patient received no treatment for one month and then new injections of chaulmoogra were given up to January, 1932, the patient receiving in all 6 cc of the drug. Another blood examination by the Vernes, Wassermann, and Kahn tests was made January 19, 1932, and the results showed that the Kahn test remained unchanged; the Vernes decreased from 23 to 17, and the Wassermann reaction decreased also, even though slightly (+). The condition of the leprotic lesions on January 19, 1932, revealed slight improvement.

TABLE 3.—*The results of Vernes, Wassermann, and Kahn tests in five lepers treated with chaulmoogra and neosalvarsan.*

No.	Name.	Nationality.	Sex.	Age.	Type of lesion.	Lepra bacilli.	First blood examination.
				Yrs.			
1	P. A.	Filipino	M	22	C	+	November 4, 1931.
2	C. A.	do	F	38	M	+	November 4, 1931.
3	P. B.		M	67	M	+	November 4, 1931.
4	P. V.	Filipino	M	44	M	+	November 4, 1931.
5	J. M.	do	M	54	M	+	November 4, 1931.

No.	Name.	Nationality.	Test.			Drug received up to the time of blood examination.
			Vernes.	Wassermann.	Kahn.	
1	P. A.	Filipino	23	++	++++	45 cc chaulmoogra.
2	C. A.	do	20	+	++++	13 injections of bismugenol. 0.15 g neosalvarsan.
3	P. B.		0	—	—	Neosalvarsan: 0.15, 0.30, 0.60
4	P. V.	Filipino	1	—	—	Neosalvarsan: 0.15, 0.30, 0.45, 0.60, 0.75, 0.90
5	J. M.	do	0	—	—	Neosalvarsan: 0.15, 0.30, 0.40, 0.45, 0.60, 0.90

Three months later beginning April 8, 1932, the patient was given three injections of neosalvarsan (0.30, 0.45, and 0.60 g). The Vernes test dropped to negative on April 29, 1932, and later the Kahn test on June 17, 1932; the Wassermann reaction however remained unchanged, that is, 1 plus.

After neosalvarsan treatment the macular skin lesions improved markedly up to November 28, 1932. At this date the Vernes test was negative, the Wassermann 1 plus, and the Kahn test increased again up to 3 plus (see serologic curve case 1).

Patient 2 was considered as a suspicious leper by the clinical appearance; the bacteriological examinations of lesions were always negative for lepra bacilli. After admission to the hospital, however, microscopical examination of the lesions in two instances revealed lepra bacilli.

Soon after this patient was admitted, his blood was examined in the laboratory of the hospital by the Wassermann and Kahn tests and showed strongly positive reactions.

This patient received no injection of chaulmoogra whatsoever but only antitreponematous treatment (first thirteen injections of bismugenol and later 0.15 g of neosalvarsan), during her stay in the hospital.

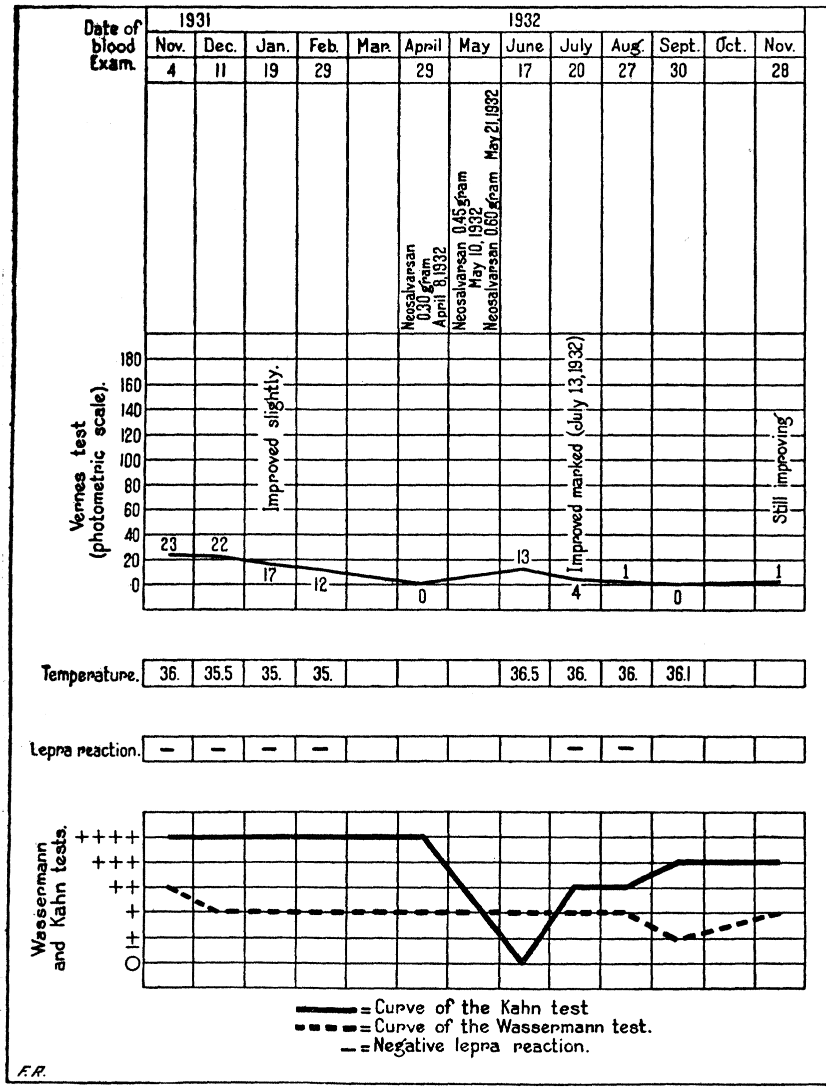

FIG. 1. Leper treated with chaulmoogra and neosalvarsan. Case 1.

Two months after the neosalvarsan injection blood examinations (case 2) showed the following: Vernes reaction, 20; Wassermann reaction, + +; Kahn reaction, + + + +.

Repeated serologic examinations were performed later during a period of three months and the results of these are given in the same table. The results indicate that the Vernes reaction

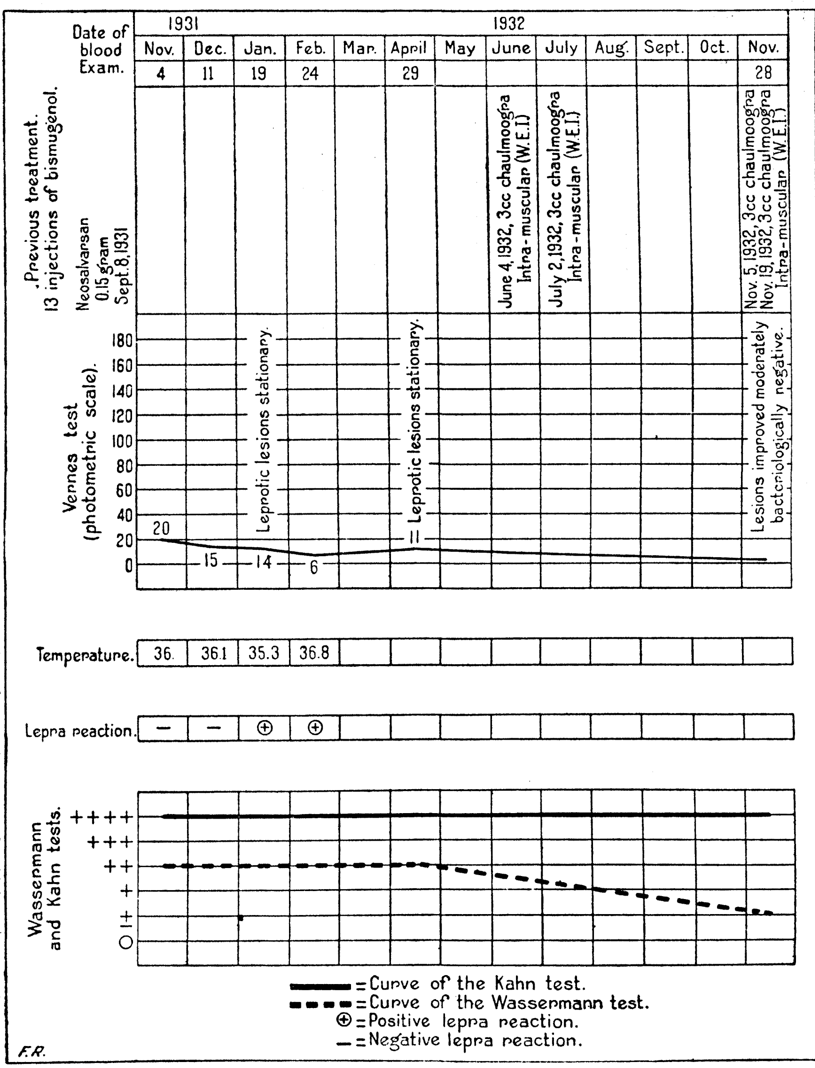

FIG. 2. Leper treated with chaulmoogra and neosalvarsan. Case 2.

decreased only slightly, but the Wassermann and Kahn reactions remained unchanged.

The leprotic lesions of this patient for the present are apparently stationary, but the lepra bacilli in the same lesions disappeared in spite of the absence of specific treatment for leprosy. On account of the little change observed in the serologic curve of this patient from November 4, 1931, to April 29, 1932, and practically no improvement of the leprotic lesions, this pa-

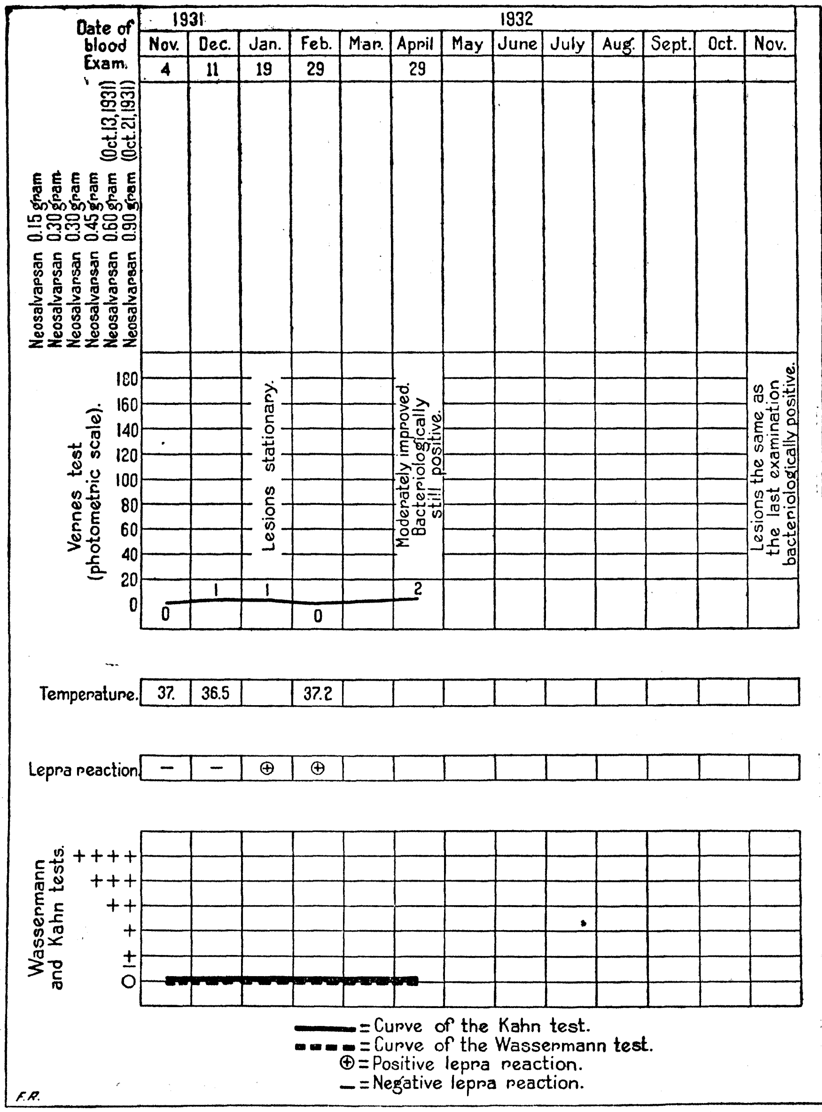

Fig. 3. Leper treated with chaulmoogra and neosalvarsan. Case 3.

tient was given starting from June 4 to November 19, 1932, 12 cc of chaulmoogra (W. E. I.). The Vernes test on November 28 dropped to negative; the Wassermann was ±, but the Kahn test remained + + + +.

Cases 3, 4, and 5 are clinically and bacteriologically positive. These patients received since admission several injections of chaulmoogra. In spite of the treatment the lesions did not im-

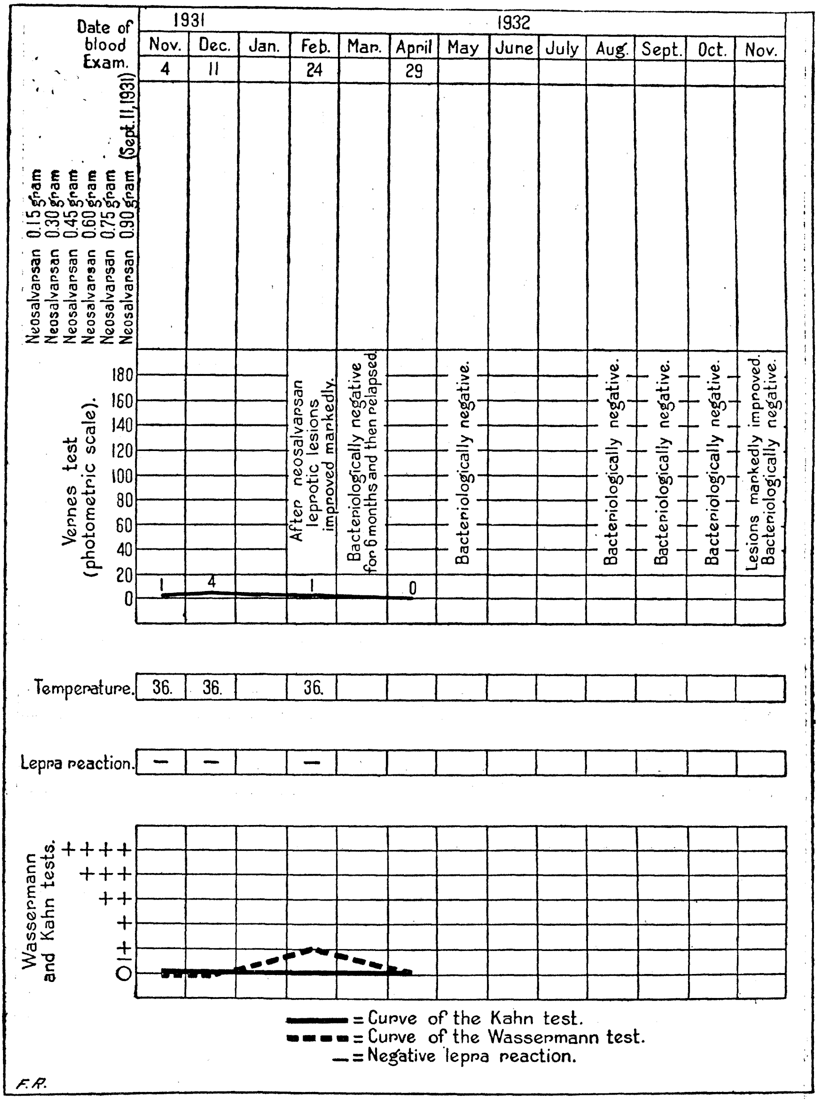

Fig. 4. Leper treated with chaulmoogra and neosalvarsan. Case 4.

prove much, but the blood examinations for the Wassermann and Kahn reactions performed in the laboratory of the hospital showed strongly positive results.

On account of the strongly positive serologic findings these patients were given later neosalvarsan injections (from 0.15 g up to 0.90 g). About seven months after the neosalvarsan treat-

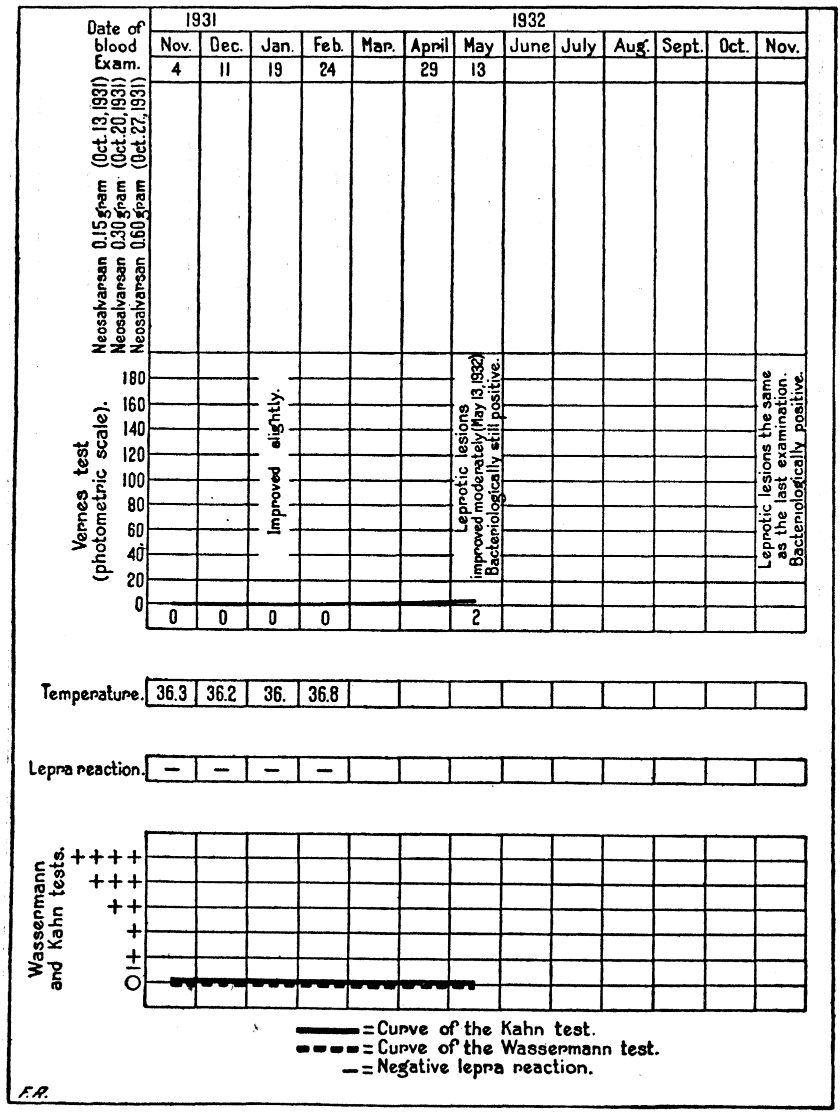

FIG. 5. Leper treated with chaulmoogra and neosalvarsan. Case 5.

ment, cases 3 and 5 showed moderate improvement of the leprotic lesions, and case 4 a marked improvement in about five months. In case 4 the bacteriological examinations of the lesions became negative for lepra bacilli, during six months, but at the end of this period the lepra bacilli reappeared in the same lesions to become again negative in May, 1932, up to the present (November, 1932).

The Vernes, Wassermann, and Kahn reactions performed with the blood of all these patients after neosalvarsan treatment, were negative by the three tests, and remained so until the present, a period of one year.

From the above data, it is evident that the results of the three tests under consideration agree with each other, and that the administration of neosalvarsan affects the degree of all of these reactions in a like manner.

The leprotic lesions in our cases improved also after neosalvarsan treatment.

SUMMARY OF THE VERNES, WASSERMANN, AND KAHN TESTS IN EIGHTY-FOUR TREATED AND UNTREATED LEPERS

Summarizing the total of eighty-four lepers treated and untreated positive Vernes test was observed with the serum of twenty-two (26.1 per cent); a positive Wassermann test with the serum of thirty-two (38.0 per cent); and, a positive Kahn test with the serum of eighteen (21.4 per cent).

In seventeen cases the three tests considered were found positive without exception (20.2 per cent).

In not a single case were the Wassermann and Kahn tests found positive and the Vernes negative, while in fourteen cases the Vernes and Kahn tests were negative and the Wassermann was slightly positive (± and + +).

From the above data it seems that the Vernes test behaves in leprosy in a manner similar to the Kahn test. The Wassermann reaction is a little more sensitive, taking into consideration the greater number of patients showing weakly positive reactions of ± to + +; strong reactions, however, are rarely observed with our Wassermann reaction.

THE AGE INCIDENCE IN THE EIGHTY-FOUR LEPERS SHOWING POSITIVE VERNES, WASSERMANN, OR KAHN TESTS

THE RELATION OF POSITIVE SEROLOGIC TESTS WITH THE PRESENCE OR ABSENCE OF LEPRA BACILLI IN THE LESIONS OF THE SAME PATIENTS

In studying the age incidence in lepers showing positive Vernes, Wassermann, or Kahn tests as presented in Table 4, it can be observed that positive reactions occur more frequently in patients over 30 years old than in those under 30 years of age; the percentage being 94.2 and 77.5, respectively.

It will also be noted from the study of Table 5 that positive Vernes, Wassermann, or Kahn tests are more frequent in bacteriologically positive lepers than in those in which the microorganisms cannot be demonstrated. The percentages are 84 and 46.6.

TABLE 4.—*The age incidence in 84 lepers showing positive Vernes, Wassermann, and Kahn reactions.*

Age.	Vernes.			Wassermann.			Kahn.			Positive in the three cases.	
	Cases.	Positive.		Cases.	Positive.		Cases.	Positive.			
Yrs.			*P. ct.*			*P. ct.*			*P. ct.*		*P. ct.*
5–10	2	1	50.0	2	1	50.0	2	1	50.0	------	--------
11–19	16	3	18.7	16	9	56.2	16	2	12.5	------	--------
20–29	31	6	19.3	31	10	3.2	31	5	16.1	------	--------
30–39	12	4	33.3	12	3	25.0	12	3	25.0	------	--------
40–49	9	2	22.2	9	3	33.3	9	2	22.2	------	--------
50–67	14	5	35.7	14	6	42.8	14	5	35.7	------	--------
5–29	49	10	20.4	49	20	40.8	49	8	-------	38	77.5
30+	35	11	-------	35	12	-------	35	10	-------	33	94.2

TABLE 5.—*The relation of the positive Vernes, Wassermann, and Kahn tests in connection with the presence or absence of lepra bacilli in the blood of 84 patients.*

Bacteriological findings in the blood.	Vernes.			Wassermann.			Kahn.			Positive in three tests.	
	Cases.	Positive.		Cases.	Positive.		Cases.	Positive.			
			P. ct.			*P. ct.*			*P. ct.*		*P. ct.*
B. lepræ +	69	18	26.0	69	26	37.6	69	14	20.2	58	84
B. lepræ —	15	2	13.5	15	3	20.0	15	2	13.5	7	46.6

THE RELATION OF POSITIVE VERNES, WASSERMANN, OR KAHN TO THE TYPES OF LEPROSY

For the purpose of this study, our cases have been classified into three types; namely, the cutaneous (C), the neural (N), and the mixed type (M). This classification is based on the presence of pure dermal or neural manifestations or both. Unfortunately, we have been unable to secure enough cases of the cutaneous and neural types to render our results more valuable.

In this study are considered ten cases with dermal manifestations (cutaneous), five cases of nerve involvement classed as neural, and sixty-nine cases with both neural and dermal (mixed type). The results demonstrated in Table 6 that positive Vernes, Wassermann, or Kahn tests are frequently observed in lepers of the mixed type; the lowest incidence is among the cutaneous forms. The percentage of positive reactions for any one of the three tests in the three mentioned types of leprosy are the following: Cutaneous type, 12; neural type, 60; mixed type, 82.5.

TABLE 6.—*The relation of positive Vernes, Wassermann, and Kahn tests in connection with the clinical types of leprosy in 84 lepers.*

Types of leprosy.	Vernes.			Wassermann.			Kahn.			Positive in three tests.	
	Cases.	Positive.		Cases.	Positive.		Cases.	Positive.			
			P. ct.			*P. ct.*			*P. ct.*		*P. ct.*
Cutaneous	10	3	30	10	6	60	10	3	30	12	120
Neural	5	1	20	5	1	20	5	1	20	3	60
Mixed	69	18	26	68	25	36.7	69	14	20.2	57	82.5

CHANGES OBSERVED IN THE RESULTS OF THE VERNES, WASSERMANN, AND KAHN TESTS, IN RETESTING THE SERA OF NINETEEN LEPERS TREATED EXCLUSIVELY WITH CHAULMOOGRA.

For this experiment we selected from the groups of untreated lepers, nine patients who had been recently admitted to San Lazaro Hospital. The blood of these patients, when tested by the Vernes, Wassermann, and Kahn reactions, showed moderate and strong positive results. These patients received later several injections of chaulmoogra for a period of six months to one year, and the changes in the degree of the reactions were observed during these periods of treatment. The results were registered by drawing serologic curves.

Parallel tests were performed with another group of eight patients obtained from these treated groups of lepers who had received variable amounts of chaulmoogra oil in the past. The blood of these patients still showed at the time of the tests positive readings by the Vernes, Wassermann, and Kahn reactions. These reactions, however, were much less pronounced. These lepers have been retested monthly during further chaulmoogra treatment over six months to one year, and further changes in the degree of reactions were observed. None of these cases retested had received antisyphilitic treatment.

From our investigation we conclude that definite changes in the results of the Vernes, Wassermann, and Kahn tests may be noticed by retesting the sera of lepers who received exclusively injections of chaulmoogra. These serological changes, however, are not necessarily accompanied by much improvement in the clinical manifestations of leprosy.

The serologic changes due to chaulmoogra treatment occur in one or in all of the three tests and become evident in that a positive serum becomes negative or that the reactions become stronger or weaker in the course of the treatment.

The three tests are not always comparable, as shown by the fact that the Vernes and Wassermann tests in few cases have become promptly negative or decreased in degree after a short period of treatment, while the Kahn test remained unchanged (fig. 6, cases 1 and 2).

In the majority of cases, however, the Wassermann and, particularly, the Kahn tests remained unchanged for a long period in spite of the continuous treatment with chaulmoogra, but the Vernes test, while still positive, decreased considerably during the same period of treatment (fig. 6, case 3).

In very few patients after few injections of chaulmoogra have been administered the Kahn test first then the Wassermann test became negative, while the Vernes test decreased only to a certain extent (fig. 6, case 4).

Finally, in a few cases all three tests become negative or practically negative, not immediately but after a long period of treatment (fig. 6, case 5).

EXPERIMENTS WITH PHILIPPINE MONKEYS CONCERNING THE EFFECTS OF CHAULMOOGRA TREATMENT UPON THE SEROLOGIC REACTIONS CAUSED BY ARTIFICIAL INFECTION WITH TREPONEMATOSES.

Five Philippine monkeys that had been inoculated about five years ago with syphilis and yaws were used in this investigation. All five monkeys showed strong positive results by the Vernes, Wassermann, and Kahn tests at the time of the experiment.

Only monkey W–43 survived. This monkey had been inoculated with Kadangan and Guzon [6] strains of yaws February 6, 1928, and February 21, 1929, respectively. After the first inoculation with Kadangan strain (February 6 to 28) the animal developed a typical yaws lesion. A superinoculation performed one year after (February 21, 1929) with Guzon strain did not

[6] Kadangan and Guzon strains of yaws were isolated from patients in the Philippine Islands March 4, 1925, and November 15, 1928, respectively. Both strains produced typical local yaws and strongly positive serologic reactions in inoculated monkeys. Both strains have been kept alive by successive passages through Philippine monkeys.

produce yaws lesion as result of immunity that developed against yaws infection. The control monkey developed typical yaws with Guzon strain.

Four months later (June 22, 1929) monkey W–43 received an intradermal inoculation with syphilis (Nichols strain) on the scrotum. The animal did not develop syphilitic lesion. October 22, 1929, the inguinal lymph glands corresponding to the point of inoculation with syphilis were removed asceptically and transplanted to the testicles of two normal rabbits. Neither of these rabbits developed syphilitic lesions. Normal monkeys inoculated with Nichols strain of syphilis developed typical syphilitic lesions, and the lymph glands contained viable *T. luis*, when transplanted to testicles of rabbits.

From this experiment Schöbl[7] concluded that immunity gained by yaws injections protects Philippine monkeys against cutaneous inoculation with syphilis.

Monkey W–43 after his first inoculation with yaws on February 6, 1928, up to the time of our experiment received no injections of antitreponematous drugs whatsoever. Its blood was examined by the Vernes, Wassermann, and Kahn tests before the administration of chaulmoogra oil and showed the following results: Vernes, 30; Kahn, + + + +; Wassermann, + + + +. (See fig. 6.)

This monkey, W–43, received later within a period of one month 7.5 cc of pure chaulmoogra oil in subcutaneous injections at weekly intervals and progressive doses. At the end of this period of treatment, the Vernes reaction became almost negative (=5); the Kahn test dropped from 4 plus to negative, and the Wassermann reaction decreased only slightly, from 4 plus to 2 plus.

Later this monkey was given a rest of three months without receiving chaulmoogra oil, and then another sample of blood was withdrawn from his heart and examined by the Vernes, Wassermann, and Kahn reactions. The results of this last examination showed the following: Vernes, negative (=2); Kahn, negative; Wassermann, ±.

GENERAL SUMMARY

The blood of eighty-four lepers was examined; namely, eighty-one Filipinos, two Chinese, and one native of Guam. Forty-six of these patients received no injection of chaulmoogra prepara-

[7] Philip. Journ. Sci. 43 (1930) 263.

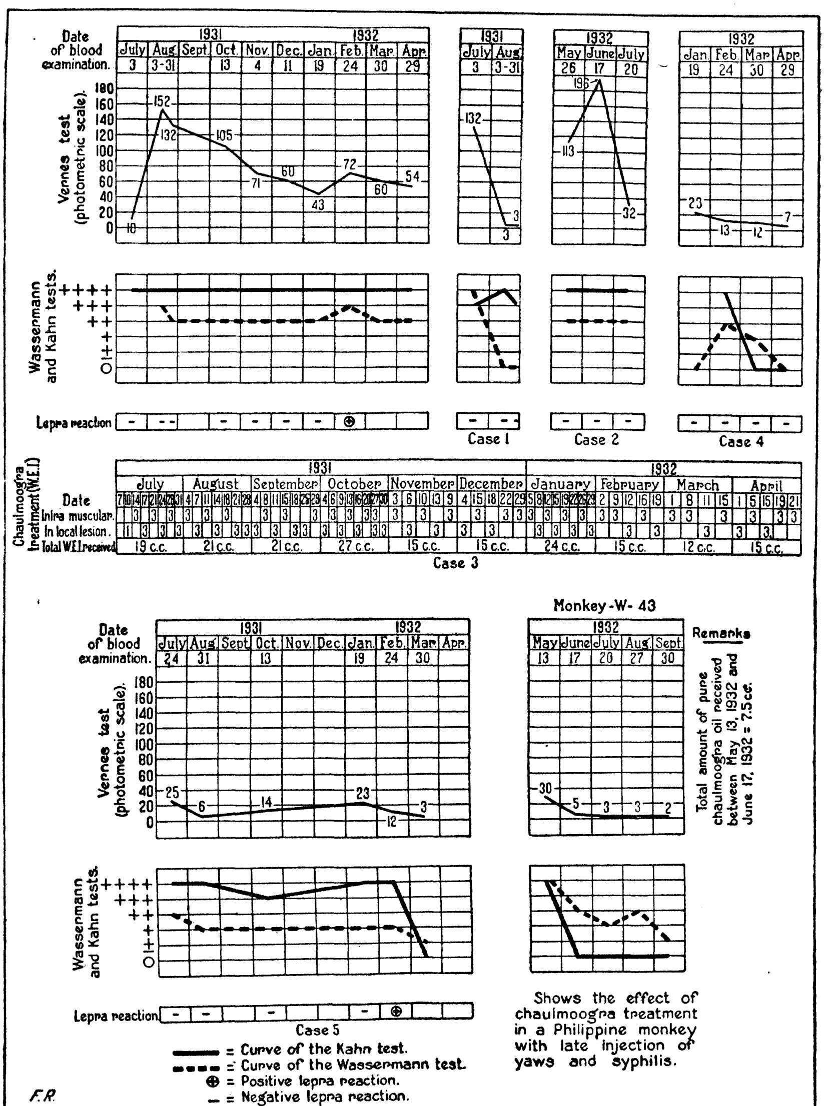

FIG. 6. The effect of chaulmoogra injections on the serologic curve of the Vernes, Wassermann, and Kahn reactions.

tion whatsoever before the time of the experiment. Of the rest, thirty-three lepers received chaulmoogra injection, and five patients received besides chaulmoogra also antitreponematous treatment.

The results obtained with the Vernes, Wassermann, and Kahn methods are compared. They show a general agreement of results, both in untreated and treated lepers. It seems, however, that the Vernes test behaves in leprosy more like the Kahn test and that the positive reactions obtained with these tests in lepers are usually stronger compared with the results of our Wassermann reaction. However, there are more lepers showing weakly positive Wassermann reaction (1 plus to 2 plus) than positive Vernes and Kahn tests.

In the total of eighty-four lepers the positive percentage of the Vernes test is 21.6, the positive percentage for Wassermann reaction is 39.2, and the positive percentage for the Kahn test is 21.4. The percentage of positives without exception for all three tests is 17.8.

The relation between the serologic results, taking into consideration the age of the patients and the clinical and bacteriological forms of the disease, is also discussed. Our findings demonstrated that positive reactions occur more frequently in patients over 30 years old (94.2 per cent) than in those under 30 years of age (77.5 per cent).

Positive serologic findings have been more frequent among lepers with lepra bacilli in the lesions (84 per cent) than among lepers with negative bacteriological findings (46.6 per cent).

Positive serologic reactions for any one of the three tests in the varieties of leprosy (dermal, neural, and mixed) were more frequently observed in the mixed type of leprosy (82.5 per cent).

The effects of chaulmoogra and neosalvarsan treatments upon the serologic results and the improvement of lesions are also discussed.

Our experiments showed that the exclusive and continuous administration of chaulmoogra in leprosy may bring about a marked decrease of the positive serologic reactions encountered in lepers. This decrease in the serologic curve, however, is not always immediately accompanied by much improvement of the leprous lesions.

In a very limited number of lepers, who received besides chaulmoogra injection also antitreponematous treatment, the results of the three tests under consideration agree with each other and the administration of antitreponematous drug (neosalvarsan) affects also the degree of these reactions in a like manner. In these few cases studied a more rapid and marked improvement of the leprotic lesions was noted after neosalvarsan treatment.

The exclusive administration of chaulmoogra oil in Philippine monkeys showing positive serologic findings with the Vernes, Wassermann, and Kahn reactions may bring about also a decrease in the positive serologic reactions due to long standing infection with yaws and syphilis in these animals.

In the course of this study it has been noted repeatedly that of the three applied methods—that is, Wassermann, Kahn, and Vernes reactions—the Vernes reaction answered more promptly in manifesting the quantitative changes of the serologic findings which ensued as a consquence of chaulmoogra treatment.

CONCLUSION

1. In the serum of lepers, the Vernes, Wassermann, and Kahn reactions were found positive in 17.8 per cent of the cases examined (84) without exception in all three tests.

2. The positive Vernes, Wassermann, and Kahn reactions in lepers may be converted to negative reactions after prolonged administration of chaulmoogra oil exclusively. These serologic changes, however, are rarely observed immediately with the ordinary Wassermann and Kahn methods but only after several months of continuous treatment. In the case of the Vernes test marked quantitative changes are easily demonstrated after a few injections of chaulmoogra.

3. The favorable quantitative changes observed in the serologic curve of the Vernes, Wassermann, and Kahn reactions as a result of chaulmoogra treatment are not always accompanied by marked improvement of the leprous lesions.

4. The positive blood findings with Vernes, Wassermann, and Kahn reactions in Philippine monkeys with latent experimental infections of yaws and syphilis are converted also to negative or almost negative under the influence of exclusive administration of chaulmoogra oil.

ACKNOWLEDGMENT

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ILLUSTRATIONS

TEXT FIGURES

THE FISHERY INDUSTRIES OF SOUTHWESTERN SAMAR [1]

By AGUSTIN F. UMALI

Of the Fish and Game Administration, Manila

SEVEN PLATES AND EIGHT TEXT FIGURES

Samar, the fourth largest island of the Philippines, lies southeast of Luzon. It is more or less triangular in shape and separated from Sorsogon Province by San Bernardino Strait and from Leyte Island by San Juanico Strait. The low but numerous mountain ranges give to Samar a very rugged surface. The topography of the island being such, the majority of the towns are located along the coast, where fishing is almost the only practicable mainstay of the people, especially along the southwestern coast—the second district, where, according to estimates, no less than 300,000 pesos is invested in boats, gear, and other appliances used in the catching of fish. The municipalities of this district net an aggregate yearly collection of about 15,000 pesos based on taxes derived from this industry alone. There is here a predominance of rich and favorable fishing grounds along this portion of the coast line, the region of many islets and islands being less exposed to the two prevailing monsoons of the year. Although Samar lies directly in the path of typhoons, such disturbances cause only a brief interruption of the fishing activity. Maqueda and Villareal Bays and the surrounding waters teem with fish.

Plate 1 shows a map of the regions covered in this survey together with the extent of their fishing grounds. The condition and the relative importance of the fishing industry in each of the municipalities, from Gandara in the north to Basey in the south, observed during the time of the survey (March, 1932), are presented in the following paragraphs.

Gandara.—Gandara is an interior town, located alongside Gandara River. It is more of an agricultural town than a fishing community, its sea fisheries being confined to the vicinity of the

[1] Contribution No. 6 from the Fish and Game Administration, Department of Agriculture and Commerce.

mouth of the river, where fish corrals abound during the northeast monsoon—the deep-water corrals (*paugmad*) at Napalisan Barrio and the shallow-water corrals (*pahubas*) at Opong Barrio. To a certain extent anchovies are caught around its jurisdiction by the *lawag* fishers of other municipalities, in which case a tax is collected.

To a very limited extent fresh-water fish are caught for home consumption in Gandara River by individual fishermen. The commoner species [*aguas* (mullet), *Mugil* spp.; *mulan bulan* (tarpon), *Megalops cyprinoides* (Brouss.); *haruan* (murrel), *Ophicephalus striatus* Bl.; *gongong* (grunt), *Therapon* spp.; snappers, family Lutjanidæ and sharks] are caught by hook and line and such nets as the *anud* and the *solambao*.

The swamp lands are narrow fringes at the mouth of the river. Although their soil is favorable for fishpond construction, their narrowness makes them unsuitable for utilization.

Tarangnan.—As this is a coastal town, situated on land with a more or less rugged surface, fishing is among the important industries of the people. The presence of bays and indentations along its coasts renders it a favorable abode of fish. Although the inhabitants fish mainly by means of fish corrals similar to those found in Gandara, the municipal government collects a good income from fishermen of other municipalities who come to fish within its rich fishing areas. There is but one locally owned lawag outfit in this region, but due to the abundance of anchovies here, several outfits from neighboring towns fish around its municipal jurisdiction. Because of the absence of preservation plants and the very limited market for fresh fish, the catches are usually sold in Catbalogan.

Catbalogan.—Catbalogan, the capital of Samar, is the real fishing center of the southwestern coast. It is ideally located at the head of a small bay at the mouth of Catbalogan River; it is not only a central market for the merchandising of the catch, but its municipal waters are rich fishing grounds. Catbalogan is a fishing town as well as a commercial center. Practically all barrios of Catbalogan are fishing villages, agriculture being almost impossible because of the very rugged nature of the topography. Around Canahauan, Buri, and Basiao Islands are rich fishing grounds for anchovies, mackerels, and various other species.

Catbalogan is the center of the landing of the catch around Maqueda and Villareal Bays. Here salting and drying of the catch is carried on extensively, mostly by Chinese; in fact, there is only one Filipino engaged in this business in Guinsoroñgan, Mercedes, Silanga, and Sierra Barrios. Catbalogan exports both the dried and the salted products to Manila and the Ilocano provinces, and to a certain extent to Hawaii. It is one of the sources, if not the principal source, of *bagoong* in the Philippines. In 1930 the municipal collections of duties imposed on these preserved products amounted to 4,040.48 pesos, which increased to 5,116.72 pesos in 1931. Although some of these products were exported in the form of dried fish, most of them were converted into salted and fermented anchovies or bagoong. For each can of bagoong exported the municipality exacts a duty of 2 centavos. In 1930 no less than 2,000 cans were exported, while in 1931 the exportation amounted to about 2,500 cans. The fishermen engaged in the catching of anchovies by means of the lawag are residents of Catbalogan, where there are no less than twenty such outfits. Aside from the lawag, the *langbat* and the deep-water corrals help to raise the daily hauls of fish to commercial proportions.

Zumarraga.—Next to Catbalogan in importance as a fishing center is the municipality of Zumarraga located at the southwestern end of Buad Island. It is the least suitable for agriculture, but its surrounding waters are extensive and rich fishing grounds. Anchovies are caught in abundance the year round. While the fishing activities in Catbalogan are somewhat affected by the southwest monsoon, here, because of the ideal location of the island, they are practically continuous since they may be shifted from one side to the other with the change in the direction of the wind. Thus when the lawag outfits of Catbalogan are unable to operate in their vicinity they oftentimes switch their activity to these regions.

The municipal council has recently passed an ordinance imposing the prohibitive tax of 1,000 pesos per annum on the lawag. This action has brought about a considerable decrease in the income of the municipality from the fisheries, as most of the lawag fishers registered in the neighboring municipality, Villareal, which imposes only 150 pesos per annum. These outfits actually fish in Zumarraga waters close to the boundary of the two municipalities, so that if an attempt is made to arrest them they can easily row to the waters of Villareal.

The market for fresh fish is very limited, and although drying is carried on along the beach near the townsite, there are no large preservation plants, and most of the hauls of the fishermen are brought to Catbalogan and marketed there. Ilongo sailboats (boats from Iloilo Province) usually call at Zumarraga to purchase fish.

The principal gear used here are lawag, fish corrals, *baring,* and *bahan.*

Wright.—Wright, formerly Paranas, is located at the head of Maqueda Bay. Although ideally located for fishing, it does not have an extensive fishing industry. There are no fish nets in this region and fishing is carried on only by means of shallow-water fish corrals. The coasts are fringed with narrow strips of swamp lands; the soil is suitable for fishponds, although typhoons constitute a great menace and the townsite itself has been gradually eaten away by the sea. Bañgos are said to enter the swamps, and most probably bañgos fry are found here along the sandy coasts at the mouths of rivers.

Calbiga.—Like Gandara, this town is located in the interior, where fishing is insignificant. Swamp lands along the coast were observed, but no detailed survey was conducted.

Villareal.—This municipality is situated at the southern head of Villareal Bay; the latter is so rich a fishing ground that fishermen from Zumarraga and Catbalogan often visit it, especially the lawag outfits. As there are no preservation plants here and the market for fresh fish is limited, the catches are taken to Catbalogan.

The most important gear used are the bahan, fish corrals, and baring. Talalora Barrio is significant, as it is usually visited by Ilongo sailboats for the purchase of fish from the catch around Villareal Bay. These are cured and dried in the boats and later taken to Panay and Bohol.

Santa Rita.—This is another coastal town, situated at the eastern head of Janabatas Channel. Fishing is not carried on extensively. The most important gear employed is the fish corral of the *pangalato* style.

Basey.—Basey is situated at the northern part of San Pedro Bay—a fishing as well as an agricultural town. The principal fishing ground is San Pedro Bay, a rich area, somewhat exposed, especially during the southwest monsoon. Salvacion Barrio, on Jinamoc Island, is settled mostly by Cavite fishermen who have introduced many and varied Tagalog methods of fishing in this locality. The important gear used are various types and styles of fish corrals, the *pante, kitang, laya, conay,* and *cobcob.*

There are no preservation plants here, although small quantities of fish are dried for local consumption. The catches are usually disposed of at the town market and at Tacloban, the capital of Leyte—the latter only twenty minutes from Basey by motor boat. Swamp lands along the banks of the mouth of Basey River appear to be good fishpond sites, but limited in extent.

Table 1, obtained through the courtesy of the office of the provincial treasurer, shows the approximate annual income derived from the fisheries of each of the municipalities of the second district and serves to indicate the relative importance of the fishing industry in each.

TABLE 1.—*Income from fisheries in Samar.*

Municipality.	1930	1931	1932
	Pesos.	*Pesos.*	*Pesos.*
Gandara	127.25	127.25	127.25
Tarangnan	2,056.00	1,027.00	(a)
Catbalogan	2,220.00	2,220.00	6,170.00
Zumarraga	7,759.15	6,072.65	475.75
Wright	487.00	432.50	427.20
Calbiga	71.00	71.00	59.50
Villareal	923.50	611.50	(a)
Santa Rita	632.76	588.80	(a)
Basey	1,518.00	894.00	83.00
Total	15,794.66	12,050.70	----------

[a] No figures were available.

As shown in Table 1 the real fishing activities of the second district center around the municipalities of Tarangnan, Catbalogan, and Zumarraga. Although varied species of food fishes are caught here, it was observed during the course of the survey that the bulk of the catch is composed of anchovies (bolinao) which are caught on a commercial scale and dried or salted. According to the fishermen of these regions the anchovies caught during the warm months of the year are full grown, some having been observed to contain eggs, while those taken during September are usually small. Although no detailed study on the spawning habits of this fish has been conducted in the Philippines, the breeding season may be assumed to occur during the warm or dry months of the year from March to May.

Next in importance to the anchovies are the mackerels. Most of these are caught by the langbat or cobcob and in fish traps or *bunuan*. Two species are common—the *burao* (striped mackerel), *Rastrelliger chrysozonus* (Rüppell), and the *aguma-a* (short-bodied mackerel), *Rastrelliger brachysomus* (Bleeker), the latter locally known as *hasa-hasâ* when immature.

The oceanic bonito (*Euthynnus yaito* Kishinouye) and the frigate mackerel (*Auxis* sp.) are caught in great quantities at certain seasons. Other species caught in varying quantities and either sold locally in the fresh state or cured for exportation, are listed in Table 2.

TABLE 2.—*Local names of fishes.*

Samareño.	English.	Scientific name of commonest species in the market.
Abo	Croaker	Sciænidæ.
Abo-abo	Grouper	*Epinephelus undulosus* (Quoy and Gaimard).
Aguut	Grunt	*Pomadasys hasta* (Bloch).
Alhó	Ten pounder	*Elops hawaiensis* Regan.
Alibang-bang	Butterfly fish	Chætodontidæ.
Alimosang	Catfish	Siluridæ.
Apahan	Cavallas	Carangidæ.
Arad-ad	Grunt	*Therapon* spp.
Babakolan	Cavallas	*Caranx sexfasciatus* Quoy and Gaimard.
Bag-añgan	Porgy (immature)	*Lethrinus opercularis* Cuvier and Valenciennes.
Bagaong	Grunt	*Therapon jarbua* (Forskål).
Baghak	Grouper	*Epinephelus megachir* (Richardson).
Bakagan	Slipmouth	*Leiognathus daura* (Cuvier).
Balira	Dorab	*Chirocentrus dorab* (Forskål).
Balo	Garfish	Belonidæ.
Bañgan	Ambassid	Ambassidæ.
Bañgros	Milkfish	*Chanos chanos* (Forskål).
Banogon	Cow-nosed ray	*Rhinoptera javanica* Müller and Henle.
Barewan	Guitar fish	*Rhynchobatus djiddensis* (Forskål).
Bayang	Drepane	*Drepane punctata* (Linnæus).
Bolinao	Anchovy	Engraulidæ.
Boris	do	*Stolephorus indicus* (van Hasselt).
Bugiw	Halfbeak	Hemiramphidæ.
Calapeon	Hardtail	*Megalaspis cordyla* (Linnæus).
Codosan	Hammer-head shark	*Sphyrna zygaena* (Linnæus).
Cogtong	Grouper (large)	Serranidæ.
Dahonan	Sting ray	*Dasybatus uarnak* (Forskål).
Dapak	Red snapper	*Lutjanus malabaricus* (Schneider).
Darapogan	Leaf fish	*Platax orbicularis* (Forskål).
Dumpilas	Big-eyed herring	*Ilisha hoevenii* Bleeker.
Gabilan	Grunt	*Spilotichthys pictus* (Thunberg).
Gela-gela	Crevalle	*Caranx kalla* Cuvier and Valenciennes.
Genok	Goatfish (immature)	Mullidæ.
Gongong	Grunt	*Therapon* spp.
Hamorok	Mojarras	*Gerres punctatus* (Cuvier and Valenciennes).
Haruan	Murrel	*Ophicephalus striatus* Bloch.
I-ito	Catfish	*Plotosus anguillaris* (Bloch).
Kabasi	Gizzard shad	*Nematolosa nasus* (Bloch).
Kikiro	Spadefish	*Scatophagus argus* (Boddaert).
Kini	Shark sucker	*Echeneis naucrates* (Linnæus).
Kirawan	Porgy (large)	*Lethrinus opercularis* (Cuvier and Valenciennes).
Laboñgan	Snapper	*Lutjanus* spp.
Laguis	Croaker (large)	Sciænidæ.

TABLE 2.—*Local names of fishes*—Continued.

Samareño.	English.	Scientific name of commonest species in the market.
Lambiao	Crevalle	*Caranx leptolepis* (Cuvier and Valenciennes).
Lañgisi	Snapper (red)	*Lutjanus* spp.
Lapis	Leather jacket	*Chorinemus lysan* (Forskål).
Lawayan	Slipmouth (large)	*Leiognathus equulus* (Forskål).
Lumo-an	Slipmouth	*Leiognathus* sp.
Lumod	Swordfish	*Xiphias gladius* Linnæus.
Lusod	Barracuda (large)	*Sphyraena jello* (Cuvier and Valenciennes).
Macatod	Snapper	*Lutjanus vitta* Quoy and Gaimard.
Magca-agum	Crevalle	*Caranx djedaba* (Forskål).
Magcotcot	Scolopsid	*Scolopsis bimaculatus* (Rüppell).
Malamban	Halfbeak	Hemiramphidæ.
Mararapad	Gizzard shad	*Anodontostoma chacunda* (Hamilton-Buchanan).
Matang baca	Crevalle	*Caranx boops* Cuvier and Valenciennes.
Modbod	Milkfish (spawner)	*Chanos chanos* (Forskål).
Moong	Cardinal fish	*Amia* spp.
Mulan bulan	Tarpon	*Megalops cyprinoides* (Broussonet).
Muray buray	Silver batfish	*Monodactylus argenteus* (Linnæus).
Nepis-nepis	Slipmouth	*Leiognathus ruconius* (Hamilton-Buchanan).
Ogdok	Eel (marine)	Murænesocidæ.
Osoos	Whiting	*Sillago sihama* (Forskål).
Pagapa	Lactarid	*Lactarius lactarius* (Bloch and Schneider).
Pakañgan	Sawfish	Pristidæ.
Pating	Shark	Galeidæ.
Perisan	Sting ray	*Dasybatus kuhlii* (Müller and Henle).
Sagisi-on	Nemipterid	*Nemipterus japonicus* (Bloch). *Nemipterus taeniopterus* (Cuvier and Valenciennes).
Sandatan	Pomfret	*Stromateus niger* (Bloch).
Sapsap	Slipmouth (small)	*Leiognathus equulus* (Forskål).
Saraming	Cavallas	*Caranx* spp.
Sarañga	Devil ray	Mobulidæ.
Silag	Herring	*Clupeoides lile* (Cuvier and Valenciennes).
Silag-habato	Big-eyed herring	*Ilisha hoevenii* Bleeker.
Sinao-an	Caesio	*Caesio* spp.
Sorahan	Surgeon fish	*Acanthurus* spp.
Subla	Grouper	*Ephinephelus* spp.
Sugui	Halfbeak	Hemiramphidæ.
Sunog	Flathead	*Platycephalus* spp.
Tabangkô	Barracuda (small)	*Sphyraena* spp.
Tabañgoñgo	Catfish	Ariidæ.
Talhô	Lizard fish	*Saurida tumbil* (Bloch).
Tamban helos	Herring	*Dussumieria* sp.
Tamban lirayan	Round-bodied herring	*Sardinella fimbriata* (Cuvier and Valenciennes).
Tamban lison	Sardine	*Sardinella longiceps* (Cuvier and Valenciennes).
Tamban yapad	Deep-bodied herring	*Sardinella perforata* (Cantor).
Tañgigui	Spanish mackerel	*Cybium commersoni* Lacépède.
Tase	Sergeant fish	*Rachycentron canadus* (Linnæus).

TABLE 2.—*Local names of fishes*—Continued.

Samareño.	English.	Scientific name of commonest species in the market.
Tarakitok	Cavallas	*Caranx* spp.
Tawa-ay	Threadfish	*Alectis* spp.
	Jack	*Hynnis momsa* Herre.
Tiao	Goatfish (large)	Mullidæ.
Tiñgag	Grouper (immature)	Serranidæ.
Toros	Siganid	Teuthidæ.
Turiñgan	Tuna	Thunnidæ.

FISHING METHODS

Fishing in Samar, as in other regions of the Philippines, has been confined to pelagic and shore activity. With few exceptions the methods employed, although varied and numerous, are antiquated. Fishing is carried on in dugouts, motor boats being used only for towing the former to and from the fishing grounds. The nets are of fine mesh and, therefore, heavy, so that many fishermen are required for their operation. The methods of fishing range from the catching of fish with the hands to the employment of light in net fishing for anchovies on a commercial scale. Many of the gear used have been introduced by fishermen from Bohol and Luzon.

The sapiao.—Of first commercial importance is the sapiao, a round haul seine of cotton twine. Here two kinds of sapiao are distinguished—the ordinary *sapiao de cuerdas,* or simply *de cuerdas,* and the *sapiao lawag,* or simply *lawag*—the former obsolete, having been replaced by the latter.

At first the sapiao de cuerdas was employed in the extensive anchovy fisheries of this region. Later was added to it the use of light, at the start only in the form of a petroleum torch, locally known as *dukalwong.* Finally the "gral," an incandescent gasoline lamp, was employed, and is still used in the present lawag.

A lawag outfit is composed of a motor boat of about 9 tons gross equipped with a 25-horsepower crude-oil engine, two *sapiao-an,* three *lawagan,* and one sapiao. This is operated by a crew of from 32 to 35 men.

The motor boat acts as a mother ship, towing the baroto to and from the fishing ground. The sapiao-an are ordinary dugouts of not more than 3 tons, each provided with one outrigger so that they can come close to each other in the actual fishing operation. These are the fishing boats proper and are at the same time used for loading the catch. Often an extra sapiao-an, the *convoy,* is towed for loading large catches. The lawagan are small dugouts provided with two outriggers and a stand, the latter employed to hold one or two grals. These gasoline lamps, which are used to attract the anchovies, have an intensity of from 1,200 to 1,600 candle power.

The sapiao or the net proper, as stated in the foregoing paragraphs, is a round-haul seine of cotton twine, which in actual operation is converted into a huge dip net by the hauling in of the bottom line. It is a somewhat rectangular net with a width of from 100 to 300 feet and a depth of from 150 to 400 feet. The sides are selvaged with three meshes of No. 18 [2] twine towards the inside and four meshes of No. 21 or No. 22 towards the outer edge. The float-line is provided with about sixty one-bamboo-joint floats attached at intervals of 5 feet. To the bottom line are attached sixteen ropes called *palihan,* or pull ropes, which are $\frac{3}{4}$-inch abacá ropes, each about 250 feet long, used for hauling in the bottom line. Eight ropes are held by eight men from each of the two sapiao-an. Of the eight ropes in each sapiao-an, four carry 2.2-pound stone weights—the first two ropes towards the bow with three weights; the third with two and the fourth with one. The structure of the entire net is shown in fig. 1.

The crew of from 32 to 35 men are fishermen who work during the dark of the moon. They are usually paid in advance and are under contract to work until they cover the payment of the advance—their share being computed according to the market prices of the catch for that day. They are, as a rule, given free food, and each is given the privilege of selecting the bigger fishes included in the catch for home consumption. This they term *recalmon* which oftentimes amounts to more than enough for their families; in that case they sell the remainder at the fresh-fish market.

The motor boat tows one or two outfits (4 to 12 barotos) to the fishing ground. They usually start at 3 o'clock in the afternoon and reach the fishing ground exactly at dusk. The lawagan are then given their supply of oil and matches, whereupon they station themselves at different points where fish are supposed to be abundant. The grals are lighted, and in the meantime the two sapiao-an, with the net shared equally in each of

[2] The standards are those used in the Philippines.

them, drop anchor and lie in wait. When large schools have been attracted by a lawagan, the *timonel* (steersman) of the latter blows his conch-shell horn, whereupon the two sapiao-an approach to a distance of about 300 feet. Then the net is laid out from the two sapiao-an, the bunt first and then the wings. The entire net is completely stretched out in the form of a semicircle by the spreading apart of the two sapiao-an which have lain side by side; simultaneously the fishermen let loose the pull ropes so that the entire gear hangs vertically from the surface of the water in the form of a curtain. As the net is always set against the current, it bulges at the center forming a bag.

The lawagan then enters the inclosed area leading or escorting the school of anchovies. The two sapiao-an are then rowed towards each other, while simultaneously the eight men in each gradually haul in the pull ropes. Completely inclosed and the bottom line hauled in, the net is gradually reduced in size by hauling in the wings and concentrating the catch at the bunt; the lawagan is then rowed towards the outside—the timonel of the lawagan supporting the float-line of the bunt. Then the two sapiao-an are rowed towards each other until they lie side by side and are secured to each other by a rope, transforming the gear into a bag, from which the anchovies are brailed out into the boat by dip nets.

This particular lawagan again is on its way to attract other schools, while the other two lawagan are almost ready to be surrounded with the net. The operation is then repeated—this routine of the fishing process being followed from dusk until dawn of the next morning. The whole outfit is then towed homeward and in case fishing is good the lawagan are sometimes left behind at the nearest barrio, so that during dusk they may begin their work before the entire outfit arrives.

The catch consists largely of anchovies (bolinao) of which three distinct kinds are known—the *parañganon*, the *kawayanon*, and the *boris*. Included in the hauls are also small amounts of mackerel, barracuda, herring, cutlass fish, dorab, and squid. A fishing trip usually nets a catch of from 50 to 300 *fanegas* (1 fanega equals 11 pounds). A fanega of fish has a market value of from 0.50 to 3 pesos.

The catch of the lawag, like that of the other fishing gear, is divided into three parts after all expenses have been deducted.

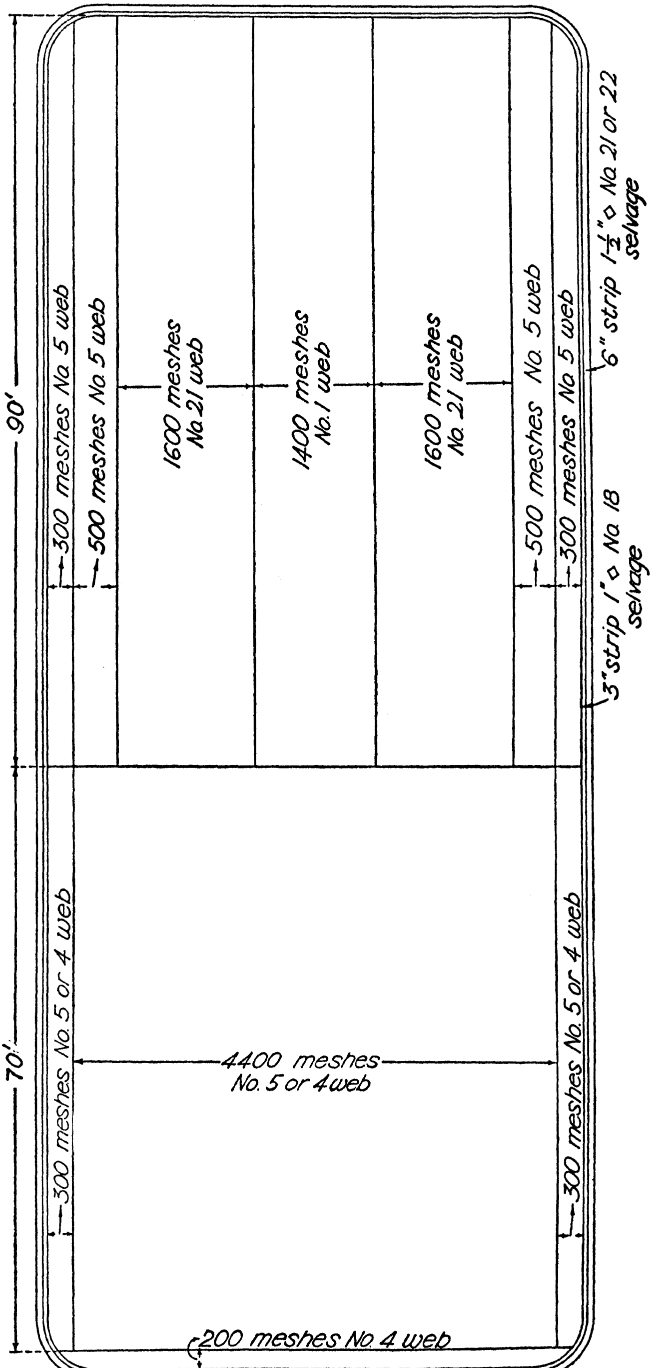


FIG. 1. Structure of the sapiao lawag; diagrammatic.

One-third is for the owner of the apparatus and two-thirds are for the crew—the timonel receiving more than the others.

The cost of an outfit is as follows:

	Pesos.
1. Motor boat	6,000.00
2. Three sapiao-an	900.00
3. Three lawagan	90.00
4. Three gral	270.00
5. Net (lawag)	900.00
Total	8,160.00

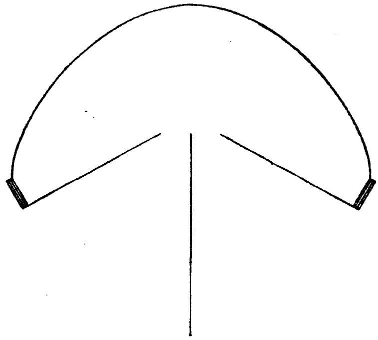


FIG. 2. Inangcla bunuan without any pound or cribs on one side only; diagrammatic.

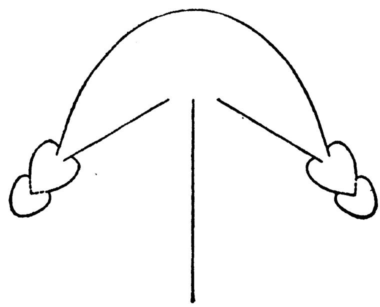


FIG. 3. Inangcla bunuan with two pounds or cribs on each side; diagrammatic.

The sapiao de cuerdas is of the same construction as the lawag although the interior netting of the former is of wider mesh and larger twine—No. 10 twine with a mesh of from $1\frac{1}{2}$ to $1\frac{3}{4}$

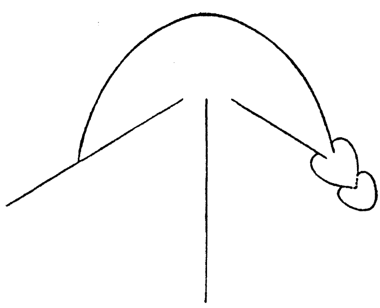


FIG. 4. Inangcla bunnan with two pounds or cribs on one side and a prolongation of the wing on the other; diagrammatic.

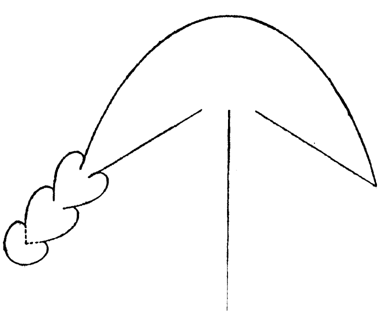


FIG. 5. Inangcla bunuan with three pounds or cribs on one side only; diagrammatic.

inches stretched. The de cuerdas, unlike the lawag, is operated without the use of light although fishing is also done during dark nights. The meshes being wider, this gear catches the larger species of fish such as cutlass fish (lahing), large milkfish (modbod), spotted mackerel (aguma-a), etc.

The bunuan (fish corrals).—Next in importance are the fish corrals locally known by the general vernacular name "bunuan." These bunuan are either the deep-water or the shallow-water fish traps. They are usually set in November or December and removed in May or June, the season being within the northeast monsoon.

Various styles of bunuan were observed, the most common being the *inangcla,* a style introduced here by Cavite fishermen (figs. 2 to 5). This is planted in either shallow or deep water. The shallow-water bunuan of this style are constructed of bamboo poles and matting of split bamboo strips, requiring an investment of from 20 to 100 pesos. Here the catch is concentrated in a pound or crib from where it is brailed out by means of a dip net.

The deep-water bunuan of the inangcla style are constructed at a depth of from 9 to 11 fathoms, *palma brava* being used for posts. These deep-water fish traps may or may not have a pound. When they are not equipped with a crib, as those common in Catbalogan and Basey, the catch is collected by seining the heart with a drag net locally known as *siguin.* This deep-water trap, known as *paugmad* in Calbayog and Tarangnan and as *habug* in Basey, may require an investment of from 3,000 to 4,000 pesos.

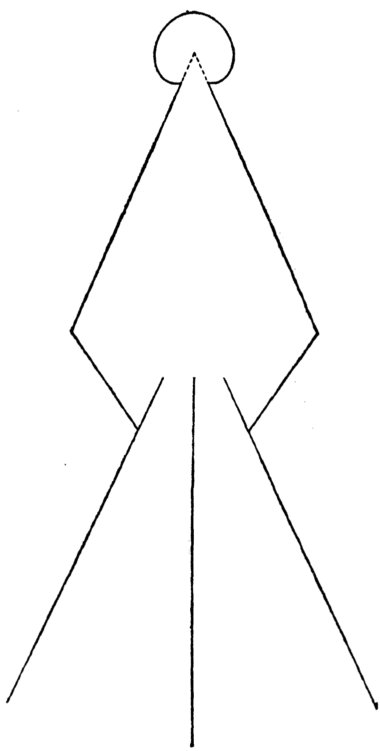


FIG. 6. Pangalato style of bunuan; diagrammatic.

Another style of fish corral is the *pangalato* commonly seen around the municipal waters of Santa Rita and Basey. A diagram is shown in fig. 6. The pangalato, a shallow-water fish trap constructed close to the shore, requires a capital of about 150 pesos.

For shallow water, however, the commonest style in use is the *bunuan ordinario,* fig. 7, constructed of bamboo poles and *banata* (split-bamboo matting). The catch is collected in a crib from which it is brailed out by means of a dip net. The cost is almost the same as that of the shallow-water inangcla bunuan. The bunuan ordinario is of the style common in Bunuanan and Jiabong Barrios, of Catbalogan, and in Wright.

Besides the sapiao, nets of commercial importance are the various types of seines (langbat, baring, bahan, and ligcop); several kinds of gill nets (malawâ, salibut, kayagkag, banata, and pante); an assortment of huge dip nets (sodsod, solambao or conay, and cabiao); and the cast net (laya).

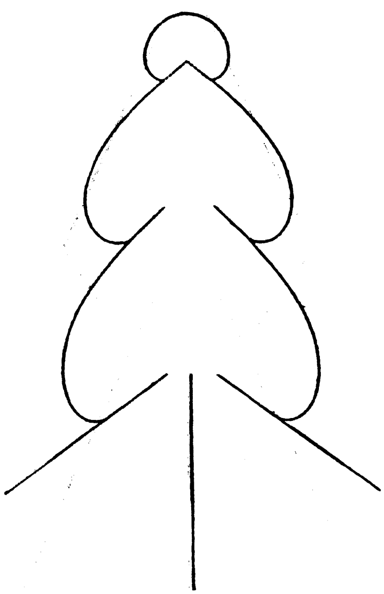


FIG. 7. Bunuan ordinario (shallow water); diagrammatic.

Langbat.—This is an introduced fishing gear, the original being the cobcob or purse seine. The Samareño fishermen, believing that it works just as well without pursing the bottom line, have done away with the purse rings, transforming the gear into a sapiao. This net ranges from 500 to 1,000 feet in length and from 75 to 250 feet in depth. The floatline is provided with wooden floats set about a foot apart, while the bottom line is weighted with lead sinkers attached at intervals of from 3 to 9 inches. The webbing is of No. 5 cotton twine with a mesh of 2 inches stretched. This gear catches pelagic species that run in schools, such as aguma-a, burao, and *turiñgan.* The entire outfit, including one banca, represents an investment of about 1,000 pesos.

Baring.—This is a beach seine of sinamay, which may or may not have a bag, and is operated either with or without the use of light. When used with the aid of light an outfit is composed of one *bariñgan,* one lawagan with one or two grals, and one net or *baring* proper.

The bariñgan is a dugout similar to the sapiao-an, which in this case is used for loading and transporting the net and the catch. The lawagan, just like that of the lawag, is provided with one or two gasoline lamps (gral). The baring is about 380 feet in length with a depth of from about 14 feet at the wings to about 25 feet at the bunt or the central portion. The sides are selvaged with hand-made abacá twine about $\frac{1}{8}$ inch in diameter, with a mesh of about 3 inches stretched. The upper line is provided with wooden floats and the bottom line with lead sinkers. These lines are prolonged into the wing bridle to which is attached the wooden brail. To the bridle is attached the palihan, a rope about $\frac{1}{2}$ inch in diameter, which is used for drawing the net to the shore. The structure of a baring is shown in fig. 8. An outfit of this type requires an investment of from 300 to 350 pesos.

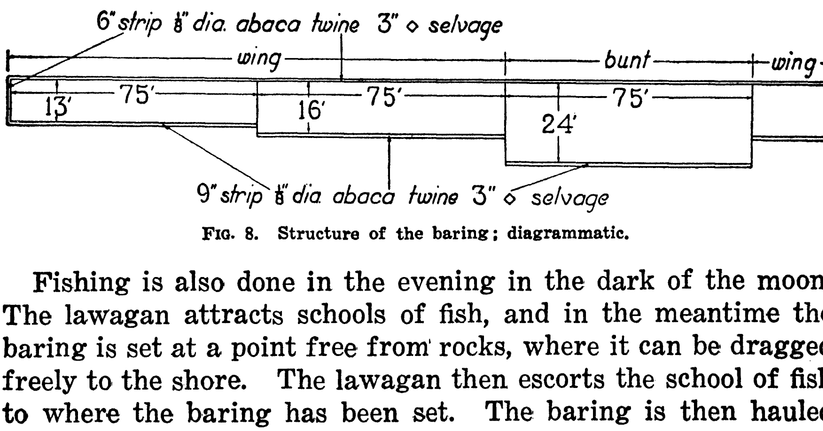


FIG. 8. Structure of the baring; diagrammatic.

Fishing is also done in the evening in the dark of the moon. The lawagan attracts schools of fish, and in the meantime the baring is set at a point free from rocks, where it can be dragged freely to the shore. The lawagan then escorts the school of fish to where the baring has been set. The baring is then hauled towards the shore. The catch consists mostly of anchovies with a mixture of other species.

When the baring is used without the aid of light it is an ordinary *chinchorro,* or beach seine, which may be operated either during the day or at night.

Bahan.—This outfit is a very common gear in Villareal. It is used to catch coral-reef fishes similar to the hauls of the Japanese muro-ami outfits. The gear itself is a baring which serves as the bunt and the bahan proper (the scareline composed of coco-palm leaves, each 500 feet long) attached to the ends of the wings of the baring, thus serving as the wing of the outfit.

The baring is paid out in the form of a semicircle, followed by the bahan toward each wing. Eight divers then pull the bahan, scaring and driving the fish towards the baring. Inclosed in the baring the catch is hauled towards the shore.

This type of fishing gear requires a capital of from 200 to 250 pesos.

Ligcop.—Another net employed in catching coral-reef fish is the ligcop (Plate 3, fig. 3), a drag seine with a length of from 900 to 1,500 feet and a depth of about 8 feet. The netting is of hand-made abacá twine about $\frac{1}{4}$ inch in diameter, knitted by hand with a mesh of $1\frac{1}{2}$ inches stretched. The cork line is provided with wooden floats, while the ground line is anchored by means of stone weights. In actual operation the cork line is submerged and held in place by means of three bamboo poles attached to it and held by three men in three bancas.

After a school of fish has been surrounded, one end of the net is gradually hauled towards the shore, women and children being employed in drawing the pull rope. Three to four divers continuously free the ground rope from rocks, for this gear is operated along rocky shores at a depth of about 10 fathoms. The catch is then concentrated at the other end, whence it is hauled along the shore.

Among the gill nets commonly employed are the malawâ, the salibut, the kayagkag, the banata, and the pante.

Malawâ—This gear is used in deep water. It is from 350 to 750 feet long and from 18 to 25 feet deep, with a netting of hand-made abacá twine $\frac{1}{16}$ inch in diameter and knitted with a mesh of 6 inches stretched. To the cork line are attached "bitoon" floats; the ground line is never weighted. The net, when paid out (always perpendicular to the direction of the current), hangs vertically from the cork line like a curtain.

Salibut.—The salibut resembles the malawâ in all respects except that its meshes are much smaller (3 inches stretched) and that the bottom line is provided with sinkers either of lead or of conch shells. This gear is usually operated in shallower waters.

Both the malawâ and the salibut are generally operated when and where the current is not very strong. When the current is very strong the malawâ floats while the salibut sinks. The catch of the two differs only in size and consists mostly of cutlass fish, milkfish, leather jacket, etc.

Kayagkag.—The net, which is of hand-knit abacá twine with a mesh of 2 inches stretched, measures about 400 feet in length and about 8 feet in depth. The upper line is provided with wooden floats; the bottom line is not weighted. This net is paid out from a banca in the form of a circle and the inclosed fish are scared into its meshes by means of a plunger (a wooden pole with a disklike cup at one end). This gear catches shark, mullet, snapper, grunt, and various other larger species.

Banata.—This is very similar to the kayagkag, although the netting is of cotton twine. The upper line is also provided with wooden floats, but the bottom line is weighted with lead sinkers attached every 2 feet. The catch consists mostly of *mararapad* (gizzard shad).

Pante (*Plate 5, fig. 3*).—This is the gill net used by the Tagalog, the gear having been introduced here by the fishermen from Cavite. It is especially common in the Caviteño settlement at Salvacion, Basey. The catch consists mostly of *magca-agum* (hard-tail), *tabañgoñgo* (catfish), *pating* (shark), and *lapis* (leather jacket).

Other fishing contrivances, which are more or less huge dip nets, are the *sodsod,* the *solambao* or *conay,* and the *cabiao.*

Sodsod.—This is an introduced fishing gear corresponding to the sakag of the Tagalog and is very common in Basey. The cross-poles are usually made of bamboo and the netting is of either abacá or cotton twine. The shoes are of coconut husk. When operated at night, a torch (petroleum) is used in connection with it. The catch consists mostly of shrimps.

Solambao, or conay (*Plate 4, figs. 1 and 2*).—This gear is a sodsod without shoes plus a scare line that consists of an abacá rope 200 feet long to which are fastened at intervals coconut husks and buri-palm leaves. The web of the sodsod is of No. 40 cotton thread with a mesh of 1 inch stretched. This is a very common fishing appliance in Catbalogan where it is called *solambao,* and in Basey where it is known as *conay.* A complete outfit, consisting of a net, a scare line, and a banca, is operated by four persons, and requires an investment of about 40 pesos. The catch consists mostly of young mullet.

Cabiao.—This is a more or less square net measuring 20 feet on each side and made of No. 20 cotton thread that is webbed with a stretched mesh of $\frac{5}{8}$ of an inch. The sides are selvaged with coarser twine of the same mesh. It is operated by four men on bamboo stands built at the side of the river. Each corner of this net is attached to a bamboo pole, which in turn is held by each of the four men on the stand. The entire net is sunk into the water in the form of a huge dip net. Upon their discretion the fishermen haul it by lifting the poles. The catch consists mostly of *balanak* (mullet).

A somewhat different method of operating this net was observed in Basiao, Catbalogan. Here one side of the net (the one away from the shore) is attached to a long one-piece bamboo float, which in turn is attached to two poles stuck into the bottom of the sea. The side towards the shore and parallel to the floated side is weighted with two stones attached to the corner of the square net. The attending banca lies adjacent to the weighted side. When ready to haul, the men from the banca lift the weights and haul the net from this side towards the floated side.

Laya.—This is the cast net (dala) of the Tagalog. It is operated either along wading depths or in deep water. In the latter case a banca is used in connection with its operation. A fleet of laya fishermen from Bunuanan Barrio, Catbalogan, furnishes the fresh-fish market with a daily supply of a delicious fish locally known as *silag, Clupeoides lile* (Cuvier and Valenciennes). Another deep-water cast net in use is that designed for catching herring similar to those in Parañaque, Rizal.

Kitang.—This is another introduced fishing appliance, having been brought by the Cavite immigrants. It is operated as in the Tagalog regions and catches large fish, which are sold in the local fresh-fish markets.

Other gear of lesser importance, some of which are already obsolete, are the following:

Anud.—A drifting gill net operated from two bancas.

Kalamba.—A gill net used for catching mullet, mojarra, slipmouth, catfish, etc.

Sarap banata.—A drag net of sinamay about 80 feet long and about 15 feet deep; used for catching shrimps.

Banata pukot.—A drag net similar in construction to the bating of the Tagalog. The net is 400 feet long and from 40 to 60 feet deep, of No. 20 cotton twine with a mesh of 2 inches stretched. Catches hardtails, etc.

Tambog.—A gill net similar to the kayagkag and the banata.

Paeligan.—An inclosure consisting of barricades of stones and rocks, provided with openings where the collecting traps are set.

Sinduk.—This is a sodsod without shoes or sliders.

Padlas.—A gill net, 70 feet long and 70 feet wide, operated from two boats. Before being used the net is immersed among crushed shrimp. The particles of shrimp that stick to the twine serve as bait.

Ragonot.—A gill net, which in operation is aided by the use of a scare line.

Bobo.—A bamboo fish basket serving as a trap.

Tinumpang and guinancho.—Similar to the banata.

Sarap.—A drag seine of sinamay, usually 75 by 20 feet; used for catching shrimps.

Pa-abung.—A gill net, 50 to 75 feet long and 20 feet deep, of abacá twine. It is without floats and weighted with two stones on the bottom line and operated from two bancas. Used for catching gizzard shad.

Arong.—Similar to the bonbon of the Tagalog.

Pabjas.—Synonym of pahubas, a type of shallow-water fish corral.

Pañgawel.—Fishing by trot line or trolling.

FISH-PRESERVATION METHODS

Because of the very limited local market for the voluminous catch, the problem of fish preservation is of paramount importance. The curing and preservation plants are all located in the municipality of Catbalogan, where two barrios, Mercedes and Guinsoroñgan, are almost exclusively devoted to this industry. There are two plants in the former barrio and four in the latter, with but one exception all owned and operated by Chinese. Aside from these plants was one in Silanga Barrio and another small one at Sierra.

The fish-preservation methods employed are similar to those followed in other fishing centers in the Philippines, such as Estancia, Sitanki, and Manila—drying and salting.

Drying.—Two types of catches are dried—the catch of the fish corrals and those of the commercial fish nets (langbat and lawag). The deep-water bunuan are usually seined three times a day; the catch, consisting of several species—crevalle, grunt, pomfret, hairtail, slipmouth, threadfin, croaker, dorab, mackerel, etc.—is brought directly to the preservation plants, although limited amounts are sold at the fresh-fish markets. From the bancas they are placed in baskets (canastros), washed in sea water, and brought to the shed, where they are sorted by size. The small and medium-sized fishes, which are cured in the round, are placed in concrete brining tanks or vats containing strong brine. The surface of this mixture is covered with additional coarse salt, and the solution is used over and over. The fish are left in this solution for from three to five hours, depending upon the size, species, and abundance of fish. Then they are washed in sea water and dried on elevated platforms with split-bamboo matting. From three to five days are required to dry the fish thoroughly.

The large species included in the catch are gutted and split or sliced before undergoing the dry-salting process discussed in the foregoing paragraph.

The langbat catches include the common pelagic species that run in schools, such as the chub mackerel and the herring, although the latter was uncommon during the period of the investigation. The small and medium-sized fish (hasa-hasâ) are prepared in the round, while the large ones are also gutted and split.

The catches of the lawag are mostly anchovies (bolinao). During sunny days, most of the catches of anchovies are dried. From the boats (sapiao-an) the fish are placed in canastros, washed in sea water, and landed and spread to dry on elevated platforms of split-bamboo matting. From time to time the fish are turned over by tilting portions of the somewhat flexible matting, in order that both sides of the fish may dry equally. Here no salt is used, as the anchovies are small and thin enough to be thoroughly dried in the sun. These dried products are packed in sacks and boxes and shipped to Manila, Bohol, Leyte, and other localities.

The following items enter into the cost of producing and transporting one sack of dried anchovies to Manila:

	Pesos.
Raw fish	1.50
Labor	0.40
Cost of sack (container)	0.10
Freight	0.16
Cargador and internal-revenue tax	0.07
Total	2.23

As previously stated, three species of anchovies are distinguished in Samar, each with a different preserving quality—the *paranganon* (*Stolephorus commersonii*), the *kawayanon* (*Stolephorus* sp.), and the *boris* (*Stolephorus indicus*). It is claimed that of the three species the boris is the best for drying as it does not readily rust and therefore commands a higher price. The rusting is due to the oxidation of the fat upon exposure to the air, and the boris apparently contains less fat than the first two species.

Salting of anchovies.—The lawag outfits that supply the raw materials for this industry of preparing "bagoong" locally known as *bodo,* land their catch in the morning. From the holds of the sapiao-an the fish are placed in bamboo baskets (canastros). These are first dipped in sea water before being brought to the salting shed. In the plant the anchovies are salted in elevated wooden vats (Plate 6, fig. 2), or sometimes in holds of worn-out bancas—the proportion of salt to fish being one part of salt to two parts of fish. The salt and fish are gradually and uniformly mixed together by the use of an enamel plate or a scoop.

The mixture of salt and fish is then placed in concrete vats where it is allowed to cure for from one to three days depending upon the supply of fish. At this stage the vats are usually exposed and give flies an opportunity to deposit their eggs. The vats are covered with webbed bamboo matting, or *sawalî*, which does not exclude the flies.

After having undergone curing, the product is placed in 5-gallon petroleum cans by women and children. The cans used are those provided with a more or less circular opening. The containers with the mixture of salt and fish are set aside for a period of one week or more with the circular orifice left open to allow the salted product to cure further and the gaseous formation resulting from the fermentation process to escape. It is essential at this stage to cover this opening temporarily with cheesecloth in order to prevent flies from gaining access to the fermenting product. The cans are then hermetically sealed by soldering a piece of tin plate to the circular opening. The sealed cans are stored for some time before shipment, their condition being observed from time to time. "Swells" are discarded, and the other cans are shipped to Manila, the Ilocano provinces, and Hawaii.

The following items enter into the cost of producing and transporting one can of bagoong to be marketed in Manila:

	Pesos.
Raw fish	0.30
Salt	0.20
Labor	0.10
Cost of can (container)	0.30
Freight	0.20
Total	1.10

Salt used in the preparation of bagoong.—Two types of salt are commonly used; Manila salt (produced by solar evaporation of sea water), which is used by the Chinese, and Ilocano salt (sea or salt-spring water evaporated by artificial heat) by the Ilocanos. The former is coarse, while the latter is fine. The results of the analyses of the two samples, by the Bureau of Science, are given in Table 3.

TABLE 3.—*Analyses of two samples of salt.*

Substance present.	Manila salt.	Ilocano salt.
	Per cent.	*Per cent.*
Alkaline chlorides (by difference)	91.18	94.23
Calcium sulphate ($CaSO_4$)	1.55	4.13
Magnesium sulphate ($MgSO_4$)	3.90	0.93
Magnesium chloride ($MgCl_2$)	2.76	0.59
Iron and aluminum oxide (R_2O_3)	0.003	0.005
Residue insoluble in water	0.61	0.12

From the analyses it is evident that the Ilocano salt is the purer salt, its sodium chloride content being 94.23 per cent and that of the Manila salt 91.18 per cent. The claim of the residents of Samar that the Ilocano product is extremely salty and has a peculiar biting taste is explained by the abundance of calcium salt which, according to Taylor,[3] "has an acrid taste and greatly accentuates the 'saltiness' of salt." Magnesium salts produce the same effect as the calcium, but not to the same degree. The Philippine salts as a whole are quite impure compared with those used in foreign countries. The Turks Island salt, for example, contains 96.52 per cent sodium chloride; the Trepani Italian salt 95.82 per cent; the Iviza Spanish salt 98.05 per cent; the Diamond Flake domestic salt 99.78 per cent; and the Leslie Velvet Grain California salt, 99.96 per cent.

Although the Manila salt (Malabon and Parañaque salts) contains less sodium chloride, its calcium content is very much less than that of the Ilocano salt.

The use of a much purer salt than the Manila or Ilocano salt is needed before any decided improvement in both the keeping quality and the flavor of the salted product can be expected.

CONCLUSIONS AND RECOMMENDATIONS

1. The center of the entire fishing activity of the southwestern coast of Samar is Catbalogan. It is an ideal site for an experimental station, its location being halfway between Manila and Zamboanga.

2. The experimental station needed is one similar to that proposed for Estancia—to conduct research on the problem of how

[3] Taylor, H. F., Principles involved in the preservation of fish by salt, appendix II, Report U. S. Commissioner of Fisheries for 1922, p. 8.

to improve the methods employed in the preservation of the large catches which cannot be utilized in the local fresh-fish market but could be disposed of in other markets in the cured or frozen state. In conjunction with this, extensive studies on the spawning habits and migrations of the common food fishes should be carried on.

3. The anchovy fishery is the most extensive. While measures are necessary for its protection and conservation, further studies on the life history of the species are needed before proper protective legislation can be formulated. Only by exhaustive research can it be determined when, where, and why the species needs protection. It is further recommended that a complete yearly statistical record of the catch be kept as a basis for the determination of depletion and inflation of the fisheries.

4. Opinions on the effect of fishing with light are varied. Some authorities claim that sea fishes as a rule are repelled by light, while in Japan and the Mediterranean it is employed in the catching of pelagic species such as anchovies, herrings, sardines, and mackerel, these being the fishes attracted by light. Its continuous employment in fishing will, no doubt, have some telling effect upon the abundance of these species as they are caught in great quantities within a short time, irrespective of size and age. On the other hand, since the anchovies are small it is only by the use of a fine-meshed net in connection with light that their capture can be successfully effected. It is, therefore, recommended that the use of such an outfit as the lawag and baring with light be confined to the catching of anchovies. For the protection of this fishery, various self-regulatory factors have been in operation, among which are the confinement of the fishing period to the dark of the moon; the operating expenses are excessively high so that when the catch is very small, fishing stops; finally, the taxation imposed upon this mode of fishing is almost prohibitive.

With regard to other species, such as the herrings, the sardines, and the mackerels that attain medium size and may be caught by gear other than the lawag and the baring, wholesale capture by the use of the above-mentioned nets should be prohibited.

Only by such compromise measures can the anchovy fisheries be exploited; otherwise they would remain untouched. These measures would at the same time effect the least destruction of the other pelagic species.

5. Certain sections of Maqueda (the northern) and Villareal Bays are trawlable. San Pedro Bay, which is more or less exposed, has a rugged bottom and is not, therefore, good for trawling (Plate 1). Only by the employment of such deep-sea fishing devices can the demersal resources of these seas be exploited; as yet, they are utilized only to a very limited extent.

6. While tracts of swamp lands, which are fringes along the shore, are favorable fishpond sites and while bañgos fry could be obtained locally, the rearing of such fish on a commercial scale has very limited possibilities in a region where an abundance of marine species exists. In fact, such an enterprise should not be undertaken in localities where the market is very limited, for while sea fishes could be procured with the mere investment in catching facilities, the production of such a commodity in regularly constructed fishponds entails expenses that will tend to increase the selling price. Such items as the cost of constructing the pond, of the fry, and of marketing are expenses which must be taken into consideration. Added to this is the fact that the flavor of marine species is generally superior to that of any pond fish of the same species. The prevalence of typhoons and floods in this region also adds to the difficulty.

7. The fresh-water fishery in these regions is insignificant.

8. The fish-preservation methods could be improved by exercising proper care of the catch before it reaches the preservation plants; by the use of salt purer than the Manila or Ilocano salts, which will tend to increase the product's keeping quality and at the same time improve its flavor; by observing sanitary rules in the course of the preparation so as to exclude flies from the salted products and dirt and dust from the dried ones; and, finally, by the employment of containers other than boxes, cans, and sacks so as to avoid moisture during storage and in transit.

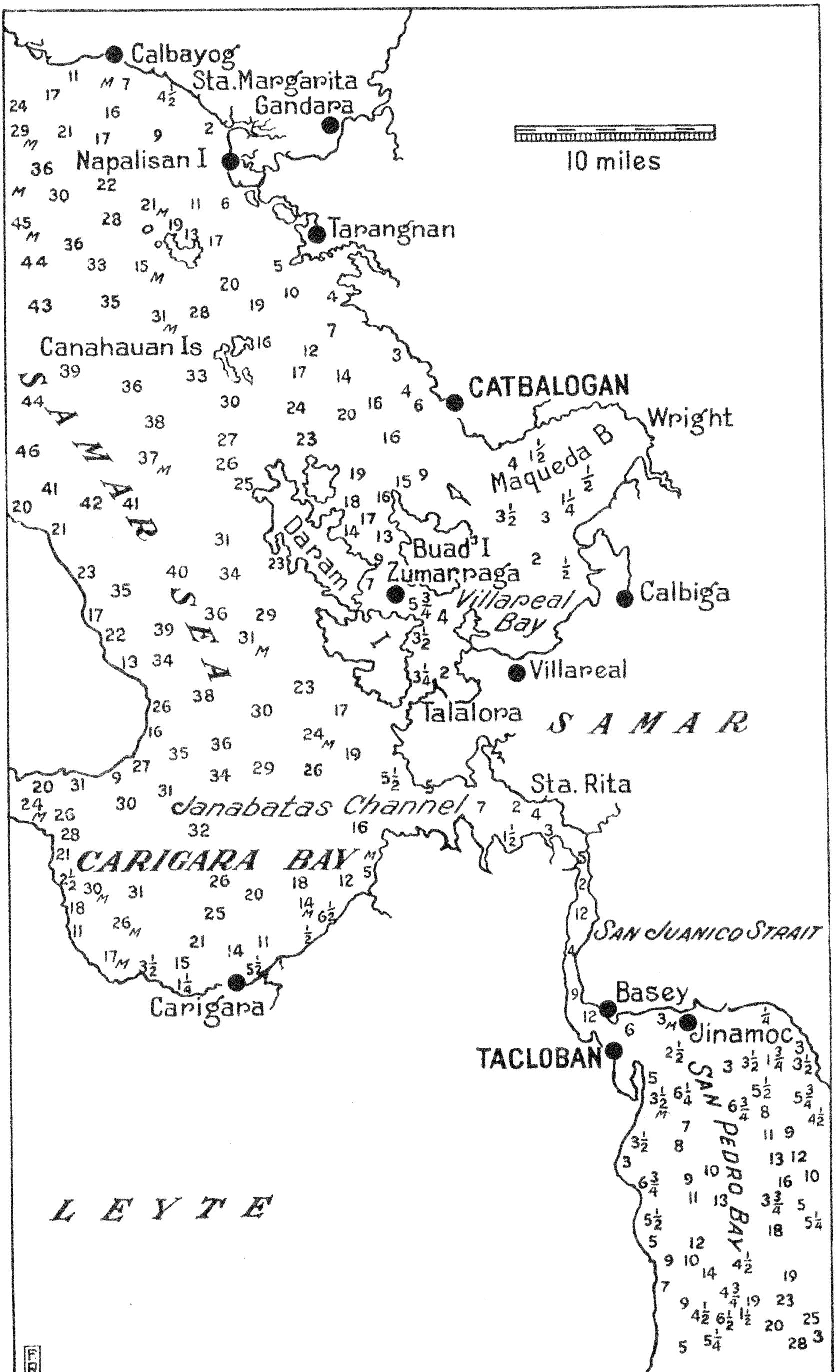
9. Inasmuch as the catch is more than the demand, attention should be given to the promising markets for fresh fish in big centers such as Cebu, Bohol, Iloilo, Zamboanga, and Manila by the employment of refrigeration. For the present, direct icing is employed in the Islands, although rapid freezing is the most recent method in vogue in foreign countries. Only fish in the best and freshest condition should be iced and shipped; hence they require the utmost care before they are refrigerated or iced. Eviscerated fish are the most profitable to market in this way.

10. Compared with the fees in other regions, the taxation imposed upon the privilege of fishing in southwestern Samar is excessive if not prohibitive. While this is the best means of guarding against overfishing, especially with regard to the lawag and the baring used in connection with light, it is recommended that a reduction in the fees of the other less-destructive gear that operate on a capital basis be adopted. It is also recommended that the fees on the gear that operate on a small scale, catches of which are just enough for home consumption, be abolished.

ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Structure of the sapiao lawag; diagrammatic.
2. Inangcla bunuan without any pound or crib (deep water); diagrammatic.
3. Inangcla bunuan with two pounds or cribs on each side; diagrammatic.
4. Inangcla bunuan with two pounds or cribs on one side and a prolongation of the wing on the other; diagrammatic.
5. Inangcla bunuan with three pounds or cribs on one side only; diagrammatic.
6. Pangalato style of bunuan; diagrammatic.
7. Bunuan ordinario (shallow water); diagrammatic.
8. Structure of the baring; diagrammatic.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10 miles
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Tarangnan
Canahauan Is
CATBALOGAN
Wright
Maqueda B
SAMAR SEA
Daram I
Buad I
Zumarraga
Calbiga
Villareal Bay
Villareal
Talalora
SAMAR
Sta. Rita
Janabatas Channel
CARIGARA BAY
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Jinamoc
TACLOBAN
San Pedro Bay
LEYTE
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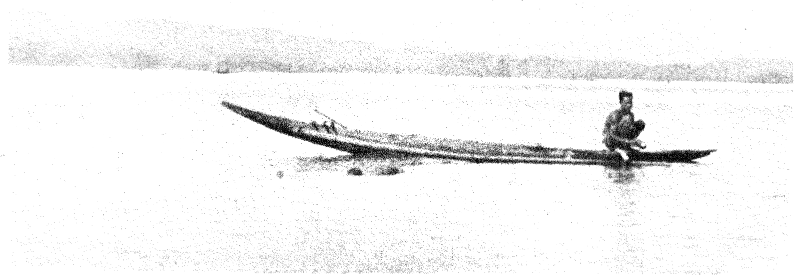
PLATE 1.



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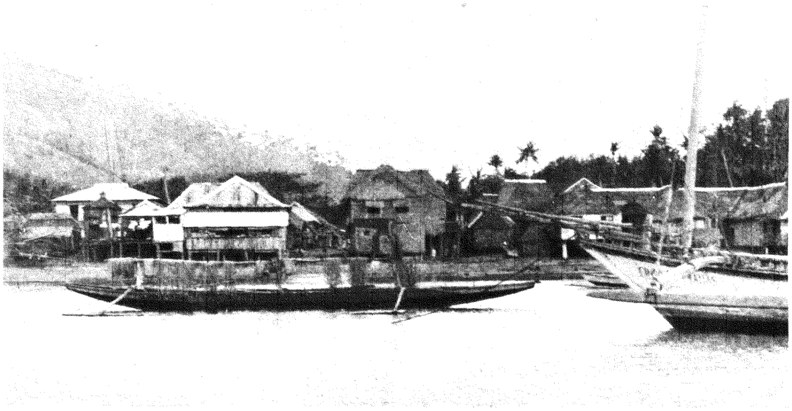

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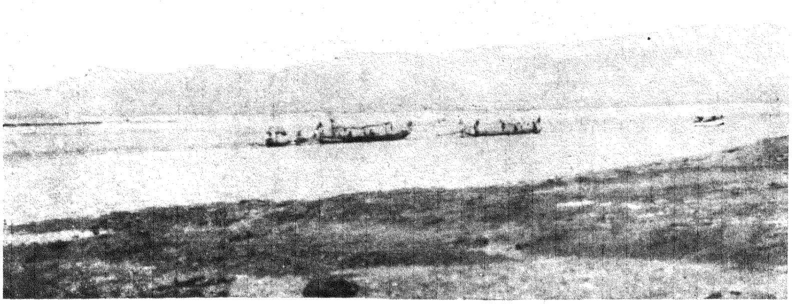

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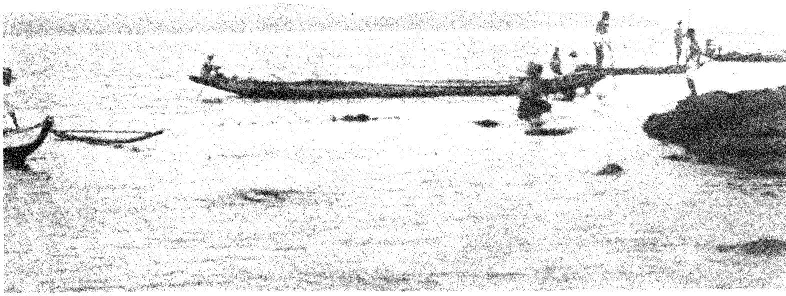

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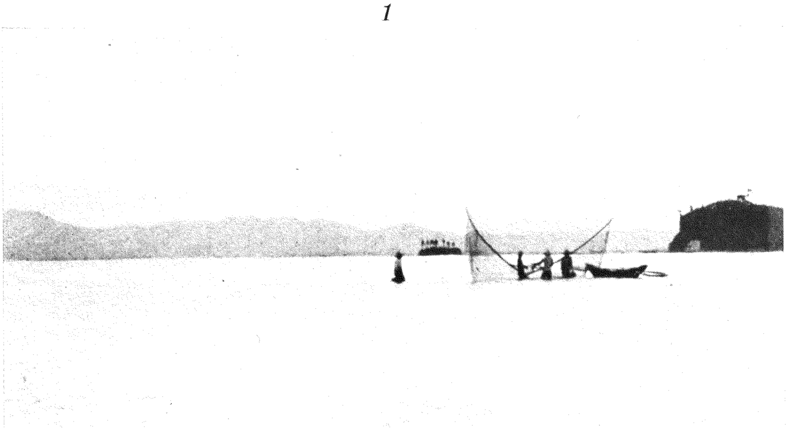

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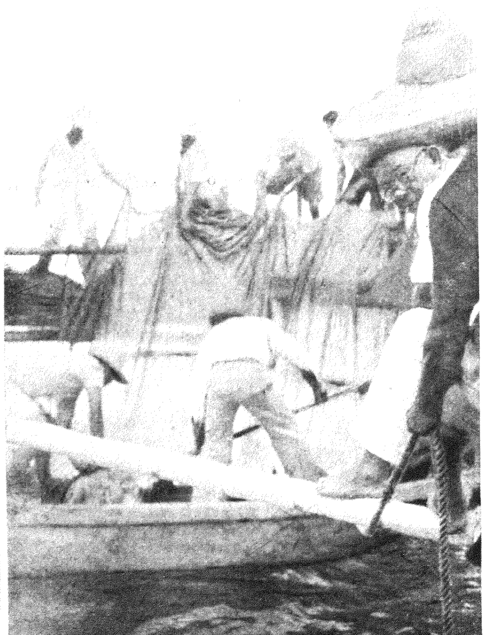
PLATE 4.



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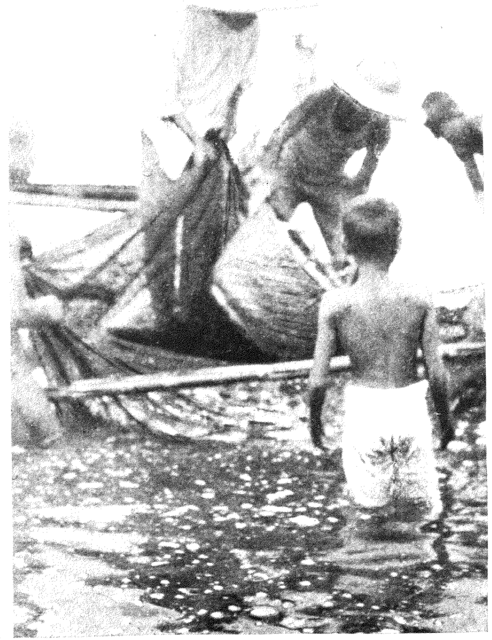

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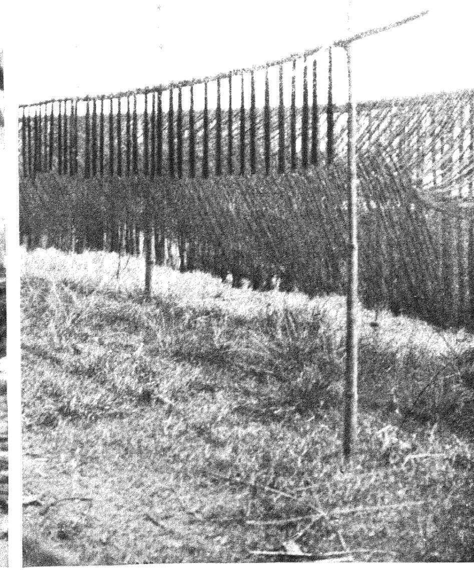

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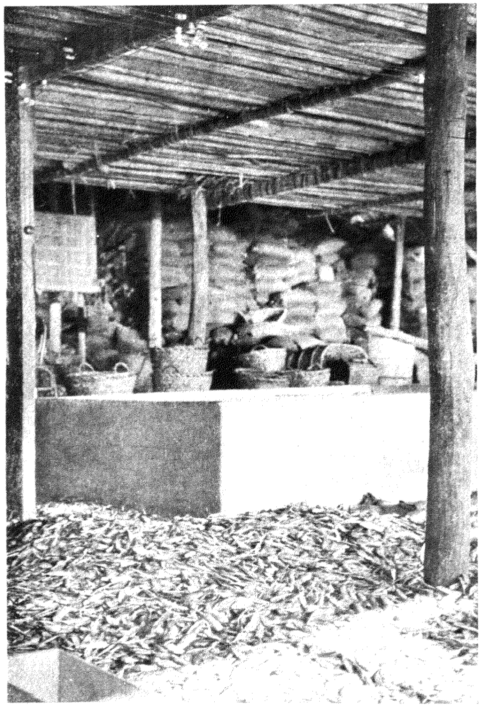

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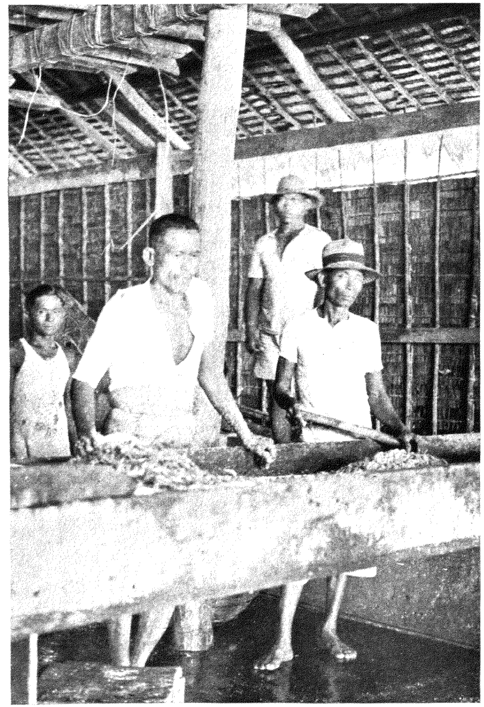

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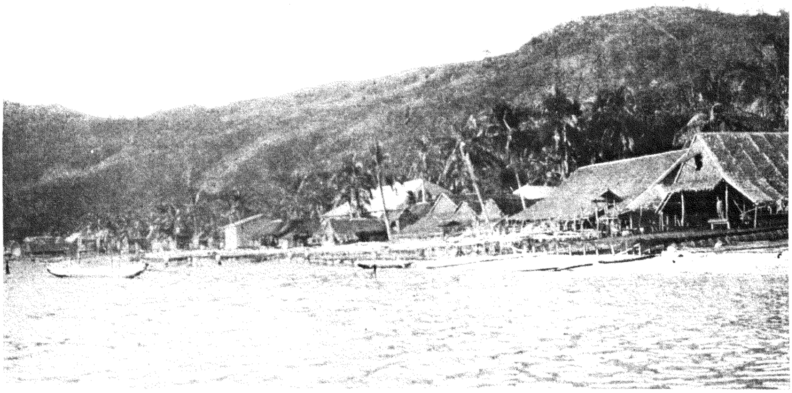
PLATE 6.



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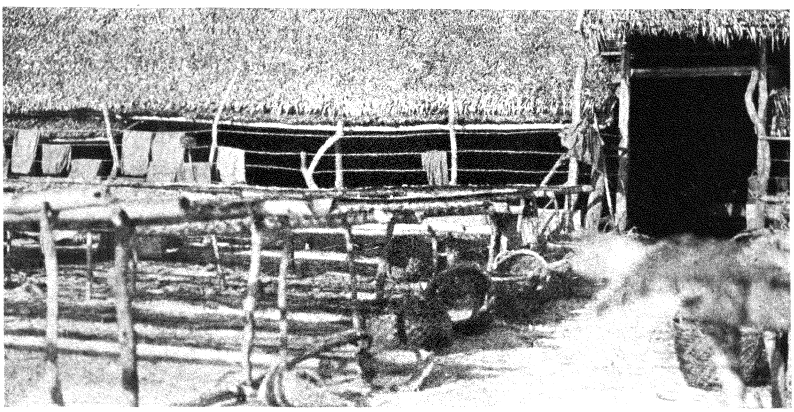

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PLATE 7.

A REVIEW OF PHILIPPINE MUGILIDÆ [1]

By HILARIO A. ROXAS

Of the Fish and Game Administration, Manila

TWO PLATES

Since 1907 a large amount of ichthyological material has been collected from different parts of the Philippines by various persons and deposited in the Government collections originally of the division of fisheries of the Bureau of Science, now transferred to the Fish and Game Administration of the Department of Agriculture and Commerce. A part of this collection has been worked out by Seale (1908), Herre (1923–1929), Herre and Montalban (1927–1930), Montalban (1927), and de Beaufort (1932).

The mullets are known as *aguas, balanak,* and *saranaa* in the Bicol provinces; as *lumitog, pasga, sisiao,* and *purong* in the Ilocano provinces; and *aligasin, talilong, banak,* and *balanak* in the Tagalog and Visayan provinces. They are mostly shore fishes feeding on algæ and other minute water plants contained in mud. They are encountered most often in bays with a more or less muddy bottom. They may be seen in schools of variable sizes and some species have the habit of jumping out of the water when surprised. Some of the Philippine mullets feed for the most part in ponds or lakes or upper portions of fresh-water streams and migrate to the sea only to spawn. Some mullets, however, are exclusively salt-water or brackish-water dwellers. The latter forms, it is believed, may, if tried, be amenable to culture much in the same manner as the *bañgos* (*Chanos chanos* Forskål).

MUGILIDÆ

The status of the various genera proposed under the family Mugilidæ is so uncertain that it is probably worth while to go over its literature. Cuvier and Valenciennes (1836) in the His-

[1] Contribution No. 7 from the Fish and Game Administration, Department of Agriculture and Commerce, Manila, P. I.

toire Naturelle des Poissons recognized four genera of Mugilidæ, as follows:

Mugil. With the edge of lower jaw angular.

Cestræus. With the edge of lower jaw rounded; mouth opening reaching up to level of hind edge of eye; lower jaw toothless.

Dajaus. With edge of lower jaw rounded; mouth opening reaching at most to level of front edge of eye; both jaws toothed.

Nestis. With edge of lower jaw rounded; mouth opening reaching to level of hind edge of eye; lower jaw toothless.

Günther (1861) united the three genera with rounded lower jaw and used an old name, *Agonostomus* of Bennett (1830) for the three of them, at the same time dividing the genus *Mugil* of Cuvier and Valenciennes into two: *Mugil,* with horizontal mouth cleft, and *Myxus,* with oblique mouth cleft. Thus his genera were—

Agonostomus. With rounded lower jaw margin.

Mugil. With angular lower jaw margin and horizontal mouth cleft.

Myxus. With angular lower jaw margin and oblique mouth cleft.

Weber and de Beaufort (1922) recognized both *Mugil* and *Myxus* of Günther, but used the name *Cestræus* of Cuvier and Valenciennes for all forms with rounded lower jaw margin. They, however, defined *Cestræus* in such a way as to include both *Nestis* and *Dajaus* of Cuvier and Valenciennes. *Agonostomus,* as originally used by Bennett, is equivalent only to *Nestis* Cuvier and Valenciennes so that *Agonostomus* of Bennett has to be considered as synonymous to *Cestræus* of Weber and de Beaufort. Mohr's suggestion (1927), therefore, to use all the three genera of Günther, cannot be followed.

Jordan and Swain (1884) attempted to solve the problem by stressing a variable character, the number of anal spines. Their genera were—

Querimana. With two anal spines.

Mugil. With three anal spines; mouth cleft, short, not lateral; lower jaw broad; "cilia" in one or few rows.

Chaenomugil. With three anal spines, mouth cleft lateral, lower jaw narrow, dentiform "cilia" in very numerous rows.

This division neglected to take into account a constant character, the kind of mouth formation, in the creation of the genus *Querimana.* Mohr (1927, pp. 197–200) has shown that all species described under this genus are young forms belonging to either *Mugil, Myxus,* or *Cestræus.* The word *Querimana* is now used to designate a young form of mullet with two anal spines.

Genus *Chænomugil* of Gill (1863) has for its type *Mugil proboscideus* Günther. An examination of Günther's figure (1861,

p. 460) shows that this animal has an oblique mouth cleft, thick fleshy upperlip, included mandible, and a cushion-like pad on the anterior edge of the lower jaw, and is thus a species of *Cestræus*. Genus *Chelon* of Röse (1793) with *Mugil chelo* Cuv. and Val. as type does not differ from *Mugil* and has to be considered as a synonym of the latter. The genus *Jotorus* of Poey (1861) possesses an angular lower jaw and a single series of teeth on the upper jaw, and, as such, must be considered as a synonym of the genus *Myxus*. For the same reason *Gonostomyxus* of Macdonald and *Xenorhynchthys* of Regan (1908) are also synonyms of *Myxus*.

The genus *Neomyxus* of Steindachner (1878) was separated from Günther's *Myxus* by the presence of two rows of teeth on both lips. These are smoothly compressed, three-pointed and with slender bases. The lower lip is also so placed that the teeth on it are directed outwards and downwards. I consider the genus *Neomyxus* valid.

The subgenus *Liza* of Jordan and Swain (1884) was based on the absence of an adipose eyelid. Inasmuch as many species described as belonging to *Liza* have the adipose eyelid developed to a certain degree, I am not following Oshima (1922) who has revived *Liza* as a genus.

I give here the genera that I consider valid, together with their synonyms:

1. **MUGIL** Linnæus (1758).

    Albula Catesby (1771).
    Cestræus Klein (1777), not Cuvier and Valenciennes.
    Chelon Röse (1793).
    Cephalus Lacépède (1803).
    Mugil Cuvier and Valenciennes (1836).
    Arnion Gistel (1848).
    Mugil Günther (1861).
    Rhinomugil Gill (1863).
    Liza Jordan and Swain (1884).
    Trachystoma Ogilby (1887).
    Œdalechilus Fowler (1903).

2. **CESTRÆUS** Cuvier and Valenciennes (1836), neither Klein nor McClelland.

    Agonostomus Bennett (1830).
    Dajaus Cuvier and Valenciennes (1836).
    Nestis Cuvier and Valenciennes (1836).
    Chaenomugil Gill (1863).
    Æschricthys Macleay (1863).
    Agonostomus Günther (1869).
    Cestræus Weber and de Beaufort (1922).

3. MYXUS Günther (1861).

Joturus Poey (1861).
Gonostomyxus Macdonald (1869).
Xenorhynchthys Regan (1908).

4. NEOMYXUS Steindachner (1878).

RECORD OF PHILIPPINE MUGILIDÆ

Jordan and Richardson (1910) in a check list of Philippine fishes credited the Philippine Islands with ten species of Mugilidæ, of which five belong to genus *Mugil,* four to *Liza,* and one to *Æschrichthys.* Almost simultaneously, Seale (1909) described two new species, *Mugil joloensis* and *Mugil banksi,* from the Philippines. Fowler recorded the existence of one species, *Liza labiosa* (1918) and described four new species of *Mugil* from Philippine waters (1918). Weber and de Beaufort (1922) brought up the number of known Philippine Mugilidæ to twenty by recording the presence of *Mugil subviridis, Mugil ceramensis,* and *Liza cæruleomaculatus.* To these Herre (1927) added one, *Liza melinopterus,* which he reported as present in Lake Taal, and Borodin (1930) another one, *Chaenomugil proboscideus* from Sindangan. Finally Herre (1931) recorded the presence of *Mugil seheli,* bringing the known Philippine mullets to twenty-three.

The following is a check list of the species of mullets so far reported from Philippine seas, lakes, and rivers.

Genus MUGIL Linnæus

1. MUGIL AMARULUS (Cuvier and Valenciennes).

Jordan and Seale (1906) as *Liza amarula,* Cavite; Seale and Bean (1907) as *Liza amarula,* Zamboanga.

2. MUGIL BANKSI Seale.

Seale (1909), Siquijor Island; Herre (1931), Okoi River, near Dumaguete.

3. MUGIL CÆRULEOMACULATUS (Lacépède).

Weber and de Beaufort (1922), Philippines.

4. MUGIL SEHELI (Forskål).

Herre (1931), Nasugbu, Lemery, Culion, Cebu, Dumaguete, as *Liza seheli.*

5. MUGIL CEPHALUS Cuvier and Valenciennes.

Kner (1865) as *M. cephalotus,* Manila; Jordan and Richardson (1907), Calayan; Weber and de Beaufort (1922), Philippines.

6. MUGIL CERAMENSIS (Bleeker).

Jordan and Seale (1906), Cavite; Weber and de Beaufort (1922), Philippines.

7\. **MUGIL DUSSUMIERI** Cuvier and Valenciennes.

Evermann and Seale (1906) as *M. sundanensis*, Manila; Evermann and Seale (1906) as *M. sundanensis*, Bacon; Jordan and Seale (1906) as *M. sundanensis*, Cavite; Weber and de Beaufort (1922), Philippines; Herre (1931), Bauang Sur, La Union; Laguna de Bay; Lake Bombon; Capag; Tayabas; Culion Islands; Cebu, Cebu; Dumaguete, Oriental Negros; Cotabato, Mindanao.

8\. **MUGIL ENGELI** Bleeker.

Günther (1861) as *M. kelaarti*, Philippines; Günther (1876) as *M. kelaarti*, Philippines; Day (1889) as *M. kelaarti*, Philippines; Herre (1931), Nasugbu, Batangas; Unisan, Tayabas; Capiz, Capiz; Cotabato market, Cotabato, Mindanao.

9\. **MUGIL JOLOENSIS** Seale.

Seale (1909), Jolo.

10\. **MUGIL LABIOSUS** (Valenciennes).

Fowler (1918) as *Liza labiosa*, Philippines.

11\. **MUGIL LEPIDOPTERUS** Fowler.

Fowler (1918), Philippines.

12\. **MUGIL LONGIMANUS** Günther.

Jordan and Seale (1906), Cavite; Weber and de Beaufort (1922), Philippines; Fowler (1928), Philippines; Herre (1931), Manila; Nasugbu; Alabat Islands; La Paz, Iloilo Province.

13\. **MUGIL MELINOPTERUS** (Cuvier and Valenciennes).

Herre (1927), Lake Taal (Bombon); Herre (1931), Polo Plantation, near Dumaguete; Jolo, as *Liza melinopterus*.

14\. **MUGIL OGILBY** Fowler.

Fowler (1918), Philippines.

15\. **MUGIL OLIGOLEPIS** (Bleeker).

Jordan and Richardson (1907), Iloilo; Weber and de Beaufort (1922), Philippines.

16\. **MUGIL PHILIPPINUS** Fowler.

Fowler (1918), Philippines.

17\. **MUGIL RUTHVENI** Fowler.

Fowler (1918), Philippines.

18\. **MUGIL SUBVIRIDIS** Cuvier and Valenciennes.

Weber and de Beaufort (1922), Philippines.

19\. **MUGIL MACROLEPIS** (Bleeker).

Evermann and Seale (1907), Manila; Jordan and Seale (1906), Cavite; Jordan and Richardson (1907), Lubang, Aparri, Iloilo; Seale and Bean (1907), Zamboanga, all as *Liza troscheli*; Fowler and Bean (1923) as *M. troscheli*; Weber and de Beaufort (1922), Philippines; Herre (1931), Bauang Sur, Batangas Bay, Culion, Dumaguete, Jolo as *Liza troscheli.*

20. MUGIL TADE Forskål.

Evermann and Seale (1906) as *M. planiceps*, Bulan; Weber and de Beaufort (1922), Philippines; Herre (1931), Bauang Sur, La Union Province.

21. MUGIL VAIGIENSIS (Quoy and Gaimard).

Jordan and Seale (1907), Cavite; Seale and Bean (1907), Zamboanga, both as *Liza waigiensis;* Fowler (1918), Philippines; Weber and de Beaufort (1922), Philippines; Herre (1931), Curimao, as *Liza vaigiensis.*

Genus CESTRÆUS Cuvier and Valenciennes

22. CESTRÆUS GOLDIEI (Macleay).

Jordan and Richardson (1907) as *Æschrichthys goldiei*, Mindoro; Weber and de Beaufort (1922), Philippines.

23. CESTRÆUS PROBOSCIDEUS (Günther).

Borodin (1930) as *Chaenomugil proboscideus*, Sindangan.

In addition to the above species this paper records *Mugil crenilabris* Forskål and *Cestræus oxyrhynchus* Cuvier and Valenciennes, from the Philippines. One new species, *Myxus philippinus,* is herein described.

The impression that *Mugil cephalus* is the commonest species in the Philippines is apparently wrong if our collection is used as a gauge of the relative abundance of the various species. In this collection there are only four examples of *M. cephalus,* one of which came from Honolulu and two from Hongkong. Although this species is of wide distribution, it is rarely met with in the Philippines. Weber and de Beaufort (1922) expressed surprise at the fact that although it is "known from so many localities in tropical and temperate seas all over the world," it is "very rare in the Archipelago" (Indo-Australian) "and with any certainty only represented in New Guinea and Borneo." Basing my conclusion on this collection, it appears that *Mugil dussumieri, Mugil longimanus,* and *Mugil cæruleomaculatus* are the commonest species in the Philippines.

Genus MUGIL Linnæus

Mouth cleft more or less transverse, with short lateral extension far distant from eye; mandible with angular front edge; no teeth on intermaxillary; upper lip with or without papillæ, sometimes with cilia on its lower edge; lower lip thin, may be fringed.

Key to the Philippine species of Mugil.

a^1. Adipose eyelid well developed, covering at least a third of the iris posteriorly; upper lip not particularly thick.

b^1. Anal with 9 soft fin rays.

c^1. Scales 28 to 31 in lateral series; maxillary exposed; anal ahead of second dorsal; pectorals shorter than head.

d^1. Snout equal to or shorter than eye; spinous dorsal origin midway between eye center or front edge of eye and caudal base; preorbital bent, scaly, emarginate, denticulate below and behind; maxillary does not reach below level of front edge of eye.
Mugil dussumieri Cuvier and Valenciennes.

d^2. Snout greater than eye; spinous dorsal origin midway between snout tip and caudal base; lower edge of preorbital slightly convex and finely denticulate; maxillary reaches to below level of front edge of eye.......................... *Mugil lepidopterus* Fowler.

c^2. Scales 33 to 38 in lateral series.

d^1. Maxillary slightly visible; snout equal to or longer than eye; spinous dorsal origin much nearer to end of snout than to caudal base; first third of anal before origin of second dorsal, the origin of which is opposite the 21st to 23d lateral scale; pectorals much shorter than head; least height of caudal peduncle $1\frac{2}{3}$ to 3 in head....................................... *Mugil tade* Forskål.

d^2. Maxillary hidden or nearly so; first dorsal origin about midway between end of snout and caudal base; least height of caudal peduncle more than twice in head.

e^1. Pectorals much shorter than head, reaching to 8th or 9th lateral scale .... *Mugil engeli* Bleeker.

e^2. Pectorals about equal to head, reaching to 12th or 13th lateral scale; caudal peduncle almost twice in head; snout about equal to eye.................................. *Mugil longimanus* Günther.

b^2. Anal with 8 soft fin rays.

c^1. Maxillary not visible; lips with conspicuous yellow cilia; origin of first dorsal about midway between tip of snout and caudal base.
Mugil cephalus Linnæus.

c^2. Maxillary exposed; origin of first dorsal nearer to caudal base than to tip of snout.

d^1. Snout shorter than eye; preorbital bent, denticulate at its inferior and subtruncate at its posterior border; no axillary scale above ventrals .... *Mugil subviridis* Cuvier.

d^2. Snout equal to or longer than eye; preorbital not bent, with only few obsolete denticles; axillary scale present above ventrals.

e^1. Snout longer than eye; first dorsal spine longer than second; hind edge of caudal with dusky pigments.
Mugil ruthveni Fowler.

e^2. Snout about equal to eye; first dorsal spine as long as second; no narrow dusky edge on caudal.
Mugil philippinus Fowler.

a^2. Adipose eyelid poorly developed or wanting.
b^1. Upper lip not particularly thick.
c^1. Anal with 8 soft fin rays; maxillary not visible, or only extreme end visible; head very broad and flat; scales 27 to 28 in lateral series; pectorals blackish; other fins dusky at edge.
Mugil vaigiensis Quoy and Gaimard.
c^2. Anal with 9 soft fin rays.
d^1. Maxillary not visible, scales 26 to 33 in lateral series; origin of first dorsal nearer to caudal base than to snout tip.
e^1. Snout pointed; origin of second dorsal opposite the 21st lateral scale, nearly entirely behind anal.
Mugil ceramensis Bleeker.
e^2. Snout obtuse.
f^1. Scales 26 to 29 in lateral series; first half of anal before second dorsal.
g^1. Snout longer than eye; lower edge of preorbital slightly curved, with very few minute obsolete denticles, spinous dorsal origin between hind nostril and caudal base.
Mugil ogilby Fowler.
g^2. Snout shorter than eye.
h^1. Scales 26 in lateral series; rostro-dorsal profile convex; 15 to 16 predorsal scales; pectorals not much shorter than head, reaching near to origin of first dorsal; second dorsal origin opposite 17th lateral scale.
Mugil oligolepis Bleeker.
h^2. Scales 28 to 29 in lateral series; rostro-dorsal profile horizontal; 18 predorsal scales; pectorals much shorter than head and not reaching to level of first dorsal origin; second dorsal origin opposite the 18th or the 19th lateral scale.
Mugil melinopterus Cuvier and Valenciennes.
f^2. Scales 31 to 33 in lateral series; origin of second dorsal opposite the 21st to the 23d lateral scale and to first third of anal; pectorals shorter than head, without axillary scales .... *Mugil macrolepis* A. Smith.
d^2. Maxillary hidden; scales 36 to 40 in lateral series; first dorsal origin about midway between caudal base and end of snout; anal and second dorsal almost at same level.
e^1. Scales 36 to 38 in lateral series; pectorals falcate, longer than head .... *Mugil cæruleomaculatus* Lacépède.
e^2. Scales 38 to 40 in lateral series; pectorals shorter than head.
Mugil seheli Forskål.
b^2. Upper lip moderately or very thick; anals with 9 soft fin rays.
c^1. Upper lip without papillæ; end of maxillæ visible; snout obtuse; dorsal spines weak.
Mugil amarulus Cuvier and Valenciennes.
c^2. Upper lip provided with one or several rows of papillæ.
d^1. Upper lip with several rows of papillæ.
e^1. Lower lip fringed................................ *Mugil crenilabris* Forskål.
e^2. Lower lip not fringed.

f^1. Preorbital with a very deep notch whose depth is greater than width of pupil........................... *Mugil joloensis* Seale.

f^2. Preorbital without a distinct notch........ *Mugil banksi* Seale.

d^2. Upper lip with a single row of papillæ.
Mugil labiosus Cuvier and Valenciennes.

MUGIL DUSSUMIERI Cuvier and Valenciennes. Plate 1, fig. 2.

Mugil dussumieri CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 109; DAY, Fishes of India 4°. (1878–88) 352; MAX WEBER, Nova Guinea 5, Zool. Livr. 2 (1908) 243; Nova Guinea 9 (1913) 569; MCCULLOCH, Check-list Fishes N. S. Wales 2 (1919) 38; Rec. Austr. Mus. **13** (1921) 126; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 235; FOWLER, Bull. B. P. Bishop Mus. 22 (1925) 7; Mem. B. P. Bishop Mus. **10** (1928) 122.

Mugil sundanensis BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–1859) 276; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 425; BLEEKER, Act. Soc. Sc. Indo-Neerl. 8 (1860) 45; DAY, Fishes of Malabar (1865) 139; MACLEAY, Proc. Linn. Soc. N. S. Wales 7 (1882) 362; EVERMANN and SEALE, Proc. U. S. Nat. Mus. **31** (1906) 506; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 11; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 59.

Mugil javanicus BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1852) 701.

Mugil brachysoma BLEEKER, Nat. Tijdschr. Ned. Ind. 9 (1855) 399.

Mugil valenciennesii BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–1859) 277.

Mugil meyeri GÜNTHER, Ann. & Mag. Nat. Hist. IX 4 (1872) 439.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 30; scales in transverse series 10; head 4.1; depth 3.7; snout 5.6 in head; eye 3.7; maxillary 4.3, interorbital 2.5; 20 predorsal scales.

Rostro-dorsal profile almost straight, from neck to snout slightly declivous. Greatest width of head 1.5 in its length. Interorbital slightly convex. Snout convex, its length 2.4 in its width. Eye greater than snout, 1.5 in interorbital. Adipose eyelid greatly developed, the posterior covering almost all of iris. Upper lip not particularly thick with prominent, numerous cilia. Lower lip thin, mandibular rami coming together at an obtuse angle. Nostrils well separate, anterior circular, the posterior appearing as a transverse slit. Maxillary clearly visible. Preorbital scaly, slightly notched below and prominently dentate behind.

Spinous dorsal origin halfway between caudal base and front edge of eye. Second dorsal origin in front of level of middle of anal and opposite 20th lateral scale. Both soft dorsal and anal scaly. Least height of caudal 1.3 in its length and slightly less than postorbital part of head. Pectorals shorter than head, equalling head less the snout; caudal emarginate. A short axillary at base of first dorsal and ventrals, but absent at base of pectorals.

The above description is based on No. 28353, obtained from Naujan Lake, Mindoro, August 1, 1927. Total length 11.25 inches.

LUZON, Pangasinan Province, Agno River, No. 657, 3.25 in. long, July 18, 1907; Alaminos, Nos. 24811–24812, 4 in. long, December, 1922: Pampanga Province, Guagua, Nos. 15342–15343, 7.5 in. long, April 8, 1927: Bulacan Province, Bulacan, No. 15265, 7 in. long, No. 15339, 5.5 in. long, No. 28319, 5 in. long, April 5, 1927: Manila, No. 6843, 9 in. long, June, 1910, No. 14263, 12.5 in. long, No. 28314, 12 in. long, August 20, 1926, No. 28342, 6 in. long, September 6, 1906; Paco Market, No. 41038, 7.5 in. long, July 14, 1913; Manila Bay, No. 41042, 7 in. long, October 30, 1929: Rizal Province, Montalban River, Nos. 28427–28430, 10 to 11 in. long, January 4, 1923; Pasig River, No. 28436–28437, 3 in. long, September, 1924: Bataan Province, Pilar, sitio Balat, No. 15538, 9 in. long, May 3, 1927: Batangas Province, Taal, Lake Bombon, No. 12568, 4 in. long, November 8, 1925; No. 15158, 10 in. long, April 8, 1927; Nos. 28317–28318, 4 in. long, November 8, 1925; Nos. 28323–28330, 3 to 6 in. long, April 8, 1927: Camarines Sur Province, Bicol River, No. 28404, 9 in. long, no date; Bicol River near Lake Bato, No. 11220, 10.5 in. long, September 23, 1924: Albay Province, Albay, Arimbay River, No. 13334, 7.5 in. long, February 6, 1926; Legaspi, sitio Puru, No. 13164, 4.75 in. long, February 4, 1924: Sorsogon Province, Bacon, No. 3644, 4 in. long, 1904. MINDORO, Mindoro Province, Naujan, Lake Naujan, Nos. 15424, 15430, 12 in. long, August 10, 1927, Nos. 28352–28353, 10 to 12 in. long, August 1, 1927; Butas, 28364–28365, 4.5 in. long, August 10, 1927; Puerto Galera Bay, No. 28474, 5 in. long, April, 1912. NEGROS, Oriental Negros Province, Dumaguete River, No. 28401, 5.5 in. long, March 8, 1922. SIBUYAN, Romblon Province, No. 28397, 3.5 in. long, July, 1913. PALAWAN, Palawan Province, Guinlo, No. 15292, 9 in. long, May 4, 1927. MINDANAO, Davao Province, Davao Gulf, Nos. 3149, 3196, 3.5 to 5 in. long, April 20 and 21, 1908.

MUGIL LEPIDOPTERUS Fowler.

Mugil lepidopterus FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 9.

Dorsal IV–I, 8; anal III, 9; scales in lateral series 30; scales in transverse series 10; head 4 in standard length, less than depth; depth 3.6; snout broad, convex, 3.5 in head, greater than eye; eye 4; adipose eyelid well developed, the posterior extending over last third of eye; maxillary exposed, reaches to eye; interorbital broad, slightly convex, depressed medially, 2.17 in head; 20 predorsal scales.

Dorsal outline convex, broad, moderately elongate, deepest at level of spinous dorsal origin. Head robust, somewhat constricted below. Eye nearly impinges on upper profile. Mouth slightly inferior, mandibular angle obtuse, cilia on upper lip. Upper lip little fleshy, not thick, its width about half of pupil. Lower edge of preorbital slightly convex and finely denticulate. Spinous dorsal origin midway between snout tip and caudal base. First and second spines subequal. Origin of soft dorsal opposite 19th lateral scale and opposite middle of anal. Caudal emarginate. Pectorals broad, shorter than head, reaching back to 5th or 6th lateral scale. Axillary scales at base of spinous dorsal, pectorals, and ventrals. Soft dorsal, caudal, and anal scaly for the greater extent.

This species differs from *M. dussumieri* in having the snout greater than the eye and in having the origin of spinous dorsal midway between the snout tip and the caudal base. Here also the maxillary reaches to below level of front edge of eye. It is not represented in our collection. The above description is based on that of Fowler (1918).

MUGIL TADE Forskål.

Mugil crenilabris tade FORSKÅL, Descript. anim. (1775) xiv, 74.

Mugil tade CUVIER and VALENCIENNES, Hist. Nat. Poiss. **11** (1836) 114; KLUNZINGER, Abhandl. zool.-bot Ges. Wien **20** (1870) 828; Sitzungsb. Akad Wien (1880) 394; Fische des rothen Meeres (1884) 133; MACLEAY, Proc. Linn. Soc. N. S. Wales **9** (1884) 40; DAY, Fishes of British India **2** (1889) 344; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. **4** (1922) 236; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 122.

Mugil cephalotus CANTOR (not Cuvier and Valenciennes), Cat. Malayan Fish., Journ. Asiat. Soc. Bengal **18** pt. 2 (1850) 1077.

Mugil planiceps BLEEKER, Verh. Bat. Gen. **25** (1853) 101; GÜNTHER, Cat. Brit. Mus. **3** (1859–61) 428; KNER, Fische Novara-Exp. (1865–67) 225; DAY, Fishes of India 4°. (1878–1888) 350; SEALE, Occ. Pap. B. P. Bishop Mus. **1** No. 3 (1901) 66; EVERMANN and SEALE, Bull. U. S. Bur. Fish. **26** (1906) 59; WEBER, Nova Guinea **9** pt. 4 (1913) 569.

Mugil bontah BLEEKER, Verh. Bat. Gen. **25** (1853) 48; Nat. Tijdschr. Ned. Ind. **13** (1857) 336; **16** (1858–59) 278; **18** (1859) 367; Act. Soc. Sc. Indo-Neerl. **8** (1860) 49.

Mugil belanak GÜNTHER, Cat. Brit. Mus. **3** (1859–61) 427; DAY, Fishes of India 4°. (1878–1888) 351; Fishes of British India **2** (1889) 345; VINCIGUERRA, Annal. Mus. Civ. Genova (2) **9** (1890) 180; FOWLER, Proc. Acad. Nat. Sci. 57 (1905) 455; WEBER, Nova Guinea 5 pt. 2 (1903) 244.

Mugil kandavensis GÜNTHER, Fische d. Südsee 2 (1876–1881) 215.

Dorsal IV–I, 8–9; anal III, 9; scales in longitudinal series 33–35; scales in transverse series 10–11; head 3.7–4 in standard length, depth 4.2–5.2; snout pointed, equal or longer than eye; eye 3–4.6 in head, with a posterior gelatinous eyelid covering about half of iris; maxillary visible; interorbital nearly flat, 1.5 to 2.5 times more than eye-diameter; preorbital emarginate, strongly curved, with inferior and posterior margin denticulate.

Rostro-dorsal profile nearly straight, declivous from crown to snout. Head anteriorly depressed and pointed. Origin of spinous dorsal nearer to tip of snout than to base of caudal, opposite 10th or 11th scale. Origin of second dorsal at level of anterior third of anal and opposite 21st to 23d lateral scale. Caudal slightly emarginate. Pectorals much shorter than head, reaching up to 8th lateral scale. Axillary scale at base of pectorals, very short; that on ventral about half of length of the fin.

This species has a greater scale count than *M. dussumieri* and differs from *M. engeli* in having a visible maxillary.

Evermann and Seale (1906) reported five specimens of this species as *M. planiceps,* 6.5 to 8.75 inches long, from Bulan, Sorsogon, none of which is in the collection. The above description is based on that of Weber and de Beaufort.

MUGIL ENGELI Bleeker. Plate 1, fig. 1.

Mugil engeli BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 277; Nat. Tijdschr. Ned. Ind. 15 (1858) 385; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 430; BLEEKER, Act. Soc. Sc. Indo-Neerl. 8 (1860) 78; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 122.

Mugil kelaarti GÜNTHER, Cat. Brit. Mus. 3 (1861) 429; Fische d. Südsee 2 (1876–81) 215; Rept. Voyage "Challenger" 1 (1880) 58; DAY, Fishes of India 4°. (1878–1888) 352; Fauna British India, Fishes 2 (1889) 346; FOWLER, Proc. Acad. Nat. Sci. 55 (1903) 743; Proc. Acad. Nat. Sci. 55 (1904) 743; SEALE, Occ. Papers B. P. Bishop Mus. 6 No. 1 (1906) 15; STEINDACHNER, Sitz. Akad. Wiss. Wien 115 pt. 1 (1906) 1416.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 34; scales in transverse series 10–11; head 4 in standard length; depth 4; snout 4.7 in length of head; eye 3.1 in head; maxillary 3.5; interorbital 2.1; 18 predorsal scales.

Dorsal profile almost straight, from neck to tip of snout declivous, slightly convex. Posterior region compressed, body becoming gradually thicker. Greatest thickness at region of opercle, 1.4 in the length of head. Interorbital convex. Snout also convex, its length 1.8 in its width. Eye greater than snout, 1.4 in the interorbital. Adipose eyelid well developed, the anterior covering half of iris and the posterior covering two-thirds. Upper lip thin and smooth, without cilia. Lower lip also thin, the mandibular rami coming together at an obtuse angle. Nostrils far apart, the anterior close to border of snout, the posterior much closer to anterior border of eye than to anterior nostril. Maxillary hidden or nearly so. Preorbital slightly notched, finely denticulate anteriorly and ventrally.

Spinous dorsal origin slightly nearer to caudal base than to tip of snout. First dorsal spine about 1.6 in head. Second dorsal origin at level of anterior third of anal and opposite 21st lateral scale. Least height of caudal peduncle almost 1.5 in the length and 2.3 in the head. Caudal emarginate. Pectorals are a snout length shorter than head, the tip reaching back to 9th lateral scale. Axillary scale present at base of first dorsal, pectorals, and ventrals.

The above description is based on No. 5667 obtained from Bantayan Island, off Cebu, in April, 1909. Total length 5.5 inches.

This species differs from *M. longimanus* in having shorter pectorals and in having a shallower caudal peduncle.

LUZON, Rizal Province, Parañaque, No. 28398, 4.5 in. long, date unrecorded. MINDORO, Mindoro Province, Calapan, Nos. 11433, 28405, 5.5 in. long, January 17, 1923. BANTAYAN, Cebu Province, Bantayan, Nos. 5659, 5661–62, 5664–71, 5673–74, 5691, 28466, 5 to 5.5 in. long, April, 1909.

MUGIL LONGIMANUS Günther. Plate 1, fig. 3.

Mugil longimanus GÜNTHER, Cat. Brit. Mus. **3** (1859–61) 428; STEINDACHNER, Denkschr. Akad. Wien **41** (1879) 5; MACLEAY, Proc. Linn. Soc. N. S. Wales **9** (1884) 41; JORDAN and SEALE, Bull. U. S. Bur. Fish. **26** (1906) 10; OGILBY, Ann. Queensland Mus. **9** pt. 1 (1908) 26; MCCULLOCH, Rec. Austr. Mus. **13** No. 4 (1921) 130; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. **4** (1922) 239; FOWLER, Bull. B. P. Bishop Mus. **38** (1927) 9; Mem. B. P. Bishop Mus. **10** (1928) 123.

Mugil engeli DAY, Fishes of Malabar (1865) 139.

Mugil cunnesius DAY, Fishes of India (1873) 439; WAITE, Mem. N. S. Wales Nat. Club **2** (1904) 22.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 33–34; scales in transverse series 11; head 4.3 in standard length; height 3.4; snout 4.6 in head; eye 3.6; maxillary 4.2; interorbital 1.6; 18 predorsal scales.

Rostro-dorsal profile weakly convex, from neck to tip of snout convex, declivous. Greatest width of head 1.3 in its length. Interorbital convex. Snout declivous, its length 1.8 in its width. Eye greater than snout, 1.6 in interorbital. Adipose eyelid greatly developed, the posterior covering all of posterior iris. Upper lip not particularly thick, smooth, free from cilia. Mandible thin, mandibular rami meeting at an obtuse angle. Nostrils far apart, the posterior in the form of a transverse slit, the anterior much nearer to edge of snout than to front edge of eye. Maxillary completely hidden. Preorbital scaly, nearly straight or very weakly emarginate, denticulate anteriorly and ventrally.

Spinous dorsal origin about halfway between snout tip and caudal base, opposite 11th lateral scale. First dorsal spine 2.7 in head. Second dorsal origin opposite anterior third of anal, and the 21st lateral scale. Least height of caudal 1.25 in its length and equal to postorbital part of head. Caudal emarginate. Pectorals equal to head, the tip reaching to 11th or 12th lateral scale and to level of first dorsal origin. Long axillary scales present at base of first dorsal, pectorals, and ventrals. No particular distinctive mark.

The above description is based on No. 10445 taken from Bato, Leyte, in December, 1922. Total length 7.25 inches.

This species is close to *Mugil engeli*, but has longer pectorals and a deeper caudal peduncle.

LUZON, Pangasinan Province, Agno River, No. 659; 5 in. long, July 18, 1907: Zambales Province, Subic, Nos. 12017, 28413, 4 in. long, February 20, 1925: Pampanga Province, Guagua, No. 15341, 4.5 in. long, April 8, 1927: Rizal Province, Malabon, Nos. 715, 717, 28392, 4 to 5 in. long, July 18, 1907; Parañaque, Nos. 28348–51, 5.5 in. long, July 21, 1908. MINDORO, Mindoro Province, Mangarin, Nos. 28344–45, 4.5 in. long, 1913. LEYTE, Leyte Province, Bato, Nos. 10445, 28410, 28419, 8 and 6.5 in. long, December, 1922; Carigara, Nos. 15061 and 28403, 6.5 in. long, December 1, 1926. PANAY, Iloilo Province, Iloilo, No. 28402, 6 in. long, July 19, 1922. GUIMARAS, Iloilo Province, Guimaras Strait, No. 10996, 4 in. long, May, 1922. MINDANAO, Misamis Province, Cagayan, Nos. 1448, 1467, 1524, 1550, 1753–54, 5 in. long, September 8, 1907: Agusan Province, Agusan River, Nos. 1809, 1811, 5 in. long, September, 1907: Davao Province, Davao, Nos. 3150, 3152, 3162, 4.75 to 5 in. long, April 20, 1908.

MUGIL CEPHALUS Linnæus. Plate 1, fig. 5.

Mugil cephalus LINNÆUS, Syst. Nat. ed. 10a (1758) 316; HAMILTON-BUCHANAN, Gangetic Fish (1822) 119; EVERMANN and JENKINS, Proc. U. S. Nat. Mus. 16 (1892) 136; JORDAN and EVERMANN, Fish. North and Middle America 1 (1896) 811; FOWLER, Proc. Acad. Nat. Sci. 55 (1903) 743; JENKINS, Bull. U. S. Fish. Comm. 22 (1904) 438; JORDAN and EVERMANN, Bull. U. S. Fish. Comm. 23 (1905) 139; JORDAN and SEALE, Proc. U. S. Nat. Mus. 29 (1905) 521; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 244; TANAKA, Fishes of Japan 3 (1911) 50; FOWLER, Proc. Acad. Nat. Sci. 67 (1915) 248; MCCULLOCH, Check-list of Fishes of N. S. Wales 2 (1919) 38; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 253; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 125.

Mugil öur FORSKÅL, Descr. anim. (1775) 74; RÜPPELL, Neue Wirbelthiere (1835–1840) 131; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 23 (1901) 744.

Mugil cephalotus CUVIER and VALENCIENNES, Hist. Nat. d. Poissons 11 (1836) 110; EYDOUX and SOULEYET, Voy. de la "Bonite" (1841) 175; BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 277; Act. Soc. Sc. Indo. Neerl. 8 (1860) 51; KNER, Novara-Exp. Fische 1 (1865) 224; GÜNTHER, Ann. & Mag. Nat. Hist. 20 (1867) 64; BLEEKER, Ned. Tijdschr. Dierk. 4 (1873) 100, 143; Poissons de Madagascar (1875) 45; Verh. Akad. Amsterdam 18 (1879) 2; GÜNTHER, "Challenger" Rept. 6 (1880) 33; NYSTROM, Bihang K. Sv. Vet. Akad. Handl. 8, Ajd. 4, No. 4 (1887) 38; SAUVAGE, Poiss. Madagascar (1891) 402.

Mugil japonicus SCHLEGEL, Fauna Japonica (1845) 134; BLEEKER, Verh. Bat. Gen. 25 (1853) 41; Ned. Tijdschr. Dierk 4 (1873) 143; Verh. Akad. Amsterdam 18 (1879) 17.

Mugil macrolepidotus RICHARDSON, Ichth. Seas of China and Japan (1846) 249.

Mugil dobula GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 420; Fische d. Südsee 2 (1876–81) 214; STEINDACHNER, Denkschr. Akad. Wien 70 (1900) 501.

Mugil oeur KLUNZINGER, Abhandl. zool.-bot. Ges. Wien 20 (1870) 829; DAY, Fishes of India, 4°. (1878–1888) 353; KLUNZINGER, Fische d. Rothen Meeres (1884) 132; STEINDACHNER and DODERLEIN, Fische Japans 4, Denkschr. Akad. Wien 53 (1887) 266; DAY, Fishes of British India 2 (1889) 348; RUTTER, Proc. Acad. Nat. Sci. Phila. (1897) 70; JORDAN and EVERMANN, Proc. U. S. Nat. Mus. 25 (1902) 332.

Mugil hypselosonia OGILBY, Proc. Linn. Soc. N. S. Wales 22 (1897) 74.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 37–40; scales in transverse series 14–15; depth less than head, 4.5–4.7; snout shorter than eye; eye about 4 in head; maxillary not visible; interorbital nearly flat, much broader than eye; 20 to 22 predorsal scales.

Origin of first dorsal midway between end of snout and base of caudal, or slightly nearer snout tip, opposite 11th to 12th lateral scale. Origin of second dorsal opposite 23d to 25th lateral scale and slightly behind that of anal. Pectoral acute, much shorter than head, reaching to about 9th or 10th lateral scale. Caudal deeply emarginate, the upper lobe the longer. Least height of caudal peduncle 2.25 to 2.33 in the head.

This is represented in the collection by only one specimen, No. 28426, 17 inches long, from Ilocos Sur Province, Luzon; the exact locality and date were not recorded. There are, however, three foreign specimens in the collection, No. 7470 from Honolulu, and Nos. 6280 and 6285 from Hongkong, China.

MUGIL SUBVIRIDIS Cuvier and Valenciennes.

Mugil subviridis CUVIER and VALENCIENNES, Hist. Nat. Poiss. **11** (1836) 115; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 423; DAY, Fishes of Malabar (1865) 64; Fishes of India 4°. (1889) 348; DE BEAUFORT, Bijdr. tot de Dierk. Afl. **19**, Amsterdam (1913) 107; MAX WEBER, Siboga-Expeditie, Fische (1913) 138; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 243.

Mugil alcocki OGILBY, Ann. Queensland Mus. **9** pt. 1 (1908) 21.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 28–30; scales in transverse series 11–12; head 4 in standard length; depth equal to or sometimes slightly more than head; snout shorter than eye, broad, somewhat depressed; eye 3.5–4 in head, with well developed adipose eyelid; maxillary visible; interorbital nearly flat about 2.5 in head, preorbital angularly bent, denticulate at its anterior and somewhat truncate at its ventral border.

Rostro-dorsal profile nearly straight. First dorsal origin nearer to caudal base than to end of snout, opposite the 10th or 11th lateral scale. Dorsal spines, strong, heteracanth. Second dorsal origin behind the first third of anal and opposite the 19th or 20th lateral scale. Pectorals shorter than head, reaching 7th or 8th lateral scale. Caudal broad, emarginate, and like the second dorsal and anal thickly scaled. No axillary scale above pectorals and ventral.

The above description is based on that of Weber and de Beaufort (1922) who reported this species from the Philippines.

This species differs from *M. cephalus* in having the maxillary exposed and the spinous dorsal nearer the caudal base than to tip of snout. Unlike *M. ruthveni* and *M. philippinus*, this species has the snout shorter than the eye. It is not represented in the collection.

MUGIL RUTHVENI Fowler.

Mugil ruthveni FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 3.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 30; scales in transverse series 11; head equals depth, 3.7 in standard length; snout 3.8 moderately broad, greater than eye; eye 4.5; adipose eyelid well developed, the posterior extending over last third of eye; maxillary exposed, not quite to eye; interorbital 2.4, broadly convex; 20 predorsal scales.

Body fusiform, compressed, deepest at level of spinous dorsal. Head robust, snout convex as viewed above, with length 2 in its width. Mouth slightly inferior, mandibular angle obtuse, cilia on upper jaw. Upper lip rather fleshy, with width about half of pupil. Lower edge of preorbital straight with minute denticles.

Spinous dorsal origin midway between front edge of eye and caudal base. First spine longer and stronger than second. Soft dorsal origin behind middle of anal and opposite 22d or 23d lateral scale. Caudal emarginate. Pectorals broad and short reaching 9th lateral scale. Axillary at base of pectoral short.

This species is similar in many ways to *M. dussumieri*, but the snout is greater than the eye and there are eight instead of nine anal spines. It is not represented in the collection. The above description is based on that of Fowler (1918).

MUGIL PHILIPINUS Fowler.

Mugil philippinus FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 7.

Dorsal IV–I, 8; anal II, 8; scales in longitudinal series 30; scales in transverse series 10; head equals depth; 3.8 in standard length; snout broad, widely convex as viewed above, equals eye; eye 4; adipose eyelid well developed, the posterior extending over last third of iris; maxillary exposed, almost reaching eye; interorbital broadly convex, 2.3; 19 predorsal scales.

Dorsal profile convex; head robust, mouth somewhat inferior, mandibular angle very broad and obtuse; cilia on upper jaw. Upper lip somewhat fleshy, not thick. Lower edge of preorbital straight, not notched, with few obsolete denticles.

Origin of spinous dorsal midway between front edge of eye and caudal base, first spine about as long as the second. Origin of second dorsal slightly behind that of anal, opposite 20th to 21st lateral scale. Caudal emarginate. Pectorals broad, shorter than head, reaching to 8th or 9th lateral scale. Axillary present at base of first dorsal, ventrals, and pectorals. Soft dorsal, caudal, and anal scaly for the greatest extent.

This differs from *M. ruthveni* in having the snout equal to eye, in having the first dorsal spine as long as the second and in not having the edge of the caudal dusky. It is not represented in the present collection. The above description is based on that of Fowler (1918).

MUGIL VAIGIENSIS Quoy and Gaimard. Plate 1, fig. 12.

Mugil vaigiensis QUOY and GAIMARD, Voyage "Uranie" (1925) 337; BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–59) 276; Akad. Vet. Amsterdam, Verslagen, 2d ser. **2** (1868) 300; DE BEAUFORT, Bijdr. tot de Dierk. Afl. **19** Amsterdam (1913) 107; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. **4** (1922) 244; DUNCKER and MOHR., Mitt. Zool. Mus. Hamburg **42** (1926) 131; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 124.

Mugil waigiensis PETERS, Akad. Wiss. Berlin, Monatsb. 1876 (1877) 842; GÜNTHER, Cat. Brit. Mus. **3** (1859) 435; DAY, Fishes of Malabar (1865) 144; KNER, Fische Novara-Exp. **1** (1865–67) 226; KLUNZINGER, Abh. zool-bot. Gesellsch. Wien **20** (1870) 825; MACLEAY, Proc. Linn. Soc. N. S. Wales **7** (1882) 362; KLUNZINGER, Fische d. Südsee **2** (1876–81) 216; DAY, Fishes of India 4°. (1878–88) 359; SAUVAGE, Hist. Nat. d. Poiss. de Madagascar (1891) 401; SEALE, Occ. Pap. B. P. Bishop Mus. **1** (1901) 65; STEINDACHNER, Sitz. Akad. Wiss. Wien. **115** (1906) 1416; MCCULLOCH, Checklist of the Fish and Fish-like Animals of N. S. Wales pt. 2 (1919) 38.

Liza vaigiensis KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. **26** (1911) 257; FOWLER, Copeia No. 58 (June, 1918) 62.

Liza vaigiensis SEALE, Occ. Pap. B. P. Bishop Mus. **4** (1906) 15; JORDAN and SEALE, Bull. U. S. Bur. Fish. **26** (1906) 11; SEALE and BEAN, Proc. U. S. Nat. Mus. **33** (1907) 240.

Mugil macrolepidotus RÜPPELL, Atlas Fische d. Rothen Meeres (1928) 140; CUVIER and VALENCIENNES, Hist. Nat. Poiss. **11** (1836) 99; BLEEKER, Nat. and Geneesk. Arch. Ned. Indie (3) **2** (1845) 514; CANTOR, Cat. Malay. Fishes, Journ. Asiatic Soc. Bengal **17** (1850) 1077; Journ. Soc. Cherbourg. Mem. **8** (1861) 316.

Mugil melanochir CUVIER and VALENCIENNES, Hist. Nat. Poiss. **11** (1836) 106; BLEEKER, Verh. Bat. Genootsch. **22** (1849) 5; Nat. Tijdschr. Ned. Ind. **3** (1852) 432.

Mugil tegobuan THOILLIERE, Fauna Woodlark (1857) 184.

Mugil rossii BLEEKER, Nat. Tijdschr. Ned. Ind. **7** (1854) 45; MAX WEBER, Siboga-Exp. Fische (1913) 138.

Dorsal IV–I, 8; anal III, 8; scales in longitudinal series 24–26; scales in transverse series 9; head 4; height 3.7; snout 4.2 in head; eye 4 in head; maxillary 4; interorbital 1.6; 15 predorsal scales.

Rostro-dorsal profile straight. Body rather stout, compressed posteriorly but very wide anteriorly. Greatest width of head equal to its length less the snout. Interorbital almost flat. Snout almost flat dorsally, its length 2.7 in its width. Eyes greater than snout, 2.6 in interorbital. Adipose eyelid wanting. Upper lip thin, with fine ciliary teeth. Mandibular rami meet at an obtuse angle. Nostrils well separated, the posterior slightly wider. Maxillary visible at tip. Preorbital only slightly bent, finely denticulate anteriorly and ventrally.

Spinous dorsal origin between caudal base and posterior edge of eye. Second dorsal origin opposite 18th scale and slightly behind middle of anal. Least height of caudal peduncle about equal to its length and postorbital part of head. Caudal almost truncate or only slightly emarginate. Pectoral shorter than head, its tip reaching the 8th scale, and two scales distant ahead of spinous dorsal origin. Axillary present on pectorals.

Pectorals blackish and edges of all other fins dark.

The above description is based on No. 28432, 13 inches total length, from Cabalian, Leyte Province, collected in December, 1922.

LUZON, Bulacan Province, Paombong, No. 15340, 5 in. long, April 22, 1927. MINDORO, Mindoro Province, Puerto Galera, Nos. 7159, 28360, 28394–96, 3 in. long, 1912; Calapan, No. 12349, 5 in. long, February, 1925. LEYTE, Leyte Province, Cabalian, Nos. 28431–32, 12 in. long, December, 1922. PANAY, Capiz Province, Panay, No. 15479, 17.5 in. long, August 19, 1927. BUSUANGA, Palawan Province, Busuanga, Nos. 2053, 4965, 28354, 1.5 in. long, October, 1907. PALAWAN, Palawan Province, Puerto Princesa, No. 5383, 1.5 in. long, August, 1908; Guinlo, No. 15495, 5 in. long, May, 1927. BALABAC, Palawan Province, No. 5114, 1.5 in. long, October, 1907. LUMBUCAN, Palawan Province, Lumbucan, Nos. 15681, 28470–71, 3 in. long, November, 1927. MINDANAO, Zamboanga Province, Zamboanga, Nos. 10411, 28400, 7 in. long, March, 1923. TUBIGAN, Sulu Province, Tubigan, No. 28408, 2.5 in. long, March, 1916. SIBUTU, Sulu Province, Sibutu, No. 14119, 2.5 in. long, April, 1926. Borneo, North Borneo, Sandakan, No. 14172, 8.5 in. long, November 21, 1925.

MUGIL CERAMENSIS Bleeker. Plate 11, fig. 3.

Mugil ceramensis BLEEKER, Nat. Tijdschr. Ned. Ind. **3** (1852) 699; Nat. Tijdschr. Ned. Ind. **16** (1858–1859) 277; Act. Soc. Sc. Indo. Neerl. **8** (1860) 48; GÜNTHER, Cat. Brit. Mus. **3** (1859–1861) 449; JORDAN and SEALE, Bull. U. S. Bur. Fish. **26** (1906) 11.

Dorsal IV–I, 8–9; anal III, 9; scales in longitudinal series 30–31; scales in transverse series 10–11; head 3.7 in length; depth slightly greater than head; snout acute, about equal to eye; eye 3.8 to 4 in head. Adipose eyelid poorly developed; maxillary exposed, interorbital flat or slightly convex, over twice in head; 18–19 predorsal scales.

Rostro-dorsal profile evenly descending and straight, head pointed and nearly straight. Snout acute. Preorbital slightly bent and strongly denticulate at its lower and posterior border. Origin of first dorsal much nearer to caudal base than to tip of snout. First dorsal spine longer and stronger. Origin of second dorsal almost behind anal, opposite 19th or 20th lateral scale. Pectorals shorter than head, reaching to about 7th lateral scale provided with an axillary scale.

This species is easily recognized through its pointed, nearly straight head, through the characteristic position of the second dorsal which is almost entirely behind anal and through the heavy denticulation on the anterior as well as ventral sides of the preorbital.

Six specimens of this species were reported by Jordan and Seale from Cavite in 1906. It is represented in the collection by one specimen only, No. 11530, collected from Malampaya Sound, Palawan, in 1922. Total length 8.25 inches.

MUGIL OGILBY Fowler.

Mugil ogilby FOWLER, Proc. Acad. Nat. Sci. Phila. 70 (1918) 5.

Dorsal IV–I, 8; anal III, 9; scales in lateral line 28; scales in transverse series 10; head slightly less than depth, 3.9 in standard length; depth 3.7; snout broad, widely convex, about 3.7 in head; eye 4.5; adipose eyelid little developed, the posterior extending over last fifth of eye; maxillary exposed, about to eye; interorbital broadly convex 2.25 in head; 20 predorsal scales.

Body elongate, contour fusiform, lower profile slightly more convex, deepest at level of spinous dorsal origin. Head robust, lower profile slightly more convex. Mouth little inferior, mandibular angle obtuse; cilia minute. Upper lip rather fleshy, its width about four-sevenths of pupil. Lower edge of premaxillary slightly curved with very few minute, obsolete, denticles.

Spinous dorsal origin midway between hind nostril and caudal base. First spine slightly longer, but second slightly larger. Second dorsal origin opposite middle of anal and at level of 20th lateral scale. Caudal slightly emarginate. Pectorals broad, shorter than head, reaching 7th lateral scale. Axillary scales at base of first dorsal and ventral moderate in length; those on pectorals short. Caudal, second dorsal, and anal scaly for the most part.

This differs from all other species of *Mugil* with poorly developed adipose eyelid and with obtuse snout, in having the snout greater than the eye. It is not represented in the collection. The above description is based on that of Fowler (1918).

MUGIL OLIGOLEPIS Bleeker.

Mugil macrolepis BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 422. (Name preoccupied.)

Mugil oligolepis BLEEKER, Nat. Tijdschr. Ned. Ind. 19 (1859) 437; Act. Soc. Sc. Ind. Neerl. 8 (1860) 40; GÜNTHER, Cat. Brit. Mus. 3 (1859–1861) 449; DAY, Fishes of India 4°. (1878–1888) 358; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 244; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 245.

Liza oligolepis FOWLER, Proc. Acad. Nat. Sci. 57 (1905–06) 497.

Dorsal IV–I, 8–9; anal III, 9: scales in longitudinal series 26; scales in transverse series 10–11; head 3.4 in length; depth somewhat less than head; snout blunt, shorter than eye; eye 3.5 in head; adipose eyelid wanting; maxillary exposed; interorbital slightly convex, much broader than eye and less than postorbital part of head; 15 or 16 predorsal scales.

Rostro-dorsal profile convex. Preorbital bent, emarginate with a truncate, denticulate, inferior border. First dorsal with strong spines, with origin nearer caudal base than tip of snout, opposite 9th lateral scale. Origin of second dorsal behind anterior half of anal and opposite 17th or 18th scale. Pectorals not much shorter than head, reaching almost to level of first dorsal origin.

This species differs from *Mugil ogilby* Fowler in having the snout shorter than the eye and from *Mugil melinopterus* in having fewer scales. It has been reported by Jordan and Richardson from the Philippines, but it is not represented in our collection.

MUGIL MELINOPTERUS Cuvier and Valenciennes. Plate 1, fig. 7.

Mugil melinopterus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 146; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 452; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 246; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 130.

Mugil melanopterus GÜNTHER, Fische d. Südsee 2 (1876–81) 218.

Liza melinopterus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1905) 1906, 217; HERRE, Philip. Journ. Sci. 34 (1927) 294, 296.

Liza melinoptera JORDAN and DICKERSON, Proc. U. S. Nat. Mus. **34** (1908) 607; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. **26** (1911) 256.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 28–29; scales in transverse series 10–11; head 4; height 3.5; snout 5.3 in head; eye 4 in head; maxillary 4.5; interorbital 2; predorsal scales 20.

Rostro-dorsal profile almost straight, slightly convex anteriorly. Body compressed posteriorly becoming wider anteriorly. Greatest width of head equals its length less the snout. Interorbital slightly convex. Snout broadly convex, its length 2.7 in its width. Eye greater than snout, 2.08 in interorbital. Adipose eyelid poorly developed, appearing as a narrow rim on the posterior side. Upper lip thin with a groove for reception of symphysial knob. Mandibular rami meet at an obtuse angle. Minute cilia on upper jaw. Maxillary visible. Preorbital weakly emarginate with fine dentition on anterior and ventral edges.

Spinous dorsal origin midway between front edge of eye and caudal base. Origin of second dorsal opposite 19th scale, and opposite middle of anal. Pectorals shorter than head with tip reaching up to 8th scale and two scales distant ahead of spinous dorsal origin. Least height of caudal peduncle 1.2 in its length and equal to postorbital part of head. Caudal deeply emarginate. Axillary present at base of first dorsal and ventral but absent on pectoral.

The above description is based on No. 532, obtained from Manila Market, July 10, 1927, 10.5 inches long.

Fowler (1928) has united this species with *M. vaigiensis*, although it lacks the typical black fins of *M. vaigiensis*. It also differs from *M. vaigiensis* in having nine anal rays, a narrower and more convex interorbital, and a slightly more-developed adipose eyelid. *Mugil melinopterus* does not reach as great a size as *M. vaigiensis*.

LUZON, Ilocos Norte Province, Bangui, Nos. 14325, 28409, 3.5 to 4 in. long, August 19, 1926. MINDANAO, Misamis Province, Cagayan, Nos. 1468, 1496, 1511–13, 2 to 5 in. long, September 9, 1907: Davao Province, Davao, No. 3245, 4 in. long, April 22, 1908, Samal, No. 3711, 6.5 in. long, May, 1908: Zamboanga Province, Zamboanga, No. 2982, 4.5 in. long, April 13, 1908. SIMONOR, Sulu Province, Simonor, Nos. 10748, 28407, 3.5 in. long, September, 1923.

MUGIL MACROLEPIS A. Smith. Plate 1, fig. 6.

Mugil macrolepis A. SMITH, Ill. Zool. S. Af. IV (1849) pl. 28, fig. 2 (no pagination); FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 124.

Mugil adustus BLEEKER, Nat. Tijdschr. Ned. Ind. **5** (1853) 503.

Mugil borneensis BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–59) 278; KNER, Reise "Novara" Fische **1** (1865) 5, 228; GÜNTHER, Fische d. Südsee **2** (1876–81) 218; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. **4** (1922) 249.

Liza borneensis KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. **26** (1911) 258.

Mugil troschelii BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–59) 277; GÜNTHER, Cat. Brit. Mus. **3** (1859–61) 448; SCHMELTZ, Cat. Mus. Godeffroy **4** (1869) 21; MACLEAY, Proc. Linn. Soc. N. S. Wales **7** (1882) 362; DAY, Fishes of India 4°. (1878–1888) 358.

Mugil troscheli BLEEKER, Act. Soc. Sci. Indo-Neerl. **8** (1860) 80; WEBER, Nova Guinea **9** pt. 4 (1913) 569; REGAN, Proc. Zool. Soc. London **20** pt. 6 (1914) 276; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 248; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg **42** (1926) 130.

Liza troscheli JORDAN and SEALE, Bull. U. S. Bur. Fish. **25** (1905) 217; Bull. U. S. Fish. **26** (1906) 11; EVERMANN and SEALE, Proc. U. S. Nat. Mus. **31** (1906) 506; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 244; SEALE and BEAN, Proc. U. S. Nat. Mus. **33** (1907) 240; JORDAN and EVERMANN, Proc. U. S. Nat. Mus. **25** (1903) 332; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. **26** (1911) 256.

Mugil compressus GÜNTHER, Fische d. Südsee 2 (1876–81) 217; MACLEAY, Proc. Linn. Soc. N. S. Wales (1883) 269.

Liza compressa KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. **26** (1911) 256.

Mugil rechingeri STEINDACHNER, Sitz. Akad. Wiss. Wien **115** pt. 1 (1906) 1416.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 31–32; scales in transverse series 11; head 4.2 in standard length; depth 3.8; snout 4.5 in head; eyes 3.4; maxillary 3.5; interorbital 2; 19 or 20 predorsal scales.

Dorsal profile slightly convex, from first dorsal to snout slightly declivous, snout depressed, broadly convex. Head width 1.4 in its length. Eye greater than snout, 1.7 in interorbital space, its center at anterior third of head. Adipose eyelid poorly developed, only as a narrow edge around orbit. Upper lip thin, with very minute cilia. Rami of mandibles coming together at an obtuse angle. Maxillary visible. Preorbital slightly emarginate, rounded below and finely denticulate anteriorly and ventrally. Spinous dorsal origin midway between caudal base and front edge of eye. Second dorsal origin at level of anterior third of anal and opposite 22d scale. Least height of caudal peduncle 1.4 in its length and equal to postorbital part of head. Pectorals short, equal to head without snout, reaching 9th scale and about two scales ahead of spinous dorsal origin. Very long axillary scales at base of first dorsal and ventrals, but absent at pectorals.

The above description is based on No. 9048 collected from Mangarin, Mindoro, in June, 1913. Total length 10 inches.

LUZON, Abra Province, Bangued, No. 10446, 12.5 in. long; June 7, 1923: Rizal Province, Malabon, No. 15296, 9.5 in. long, March 31, 1927: Batangas Province, Pansipit River, No. 12961, 9.5 in. long, January 10, 1926. MINDORO, Mindoro Province, Puerto Galera, Nos. 28450–53, 5 to 8 in. long, May, 1912; Mangarin, No. 9648, 9.75 in. long, 1913. MASBATE, Masbate Province, Guinobatan, No. 1076, 3.5 in. long, August 31, 1907. SIQUIJOR, Oriental Negros Province, Lazi, Nos. 1365–67, 1413–14, 3.5 to 5 in. long, September 6, 1907. MINDANAO, Misamis Province, Gingoog, Nos. 15050, 28406, 5 to 5.5 in. long, February 20, 1927: Zamboanga Province, Dapitan, No. 15051, 7.5 in. long, March 14, 1923. BUNGAU, Sulu Province, Bungau, Nos. 10455, 28454–65, 2.5 in. long, September 7, 1926.

MUGIL CÆRULEOMACULATUS Lacépède. Plate 1, fig. 8.

Mugil cæruleomaculatus LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 385, 389; CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 128; BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 484; Nat. Tijdschr. Ned. Ind. 16 (1858–59) 279; Act. Soc. Sc. Indo-Neerl. 8 (1860) 5; GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 445; SAUVAGE, Hist. Nat. d. Poissons de Madagascar (1891) 398; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 250.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 36–38; scales in transverse series 12 or 13; head 4–4.4 in standard length; height 3.6–4.2; snout 4.5–4.8; maxillary 4.3, interorbital 2; 20–22 predorsal scales.

Rostro-dorsal profile slightly convex, from second dorsal to neck almost straight, slightly declivous; greatest width of head 1.4 in length. Interorbital convex; snout convex, declivous, its length 2.2 to 2.5 in its width. Eye greater than snout, 2.2 in interorbital. Adipose eyelid wanting or very poorly developed as a very narrow edge around orbit. Upper lip thin, smooth or with few fine cilia. Mandibular rami come together in an obtuse angle. Maxillary entirely hidden. Preorbital scaly, almost straight, finely denticulate anteriorly and ventrally.

Origin of first dorsal midway between snout tip and caudal base. Second dorsal at same level as, or very slightly behind, anal, and opposite the 23d to 24th lateral scale. Least height of caudal peduncle about its length, and equal to or very slightly greater than postorbital part of head. Caudal very strongly forked. Pectorals falcate much longer than head, their tip reaching 12th to 14th lateral scale. Long axillaries present at base of pectorals, first dorsal and ventrals.

Pectorals distinctly yellowish with a black spot at base.

The above description is based on No. 28321, collected June 25, 1927, from Obando, Bulacan. Total length 9.25 inches.

LUZON, Bulacan Province, Paombong, Nos. 15237, 28313, 6.5 in. long, April 22, 1927; Obando, Nos. 15319, 28320, 28322, 8 to 9 in. long, June 25, 1927: Manila, Manila Market, Nos. 320, 5 in. long, June 17, 1927; Manila Market, No. 41043, 15.5 in. long, December 14, 1930; Manila Bay, No. 41041, 6 in. long, October, 1929. MINDORO, Mindoro Province, Mangarin, No. 28346, 8.5 in. long, 1913. CULION, Palawan Province, Culion, No. 28343, 5.5 in. long, April 20, 1908. PANAY, Capiz Province, Capiz, No. 1574, 13 in. long, August 16, 1927; Estancia, Nos. 10865–66, 6.5 to 7.5 in. long, July, 1922. NEGROS, Oriental Negros Province, Polo, Polo Plantation, No. 154437, 5 in. long, August 21, 1927. MINDANAO, Misamis Province, Cagayan, Buguey, Nos. 12849, 28399, 4.5 to 5 in. long, December 6, 1925.

MUGIL SEHELI Forskål. Plate 1, fig. 10.

Mugil crenilabris seheli FORSKÅL, Descr. Anim. (1775) 73.

Mugil seheli CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 113; KLUNZINGER, Abh. zool.-bot. Ges. Wien **30** (1870) 827; Fische d. Rothen Meeres **1** (1884) 132; DAY, Fishes of India 4°. (1878–1888) 355; MAX WEBER, Siboga-Exp. Fische (1913) 140; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. **4** (1922) 252; FOWLER, Bull. B. P. Bishop Mus. 22 (1925) 32; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg **42** (1926) 131; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 125.

Mugil axillaris CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 97; GÜNTHER, Cat. Brit. Mus. **3** (1859–61) 444; BLEEKER, Nat. Tijdschr. Ned. Ind. **16** (1858–59) 280; Soc. Ind. Neerl. Act. **6** No. 2 (1871) 34; ALLEYNE and MACLEAY, Proc. Linn. Soc. N. S. Wales **11** (1876) 341; GÜNTHER, Fische d. Südsee **2** (1876–81) 216; MACLEAY, Proc. Linn. Soc. N. S. Wales **7** (1882) 362; SAUVAGE, Hist. Nat. Poissons de Madagascar (1891) 397; SEALE, Occ. Pap. B. P. Bishop Mus. **1** No. 3 (1900) 66.

Mugil parsia CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 107; BLEEKER, Nat. Tijdschr. Ned. Ind. **3** (1852) 166; GÜN-

THER, Fische d. Südsee 2 (1876) 216; SEALE, Occ. Pap. B. P. Bishop Mus. 1 No. 3 (1901) 66.

Mugil borbonicus BLEEKER, Nat. Tijdschr. Ned. Ind. 16 (1858–59) 279.

Mugil bleekeri GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 445; MAX WEBER, Zool. Ergebn. Reise N. O. Indien 2 (1894) 416; DE BEAUFORT, Bijd. Dierk., Amsterdam 19 (1913) 107.

Mugil cylindricus BLEEKER, Nat. Tijdschr. Ned. Ind. 4 (1853) 266.

Agonostomus dorsalis STREETS, Bull. U. S. Nat. Mus. 7 (1878) 102.

Mugil decem-radiatus GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 452.

Mugil cæruleomaculatus DAY, Fishes of British India 2 (1889) 351.

Liza cæruleomaculatus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 217.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 40; scales in transverse series 14; head 4; depth 3.7; snout 5.4 in head; eye 4.8; maxillary 4.4; interorbital 1.9; 21 predorsal scales.

Rostro-dorsal profile convex, ventral also convex, making the body appear spindle-shaped. Caudal peduncle compressed, the body becoming gradually wider anteriorly. Body widest at region just behind head, at region of pectorals. Head convex dorsally with width 1.3 in its length. Interorbital convex. Snout slightly convex, its length 2.4 in its width. Eyes greater than snout, 2.4 in interorbital. Adipose eyelid wanting or very poorly developed. Upperlip not particularly thick, fleshy, smooth. Mandibular rami coming together at an obtuse angle. Maxillary completely hidden. Preorbital almost straight and indistinctly denticulate below.

Spinous dorsal origin midway between caudal base and tip of snout, opposite 13th lateral scale. Soft dorsal almost at same level as anal and opposite 26th lateral scale. Caudal peduncle greatly tapering posteriorly, its least depth 1.3 in its length and 2.1 in head. Caudal emarginate. Pectorals weakly falcate, slightly shorter than head and reaching to 12th lateral scale, not quite to level of spinous dorsal origin. Very long and pointed axillary scales present at base of first dorsal, pectorals, and ventrals.

The above description is based on No. 5460 obtained from Sitanki, Sulu, on June 30, 1930. Total length 14 inches.

This species differ from *M. cæruleomaculatus* Lacépède, to which it is closest, in having a greater scale count and in having shorter pectoral fins.

LUZON, Ilocos Sur Province, Nos. 10215, 28410, 6.5 and 4.75 in. long, February, 1923. PALAWAN, Palawan Province, Palawan, Panacan, Nos. 5309, 28336, 4.5 in. long, August 14, 1908. SIQUIJOR, Oriental Negros Province, San Juan, Siquijor, No.

13900, 3.75 in. long, March 10, 1926. MINDANAO, Davao Province, Davao Gulf, No. 3542, 11 in. long, April 10, 1928: Zamboanga Province, Zamboanga, No. 2942, 3.5 in. long, April 10, 1908. TUBINGAN, Sulu Province, No. 13785, 3.5 in. long, March, 1926.

MUGIL AMARULUS Cuvier and Valenciennes.

Mugil amarulus CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 133; DAY, Fishes of India, Text Supplement (1878) 356.

Liza amarula JORDAN and SEALE, Bull. U. S. Bur. Fish. **26** (1906) 11; SEALE and BEAN, Proc. U. S. Nat. Mus. **33** (1907) 240.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 36; scales in transverse series 12; head 4.25 in standard length; depth 4.25; eye without adipose eyelid, 4 in the head; maxillary visible; preorbital strongly bent, serrate behind; upper lip moderately thick.

Origin of spinous dorsal midway between front edge of eye and caudal base opposite the 11th lateral scale. Dorsal spines weak, the first equalling postorbital part of head. Second dorsal origin slightly behind that of anal and opposite 24th lateral scale. Pectorals about equal to head without the snout. Caudal emarginate, its central rays equal postorbital part of head. Axillary scale on pectoral short, pointed. Second dorsal and anal heavily scaled.

The above description is based on that of Day (1878).

This differs from all other species of *Mugil* with thick upper lip and without adipose eyelid, in having an upper lip without any papillæ and in having weak dorsal spines. Jordan and Seale (1906) reported one specimen 3.25 inches long from Cavite, while Seale and Bean (1907) reported numerous specimens 1 to 4.5 inches long from Zamboanga. This species, however, is not represented in the collection.

MUGIL CRENILABRIS Forskål. Plate 1, fig. 4.

Mugil crenilabris FORSKÅL, Descript. Anim. (1775) 73; CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 91; RÜPPELL, Neue Wirbelthiere, Fische (1836–1840) 132; GÜNTHER, Cat. Brit. Mus. **3** (1859–1861) 458; KLUNZINGER, Fische d. Rothen Meeres **1** (1884) 132; DE BEAUFORT, Bijdr. tot de Dierk. Afl. **19**, Amsterdam (1913) 108; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. **4** (1922) 256; FOWLER and BEAN, Proc. U. S. Nat. Mus. **71** (1927) 14; FOWLER, Bull. B. P. Bishop Mus. **38** (1927) 1; WHITLEY, Rec. Austr. Mus. **16** (1927) 11; FOWLER, Mem. B. P. Bishop Mus. **10** (1928) 126.

Mugil crenilabris KNER, Fische Novara-Exp. (1865–1867) 228; KLUNZINGER, Abh. zool.-bot. Gessellsch., Wien **20** (1870) 826; GÜNTHER, Fische d. Südsee **2** (1876–81) 219; STREETS, Bull. U. S. Nat. Mus. **7** (1877) 93; DAY, Fishes of India 4°. (1878–1888) 355, 800; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg **42** (1926) 130.

Mugil cirrhostomus (Forst.) SCHNEIDER, Bloch Syst. Ichth. (1801) 121; CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 94; LICHTENSTEIN, Forster Descr. Anim. curante (1844) 198.

Mugil fasciatus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 92.

Mugil rüppelli GÜNTHER, Cat. Brit. Mus. 3 (1865–1867) 458.

Mugil neocalidonicus CASTELNAU, Proc. Zool. and Acc. Soc. Victoria 2 (1873) 116.

Mugil papillosus MACLEAY, Proc. Linn. Soc. N. S. Wales 8 (1883) 270.

Liza crenilabris KENDALL and GOLDSBOROUGH, Mem. Mus. Com. Zool. Harvard 26 (1911) 258.

Querimana crenilabris JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 218.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 38–39; scales in transverse series 12; head 4 in standard length; depth 3.6; snout much shorter than eye, 6 in head; eye 3.2 in head; maxillary visible only at tip, 4 in head; interorbital 2; 19–20 predorsal scales.

Rostro-dorsal profile almost straight, from origin of first dorsal to snout tip, very slightly declivous. Greatest depth of body at level of second dorsal and anal origin. Caudal peduncle much compressed, its least depth 1.3 in its length and twice in head. Head width 1.3 in the length, widest at region of opercles. Snout obtuse, almost blunt, its length almost 3 in its width. Eye large, greater than snout, its center at anterior third of head; 1.7 in interorbital. Adipose eyelid poorly developed, almost wanting. Upper lip thick, almost quadrate, forming front border of snout. Its outer surface on the lower third provided with several rows of papillæ which become longer and more prominent ventrally. Lower lip thin, but divided into nine or ten fringes on each side. Mandibular rami coming together at an obtuse angle. Symphysial knob double. No teeth and no cilia. Nostrils far apart, the anterior the smaller, as near to lip border as the posterior is to edge of orbit. Maxillary hidden, except extreme ventral tip which extends to almost level of front border of orbit. Preorbital slightly notched, only denticulate on its lower tip.

Spinous dorsal origin between caudal base and front edge of eye, opposite 13th lateral scale. First dorsal spine equals postorbital part of head. Origin of second dorsal slightly behind that of anal and opposite 24th lateral scale. Caudal emarginate, its lobe pointed. Pectoral more or less falcate, as long as or a little shorter than head, extending posteriorly up to 12th or

13th lateral scale, reaching almost to level of first dorsal origin. Second dorsal, caudal, and anal scaly for the greatest part. Long pointed axillary scales present at base of first dorsal, pectorals, and ventrals.

Represented by a single specimen No. 28472, collected from Lumbucan, Balabac Island, near Palawan, November 29, 1927. Total length 4.75 inches.

This is the first Philippine locality record of this species.

This species differs from *M. labiosus* and *M. joloensis* to which it is closest, in having four series of papillæ on the upper lip and in having the lower lip fringed.

MUGIL JOLOENSIS Seale.

M. joloensis SEALE, Philip. Journ. Sci. § A 4 (1909) 500.

According to Seale, this species has: dorsal IV–I, 7; anal I, 9; scales in longitudinal series 33; scales in transverse series 10; head 4.30; depth 3.60; snout 4.10; eye 3.30; maxillary exposed at tip; interorbital 1.95; pectorals equal to head; ventrals 1.30; least depth of caudal peduncle 2.

Seale's description follows:

> The preorbital has a very deep notch, its depth being greater than width of pupil. The upper lip is very thick, with a fold, fringed with a row of papillæ, an additional row of papillæ on the lip just above the fold an additional fringed fold at each corner of the mouth; under lip with moderately broad membrane. Teeth on tongue, vomer, and palatine, none in jaws. Eye with but the slightest indication of adipose eyelid which is present as a narrow rim to orbit.

This species is not represented in the collection.

MUGIL BANKSI Seale. Plate 1, fig. 11; Plate 2, fig. 2.

Mugil banksi SEALE, Philip. Journ. Sci. § A 4 (1906) 501, pl. 5.

Dorsal IV–I, 8; anal III, 9; scales in longitudinal series 35–37; scales in transverse series 11; head 4 in standard length; depth 3.4; snout equals eye, 4.2 to 4.5 in head; eye 4 in head; maxillary concealed, 5 in head; interorbital convex, 2 in head; 20 predorsal scales.

Rostro-dorsal profile almost straight, ventral profile very convex, greatest depth of body at level of first dorsal. Caudal peduncle compressed, 1.2 in its length, and equal to postorbital part of head. Head width about 1.5 in its length. Snout obtuse, slightly pointed when viewed from below, its length 2 in the width. Eyes slightly greater than or equal to snout, 1.6 in interorbital. Adipose eyelid poorly developed, almost wanting.

Mouth slightly inferior. Upper lip high, very thick, forming front border of snout. At its lower central border are two or three series of flattened papillæ. Toward the lateral sides of the upper lip these papillæ become transformed into fleshy ridges or lamellæ. Lower lip also somewhat thick, but without fringes. Mandibular rami coming together at an obtuse angle. Symphysial knob prominent. Nostrils far apart, the posterior the larger, the anterior nearer edge of snout than posterior is to edge of orbit. Maxillary hidden except the extreme lower tip which may be visible in young specimens. Preorbital slightly concave, its lower edge truncate with distinct dentition.

Spinous dorsal origin midway between caudal base and front edge of eye, at level of 12th lateral scale. Spines weak, the first 1.8 in the head. Axillary scale at base of first dorsal about $\frac{2}{3}$ of dorsal spine. Second dorsal origin very slightly behind that of anal and opposite 23d lateral scale. Caudal emarginate. Pectorals pointed, almost as long as head, its tip reaching as far back as 12th lateral scale. Axillary scale at its base about 2.6 in its length. Axillary scale present at base of ventral, $\frac{1}{2}$ of the length of first soft rays.

This species differs from *M. labiosus*, as described by Weber and de Beaufort (1922) and Fowler (1928), in having three or four series of papillæ at lower center of upper lip and oblique fleshy folds or lamellæ at the sides. The statement that *M. labiosus* has no fringes or upper lip [Günther (1861) and cited by Seale (1908, p. 501)] is erroneous. It differs from *M. joloensis* Seale in not having a deep notch on the preorbital, in having a greater scale count, and in having no teeth on vomer and palatines.

Seale's type: No. 1412, obtained from Siquijor Island, September 6, 1907.

LUZON, Ilocos Sur, No. 9114, 11.5 in. long, no date. MINDANAO, Misamis Province, Cagayan, Pinacanawan River, No. 10987, 4 in. long, May 17, 1923; Abulog, No. 12838, 9.5 in. long, December 4, 1925; Lanao Province, Kolambugan, Titonod River, Nos. 15083, 15094, 3.5 and 6 in. long, March 7, 1927.

MUGIL LABIOSUS Cuvier and Valenciennes.

Mugil labiosus CUVIER and VALENCIENNES, Hist. Nat. Poissons **11** (1836) 95; BLEEKER, Nat. Tijdschr. Ned. Ind. **6** (1854) 213; Nat. Tijdschr. Ned. Ind. (1858–59) 278; Act. Soc. Sc. Indo-Neerl. **8** (1860) 6; GÜNTHER, Cat. Brit. Mus. **3** (1859–61) 454; KLUNZINGER, Abh. zool.-bot. Gesellsch. Wien **20** (1870) 830; Fische d. Rothen Meeres **1** (1884) 133; DAY, Fishes of India 4°. (1878–1888) 357;

MAX WEBER, Siboga-Exp. Fische (1913) 140; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 259; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 126; DUNCKER and MOHR, Mitt. Zool. Mus. Hamburg 42 (1926) 130.

Liza labiosa FOWLER, Copeia No. 58 (June, 1918) 62.

Dorsal IV–I, 7–8; anal III, 9; scales in longitudinal series 34–36; scales in transverse series 11–12; head 4 to 4.5 in standard length; depth greater than head; eye 3 to 3.5 in head, without adipose eyelid, maxillary exposed in young individuals, becoming hidden in old specimens; interorbital nearly flat and almost 2 in the head; preorbital bent, emarginate, its end truncate and finely denticulate. Upper lip thick, high. At its lower margin is a shallow groove provided with one row of pointed papillæ. Rostro-dorsal profile convex or rather steep. Origin of spinous dorsal about midway between snout tip and caudal base, opposite the 11th or 12th lateral scale. Origin of second dorsal at same level as middle of anal and opposite the 23d or 24th lateral scale. Pectorals as long as or slightly longer than head, reaching up or almost to level of first dorsal origin. Caudal emarginate. Axillary scales short.

The above description is based on that of Weber and de Beaufort (1922).

This species differs from *M. banksi* in having only one row of papillæ on the upper lip. Fowler (1918) reported this species as *Liza labiosa* from the Philippines, but none of its examples are present in this Mugilidæ collection.

Genus CESTRÆUS Cuvier and Valenciennes

Mouth cleft usually oblique; upper lip thick fleshy; mandible included; lower jaw with rounded anterior edge and with a cushion-like pad; teeth present on intermaxillary.

CESTRÆUS OXYRHYNCHUS Cuvier and Valenciennes. Plate 1, fig. 13.

Cestræus oxyrhynchus CUVIER and VALENCIENNES, Hist. Nat. Poissons 11 (1836) 162; BLEEKER, Nat. Tijdschr. Ned. Ind. 9 (1855) 307; Act. Soc. Sc. Indo-Neerl. 7 (1860) Negende Bijdr. Vischfauna Sumatra p. 9; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 4 (1922) 263.

Agonostoma oxyrhynchum GÜNTHER, Cat. Brit. Mus. 3 (1859–61) 461.

Agonostoma oxyrhynchus BLEEKER, Ned. Tijdschr. Dierk (1865) 191, 291.

Dorsal IV–I, 8; anal III, 9; ventral I, 5; scales in longitudinal series 45; scales in transverse series 14; head 4.2 in the standard length; depth 3.8; snout greater than eye, 3 in head; eye 3.8 in head, 2 in interorbital; adipose eyelid poorly developed, maxillary exposed, 3.8 in head; interorbital 3.1; 23 predorsal scales.

Rostro-dorsal profile convex; head, interorbital, and snout decidedly convex. Ventral profile also convex, greatest depth at level of first dorsal. Head width 1.5 in its length. Snout pointed, the intermaxillaries covered by a thick fleshy lip. Mouth opening more or less oblique. Mandible included, lower lip with a rounded front edge, thick and fleshy. Intermaxillary teeth in two irregular series anteriorly and three posteriorly; a patch of teeth present on either side of the vomer. Preorbitals scaly, straight and truncate behind; cheek and opercles covered by large prominent scales.

Origin of first dorsal much nearer snout tip than caudal base, opposite 13th or 14th lateral scale. Origin of second dorsal slightly behind that of anal and opposite 27th lateral scale. Both second dorsal and anal slightly emarginate. Depth of caudal peduncle 1.5 in its length and almost twice in head. Pectorals somewhat falcate, slightly shorter than head, reaching as far back as the 13th lateral scale, almost to first dorsal origin. Caudal deeply emarginate.

This species is similar to *Cestræus goldiei* in having two patches of teeth on the vomers, but differs from it in having the second dorsal and anal set far back, opposite the 27th and 25th lateral scales, respectively. Besides this species, *Cestræus goldiei* (Macleay) was reported by Jordan and Richardson (as *Æeschrichthys goldiei*) from Mindoro in 1907, and *Cestræus proboscideus* Günther by Borodin (as *Chænomugil proboscideus*) from Sindañgan in 1930.

The above description is based on No. 11368, with a total length of 11.5 inches, obtained from Ilocos Sur Province, Luzon.

Genus MYXUS Günther

Mouth cleft not horizontal, but oblique, usually longer than broad, not reaching to below level of orbit; upper lip thin, not fleshy, usually small; lower jaw thin with angular front edge; a single series of teeth present on intermaxillary, sometimes also on the lower lip.

MYXUS PHILIPPINUS sp. nov. Plate 1, fig. 9; Plate 2, fig. 1.

Dorsal IV–I, 7; anal III, 9; pectorals II, 15; ventral I, 5; scales in longitudinal series 34–36; scales in transverse series

10–11; head 4 in the standard length; depth 3.3; snout 2 in eye, 5 in head; eye 2.5 in head; maxillary visible, 3 in head; interorbital 1.7; 20 predorsal scales.

Rostro-dorsal profile almost straight, from first dorsal origin to snout slightly declivous; ventral side convex in outline. Greatest depth of body at level of first dorsal origin. Caudal peduncle compressed, its least depth slightly less than its length and 1.7 in head. Head width 1.3 in the length, widest at region of opercles. Snout blunt, flat on top, its length 2 in its width. Eye very large, impinging on dorsal profile, twice that of snout, 1.4 in the interorbital. Adipose eyelid wanting. Interorbital flat. Upper lip relatively thick, pigmented, and with a distinct fold on its lower edge. Intermaxillary provided with densely set, prominent teeth. A few teeth also present on mandible. Lower lip thin, smooth, with a notch at middle. Lower jaw more or less angular in profile. Mandibular rami coming together at an obtuse angle. Maxillary exposed at middle and below. Preorbital with a deep, wide notch through which the maxillary is visible. Width of the preorbital notch equal to diameter of pupil.

Origin of spinous dorsal opposite 13th lateral scale, midway between caudal base and center of eye. First dorsal spine greater than the second and 1.4 in the head. Origin of second dorsal opposite middle of anal, and opposite 23d lateral scale. Caudal deeply emarginate. Second dorsal, caudal, and anal scaly at basal half. Pectorals more or less triangular, as long as or longer than head, reaching to 12th or 13th lateral scale, almost to level of first dorsal origin. A long axillary present at base of first dorsal and ventral, but none at pectorals.

Type: No. 28473, 3 inches long, collected from Lumbucan Island, near Balabac, Palawan Province, November 29, 1927. Another specimen, No. 28469 collected from the same place and on the same date is also in the collection.

This is the first species of *Myxus* reported from the Philippines. Günther (1861) as well as Weber and de Beaufort (1922) recorded only one species of this genus from the Indo-Australian region, namely, *M. elongatus*. Mohr (1927) described nine new species of *Myxus* and registered seven old species. The present species resembles *Myxus goniocephalus* Mohr in having the profile of the lower jaw more or less angular, but it is distinct from all other hitherto described forms in having the prominent, wide and deep notch on the preorbital.

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ILLUSTRATIONS

PLATE 1. SCALES OF PHILIPPINE MULLETS

FIG. 1. *Mugil engeli.*
2. *Mugil dussumieri.*
3. *Mugil longimanus.*
4. *Mugil crenilabris.*
5. *Mugil cephalus.*
6. *Mugil macrolepis.*
7. *Mugil melinopterus.*
8. *Mugil cæruleomaculatus.*
9. *Myxus philippinus.*
10. *Mugil seheli.*
11. *Mugil banksi.*
12. *Mugil vaigiensis.*
13. *Cestræus oxyrhynchus.*

PLATE 2

FIG. 1. *Myxus philippinus,* character sketch.
2. *Mugil banksi,* ventral view of head.
3. *Mugil ceramensis,* scale.
4. *Mugil ceramensis,* ventral view of head.

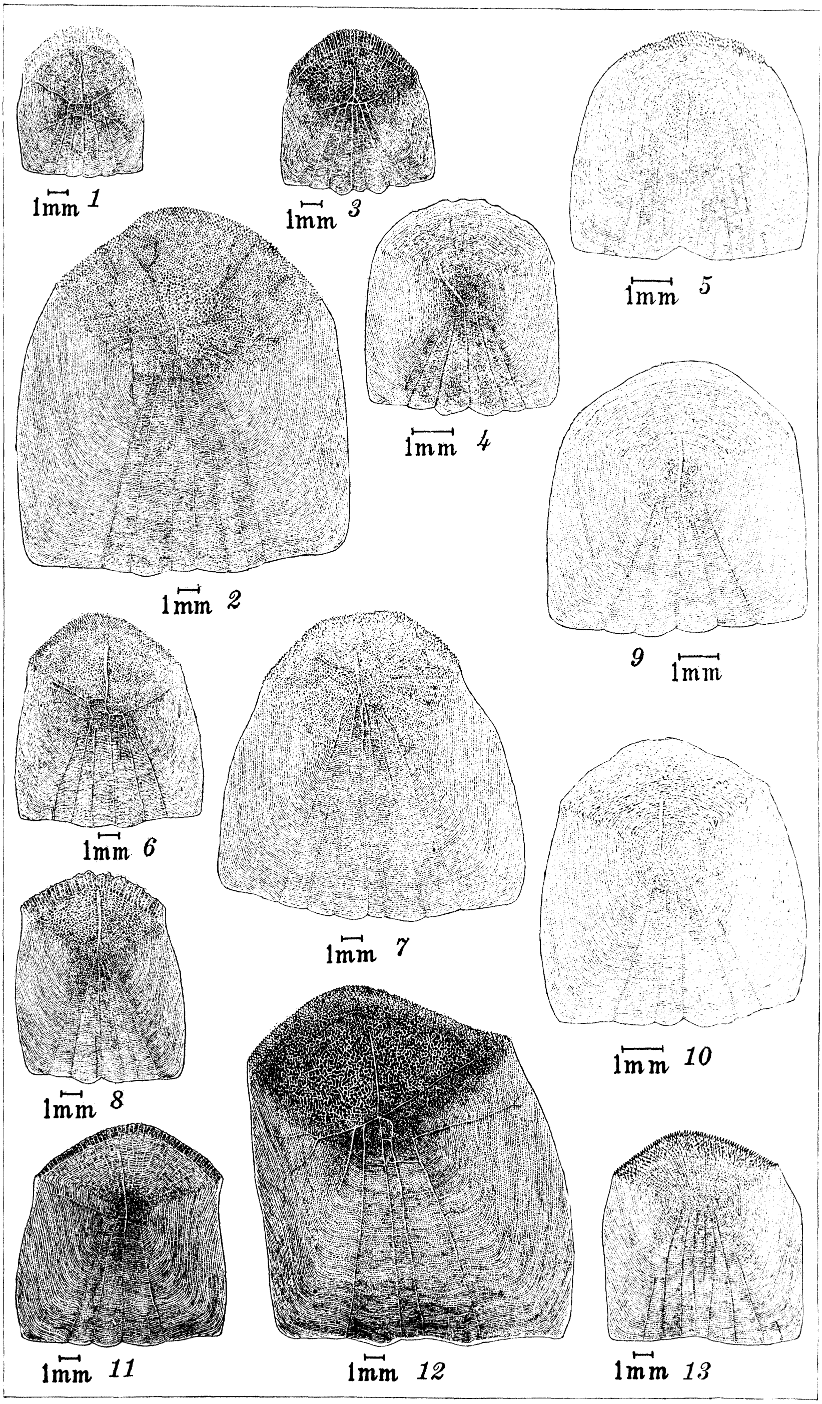
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PLATE 1.

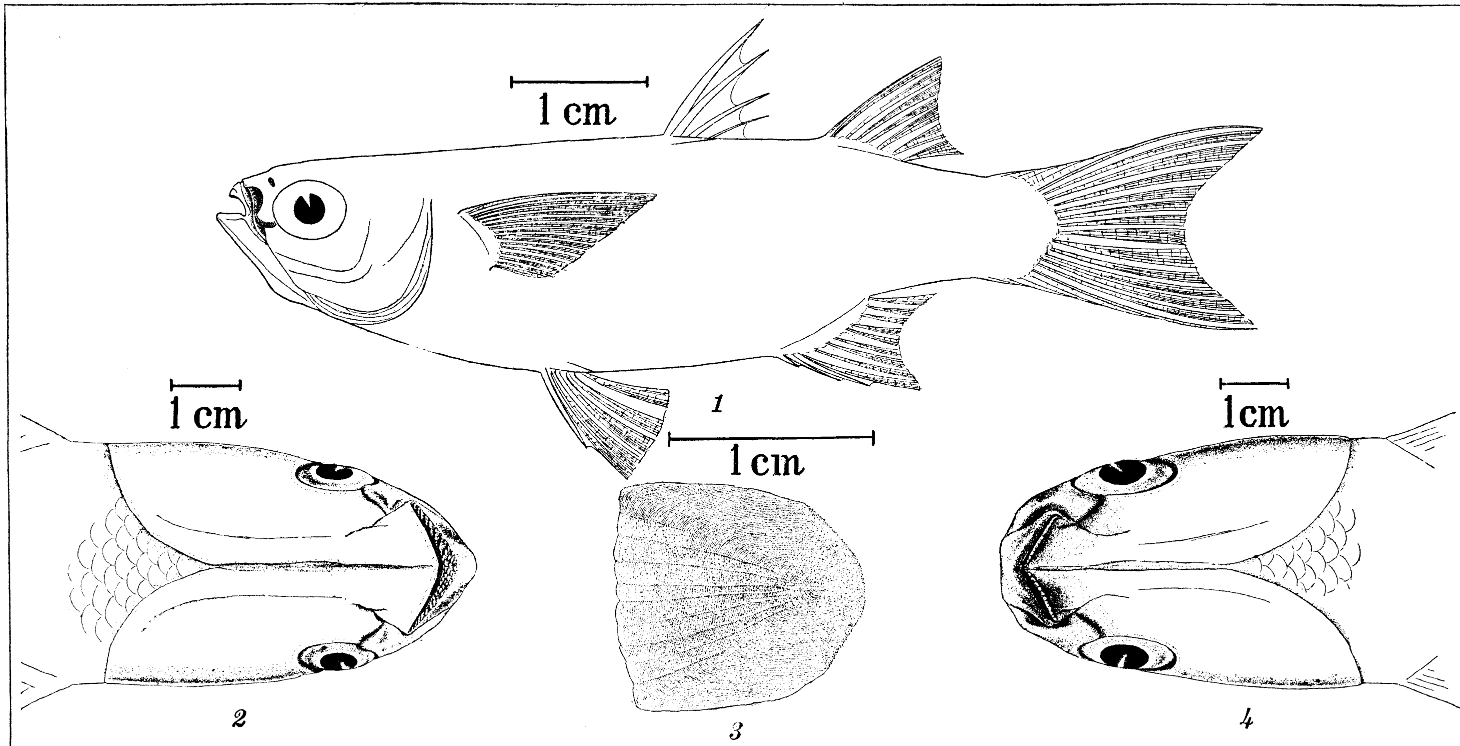

PLATE 2.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XX[1]

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

TWO PLATES

The majority of the species of crane flies discussed herewith are from western Java where they were taken by Mrs. M. E. Walsh and Mr. Owen Bryant; this material is preserved in my collection, the Bryant material through the friendly interest and generosity of the late Mr. Charles W. Johnson. Other species considered are from northern Celebes, collected by Mr. Charles F. Clagg, and from New Caledonia, taken by Dr. Jean Risbec, this material likewise being in my possession through the kindness of the collectors. A further important series of species are from northeastern New Guinea, where they were secured by the late Ludwig Biró, former Custos of the Hungarian National Museum, and loaned me for study by Dr. Z. Szilady; the types of this material are preserved in the Hungarian National Museum. Much of this last-mentioned material had earlier been reviewed by Riedel,[2] but in several instances, due to the incomplete knowledge of the Tipulidæ of Australasia and Wallacea at that date, many of the species had been left incompletely determined by Riedel and are further discussed at this time.

TIPULINÆ

PSELLIOPHORA LUCTUOSA de Meijere.

Pselliophora luctuosa DE MEIJERE, Tijd. voor Ent. 59 (1916) 199.

This superb fly was described from a unique female taken on the Goenoeng Susuruh, Preanger, western Java, by Corporaal. A small series is now available, including the hitherto unknown male, which is herewith defined as allotype.

[1] Contribution from the entomological laboratory, Massachusetts State College.

[2] Ann. Mus. Nat. Hungarici 18 (1921) 129–144.

Allotype, male, Djampangs, western Java, altitude 1,500 to 2,000 feet, April 27, 1933 (*Walsh*).

Male.—Length, about 16 millimeters; wing, 17.

Characters almost exactly as in female, except in the usual sexual differences. Head more orange than brownish red. Maxillary palpi with basal three segments obscure yellow, the terminal segment abruptly blackened. Wings intensely black. Abdomen black, with pale yellow on middle of tergites three to five and extreme caudal margin of two.

Other specimens: Males and females, Djampangs, 1,500 to 2,000 feet, February to May, 1933 (*Walsh*); one female, Wynkoops Bay, western Java, April, 1933 (*Walsh*).

PSELLIOPHORA TINCTIPENNIS ORBITALIS subsp. nov.

Male.—Length, about 12.5 millimeters; wing, 12.

Female.—Length, about 15 to 17 millimeters; wing, 13 to 15.5.

Agreeing closely with typical *tinctipennis* Edwards, of Burma and the Malay Peninsula,[3] differing in the following regards:

Female.—Head black, conspicuously pruinose; frontal prolongation of head light ashy gray; orbits and occiput conspicuously more ocherous. Halteres entirely black. Wings with cell M_1 short-petiolate; fringe of setæ on petiole long and relatively abundant. Abdomen with basal four tergites and extreme cephalic end of fifth orange; succeeding tergites, including genital shield and all valves, deep black; basal five sternites orange, with a further slight encroachment onto the sixth segment.

Male.—Similar. Antennæ entirely black, including all branches. Præscutum with three more-saturated stripes that are but little evident against the ground. Abdomen orange; segments five to eight black, excepting the extreme bases of both the tergite and sternite of segment five; segment nine chiefly obscure reddish orange, the outer ends and appendages blackened.

Habitat.—Western Java.

Holotype, male, Djampangs, altitude 1,500 to 2,000 feet, May, 1933 (*Walsh*). Allotopotype, female. Paratypes, 1 female, Djampangs Tengah, altitude 1,500 to 2,000 feet, February, 1933 (*Walsh*); 2 females, Selabintanah, Mount Gedeh, altitude 3,000 feet, March, 1933 (*Walsh*).

I believe that when the males of the two forms are available for direct comparison the present fly will require specific ranking.

[3] Bull. Raffles Mus. 7 (1932) 65–66.

Genus DOLICHOPEZA Curtis

Subgenus EUNESOPEZA subgen. nov.

Characters as in *Nesopeza* Alexander, differing in the presence of only three outer branches of media, interpreted as being M_{1+2} M_3, and M_4, with veins M_1 and M_2 fused to the margin.

Type of subgenus.—*Dolichopeza* (*Nesopeza*) *defecta* Edwards (Oriental: North Borneo).

Dolichopeza (*Nesopeza*) *epiphragmoides* Edwards (North Borneo) likewise belongs here. My good friend Edwards,[4] in describing the above very distinct species of *Dolichopeza,* did not consider the venational feature described above as being of primary importance. However, the presence of only three outer branches of media is so uncommon in the entire subfamily Tipulinæ (*Idiotipula* Alexander, Ethiopian; *Xenotipula* Alexander, Ethiopian; *Leptotarsus* Guerin: *Pseudoleptotarsus* Alexander, Australian; *Tipula* Linnæus: *Nesotipula* Alexander, Nearctic) that I believe the present group should rank as a subgenus.

DOLICHOPEZA (NESOPEZA) NEBULICOLA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

Nesopeza gracilis de Meijere (in part); ALEXANDER, Proc. U. S. Nat. Mus. **49** (1915) 179.

Allied to *gracilis;* mesonotal præscutum reddish brown without clearly defined stripes; dorsal pleurites darkened, the ventral pleurites and all coxæ light yellow; wing veins brown; male hypopygium with the outer dististyle narrow, the apex a glabrous point; eighth sternite with the caudal margin almost evenly rounded, without lobes, the border on either side of the midline with two large setiferous punctures.

Male.—Length, about 10 millimeters; wing, 10.5.

Rostrum dark brown; palpi black. Antennæ with basal three segments light yellow; remainder broken. Head dark brown, the anterior vertex more pruinose; anterior vertex approximately twice as wide as diameter of scape.

Mesonotal præscutum reddish brown, without clearly defined stripes; scutal lobes testaceous brown, the centers of lobes more reddish brown; posterior sclerites of notum reddish brown. Pleura with dorsal sclerites, including the anepisternum, dorsal pteropleurite and pleurotergite dark brown; ventral pleurites

[4] Journ. Fed. Malay St. Mus. **17** (1933) 289.

and all coxæ pale yellow. Halteres pale yellow, knobs brownish black. Legs with coxæ as described; trochanters yellow; remainder of legs broken. Wings (Plate 1, fig. 1) with the brown pattern of *gracilis* and allies; central portion of cell Sc_2 brightened; veins brown, including the medial veins. Macrotrichia of veins relatively abundant, including a series on distal third of vein 1st A. Venation: Spur at origin of Rs long and gently curved; medial forks deep; m-cu more than one-half its length before the fork of M.

Abdomen with basal segments more or less bicolorous, yellow and brown, the outer segments more uniformly darkened; hypopygium dark. Male hypopygium with the ninth tergite having only a low, obtuse, median lobule. Outer dististyle (Plate 2, fig. 25, *od*) unusually slender, especially in lateral view, as shown, the tip narrowed into a glabrous point. Eighth sternite, 8*s*, with caudal margin evenly rounded or with the median portion narrowly truncate, the mid-area at margin pale and membranous, continued caudad the entire length of sclerite as a weak impressed line; at caudal border, on either side of midline, with two short points on either side, these apparently representing basal spurs of powerful setæ.

Habitat.—Western Java.

Holotype, male, Tjibodas, Mount Gedeh, altitude 9,000 feet, 1909 (*Bryant and Palmer*). Paratopotype, male, in United States National Museum, determined by myself as *gracilis*, 1914.

It is evident that there are numerous Malayan species of *Nesopeza* that are closely allied to *gracilis* but differ in a decisive manner in the structure of the male hypopygium. The present fly and the species next to be described had earlier been misdetermined by me as being *gracilis*. Edwards [5] has described the hypopygium of *gracilis* which has thus been shown to be a very distinct fly, with a greatly modified eighth sternite. I have male specimens of this same species from Sumatra and Java and it is evident that Edwards's conception of *gracilis* is the correct one.

DOLICHOPEZA (NESOPEZA) INSOLIDA sp. nov. Plate 2, fig. 26.

Nesopeza gracilis de Meijere (in part); ALEXANDER, Proc. U. S. Nat. Mus. **49** (1915) 179.

Allied to *gracilis;* mesonotum light reddish brown to testaceous brown, unmarked; dorsal pleurites darkened, the ventral pleu-

[5] Bull. Raffles Mus. 7 (1932) 53.

rites and all coxæ clear light yellow; wings whitish subhyaline with a dark costal pattern; veins of undarkened portions light yellow; anterior cord nearly transverse; abdominal tergites darkened, with an obscure yellow area on sides at near midlength of the segments; male hypopygium with median lobe of tergite very low and obtuse; outer dististyle long and narrow, with setæ to apex; inner dististyle with a deep U-shaped incision on side; eighth sternite broadly transverse, the caudal margin very gently rounded, without setæ except on sides.

Male.—Length, about 9 millimeters; wing, 9.

Frontal prolongation of head dark brown; palpi brown. Antennæ with basal two segments yellow, flagellum brown; flagellar segments long-cylindrical, with dense short pubescence and short verticils. Head light brown; anterior vertex relatively narrow.

Mesonotum entirely uniform light reddish brown to testaceous-brown, unmarked. Pleura with the dorsal sclerites darkened, extending from the propleura to base of abdomen, the ventral pleurites abruptly light yellow. Halteres yellow, the knobs blackened. Legs with the coxæ and trochanters pale yellow; femora whitish yellow, the tips blackened; tibiæ white, the tips narrowly blackened; tarsi white. Wings with the ground color whitish subhyaline, the dark costal pattern about as in *gracilis;* a whitish spot in basal costal cell, before h; dark seam on anterior cord narrow and nearly transverse in position; no darkening on posterior cord or on posterior margin at termination of vein Cu; veins of undarkened portions of wing light yellow, much paler than in *nebulicola.* Venation: Spur at origin of Rs straight; anterior cord nearly transverse; medial forks shallower than in *nebulicola;* cell 2d A a little narrower.

Abdominal tergites chiefly darkened, the segments variegated with obscure yellow on sides at near midlength of the segments; outer segments more uniformly darkened. Male hypopygium with the median lobe of tergite very low and obtuse. Outer dististyle (Plate 2, fig. 26, *od*) relatively long and narrow, with conspicuous setæ to apex. Inner dististyle, *id,* with a deep U-shaped incision, cutting off a slender basal lobe from the outer beaklike portion. Eighth sternite, *8s,* broadly transverse, the caudal margin very gently rounded, entire; median area without setæ, these punctures occurring on subbasal half of sclerite and on sides of the rounded portion.

Habitat.—Western Java.

Holotype, male, Tjibodas, Mount Gedeh, altitude 4,500 feet, 1909 (*Bryant and Palmer*). Paratopotype, male, in United States National Museum, determined by myself as *gracilis*, 1914.

The distinctions between this species and the other regional members of the group are indicated in the above diagnosis and in the account given under the description of *Dolichopeza* (*Nesopeza*) *nebulicola* sp. nov.

DOLICHOPEZA (NESOPEZA) SUBCUNEATA sp. nov. Plate 1, fig. 2; Plate 2, figs. 27, 28.

Belongs to the *cuneata* group; most nearly allied to *cuneata*, differing chiefly in the details of the male hypopygium; ninth tergite with median lobe short, the lateral shoulders obtuse; outer dististyle short and dusky; eighth sternite large and conspicuously sheathing, its caudal margin obtusely rounded.

Male.—Length, about 10 millimeters; wing, 10.5.

Female.—Length, about 11.5 millimeters; wing, 10.8.

Frontal prolongation of head obscure yellow; basal two segments of palpi yellow, terminal segments blackened. Antennæ with pedicel light yellow, the remainder of organ black; flagellar segments (male) with very short verticils. Head with anterior vertex brownish yellow, the posterior portions darker brown.

Mesonotal præscutum with four dark reddish brown stripes that are a trifle paler than the interspaces; posterior sclerites of notum uniformly darkened. Pleura yellow, variegated with brown, the latter color on the anepisternum, dorsal pteropleurite, dorsal pleurotergite, ventral sternopleurite, and ventral meral region. Halteres elongate, pale yellow, the knobs blackened. Legs with coxæ and trochanters pale yellow; femora brown, obscure yellow basally, the tips passing into black; tibiæ brownish black, the tips passing into black, the extreme bases whitened; basitarsi extensively blackened, the fore pair white at both ends, the bases about one-half as extensively as the tips; mid-pair with only the tips narrowly whitened; posterior pair with the black ring narrow, the bases and tips broadly and subequally whitened; remainder of tarsi white, the last segment a little darkened. Wings (Plate 1, fig. 2) with a dusky tinge, cell Sc more darkened; stigma oval, dark brown; veins black. Venation: Rs subequal to or shorter than R_{2+3}; m-cu only a short distance before fork of M; Cu_2 reaching wing margin; vein 2d A running very close to the anal margin, as in group.

Abdominal segments bicolorous, the incisures brownish black, the bases more narrowly darkened; intermediate portions of segments narrowly obscure yellow; sternites more extensively pale.

Male hypopygium with the median lobe of tergite (Plate 2, fig. 27, 9*t*) shorter than in *cuneata* (Plate 2, fig. 28, 9*t*), the lateral shoulders obtuse, acute in *cuneata*. Outer dististyle, *od*, short and dusky, in length considerably shorter than the inner dististyle, *id*. Eighth sternite conspicuously sheathing, much larger than in *cuneata*, its apex obtusely rounded, provided with setæ of moderate length; in *cuneata*, the margin transverse or subtransverse, with long powerful setæ.

Habitat.—Western Java.

Holotype, male, Bibidjilan, Djampangs, altitude 2,000 feet, September, 1933 (*M. E. Walsh*). Allotopotype, female.

Although closely allied to *Dolichopeza* (*Nesopeza*) *cuneata* Edwards (North Borneo, in mountains), I must regard the present fly as being distinct. It is more remotely allied to *D.* (*N.*) *angusta* Edwards (Malay Peninsula) and *D.* (*N.*) *sandakanensis* Edwards (Borneo, lowlands), which again differ chiefly in the structure of the male hypopygia.

SCAMBONEURA MINAHASA sp. nov. Plate 1, fig. 3.

Thoracic dorsum reddish yellow, without markings; antennal flagellum bicolorous; legs yellow throughout, the outer tarsal segments darkened; wings light yellow, cell Sc clearer yellow; anterior cord subtransverse, only slightly bowed; abdominal tergites yellow, each with a quadrate blackish area on disk, these broadly interrupted at the incisures.

Female.—Length, about 16 to 17 millimeters; wing, 12.5 to 13.5.

Frontal prolongation of head, including nasus, yellow; palpi yellow, only the terminal segment darkened. Antennæ with scape, pedicel, and first flagellar segment yellow; succeeding flagellar segments bicolorous, the bases brownish black, the apices obscure yellow, on outer segments uniformly darkened. Head obscure yellow, the occipital brand lacking or scarcely differentiated from the color of the remainder of head.

Mesonotum uniform reddish yellow, without markings, the surface subnitidous. Pleura yellowish testaceous, unmarked. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters yellow, remainder of legs yellow, the outer tarsal segments passing into brownish black. Wings (Plate 1, fig. 3) with the ground color light yellow, cell Sc clear yellow; stigma brown; veins brown, prearcular veins and Sc more yellowish. Macrotrichia of veins of moderate length only. Venation: Anterior cord only slightly bowed, subtransverse, the inner end of cell R_5 a very little more proximad than that of cell R_3; a strong arcuation on r-m near its cephalic portion; Rs lying distinctly distad of r-m.

Abdominal tergites yellow, each with a quadrate blackish area on disk, broadly interrupted on the incisures, more broadly so on the bases of the segments than on the apices; sternites pale but almost hidden by the tergites, the exposed outer two sternites more darkened.

Habitat.—Northern Celebes.

Holotype, female, Roeroekan, Minahassa, altitude 4,000 feet, April 18, 1931 (*Clagg*). Paratopotype, female, April 13, 1931.

The species is named after an aboriginal tribe of northern Celebes, the Minahasa. In the venation, especially the subtransverse anterior cord, the present fly is closest to the otherwise very different *Scamboneura subtransversa* Alexander (Luzon). In the immaculate mesonotum, it agrees more nearly with *S. claggi* Alexander (Mindanao) and *S. primogenia* Alexander (Luzon), differing in the venation and bicolorous flagellum. The venation of *S. minahasa* is very like that of the species identified by Edwards from north Borneo as *S. quadrata* de Meijere.[6] According to de Meijere's original description of *quadrata*[7] his species (from Java) has a venation agreeing exactly with Osten Sacken's figure of *S. dotata* Osten Sacken[8] that is with the strongly bowed anterior cord of the wing, quite different from the more-generalized condition obtaining in the present fly.

SCAMBONEURA SUBFACETA sp. nov. Plate 1, fig. 4.

Mesonotum yellow, the præscutum with three blackish stripes that are not bordered by darker; scutellum and mediotergite yellowish; antennal flagellum brownish black; wings with a faint brown tinge; stigma unusually small, brown; abdominal tergites yellow, with large brownish black areas on each segment.

Female.—Length, about 17 millimeters; wing, 14.5.

Frontal prolongation of head yellow, more orange-yellow dorsally; nasus long and slender; basal segment of palpi testaceous, the outer segments brown. Antennæ with scape orange-yellow, pedicel yellow; flagellum brownish black, the distal ends of basal three segments very vaguely paler but the organ definitely unicolorous. Head obscure brownish orange, the small occipital brand darker, its limits not well-marked.

[6] Journ. Fed. Malay St. Mus. 16 (1931) 504.
[7] Tijd. voor Ent., Suppl. 56 (1913) 8–9.
[8] Berlin. Ent. Zeitschr. 26 (1882) 95, fig. 1.

Pronotum reddish brown, bordered by yellow. Mesonotum yellow, the præscutum with three blackish stripes that are not bordered by other colors, the median stripe with lateral margins of cephalic portion vaguely pruinose, the remainder of stripes polished; scutal lobes almost entirely covered by a polished black area on each; scutellum brownish yellow, the extreme cephalic end clearer yellow; mediotergite yellow, the posterior border darker. Pleura obscure yellow, vaguely patterned on anepisternum with more reddish. Halteres obscure yellow, the extreme base of stem pale. Legs with the coxæ and trochanters yellow; femora brownish yellow, clearer yellow basally; tibiæ light brown; tarsi passing into brownish black. Wings (Plate 1, fig. 4) with a faint brownish tinge, cell Sc more yellowish; stigma unusually small, brown; veins brownish black. Venation: R_3 elongate, running close to costa, with trichia only on basal third, the distal portion whitish; anterior cord strongly bowed, as usual in the more-specialized forms of the genus, the most basal point being on r-m just before it unites with R_{4+5}; forks of medial cells deep.

Abdominal tergites with a large brownish black area on each segment, narrow on basal portion, thence broadened and occupying the disk of the segment, the caudal and lateral margins broadly yellow; sternites uniformly yellow.

Habitat.—Northern Celebes.

Holotype, female, Roeroekan, Minahassa, altitude 4,000 feet, April 17, 1931 (*Clagg*).

Although very close (at least in the female sex) to *Scamboneura faceta* Alexander (Alabat Island, Luzon) I must regard the present fly as being distinct. The coloration of the posterior sclerites of the mesonotum and the details of venation of the radial field, especially the length and close approximation to the costal margin of vein R_3, furnish the most obvious characters in this sex.

MACROMASTIX RISBECI sp. nov. Plate 1, fig. 5.

Antennæ (male) elongate; with abundant, relatively short, erect setæ; eyes (male) very large, reducing the vertex to a narrow strip; general coloration of thorax light reddish brown, the pleura yellow; wings brownish yellow, the oval stigma dark brown; abundant macrotrichia on outer radial and medial veins; r-m connecting with Rs before its fork; cell M_1 short-petiolate; m-cu at midlength of cell 1st M_2; abdominal tergites conspicuously dimidiate, dark brown, broadly margined caudally with yellow; sternites chiefly light yellow; hypopygium dark brown.

Male.—Length, about 7.5 millimeters; wing, 9.5; antenna, about 11.

Frontal prolongation of head of moderate length, about one-third the remainder of head, light brown, without nasus; palpi dark brown. Antennæ (male) elongate, exceeding the wing in length; second to seventh flagellar segments longer than the first; flagellar segments with an abundant erect pubescence that is much shorter than in the male sex of *cockerellæ*, the longest not exceeding three times the diameter of segment at point of insertion; on first flagellar segment, the setæ are even finer and denser, the longest shorter than the diameter of the segment; scape and pedicel yellow; basal flagellar segments obscure yellow, the apices narrowly darkened, this color becoming more extensive on the fourth segment, the succeeding segments uniformly dark brown. Eyes very large, on dorsum reducing the vertex to a narrow strip; visible portions of head testaceous brown.

Pronotum obscure yellow. Mesonotal præscutum and scutum uniformly light reddish brown, the former somewhat darker in front; scutal lobes with centers slightly darkened; scutellum testaceous brown; mediotergite light brown, pale laterally. Pleura yellow, the pleurotergite light brown. Halteres dark brown, the base of stem narrowly yellow. Legs with the coxæ and trochanters yellow, the mid-coxæ slightly darker; femora obscure yellow, the tips narrowly blackened, the amount subequal on all legs; tibiæ dark brown; tarsi brownish black. Wings (Plate 1, fig. 5) with the ground color brownish yellow, cells C and Sc clearer yellow; stigma oval, dark brown; wing tip and margin as far back as vein Cu_1 insensibly suffused with brown; very narrow and ill-defined darkenings along cord, most evident on anterior cords; veins brown, more yellow in the costal field. An abundant series of macrotrichia on entire length of veins R_3, R_{4+5}, M_1, M_2, M_3, M_4, and distal section of Cu_1; no trichia on R_{1+2} or R_2. Venation: R_{1+2} about in longitudinal alignment with R_2; r-m connecting with Rs immediately before the fork; cell M_1 very deep, its petiole only about one-third m; basal section of M_3 longer than m and not in transverse alignment with it, so m-cu is at midlength of cell 1st M_2; cell 2d A wide.

Abdominal tergites conspicuously bicolorous; segment one obscure yellow; segment two dark brown on basal ring, the apical ring yellow; segments three and four dark brown basally, the apices broadly yellow; segment five uniformly brownish black; segments six and seven almost uniformly yellow; sternites light yellow, the apices of segments five and six narrowly darkened; hypopygium dark brown.

Habitat.—New Caledonia.

Holotype, male, Poindimie, July 13, 1931 (*J. Risbec*).

I take great pleasure in naming this distinct fly in honor of Prof. Jean Risbec, distinguished malacologist. The interrelationships of the four species of *Macromastix* now known from New Caledonia are shown by the following key.

Key to the species of Macromastix of New Caledonia.

1. Wings veins beyond cord with numerous trichia, including complete series on veins R_3, M_1, M_2, M_3, M_4, and distal section of Cu_1; r-m connecting with Rs before fork; antennæ (male) elongate. *risbeci* sp. nov.
   Wing veins beyond cord glabrous or nearly so, at most with an incomplete series on outer portion of vein R_{4+5}; r-m connecting with R_{4+5}, the basal section of the latter conspicuous; antennæ (male) short or elongate .... 2.
2. Antennæ short in both sexes; m-cu opposite midlength of cell 1st M_2, the basal section of M_3 not being in alignment with m. *novocaledonica* Alexander.
   Antennæ (male) elongate, in female shorter but still about as long as the thorax alone; m-cu opposite or beyond the outer end of cell 1st M_2, the basal section of M_3 being in transverse alignment with m or approximately so .... 3.
3. Abdominal tergites uniformly dark brown; antennæ (male) of moderate length, subequal to wing (12 millimeters or less). *cockerellæ* Alexander.
   Abdominal tergites conspicuously ringed caudally with silvery; antennæ (male) very long (20 millimeters), being about a third longer than wing .... *caledoniana* sp. nov.

MACROMASTIX CALEDONIANA sp. nov. Plate 1, fig. 6.

Antennæ (male) elongate, the flagellar segments with abundant long erect setæ; thorax obscure yellow, the præscutum with four reddish brown stripes; wings pale yellowish subhyaline, the stigma scarcely darker; outer veins of wing without trichia, excepting a series on outer half of R_{4+5}; r-m a little longer than the basal section of R_{4+5}; m-cu opposite outer end of cell 1st M_2; abdominal tergites dark brown, the caudal borders broadly silvery gray.

Male.—Length, about 12 millimeters; wing, 15; antenna, about 20.

Frontal prolongation of head light brown; palpi more testaceous-yellow, the terminal segment darkened. Antennæ (male) elongate, much exceeding the wing length; first flagellar segment relatively short, less than one-half the second; second segment nearly three-fourths the third; flagellar segments with long erect setæ that are much longer than the diameter of segment at point of insertion; on first segment about four times this diameter, on the outer more slender segments six or seven times this diameter; scape and pedicel brownish yellow; basal flagellar segments brownish yellow, the outer segments more uniformly dark brown. Eyes large; anterior vertex wide, approximately twice the diameter of scape, reddish brown, suffused with darker brown.

Mesonotal præscutum short, obscure yellow, with four reddish brown stripes, intermediate pair confluent in front; anterior interspaces with golden yellow setæ; scutum and scutellum more testaceous-yellow, the scutal lobes slightly and indistinctly darkened; mediotergite yellowish gray. Pleura yellow, the propleura and posterior portion of anepisternum infuscated; a linear blackish area on cephalic border of pteropleurite, ventrad of wing root. Halteres with stem pale yellow, knobs broken. Legs with the coxæ and trochanters yellowish testaceous; femora obscure yellow, the tips narrowly brownish black; tibiæ obscure yellow, the outer ends and the tarsi brownish black. Wings (Plate 1, fig. 6) pale yellowish subhyaline, cell Sc weakly darkened; stigma scarcely darker; veins bright reddish brown. No macrotrichia on vein R_3 or on any medial veins; a series of trichia on distal half of outer section of R_{4+5}. Venation: Free tip of Sc_2 lying very close to R_{1+2} and parallel with it, cell Sc_2 thus very narrow; R_{1+2} in longitudinal alignment with R_2, r-m only a trifle longer than basal section of R_{4+5}; petiole of cell M_1 a little shorter than m; basal section of M_3 in transverse alignment with m, m-cu lying on M_4 beyond the fork and thus opposite or slightly beyond the outer end of cell 1st M_2; cell 2d A wide.

Abdominal tergites beyond the brownish yellow first segment dark brown, the caudal borders broadly silvery gray; seventh tergite chiefly yellow; remaining segments and hypopygium chiefly dark brown; sternites yellow, the outer segments darkened.

Habitat.—New Caledonia.

Holotype, male, Ponerihouen, July 7, 1931 (*J. Risbec*).

The nearest ally of the present fly is *Macromastix cockerellæ* Alexander, as is shown by the key to the species in New Caledonia given with the preceding form.

TIPULA LEUCOSTICTA sp. nov. Plate 1, fig. 7; Plate 2, fig. 29.

Belongs to the *omissinervis* group; antennal flagellum bicolorous; mesonotal præscutum with three reddish brown stripes that are narrowly bordered by darker brown; tarsi and tips of tibiæ white; wings with a restricted but conspicuous brown pattern, together with several small white to yellowish white spots; m-cu opposite midlength of M_{3+4}; male hypopygium with the outer dististyle terminating behind in an acute spinous point.

Male.—Length, about 15 millimeters; wing, 16.

Frontal prolongation of head light brown; nasus long and slender. Antennæ relatively short, only a little longer than the combined head and front; basal three segments light yellow; succeeding segments bicolorous, black basally, the tips yellow, the outer segments more uniformly darkened; verticils very long and conspicuous, exceeding twice the length of the segments.[9] Head obscure fulvous, the center of vertex darker, sending a narrow brown vitta onto the low vertical tubercle.

Pronotum dark brown above, gray laterally. Mesonotal præscutum with the ground color grayish brown, with three reddish brown stripes that are narrowly bordered by darker, the lateral margin of the median stripe connected across humeri with the pseudosutural fovea by a dusky line, delimiting the interspaces in front; extreme cephalic portion of median stripe with a black streak, indicating the position of a normal median dark vitta; scutellum and mediotergite reddish brown, more grayish laterally. Pleura pale yellow, variegated by pale brown spots. Halteres elongate, dark brown, base of stem light yellow. Legs with coxæ pale yellow, variegated by pale brown spots at tips and bases; trochanters pale yellow; femora light brown, the tips passing into black; tips of tibiæ and the tarsi yellowish white; remainder of tibiæ brownish black (Riedel says with white rings at bases of tibiæ, legs now badly broken). Wings (Plate 1, fig. 7) with a faint brown tinge, stigma and costal region darker brown; arcular region narrowly darkened; a narrow seam along cord, broken at fork of M; outer radial cells to wing tip narrowly darkened; a brown spot at just beyond one-third the length of cell Cu, followed by a clear hyaline spot of equal size; several white or yellowish white spots on wing, as follows: A major area before stigma and anterior cord; a small poststigmal area; small yellow spots at ends of veins R_3 and R_{4+5}; white obliterative points across cell 1st M_2, including basal sections of veins M_{1+2} and M_3; veins very delicate, brown. Veins behind R unusually glabrous, with a single strong seta

[9] As figured by Riedel, as *Tipula venusta;* Ann. Mus. Nat. Hungarici 18 (1921) 142, fig. 7.

on Rs. Venation: R_{1+2} entirely atrophied, as in group; Rs short, pale; cell 1st M_2 large; m-cu at midlength of vein M_{3+4}; petiole of cell M_1 about twice m; Cu_2 extending entirely to margin; cell 2d A of moderate width.

Abdomen darkened. Male hypopygium (Plate 2, fig. 29) with the tergite, *9t*, separated from the sternite, *9s*, by membrane; basistyle entirely fused with sternite except for a delicate ventral suture. Ninth tergite, *9t*, with the caudal margin having a broad V-shaped notch, the lateral lobes thus formed obliquely truncated, with abundant setigerous punctures; dorsal portion of tergite entirely without a median depressed line. Outer dististyle, *od*, with the cephalic lobe flattened, the posterior portion directed caudad and mesad into a powerful spine that terminates in a blackened point and bears another similar black spine on side before tip (*od, va,* ventral aspect). Inner dististyle, *id*, with a blackened detached blade on inner face near base; outer margin of style with long delicate setæ in an almost continuous row, as in most species of *Indotipula.* Eighth sternite, *8s*, unarmed.

Habitat.—New Guinea.

Holotype, male, Stephansort, Astrolabe Bay, March 30, 1900 (*Biró*).

This specimen had earlier been referred to *Tipula* (*Tipulodina*) *venusta* Walker by Riedel,[10] but certainly does not pertain to that subgenus or species. It is allied to *Tipula omissinervis* de Meijere, *T. dentata* de Meijere, and *T. divergens* de Meijere, all from various parts of New Guinea. The coloration of the legs of the present fly readily separates it from all of the three allies indicated. It seems certain that a new subgeneric group will be required for these species, falling close to *Acutipula* Alexander, *Indotipula* Edwards, and *Tipulodina* Enderlein.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) PACATELLA sp. nov. Plate 1, fig. 8.

Belongs to the *pacata* group; mesonotal præscutum with cephalic and lateral portions broadly obscure brownish yellow, the central portion of disk dark brown; dorsal pleurites largely covered by a broad, brownish black, longitudinal stripe.

Female.—Length, about 4.5 millimeters; wing, 4.5.

[10] Loc. cit.

Rostrum and palpi brownish black. Antennæ black throughout; flagellar segments oval, the terminal segment considerably longer than the penultimate. Head brownish black.

Mesonotal præscutum with cephalic and lateral portions broadly obscure brownish yellow, the restricted central portion of disk dark brown, the latter color thus virtually restricted to the posterior portion of the usual median stripe; scutal lobes dark brown, the median region of scutum narrowly pale; posterior sclerites of notum brown. Pleura obscure brownish yellow dorsally, with a broad, brownish black, longitudinal stripe extending from the cervical region to the abdomen, inclosing the root of halteres; ventral sclerites, including the entire sternopleurite and meral region, abruptly light yellow. Halteres blackish, the extreme base of stem obscure yellow. Legs with fore coxæ weakly darkened basally; remaining coxæ and trochanters yellow; femora and tibiæ brown, the tips still darker; tarsi paling to dirty brownish white. Wings (Plate 1, fig. 8) with a brownish tinge, the oval stigma darker brown; a very vague darkening along cord and vein Cu_1; veins brown. Venation: Sc relatively long, Sc_1 ending about opposite three-fourths the length of Rs, Sc_2 at its tip; free tip of Sc_2 and R_2 in transverse alignment; Rs weakly angulated at origin, nearly three times the basal section of R_{4+5}; cell 1st M_2 open by atrophy of m; m-cu at fork of M; anal veins strongly convergent at bases.

Abdominal tergites dark brown; sternites light yellow. Ovipositor with cerci very small and slender at tips; hypovalvæ stouter, their bases conspicuously blackened.

Habitat.—Western Java.

Holotype, female, Soekaboemi, altitude 1,800 feet, June 3, 1933 (*M. E. Walsh*).

The nearest described ally is *Limonia* (*Limonia*) *subprolixa* Alexander (Mindanao), which differs in the larger size, more uniform coloration of the mesonotum, the scarcely or but slightly darkened thoracic pleura, and the details of venation, as the longer Rs and more extended cell 2d A. I am not at all certain that *L.* (*L.*) *pacatina* Edwards (North Borneo) belongs to this same group, despite the close resemblance in structure of the male hypopygium. Cell 1st M_2 is closed and the general appearance is rather different from the other members of the *pacata* group.

LIMONIA (LIBNOTES) RIEDELELLA sp. nov. Plate 1, fig. 9.

Libnotes species RIEDEL, Ann. Mus. Nat. Hungarici 18 (1921) 134.

The specimen upon which this description is based was received by me from Doctor Szilady in fragmentary condition, almost the only parts of the body remaining being the wings and legs. Since the chief specific characters in the subgenus lie in these two organs, I do not hesitate to describe this very distinct species as new, using some of the characters earlier mentioned by Riedel in his brief account of the fly as cited above (No. 17).

Male.—Length, about 15 millimeters; wing, 18.

Having the general appearance of *Limonia* (*Libnotes*) *affinis* (de Meijere). General coloration of entire body pale yellow. Legs yellow; femora before tips with a relatively narrow brown ring; tibiæ yellow, the tips narrowly dark brown, with a moderately broad brown subbasal ring, placed about its own length beyond the base and about one-half wider than the subapical ring on femora; tarsi yellow, the tips of segments one and two, and all of segments three and four, brown. (Riedel describes the tibia as having a subterminal dark ring but in the detached legs that I associate with the above fly, the coloration is more as noted.) Wings (Plate 1, fig. 9) yellowish, with a restricted brown pattern, including two larger areas at tip of Sc and tip of R_1, respectively; other smaller dark seams on veins, including the cord, outer end of cell 1st M_2, the supernumerary crossveins in radial field, a spot on R_3 before midlength and on the outer third of M_{1+2}; small marginal clouds on M_3, M_4, Cu_1, and the anal veins; axillary region darkened; veins yellow, darker in the clouded areas. Macrotrichia at base of costa small and relatively sparse. Venation: Free tip of Sc_2 and R_2 in transverse alignment, R_{1+2} extending just beyond this level as a scarcely apparent spur; radial veins very strongly deflected caudad; a supernumerary crossvein in each of cells R_3 and R_5, the former just beyond midlength, the latter just beyond one-third the length of cell.

Habitat.—New Guinea.

Holotype, a fragmentary male, Graget Island, May 1, 1901 (*Biró*).

There are only two described species of *Libnotes* having two supernumerary crossveins in the radial field of the wing (*regalis* Edwards, of Formosa; *diphragma* Alexander, of western China). The present fly differs notably from both of these flies in the pattern of the legs and wings. It should be noted that the relative position of the supernumerary crossveins is nearly the same in all species (that in cell R_5 being far proximad of the one in cell R_3, more or less in transverse alignment with the basal section of M_3). I name this fine species in honor of my old friend and coworker on the Tipulidæ, Postamtrat M. P. Riedel.

LIMONIA (LIBNOTES) DJAMPANGENSIS sp. nov. Plate 1, fig. 10.

General coloration of thorax almost uniformly reddish brown; rostrum, palpi, and antennæ black; legs reddish brown, only the terminal tarsal segments brownish black; wings with a weak brownish tinge, cells C and Sc more strongly infumed; stigma virtually lacking; R_2 and free tip of Sc_2 nearly in transverse alignment; tips of outer radial veins only slightly decurved; Rs longer than cell 1st M_2, only moderately oblique; m and basal section of M_3 in transverse alignment; m-cu at near two-thirds the length of cell 1st M_2; abdomen reddish brown, the subterminal segments blackened; ovipositor with valves very short, the blackened cerci bifid at tips.

Female.—Length, about 15 millimeters; wing, 13.

Rostrum black, a little longer than the scape; palpi black. Antennæ black throughout; basal flagellar segments oval, the middle ones more cylindrical with long verticils that are fully twice the length of the segments; outermost segments even more elongate, the terminal segment nearly twice as long as the penultimate. Head dark gray, the anterior vertex immediately cephalad of the eyes more golden-yellow; posterior vertex with a median dark vitta; anterior vertex reduced to a hairlike line, the eyes actually contiguous for a distance.

Pronotum blackish above, more brown on sides. Mesonotum almost uniformly reddish brown, the humeral and lateral portions of præscutum vaguely darker. Pleura reddish brown. Halteres relatively long and slender, black, the bases narrowly yellow. Legs with the coxæ and trochanters reddish brown; remainder of legs reddish brown, the outer tarsal segments brownish black. Wings (Plate 1, fig. 10) with a weak brown tinge, cells C and Sc much more strongly infumed; stigma so small as to be virtually lacking, including a tiny cloud at point of union of free tip of Sc_2 and R_2; certain of the longitudinal veins, especially Cu and the anterior branch of Rs, narrowly seamed with brown; wing tip and entire apical and posterior border very narrowly bordered with brown; axilla restrictedly darkened; veins brownish black to black. Venation: Free tip of Sc_2 and R_2 almost in transverse alignment, the latter only moderately long; outer radial veins at margin only weakly decurved; Rs longer than cell 1st M_2, only moderately oblique; cell 1st M_2 elongate, m and basal section of M_3 subequal and in transverse alignment; m-cu at near two-thirds the length of cell; anal veins convergent.

Abdomen reddish brown, unmarked except for extensively blackened areas on segments seven to nine, segment eight entirely blackened. Ovipositor with valves very short, piceous, the cerci with the tips bifid by apical notches; hypovalvæ a little exceeding the cerci.

Habitat.—Western Java.

Holotype, female, Djampang Tengah, altitude 1,500 to 2,000 feet, March, 1933 (*M. E. Walsh*).

By Edwards's key to the species of *Libnotes*,[11] the present fly runs to those species included between couplets 28 and 53, disagreeing in characters with all species beyond couplet 29. It is most similar to species such as *Limonia* (*Libnotes*) *ferruginata* Edwards (Buru), *L.* (*L.*) *rufata* Edwards (North Borneo), and *L.* (*L.*) *simplex* (Osten Sacken) (Ternate and North Borneo), differing in the coloration of the body, legs, and wings, venational details, structure of the anterior vertex, and nature of the ovipositor.

LIMONIA (LIBNOTES) MOPSA sp. nov. Plate 1, fig. 11.

Allied to *nigricornis;* general coloration of mesonotal præscutum almost concealed by a brownish black dorsal shield, comprised of three confluent stripes; rostrum, palpi, and antennæ black throughout; legs brown; wings faintly tinged with brown, cells C and Sc, with the small stigma, darker brown; wing apex and posterior border as far back as vein Cu_1 very narrowly seamed with brown; Sc_2 at tip of Sc_1; veins beyond cord unusually long, the distal section of M_{1+2} nearly three times the second section; m-cu at midlength of cell 1st M_2.

Female.—Length, about 5 millimeters; wing, 5.3.

Rostrum and palpi black. Antennæ black throughout; flagellar segments with very short, glabrous, apical pedicels; terminal segment strongly narrowed on outer half, longer than penultimate; longest flagellar verticils only slightly exceeding the segments. Head dark gray, lighter gray in front; anterior vertex reduced to a linear strip.

Pronotum obscure yellow. Mesonotal præscutum with ground color almost concealed by three confluent brownish black stripes, the humeri and lateral borders broadly obscure yellow; poste-

[11] Journ. Fed. Malay St. Mus. 14 (1928) 74–80.

rior sclerites of notum almost uniformly dark brown. Pleura, especially the dorsal sclerites, infuscated. Halteres dark brown, the base of stem yellow. Legs with coxæ and trochanters obscure yellow; remainder of legs uniformly brown. Wings (Plate 1, fig. 11) with a faint brown tinge, cells C and Sc, together with the small inconspicuous stigma darker brown; wing apex and posterior border as far back as vein Cu_1 very narrowly and insensibly seamed with brown; veins dark brown. Venation: Sc_1 ending just beyond fork of Rs, Sc_2 at its tip; Rs long, gently arcuated; free tip of Sc_2 and R_2 both pale, in approximate transverse alignment; veins beyond cell 1st M_2 elongate, last section of M_{1+2} nearly three times the second section; M_4 a little longer than cell 1st M_2; m and basal section of M_3 both short and subequal; m-cu at midlength of cell 1st M_2, about two-thirds as long as the distal section of Cu_1; anal veins parallel at bases.

Abdominal tergites dark brown, the pleural region and sternites more yellowish; cerci small and slender; hypovalvæ blackened at bases.

Habitat.—New Guinea.

Holotype, female, Stephansort, Astrolabe Bay, 1900 (*Biró*). Paratopotype, female.

By Edwards's key to the species of *Libnotes*,[12] the present fly runs to *Limonia* (*Libnotes*) *nigricornis* (Alexander), of western Java, which is apparently still the nearest ally. The two flies agree in the general appearance but are readily told by the coloration of the thorax and by the venation, especially the long medial veins and short m of the present fly. The types earlier had been determined tentatively by Riedel [13] as being *Limonia* (*Geranomyia*) *argentifera* (de Meijere), which they superficially resemble, but in reality they pertain to the subgenus *Libnotes*, as described. Both specimens are females.

LIMONIA (IDIOGLOCHINA) FLAVALIS sp. nov. Plate 1, fig. 12; Plate 2, fig. 30.

General coloration of body, legs, halteres, and wings yellow; Sc unusually short, the distance on costa between tip of Sc_1 and the origin of Rs about equal to twice the length of the latter vein.

Male.—Length, about 5 to 6 millimeters; wing, 5.5 to 6.5.

Rostrum yellow, about one-half the remainder of head; palpi dark brown. Antennæ yellow, only the outer segments darkened;

[12] Loc. cit. [13] Ann. Mus. Nat. Hungarici 18 (1921) 131, No. 9.

flagellar segments with the lower face strongly produced, more accentuated on the intermediate segments. Head gray pruinose; anterior vertex about one-third wider than the diameter of scape; posterior vertex with indications of an impressed median line.

Pronotum brownish yellow. Mesonotum chiefly obscure yellow, the præscutum with the lateral brown stripes reddish brown, distinct; intermediate stripes much paler, scarcely darker than the ground, separated by a capillary pale vitta; mediotergite somewhat more darkened. Pleura reddish yellow, sparsely pruinose. Halteres yellow. Legs yellow, the terminal tarsal segments darker. Wings (Plate 1, fig. 12) yellow, the veins darker yellow. Both anal veins with macrotrichia at outer ends. Venation: Sc very short, the distance on costa between tip of Sc_1 and origin of Rs about equal to twice the length of the latter vein; R_1 and R_2 forming a common, gently arcuated vein, R_1 with three strong trichia, R_2 glabrous, m-cu at fork of M.

Abdominal tergites light yellowish brown; sternites and hypopygium yellow. Male hypopygium (Plate 2, fig. 30) with the setæ at apices of lobes of tergite, *9t*, unusually strong and powerful.

Habitat.—New Guinea.

Holotype, male, Seleo, Berlinhafen, 1896 (*Biró*). Paratopotype, male.

Limonia (*Idioglochina*) *flavalis* is best characterized by the light yellow coloration of the body and appendages. The structure of the male hypopygium is remarkably uniform and monotonous throughout this entire group (*de-beauforti*) of the subgenus.

LIMONIA (ALEXANDRIARIA) CINEREICAPILLA sp. nov. Plate 1, fig. 13.

General coloration of entire body pale yellow or reddish yellow; outer flagellar segments darkened; legs and wings pale yellow; Sc short, Sc_1 ending far before origin of Rs, the distance on costa between the two veins about one-half longer than Rs alone; free tip of Sc_2 some distance before R_2; m-cu before fork of M, longer than distal section of Cu_1.

Female.—Length, about 6 millimeters; wing, 5.8.

Rostrum and palpi pale. Antennæ with basal four or five segments yellow, the remaining segments passing into dark brown; flagellar segments oval, the verticils about equal in length to the segments; terminal segment a little larger than the penultimate. Head entirely light silvery white.

Mesothorax entirely pale reddish yellow. Halteres pale yellow throughout. Legs pale yellow, the outer tarsal segments very faintly darkened. Wings (Plate 1, fig. 13) pale yellow, the costal border slightly more saturated; veins pale yellow. Macrotrichia of veins relatively numerous, including a series of four or five on basal half of Rs; all outer radial and medial branches with trichia. Venation: Sc short, Sc_1 ending far before origin of Rs, the distance on costa about one-half longer than Rs; Rs and basal section of R_{4+5} subequal and in approximate oblique alignment; free tip of Sc_2 some distance before R_2; m-cu before fork of M, longer than the distal section of Cu_1.

Abdomen uniformly pale reddish yellow. Cerci long and straight.

Habitat.—New Guinea.

Holotype, female, Seleo, Berlinhafen, 1896 (*Biró*).

I am under the belief that when the male sex of the present fly is discovered it will be found to belong to the subgenus *Idioglochina* rather than to *Alexandriaria* where it must now be referred. If the above belief is well founded, another subgenus of *Limonia* will be added to the list of groups in the genus showing this reduced venation of the medial field (at present including *Dicranomyia* Stephens and *Euglochina* Alexander). The present fly is readily told from the other regional species of *Alexandriaria* having a uniformly pale color by the entirely silvery white head.

HELIUS (HELIUS) SUBARCUARIUS sp. nov. Plate 1, fig. 14; Plate 2, fig. 31.

Allied to *arcuarius;* antennæ short; general coloration of mesonotal præscutum brownish black medially, paling to dark reddish brown on sides; dorsal pleural region dark brown, the ventral sclerites paler; legs brownish black, the extreme outer tarsal segments brownish white; wings dusky, the stigma and cells C and Sc dark brown; wing margin narrowly darkened; anterior branch of Rs not running close to R_1; cell 1st M_2 nearly three times as long as wide; male hypopygium with the mesal lobe of basistyle conspicuous; outer dististyle slender, the tip simple.

Male.—Length, including rostrum, about 5 millimeters; wing, 5.5.

Rostrum black, subequal in length to remainder of head; palpi black. Antennæ black throughout; flagellar segments short-cylindrical, with an abundant short erect pubescence; antennæ (male) about as long as the head, including rostrum. Head blackish; anterior vertex reduced to a linear strip that is about equal in width to two ommatidia.

Pronotum dark brown. Mesonotal præscutum brownish black medially, paling on sides to dark reddish brown; lateral stripes not differentiated; posterior sclerites of notum dark brown, the median area of scutum and lateral portions of scutellum somewhat paler. Pleura with dorsal sclerites and all of pteropleurite and pleurotergite dark brown, the sternopleurite and meral region paling to testaceous-yellow. Halteres with stem dirty white, the knobs brown. Legs with fore coxæ dark brown, the remaining coxæ more testaceous-brown; trochanters testaceous; femora brownish black, the bases narrowly pale; remainder of legs black, the extreme outer tarsal segments paling to brownish white. Wings (Plate 1, fig. 14) with a dusky tinge, cells C and Sc, together with stigma, dark brown; outer margin of radial field to wing apex narrowly darkened, the color continued as an even narrower seam to opposite end of vein 2d A; veins black. Venation: Basal section of R_{4+5} subequal to r-m; anterior branch of Rs not strongly arcuated and running close to R_1, as is the case in *arcuarius;* cell 1st M_2 long and relatively narrow, nearly three times as long as wide; m-cu about one-half its length beyond the fork of M; m-cu about one-half the distal section of Cu_1.

Abdominal tergites dark brown; sternites obscure brownish yellow. Male hypopygium (Plate 2, fig. 31) with the mesal lobe of basistyle, *b,* large and conspicuous, with spinous setæ. Outer dististyle, *od,* slender, gently curved, the tip simple. Interbase, *i,* with base dilated, the apex greatly produced into a long curved spine, which, on distal third, bears a nearly hyaline flange back from tip.

Habitat.—Western Java.

Holotype, male, Djampangs, altitude 1,500 to 2,000 feet, August, 1933 (*M. E. Walsh*).

The nearest ally of the present fly seems to be *Helius* (*Helius*) *arcuarius* Alexander (Luzon). This latter species differs in the even more arcuated anterior branch of Rs, which is nearly perpendicular to a point opposite the fork of Sc, thence running parallel and very close to R_1. The hypopygial details, especially the shorter and stouter outer dististyle, and the stout mesal lobe of the basistyle, are similarly distinct.

HEXATOMINI

LIMNOPHILA (ELÆOPHILA) MARMOREA sp. nov. Plate 1, fig. 15; Plate 2, fig. 32.

General coloration dark brown, variegated with gray; femora yellow, the tips vaguely darkened; wings (male) broad, with a heavy dark pattern, including a broad, continuous band at cord that is interrupted only by a small pale area beyond tip of vein Sc; major dark areas in costal field wider than the interspaces, beyond the cord inclosing only single darkened spots; male hypopygium with the outer dististyle bearing a slender lobule on outer margin.

Male.—Length, about 5 millimeters; wing, 5.5 by 1.8.

Rostrum and palpi black. Antennæ broken. Head gray.

Pronotum dark brown, heavily pruinose. Mesonotal præscutum with the ground color grayish brown, the lateral borders broadly and conspicuously dark brown; posterior ends of lateral and intermediate stripes indicated by narrow dark lines before suture; interspaces with a series of four or five dark dots extending from the suture cephalad; scutal lobes variegated with pale; posterior sclerites of notum blackish, the mediotergite with paler pollinose areas. Pleura dark, variegated by silvery and grayish areas. Halteres broken. Legs with the coxæ blackened; trochanters yellow; femora yellow, with faint indications of a darker subterminal ring, best delimited internally; tibiæ and tarsi yellow, the terminal segments of the latter darkened. Wings (Plate 1, fig. 15) broad (male), whitish subhyaline, with a very heavy, dark brown, banded and dotted pattern, including major areas and crossbands beyond arculus; a complete parallel-sided band at level of origin of Rs; a complete band at cord, expanded at cephalic end and broken only by a small pale area in cell Sc_1 beyond the fork of vein Sc; large areas at wing tip and at end of vein R_3; outer end of cell 1st M_2 darkened; abundant dots in all the interspaces; veins yellow, darker in the clouded areas. Costal fringe short. Venation: Sc_1 ending just beyond fork of Rs, Sc_2 near its tip; cell 1st M_2 large, with m-cu at near one-fifth its length; supernumerary crossvein opposite origin of Rs.

Abdomen brownish black. Male hypopygium (Plate 2, fig. 32) with the outer dististyle, *od,* bearing a slender lobule on outer margin, more basad than the numerous spinules before the apical spine; apical notch oval. Phallosomic armature, *p,* relatively conspicuous.

Habitat.—Western Java.

Holotype, male, Soekaboemi, altitude 1,800 feet, March 8, 1933 (*M. E. Walsh*).

In its small size, the present fly suggests *Limnophila* (*Elæophila*) *dietziana* Alexander (Japan) and *L.* (*E.*) *serrulata* Alexander (western China). It is more nearly allied to the larger *L.* (*E.*) *granulata* Edwards (North Borneo), which likewise has the wings of the male greatly dilated opposite the termination of vein 2d A. The present fly has the dark wing pattern much heavier, restricting the ground color, more conspicuously so in the costal and apical fields. The darkened femoral rings are very much reduced and the male hypopygium is slightly different.

HEXATOMA (ERIOCERA) MALANGENSIS sp. nov. Plate 1, fig. 16.

Belongs to the *nepalensis* group; mesonotum deep velvety black, opaque; antennal flagellum extensively yellow; legs black, the femoral bases broadly yellow; an extensive elongate-oval white area before cord; no macrotrichia on Rs, R_{2+3+4}, or R_3; R_2 very oblique in position; inner end of cell 1st M_2 strongly arcuated, m-cu close to its outer end; abdomen black throughout; tergites one to five shiny, the narrow caudal borders opaque.

Female.—Length, about 16 millimeters; wing, 12.

Rostrum and palpi black. Antennæ (female) 10-segmented; scape and pedicel black; flagellar segments one to four light yellow; succeeding segments brownish black; basal flagellar segments with long coarse verticils on all faces. Head black.

Mesonotum and pleura entirely deep velvety black, opaque. Halteres short, black throughout. Legs with the coxæ and trochanters black; remainder of legs black, the femoral bases broadly yellow, on fore legs including a little more than basal half, on midlegs approximately the basal two-thirds, on posterior legs a little more than the basal three-fourths. Wings (Plate 1, fig. 16) dark brown, the prearcular and adjoining regions conspicuously bright yellow, the extreme wing base again narrowly blackened; an elongate-oval white area before cord, extending from vein R_1 to 2d A, widest in cell R; veins dark brown, yellow in the pale areas. No macrotrichia on Rs, R_{2+3+4}, or R_3; sparse but conspicuous trichia on outer sections of M_{1+2} and M_3. Venation: Sc_1 ending beyond distal end of R_2, Sc_2 far from its tip; R_2 very oblique in position, R_{2+3} short; inner end of cell 1st M_2 strongly arcuated, with m-cu close to its outer end.

Abdomen black throughout, tergites one to five shiny except for narrow caudal margins, the succeeding segments opaque black; genital shields black; ovipositor with valves elongate, the cerci blackened at bases, slender.

Habitat.—Western Java.

Holotype, female, Goenoeng Malang, Djampangs, altitude 3,000 feet, July 10, 1933 (*M. E. Walsh*).

The four Javanese species that show the following group characters are separated by the key that follows:

Mesothorax opaque velvety black, unmarked (blue-gray in *diengensis* type, this possibly due to immersion in spirit). Wings with cell M_1 lacking. Base of wing yellow; a conspicuous whitish area before cord; no white or yellow areas on wing beyond cord.

Key to Javanese species of Hexatoma.

1. Cell 1st M_2 small, its inner end only slightly arcuated, m-cu at midlength; distal section of Cu_1 nearly two times m-cu; antennal flagellum black. *diengensis* Alexander.
   Cell 1st M_2 with its inner end arcuated, lying nearly as far basad as inner end of cell R_4; m-cu near outer end of cell 1st M_2; distal section of Cu_1 subequal to m-cu; antennal flagellum either black or yellow.... 2.
2. R_2 very oblique in position, at or close to fork of R_{2+3+4}; antennal flagellum chiefly light yellow.......... 3.
   R_2 subtransverse, subequal to R_{2+3}; antennal flagellum black. *atricornis* sp. nov.
3. Abdomen with segments two to five conspicuously yellow; vein R_3 with macrotrichia .... *salakensis* Edwards.
   Abdomen black throughout, the basal portions of tergites one to five shiny, the margins opaque; vein R_3 without macrotrichia. *malangensis* sp. nov.

HEXATOMA (ERIOCERA) ATRICORNIS sp. nov. Plate 1, fig. 17.

Belongs to the *nepalensis* group; mesonotum deep velvety black, opaque; antennæ black throughout, 11-segmented (female); legs black, the femoral bases yellow; wings broad, intensely blackened, the prearcular cells narrowly yellow; a conspicuous white discal area before cord; an abundant series of macrotrichia on vein R_3; R_2 subequal in length to R_{2+3}, subtransverse; inner end of cell 1st M_2 strongly arcuated; abdomen entirely black, the incisures of the tergites opaque, the intermediate portions polished; genital shield entirely opaque black.

Female.—Length, about 18 millimeters; wing, 14.

Rostrum and palpi black. Antennæ black throughout, 11-segmented (female); flagellar segments gradually decreasing in length to the fifth, the succeeding three subequal; terminal segment scarcely one-half longer than penultimate; flagellar segments with long coarse setæ, distributed on all faces. Head dark blackish gray; anterior vertex very wide.

Mesonotum and pleura entirely deep velvety black. Halteres short, black throughout. Legs with coxæ and trochanters black; remainder of legs black, the femoral bases obscure yellow, narrowest on forelegs where about one-fifth is included, broader on the middle and hind legs where one-fourth to nearly one-third is brightened. Wings (Plate 1, fig. 17) broad, the ground color intensely blackened; prearcular region to just beyond level of h bright yellow, the extreme base again darkened; an irregularly oval white discal area, extending from cell R_1 to cell M, widest in cells R and M, narrowest in cell R_1 where it does not reach vein R_1; anal cells a trifle paler than the remainder of the darkened ground; veins black, a trifle paler in the white discal area, light yellow in the prearcular field. Macrotrichia of veins relatively abundant, including complete series on R_3 (about 35 to 40), on R_{2+3} (about 6), and on R_{2+3+4}; M, Cu, and 1st A, with all branches, glabrous. Venation: Sc_1 extending to shortly beyond R_2, Sc_1 long; R_2 fully its own length beyond fork of R_{2+3+4} and thus subequal to R_{2+3}, subtransverse in position, without trichia; inner end of cell 1st M_2 strongly arcuated; m-cu at outer end of cell, subequal to or slightly longer than the distal section of Cu_1.

Abdomen entirely black, the bases of tergites broadly shiny black to nacreous, the apical third or fourth opaque velvety black, the extreme bases of segments similarly opaque; sternites opaque black; genital shield entirely opaque black; ovipositor with valves black, the tips narrowly brown.

Habitat.—Western Java.

Holotype, female, Djampangs, altitude 1,500 to 2,000 feet, May, 1933 (*M. E. Walsh*).

The relationships of the present fly have been discussed under the preceding species.

HEXATOMA (ERIOCERA) SALAKENSIS (Edwards).

Eriocera salakensis EDWARDS, Treubia 6 (1925) 167–168.

Described from a single female, taken at Tjitjoeroek, Salak, western Java, altitude 3,250 feet, March 6, 1921 (*Karny*).

A male is before me, herewith characterized as allotype.

Male.—Length, about 18 millimeters; wing, 13.

Characters as in female, as described by Edwards, with the following differences: Antennal flagellum, excepting outer segments, light yellow. Wings with the very oblique R_2 at or just before fork of R_{2+3+4}. Abdomen relatively long for the male sex, somewhat as in *acrostacta*.

Allotype, male, Selabintanah, Mount Gedeh, western Java, altitude 3,000 feet, December, 1932 (*M. E. Walsh*).

HEXATOMA (ERIOCERA) BENGALENSIS CONSTRICTA subsp. nov.

Limnophila bicolor MACQUART, Dipt. exot. 1 (1838) 66, pl. 7, fig. 2.
Eriocera bicolor VAN DER WULP, Mid-Sumatra Exped., Diptera (1892) 11, pl. 1, figs. 5–6.
Eriocera bicolor DE MEIJERE, Tijd. voor Ent. 54 (1911) 57–58.
Hexatoma (Eriocera) bengalensis ALEXANDER, Philip. Journ. Sci. 52 (1933) 148 (renaming of *bicolor*, preoccupied).

Female.—Length, about 15 millimeters; wing, 12.

Rostrum and palpi dark. Antennæ black, the scape pruinose; extreme base of first flagellar segment pale yellow; 10-segmented (female), segments gradually decreasing in length to the penultimate; last segments about one-fourth longer than the penultimate.

Mesonotal præscutum with the ground color gray, with a narrow velvety black median vitta that is dilated on anterior half of sclerite, on posterior half constricted into a mere line; the usual four præscutal stripes are more plumbeous, faintly shiny; posterior interspaces feebly dusted with gray; a large circular velvety black spot on margin of præscutum, in the region of the pseudosutural fovea. Halteres short, black throughout. Legs with coxæ and trochanters blackish, pruinose; femora chiefly black, the bases restrictedly obscure yellow, more evident on fore femora; tibiæ and tarsi black. Wings with the broad discal band slightly widened behind, extending from vein R to posterior margin; cells C and Sc more brownish yellow than remainder of wing; entire basal third of wing darkened, excepting the broad proximal ends of both anal cells. Venation: R_{2+3+4} and R_{2+3} subequal, both shorter than basal section of R_5; R_2 transverse, about one-third R_{2+3}; m-cu at near three-fourths the length of cell 1st M_2; cell M_1 present, subequal in length to its petiole.

Basal abdominal tergite velvety black on disk, bordered by orange; segments two and three orange; segments four to six, inclusive, black, the extreme bases, especially laterally, obscure orange; seventh and succeeding segments, including genital shield, orange.

Habitat.—Western Java.

Holotype, female, Djampangs Tengah, altitude 1,500 to 2,000 feet, February, 1933 (*M. E. Walsh*).

The type specimen of *bicolor* (*bengalensis*) came from Bengal. I am by no means convinced that the Javan specimens also referred to *bengalensis* really belong here. The present fly differs from other Javan and Sumatran material that has been referred to this species in the increase in dark color at the wing base, restricting the pale yellow of this field to the proximal ends of the anal cells.

Macquart's description of his *bicolor* indicates a species with the basal three abdominal segments fulvous-orange, the remaining segments black with only the valves of the ovipositor fulvous. Moreover, his figure and description of the pattern of the mesonotum differs in several important regards from that of the present fly. Van der Wulp [14] indicates that certain specimens occur in which the costal cell is darker brown than in normal individuals, which have the costal field yellow like the basal and discal bands.

GYNOPLISTIA (GYNOPLISTIA) BIRÓANA sp. nov. Plate 1, fig. 18; Plate 2, fig. 33.

Mesothorax black, the pteropleurite conspicuously silvery; halteres black, the base of stem obscure reddish; femora yellow, the extreme tips darkened; tibiæ brownish black, the posterior tibiæ more brownish yellow with darkened tips; wings with the ground color light yellow, the prearcular and costal regions clear yellow; four transverse brown fasciæ, the basal two narrow and interrupted, the outer two, including the cord and apex, very broad and continuous, almost confluent with one another; macrotrichia of veins beyond cord sparse; cell M_1 present, deep; cell 1st M_2 small; abdomen with basal tergite darkened, segments two to four bright orange; remaining segments purplish black; median region of tergite of male hypopygium produced caudad into a narrow lobe; a single simple dististyle.

Male.—Length, about 11 millimeters; wing, 10.

Rostrum and palpi light yellow. Antennæ broken. Posterior portions of head entirely light yellow.

Pronotum and propleura velvety black. Mesonotum brownish black, with faint reddish tinges. Pleura black, the pteropleurite dusted with silvery throughout its entire length. Halteres black, the extreme bases of stems obscure reddish. Legs with the coxæ and trochanters black; femora light yellow, the tips very narrowly darkened; tibiæ and tarsi brownish black, the posterior tibiæ more brownish yellow, the tips darker; tarsi relatively short, brownish black. Wings (Plate 1, fig. 18) with the ground

[14] Loc. cit.

color light yellow, the prearcular and costal regions clearer yellow; four transverse brown fasciæ, the basal pair narrow, the outer pair very broad and almost confluent; basal fascia postarcular in position, interrupted in cubital field, not crossing R; second band at origin of Rs, extending from R to M, broadly interrupted in cell M, recurring in cells Cu and 1st A; the broad outer bands include the cord and apex, confluent except for vague indications of pale washes at their union, the band at cord somewhat more suffused; veins brown, luteous in the yellow costal and prearcular fields. Macrotrichia of veins relatively sparse, there being two on R_3, six or seven on M_1, lacking elsewhere on veins M, Cu, or anals; costal setæ at wing base very long and conspicuous. Venation: Basal section of R_5 long and gently arcuated; cell M_1 deep, about one-half longer than its petiole; cell 1st M_2 small, its inner end slightly arcuated; m-cu at about one-fourth the length of the cell; vein 2d A strongly sinuous.

Abdomen with basal tergite darkened; segments two to four, inclusive, bright orange; remainder of abdomen, including hypopygium, purplish black. Male hypopygium (Plate 2, fig. 33) with the median area of tergite, *9t*, produced caudad into a narrow median lobe, its tip gently notched. Apex of basistyle, *b*, produced into a small acute spine and a longer straight rod; a single dististyle, *d*, its basal portion straight, before apex suddenly narrowed.

Habitat.—New Guinea.

Holotype, male, Simbang, Huon Gulf, 1899 (*Biró*).

This fine species is named in honor of the collector, Ludwig Biró, whose name will always be associated with notable discoveries in Papua. It is most generally similar to two other species from New Guinea, *Gynoplistia* (*Gynoplistia*) *fulviceps* Walker (northwest) and *G.* (*G.*) *nigrithorax* Alexander (southeast), agreeing in the brightly colored head and darkened thorax, differing from the former in the large size, coloration of the legs, and in the wing pattern, as the conspicuous bright yellow costal field. From the latter species, it differs in the coloration of the head, uniformly darkened thoracic pleura, coloration of legs, and the different wing pattern, especially the pale and broken basal bands. The type specimen had earlier been recorded [15] as doubtfully being *fulviceps*, which it rather

[15] Riedel, Ann. Mus. Nat. Hungarici 18 (1921) 137.

closely resembles. The two badly preserved females of the same species mentioned by Riedel were not sent to me.

ERIOPTERINI

TRENTEPOHLIA (MONGOMA) AURICOSTA sp. nov. Plate 1, fig. 19.

General coloration of thorax bright orange, the præscutum and pleura immaculate; antennæ black; scutellum black; mediotergite blackened, with a transverse yellow line at near midlength; apices of knobs of halteres yellow; legs brown to brownish black, the tips of fore and middle tibiæ and all tarsi light yellow; all femora with a basal series of small spines; wings whitish subhyaline, the costal region light yellow; apex of wing narrowly darkened; m-cu at fork of M; abdominal tergites black; sternites obscure yellow, blackened medially, the intermediate sternites chiefly pale; genital segment (female) orange.

Female.—Length, about 10 millimeters; wing, 8.5.

Rostrum and palpi black. Antennæ black throughout; flagellar segments long-cylindrical, with short verticils. Head light gray; posterior vertex with median carina; eyes opposite anterior vertex separated by a line narrower than the carina.

Cervical region brown. Pronotum and mesonotal præscutum bright orange, immaculate; scutal lobes blackened on mesal portions, the more lateral parts obscure orange; scutellum black; mediotergite chiefly blackened, yellowish laterally, with a narrow obscure yellow line across the sclerite at midlength. Pleura orange, more polished than the notum. Halteres with basal half of stem light yellow; outer half of stem and base of knob black; apex of knob conspicuously light yellow. Legs with coxæ and trochanters yellow; femora brown, passing into dark brown or brownish black on outer ends; tibiæ dark brown, the tips paler, very broadly so on fore legs, more obscurely on posterior legs; fore and middle tarsi light yellow, posterior tarsi more obscured. Fore and middle femora near base with a series of about a dozen small erect black spines; posterior femora with three or four shorter spines; posterior tibiæ before tips with four or five strong black setæ among the other vestiture. Wings (Plate 1, fig. 19) whitish subhyaline, cells C and Sc clear light yellow; stigma dark brown; a paler brown wash from stigma around margin to wing tip; a broad dark brown seam along vein Cu in cell M; narrower and less evident dark seams along Rs, R_2, R_{3+4}, and distal section of R_5; a darkened spot at point of divergence of anal veins; veins black, C, Sc, and R light yellow. Venation: Rs elongate, exceeding R_{2+3+4}; vein R_3 suberect and sinuous, cell R_3 very wide at base; m-cu at fork of M; apical fusion of veins Cu_1 and 1st A slight but distinct.

Abdominal tergites black, narrowly bordered laterally with obscure yellow; sternites obscure yellow, blackened medially, the fourth and fifth sternites chiefly pale; sixth to eighth sternites, inclusive, entirely and intensely blackened; genital segment orange; ovipositor with cerci pale horn color.

Habitat.—Western Java.

Holotype, female, Bibidjilan, Djampangs, altitude 2,000 feet, September, 1933 (*M. E. Walsh*).

The nearest ally of the present fly is *Trentepohlia* (*Mongoma*) *flavicollis* Edwards, likewise from western Java. The latter species is before me (Djampangs, western Java, July, 1933, *Walsh*). The apices of the knobs of the halteres are orange, a character not mentioned by Edwards. Both of these species are separable from *cariniceps* and its near allies by the smaller physical size and by the position of m-cu at or very close to the fork of M.

TRENTEPOHLIA (MONGOMA) AURANTICOLOR sp. nov. Plate 1, fig. 20.

Belongs to the *cariniceps* group; mesonotum and pleura clear yellow to orange-yellow; rostrum light yellow; head brownish yellow; halteres strongly infumed, the basal portion of stem yellow; legs light brown, the tarsal segments more yellowish; wings whitish subhyaline, the prearcular and costal regions clear light yellow; stigma lacking; veins dark; inner end of cell M_3 lying far basad of cells R_5 and 2d M_2; m-cu at or only a short distance beyond the fork of M; veins Cu_1 and 1st A narrowly separated at margin; abdominal tergites obscure yellow, with a conspicuous dark brown median stripe that is narrowly interrupted at the incisures; genital segment chiefly pale.

Female.—Length, about 13 millimeters; wing, 9.

Rostrum and palpi light yellow. Antennæ yellow, the outer segments a trifle more obscure; flagellar segments of outer half of organ with a powerfully developed black seta on lower face, on tenth to twelfth segments of flagellum these considerably exceeding the segments in length; on more basal segments these setæ gradually shorter and less differentiated from the remaining setæ. Head brownish yellow, the postvertical carina conspicuous.

Cervical sclerites, pronotum, mesonotum, and pleura entirely bright yellow to orange-yellow. Halteres strongly infumed, the basal portion of stem light yellow. Legs unusually long and powerful, as in the group; coxæ and trochanters light yellow; remainder of legs chiefly light brown or brownish yellow, the femoral bases clearer yellow; femoral tips narrowly and insensibly brightened; outer tarsal segments yellow; posterior and middle femora with the usual black spines at bases; posterior tibiæ with three powerful black setæ near tip. Wings (Plate 1, fig. 20) whitish subhyaline, the prearcular and costal regions clear light yellow; stigma lacking; veins dark brown, those in the yellow areas more luteous. Venation: Rs a trifle longer than basal section of R_5; R_2 nearly equal in length to R_{3+4}; vein R_4 only moderately decurved at outer end; inner ends of cells R_5 and 2d M_2 nearly in transverse alignment, of cell M_3 lying far proximad; m-cu at or only a short distance beyond fork of M; veins Cu_1 and 1st A distinctly separate at margin.

Abdominal tergites obscure yellow, with a conspicuous dark brown or brownish black median stripe that is narrowly interrupted at the bases of the segments; sternites chiefly obscure yellow; genital segment darkened medially above, the apex and lateral portions yellow; cerci reddish horn color.

Habitat.—Western Java.

Holotype, female, Selabintanah, Mount Gedeh, altitude 3,000 feet, April 15, 1933 (*M. E. Walsh*).

The regional members of the *cariniceps* group may be separated by the key accompanying the following group discussion.

The species are all of large to very large size; mesothorax yellow or orange-yellow, immaculate; median carina of posterior vertex conspicuous. The bases of femora in most species have series of few to many black spinous points arranged in a single, or, more rarely, a double row, while the posterior tibiæ before tips often have a series of long slender setæ arranged in a single series. The apical fusion of veins Cu_1 and 1st A is often very slight or lacking, and this character is apparently slightly variable within the limits of a single species.

Key to species of the cariniceps group.

1. Veins Cu_1 and 1st A distinctly separate at margin .... 2.
   Veins Cu_1 and 1st A slightly fused backward from margin .... 5.
2. All femora with spines near base .... 3.
   No spines on fore femora .... 4.
3. Head chiefly black; flagellar segments each with two dorsal setæ; mesosternum with a group of black bristles on either side of mid-line (North Borneo) .... *spiculata* Edwards.

Head ocherous; flagellar segments each with one longer dorsal seta; mesosternum bare or with inconspicuous pale setæ only (North Borneo) .... *lutescens* Edwards.

4. Outer costal region strongly infumed; m-cu its own length or more beyond fork of M; Cu_1 and 1st A widely separated at margin; genital shield (female) blackened (Western Java) .... *separata* sp. nov.

Prearcular and costal regions clear light yellow; m-cu at or only a short distance beyond fork of M; Cu_1 and 1st A narrowly separate at margin; genital shield (female) chiefly pale (Western Java). *auranticolor* sp. nov.

5. Head black .... 6.

Head ocherous .... 8.

6. Wing veins pale; abdomen uniformly yellow (Mentawi Islands, Western Sumatra) .... *siporensis* Edwards.

At least some of the wing veins darkened; abdominal tergites more or less darkened .... 7.

7. Stigmal area small or lacking; legs brown, the tarsi paler, more yellowish brown (Sumatra) .... *nigriceps* de Meijere.

Stigma distinct; legs ocherous (North Borneo) .... *spiculata* Edwards.

8. No spines at bases of femora (Sumatra and North Borneo). *cariniceps* Enderlein.

At least the hind femora with spines .... 9.

9. Mesonotum dull, pleura shiny; all femora armed basally with spines, these numerous, ten to twenty in number; abdominal sternites dark (North Borneo) .... *spiculata* Edwards.

Both mesonotum and pleura shiny; only the posterior femora with spines, these only three or four in number; abdominal sternites ocherous (North Borneo) .... *fortis* Edwards.

I have included *lutescens* and *spiculata* in two places in the above key, the character of the apical fusion of veins Cu_1 and 1st A apparently being variable in these instances.

TRENTEPOHLIA (MONGOMA) SEPARATA sp. nov. Plate 1, fig. 21.

Belongs to the *cariniceps* group; mesonotum and pleura yellow; rostrum obscure yellow; head brown; halteres, including knobs, dusky; legs light brown, the outer tarsal segments paling to yellow; wings whitish subhyaline, the stigma and outer three-fourths of cells C and Sc infumed; vein R_4 long and sinuous, strongly decurved at outer end; m-cu its own length, or more, beyond the fork of M; veins Cu_1 and 1st A distinctly separated at margin; abdominal tergites with a broad, continuous, dark brown, median stripe; sternites yellow; dorsal shield of ovipositor blackened.

Female.—Length, about 12 to 13 millimeters; wing, 9.5 to 10.

Rostrum obscure yellow; palpi yellow, the terminal segment darkened. Antennæ with scape and pedicel light yellow; flagellum brown; flagellar segments cylindrical, with short verticils, none exceeding the segments in length. Head brown; anterior vertex reduced to a narrow stripe; carina on posterior vertex relatively low and indistinct.

Cervical sclerites brownish yellow. Pronotum and mesonotum yellow, the posterior sclerites of the latter more obscure. Pleura yellow. Halteres dusky, the base of stem yellow. Legs with the coxæ orange-yellow; trochanters yellow; femora yellow basally, passing into brown, the tips again narrowly and insensibly brightened; tibiæ and basitarsi light brown, the outer tarsal segments paling to yellow; middle and hind femora with a series of eight to ten erect black spines near base; fore femora with these spines reduced to weak setæ, little evident; posterior tibiæ near tips with a series of about four black setæ, differentiated from the remaining vestiture. Wings (Plate 1, fig. 21) whitish subhyaline; stigma and outer three-fourths of cells C and Sc infumed, the basal fourth light yellow; wing tip narrowly and insensibly darkened; veins brown. Venation: R_2 a little longer than R_{3+4}; vein R_4 long and sinuous, strongly decurved on outer fourth, cell R_3 thus very wide; inner ends of cells R_5 and M_3 a little more proximad than that of cell 2d M_2 and about in alignment with one another; m-cu its own length or more beyond fork of M; veins Cu_1 and 1st A distinctly separated at margin, the distance a little shorter than m.

Abdominal tergites broadly and conspicuously dark brown, the lateral borders obscure yellow, the caudal borders very narrowly and insensibly pale, scarcely breaking the dorsal vitta; sternites yellow, the subterminal segments darkened; tergal shield of ovipositor blackened; cerci horn-colored, strongly upcurved.

Habitat.—Western Java.

Holotype, female, Djampangs Tengah, altitude 1,500 to 2,000 feet, February, 1933 (*M. E. Walsh*). Paratopotype, female.

Trentepohlia (*Mongoma*) *separata* is told from other allied species of the *cariniceps* group by the key provided with the preceding species. The Javanese record of *cariniceps* [16] is erroneous and refers either to the present fly or some closely allied form.

GONOMYIA (LIPOPHLEPS) WALSHÆ sp. nov. Plate 1, fig. 22.

Mesonotum reddish brown to brown; pleura obscure brownish yellow, with a longitudinal white stripe, bordered above and below by narrow brownish lines; legs brown, the femora unva-

[16] Alexander, Proc. U. S. Nat. Mus. 49 (1915) 173.

riegated; wings uniformly pale brown; costal region clear light yellow; stigma barely indicated; Sc relatively short; abdominal tergites with brown discal triangles, the posterior lateral angles conspicuously yellow.

Female.—Length, about 4.5 millimeters; wing, 4.2.

Rostrum and palpi black. Antennæ with scape and pedicel yellow above, darker beneath; flagellum black. Head above chiefly yellow.

Pronotum and anterior lateral pretergites light yellow. Mesonotum reddish brown, darker brown on disk, the median region even darker; scutal lobes infuscated, the median region yellow with a dusky line; scutellum dark brown, the caudal margin paler; mediotergite brownish gray, paler laterally. Pleura obscure brownish yellow, with an unusually distinct and clearly defined pure white longitudinal stripe, extending from behind the fore coxæ to the base of abdomen, bordered both above and beneath by darker brown, the latter broader, on sternopleurite. Halteres chiefly yellow. Legs with the fore coxæ darkened, mid- and hind-coxæ testaceous-yellow with only the extreme bases darkened; trochanters brownish yellow; remainder of legs brown, the femora entirely unvariegated; terminal tarsal segments blackened. Wings (Plate 1, fig. 22) with a uniform pale brown tinge, unvariegated by darker or paler areas; costal border clear light yellow; stigma long and narrow but scarcely darker in color than the ground; extremely vague indications of a dusky streak in center of cell R_4; axillary region weakly darkened; veins pale brown, Sc light yellow. Macrotrichia of veins relatively abundant, including a series along the entire length of the anterior branch of Rs and on Rs itself except at extreme base; complete series on all branches of M and Cu beyond cord, and at tips of both anal veins. Venation: Sc relatively short, Sc_1 ending a distance before origin of Rs that is a little shorter than r-m; anterior branch of Rs long and nearly straight; m-cu about one-third its length before fork of M.

Abdominal tergites with the disk of each segment chiefly covered by a brown triangle, the point directed behind leaving the narrow lateral margins and broad caudal-lateral angles yellow; sternites obscure yellow, with a dark median line.

Habitat.—Western Java.

Holotype, female, Soekaboemi, altitude 1,800 feet, June 1, 1933 (*M. E. Walsh*).

I take unusual pleasure in naming this species in honor of the collector, Mrs. M. E. Walsh. By Edwards's key to the Oriental species of *Lipophleps*,[17] the present fly runs to *Gonomyia* (*Lipophleps*) *flavomarginata* Brunetti. I have before me for comparison a specimen of this latter species, determined by Edwards. It has broader wings that are evidently variegated by dark and light areas; anterior branch of Rs shorter and more divergent from the posterior branch, without macrotrichia. Edwards [18] supplies some additional significant data concerning Brunetti's paratypes.

ERIOPTERA (METERIOPTERA) SZILADYI sp. nov. Plate 1, fig. 23; Plate 2, fig. 34.

General coloration brownish yellow; halteres with brownish black knobs; legs yellow; wings tinged with brownish; vein 2d A nearly straight; abdomen brownish yellow, with a dark brown subterminal ring; male hypopygium with the outer dististyle a simple pale rod, its blackened apex with a comb of teeth.

Male.—Length, about 4.5 millimeters; wing, about 5.

Rostrum and palpi dark. Antennæ with scape and pedicel obscure yellow; six basal flagellar segments dark brown, each truncate-fusiform; longest verticils subequal to the segments. Head in the unique type apparently dark-colored.

Pronotum testaceous-yellow. Mesonotum brownish yellow, the præscutum with a faint and narrow brownish median line; central portion of scutum restrictedly darkened; cephalic half of mediotergite darkened, the posterior half pale. Pleura pale yellow. Halteres yellow, the knobs brownish black. Legs with the coxæ and trochanters pale yellow; remainder of legs yellow, only the outer two tarsal segments darkened. Wings (Plate 1, fig. 23) relatively narrow, tinged with brownish; veins and macrotrichia darker. Venation: Sc_1 ending opposite fork of Rs, Sc_2 just beyond origin of Rs; veins beyond cord almost straight, the extreme tip of Cu_1 deflected slightly cephalad; anal veins divergent, vein 2d A very weakly sinuous at extreme tip only, cell 1st A widest at margin.

Abdominal tergites obscure brownish yellow, the sternites a trifle paler; subterminal segments dark brown, the hypopygium light yellow. Male hypopygium (Plate 2, fig. 34) with the apical lobe of basistyle, *b*, slender. Outer dististyle, *od*, a simple pale rod, nearly straight to very gently arcuate, the apex oblique, blackened, with a comb of seven or eight teeth. Inner dististyle, *id*, entirely pale, expanded at apex into a conspicuous head,

[17] Journ. Fed. Malay St. Mus. 14 (1928) 104–105.

[18] Rec. Indian Mus. 26 (1924) 301.

the outer angle narrowed into a spine, near the apex of head with several weak tubercles.

Habitat.—New Guinea.

Holotype, male, Sattelberg (Sattelberg), Huon Gulf, September 20 to 30, 1898 (*Biró*).

I take great pleasure in dedicating this very distinct fly to Dr. Z. Szilady, custodian of the Diptera in the Hungarian National Museum. In the poorly preserved material available, I cannot detect a fusion segment at the base of the antennal flagellum but from the venation and structure of the male hypopygium, I believe the present fly to be correctly referred to the subgenus *Meterioptera.* In the simple outer dististyle of the hypopygium it is more nearly allied to the group of species that centers about *Erioptera* (*Meterioptera*) *javanensis* de Meijere than to those near *E.* (*M.*) *notata* de Meijere. The plain yellow legs and coarsely toothed apex of the outer dististyle furnish quite distinct characters from those of other described members of the *javanensis* group.

TOXORHINA (CERATOCHEILUS) BIRÓI sp. nov. Plate 1, fig. 24; Plate 2, fig. 35.

General coloration dark brown, pruinose; præscutum with three scarcely delimited brown stripes; wings with a faint brown tinge, cell Sc more infumed; anterior branch of Rs sinuous, nearly perpendicular; cell 1st M_2 open by atrophy of m; abdominal segments uniformly dark brown; male hypopygium with two dististyles, the outer simple, entire; mesal face of basistyle with a densely setiferous cushion; arms of ædeagus long.

Male.—Length, excluding rostrum, about 4.5 millimeters; wing, 5.

Rostrum broken off at extreme base. Antennæ with scape and pedicel light yellow; flagellum broken. Head gray, with conspicuous black setæ on posterior vertex; anterior vertex a little narrower than diameter of scape.

Mesonotum almost uniformly brown, the posterior sclerites somewhat darker and more pruinose than the præscutum, the latter with the ground color gray, with three very poorly delimited dark brown stripes. Pleura chiefly pale brownish yellow, the propleura and anepisternum a little darker, the pteropleurite and pleurotergite pale. Halteres dusky, the base of stem yellow. Legs with the coxæ obscure yellow, weakly infumed basally; trochanters testaceous; remainder of legs broken. Wings (Plate 1, fig. 24) with a faint brownish tinge, cell Sc more infumed but with cell C undarkened; veins brown. Macrotrichia throughout entire length of Rs and its posterior branch; nearly complete dense series on outer sections of vein M_{1+2} and M_3. Venation: Anterior branch of Rs sinuous but nearly perpendicular, the distance on costa between it and tip of R_{1+2} less than the length of the vein itself; Sc_1 ending about opposite one-fourth the length of Rs, Sc_2 just beyond this origin; cell 1st M_2 open by atrophy of m; m-cu shortly before fork of M, a little longer than the distal section of Cu_1.

Abdomen dark brown, the hypopygium a little brighter. Male hypopygium (Plate 2, fig. 35) with the entire mesal face of basistyle, *b*, produced into a cushion that is provided with a double or triple row of long powerful setæ, the caudal end of the cushion further produced caudad as a glabrous obtuse blade. Outer dististyle, *od*, a simple curved spine from a dilated base. Inner dististyle, *id*, with the spine on outer border relatively small. Arms of ædeagus, *a*, long and relatively slender.

Habitat.—New Guinea.

Holotype, male, Sattelberg (Sattelberg), Huon Gulf, September 20–30, 1898 (*Biró*).

The species is dedicated to the memory of Ludwig Biró, former custodian of the Hungarian National Museum. It is most similar to *Toxorhina* (*Ceratocheilus*) *romblonensis* Alexander (Philippines) in the open cell 1st M_2 and nearly erect anterior branch of Rs. All other Oriental and Australasian members of the subgenus so far described have cell 1st M_2 normally closed. The present fly is readily told from *romblonensis* by the lack of a black dorso-longitudinal pleural stripe, the different coloration of the præscutum and abdomen, and the undarkened costal cell. Riedel [19] had earlier examined this specimen and noted its resemblance to *Ceratocheilus* but did not complete the identification.

[19] Ann. Mus. Nat. Hungarici 18 (1921) 135, No. 21, as *Teucholabis* (?) sp.

ILLUSTRATIONS

[Legend: *a*, Ædeagus; *b*, basistyle; *d*, dististyle; *dd*, dorsal dististyle; *g*, gonapophysis; *i*, interbase; *id*, inner dististyle; *od*, outer dististyle; *od, va*, outer dististyle, ventral aspect; *p*, phallosome; *s*, sternite; *t*, tergite; *vd*, ventral dististyle.]

PLATE 1

FIG. 1. *Dolichopeza* (*Nesopeza*) *nebulicola* sp. nov., venation.
2. *Dolichopeza* (*Nesopeza*) *subcuneata* sp. nov., venation.
3. *Scamboneura minahasa* sp. nov., venation.
4. *Scamboneura subfaceta* sp. nov., venation.
5. *Macromastix risbeci* sp. nov., venation.
6. *Macromastix caledoniana* sp. nov., venation.
7. *Tipula leucosticta* sp. nov., venation.
8. *Limonia* (*Limonia*) *pacatella* sp. nov., venation.
9. *Limonia* (*Libnotes*) *riedelella* sp. nov., venation.
10. *Limonia* (*Libnotes*) *djampangensis* sp. nov., venation.
11. *Limonia* (*Libnotes*) *mopsa* sp. nov., venation.
12. *Limonia* (*Idioglochina*) *flavalis* sp. nov., venation.
13. *Limonia* (*Alexandriaria*) *cinereicapilla* sp. nov., venation.
14. *Helius* (*Helius*) *subarcuarius* sp. nov., venation.
15. *Limnophila* (*Elæophila*) *marmorea* sp. nov., venation.
16. *Hexatoma* (*Eriocera*) *malangensis* sp. nov., venation.
17. *Hexatoma* (*Eriocera*) *atricornis* sp. nov., venation.
18. *Gynoplistia* (*Gynoplistia*) *biróana* sp. nov., venation.
19. *Trentepohlia* (*Mongoma*) *auricosta* sp. nov., venation.
20. *Trentepohlia* (*Mongoma*) *auranticolor* sp. nov., venation.
21. *Trentepohlia* (*Mongoma*) *separata* sp. nov., venation.
22. *Gonomyia* (*Lipophleps*) *walshæ* sp. nov., venation.
23. *Erioptera* (*Meterioptera*) *sziladyi* sp. nov., venation.
24. *Toxorhina* (*Ceratocheilus*) *birói* sp. nov., venation.

PLATE 2

FIG. 25. *Dolichopeza* (*Nesopeza*) *nebulicola* sp. nov., male hypopygium, details.
26. *Dolichopeza* (*Nesopeza*) *insolida* sp. nov., male hypopygium, details.
27. *Dolichopeza* (*Nesopeza*) *subcuneata* sp. nov., male hypopygium, details.
28. *Dolichopeza* (*Nesopeza*) *cuneata* Edwards, male hypopygium, details.
29. *Tipula leucosticta* sp. nov., male hypopygium, details.
30. *Limonia* (*Idioglochina*) *flavalis* sp. nov., male hypopygium.
31. *Helius* (*Helius*) *subarcuarius* sp. nov., male hypopygium.
32. *Limnophila* (*Elæophila*) *marmorea* sp. nov., male hypopygium.
33. *Gynoplistia* (*Gynoplistia*) *biróana* sp. nov., male hypopygium.
34. *Erioptera* (*Meterioptera*) *sziladyi* sp. nov., male hypopygium.
35. *Toxorhina* (*Ceratocheilus*) *birói* sp. nov., male hypopygium.

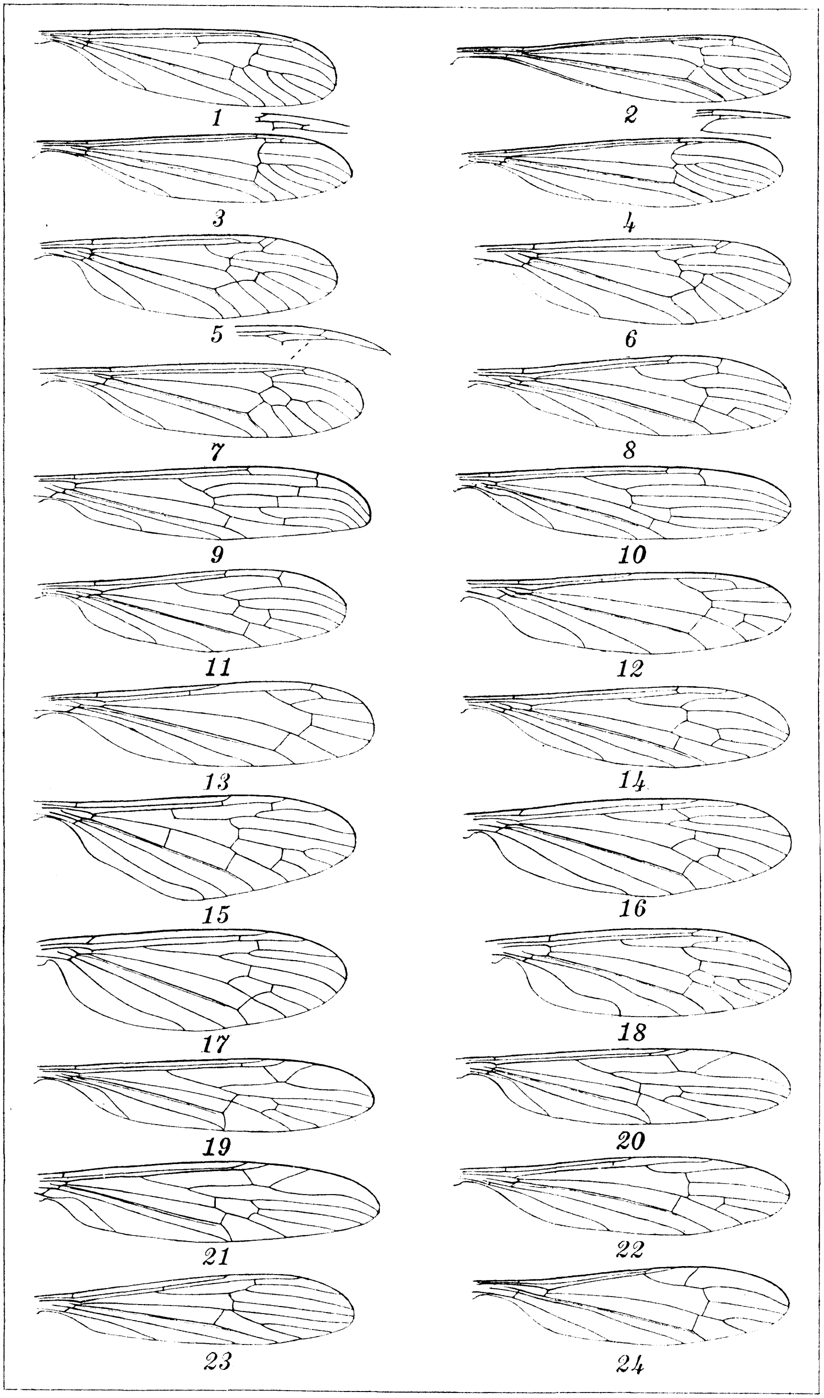

PLATE 1.

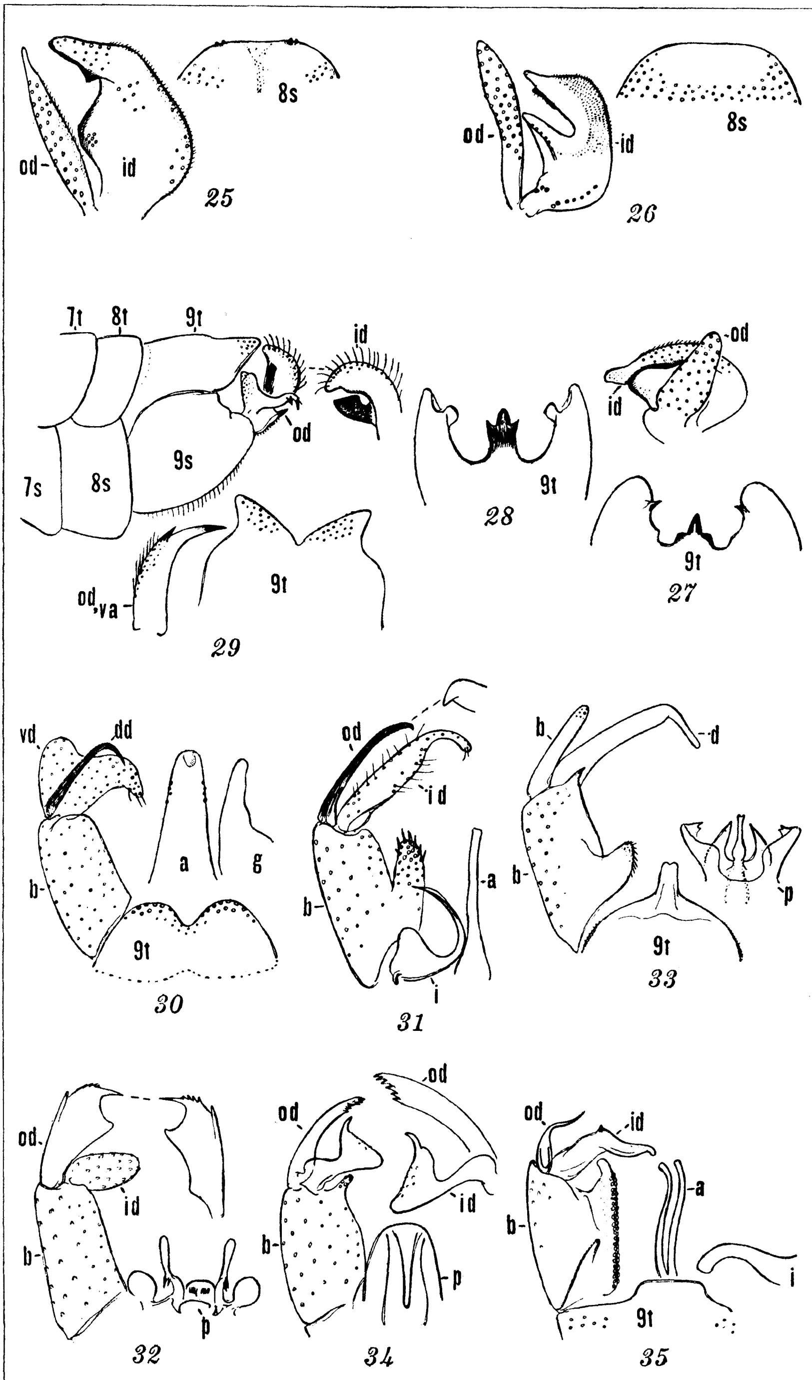
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PLATE 2.

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HEXYLRESORCINOL AS AN ANTHELMINTIC

ITS EFFICIENCY AGAINST THE INTESTINAL PARASITES OF MAN

By MARCOS A. TUBANGUI, MARIANO BASACA, and ANTONIO M. PASCO

Of the Division of Biological Products, Bureau of Science, Manila

Many of the anthelmintics that have been shown by means of critical tests to possess a high degree of efficiency are poisonous substances, for which reason their use has been followed in a number of instances by symptoms of intoxication and sometimes death. According to Lamson and Ward (1932) the only anthelmintics that from a practical standpoint can be considered as both safe and efficient are tetrachlorethylene and hexylresorcinol. The more recent observations of Christensen and Lynch (1933), however, on the effect of these two drugs on the host, have shown that the former, even in single therapeutic doses, depresses the heart and the respiration and produces pathologic changes in the small intestine, liver, and heart. In the case of hexylresorcinol no apparent symptomatic disturbances and only slight changes in the liver and heart tissues were noted.

Hexylresorcinol had long been used as a genito-urinary disinfectant before it was introduced as an ascaricide by Lamson, Ward, and Brown in 1930. It has since then been tried in different parts of the world and found to be effective, not only against ascarids but also against hookworms and other intestinal parasites. So far as we are aware it has not yet been tried extensively in the Philippines, for which reason it was decided to test its efficacy under local field conditions.

MATERIALS AND METHODS

The hexylresorcinol used was obtained directly from Messrs. Sharp and Dohme through the courtesy of their Philippine representative, Mr. C. S. Lounsbury. It was received in two shipments: the first shipment was in the form of gelatin capsules each containing 0.166 gram and the second shipment in the form of chocolate-colored sugar-coated pills each containing 0.2 gram of hexylresorcinol. We agree with the other workers who have used the drug as to the impracticability of gelatin capsules in a warm and moist environment such as that met with in the Philippines. Due most probably to the reaction of the hexylresorcinol with the gelatin, which reaction was accelerated by the conditions of the climate, the majority of the capsules arrived broken and therefore unfit for use. Those that were still intact were soft and broke easily during the process of swallowing. Besides, as will be shown later, the reaction of the drug with the gelatin seemed to have rendered it less effective as an anthelmintic.

The treatments were administered under field conditions, each individual receiving only a single treatment. The drug was given on an empty stomach early in the morning. The patients were allowed to go about their daily activities but were advised to abstain from food for at least four hours after taking the medicine. In some cases a saline cathartic (sodium sulphate) was given twenty-four hours after the anthelmintic.

The following doses recommended by the manufacturers were given:

To adults and children over 12 years of age 5 pills or 6 capsules.
To children 8 to 12 years of age 4 pills or 5 capsules.
To children 6 to 8 years of age 3 pills or 4 capsules.
To children under 6 years of age 2 pills or 3 capsules.

The efficacy of the drug was judged from the results of the examination of fæcal samples by the Stoll technic (Stoll and Hausheer, 1926) before and ten to fourteen days after the treatment. A total of 861 persons, representing both sexes and all ages from 4 years up, were treated, but only 448 of these submitted specimens for reëxamination.

EFFECT OF HEXYLRESORCINOL ON THE HOST

Of the 861 persons treated not one showed any noteworthy symptom of intoxication. A few individuals complained of slight symptoms of either gastric or intestinal irritation accompanied by headache and dizziness, but these disappeared rapidly without any treatment and in many cases they were probably due more to the fasting than to the effect of the drug. One woman, who vomited after swallowing the pills, ascribed it to the medicine; but it turned out that she was a very nervous individual and an ex-inmate of an insane asylum.

Lamson and Ward (1931) have called attention to the local irritating action of the drug on the mucous membranes of the mouth and tongue if the capsules or pills break in the mouth or are chewed against advice. When this happens the mucosa may become blanched and the superficial epithelium may even peel off. Several of our cases, most of whom were young children, met with such accidents, but they did not materially suffer from the lesions. Only the woman referred to above, who vomited the drug through the nose, was inconvenienced for several days as the result of severe burns in the nasal passages.

EFFICIENCY OF HEXYLRESORCINOL AGAINST DIFFERENT PARASITES

The observations recorded in this paper were conducted for the purpose of ascertaining the efficiency of hexylresorcinol against *Ascaris lumbricoides, Trichuris trichiura,* hookworms,[1] and other intestinal worms infesting man. The results obtained do not appear to be as satisfactory as they should be due to the poor coöperation obtained from several of the individuals treated. These partook of food soon after taking the anthelmintic, as a consequence of which they showed very little, if any, diminution in their egg counts after the treatment. These cases have been included in the tabulation of the data in order to determine, as aptly expressed by Molloy (1933), "the results which might be obtained by administering the drug under the customary field conditions."

TABLE 1.—*Ascaris: Efficiency of hexylresorcinol in gelatin capsules, followed in twenty-four hours by a purgative of sodium sulphate. (Pardo, Cebu, Cebu.)*

Cases	88
Egg count per cc (formed basis):	
Before treatment	2,420,500
After treatment	1,216,100
Reduction, per cent	49.76
Negative after treatment, per cent	11.36

[1] It has been shown by several investigators that the prevailing species of hookworm in native Filipinos is *Necator americanus.*

TABLE 2.—*Ascaris: Efficiency of hexylresorcinol pills, not followed by a purgative. (Manila.)*

Cases	232
Egg count per cc (formed basis):	
Before treatment	16,991,000
After treatment	3,051,800
Reduction, per cent	82.04
Negative after treatment, per cent	53.45

TABLE 3.—*Ascaris: Efficiency of hexylresorcinol pills, followed in twenty-four hours by a purgative of sodium sulphate. (Baao, Camarines Sur, and Cabuyao, Laguna.)*

Cases	61
Egg count per cc (formed basis):	
Before treatment	2,237,400
After treatment	333,800
Reduction, per cent	85.08
Negative after treatment, per cent	63.93

Effect on ascaris.—The effect of hexylresorcinol on ascaris was observed in a total of 381 cases, which, as shown in Tables 1, 2, and 3, were divided into three groups. Table 1 includes individuals who received the anthelmintic in gelatin capsules (followed by a purgative), Table 2 those who were given pills but were not purged, and Table 3 those who received pills, followed in twenty-four hours by a purgative of sodium sulphate. It will be seen from these tables that the effect of the capsules was much less than that of the pills. With the capsules the average reduction in the egg count was only about 50 per cent and but 11 per cent of those treated, a large number of whom were lightly infested cases with egg counts of less than 3,000 per cc, were cleared entirely of their ascaris burden. When pills were used the reduction in the egg count was 82 to 85 per cent and the number of those found negative after treatment was larger (53 to 64 per cent) and included several heavily infested cases with counts up to 150,000 eggs per cc. In the majority of instances, however, the average efficiency of the drug in heavy ascaris infestations was noted to be about 80 per cent. As observed by Molloy (1933), the anthelmintic was slightly more effective when followed by a saline purgative twenty-four hours after (Table 3).

Effect on hookworms.—The results of the treatments against hookworms are summarized in Tables 4 and 5, in which it is shown that the gelatin capsules compared with the pills were no more efficient against these parasites than against ascaris.

In the series in which gelatin capsules were used (Table 4) the reduction in the egg count was only 33.7 per cent and the percentage of those found negative after the treatment 7.7. In the group in which pills were given (Table 5) there was a reduction of 74 per cent and 25.4 per cent of the cases were found negative after the treatment. We believe that these latter figures, which agree quite closely with those obtained by Molloy in Central America, represent more or less accurately the efficiency of a single dose of hexylresorcinol against human hookworms under field conditions.

TABLE 4.—*Hookworms: Efficiency of hexylresorcinol in gelatin capsules, followed in twenty-four hours by sodium sulphate. (Pardo, Cebu, Cebu.)*

Cases	103
Egg count per cc (formed basis):	
Before treatment	524,200
After treatment	347,600
Reduction, per cent	33.69
Negative after treatment, per cent	7.76

TABLE 5.—*Hookworms: Efficiency of hexylresorcinol pills, followed in twenty-four hours by a purgative of sodium sulphate. (Baao, Camarines Sur, and Cabuyao, Laguna.)*

Cases	62
Egg count per cc (formed basis):	
Before treatment	542,000
After treatment	140,200
Reduction, per cent	74.13
Negative after treatment, per cent	25.40

TABLE 6.—*Trichuris: Efficiency of hexylresorcinol in gelatin capsules, followed in twenty-four hours by sodium sulphate. (Pardo, Cebu, Cebu.)*

Cases	99
Egg count per cc (formed basis):	
Before treatment	566,800
After treatment	404,600
Reduction, per cent	28.62
Negative after treatment, per cent	5.05

TABLE 7.—*Trichuris: Efficiency of hexylresorcinol pills, not followed by a purgative. (Manila.)*

Cases	229
Egg count per cc (formed basis):	
Before treatment	1,539,000
After treatment	1,109,200
Reduction, per cent	27.93
Negative after treatment, per cent	8.73

TABLE 8.—*Trichuris: Efficiency of hexylresorcinol pills, followed in twenty-four hours by sodium sulphate. (Baao, Camarines Sur, and Cabuyao, Laguna.)*

Cases	61
Egg count per cc (formed basis):	
Before treatment	184,200
After treatment	91,200
Reduction, per cent	50.5
Negative after treatment, per cent	18.0

Effect against trichuris.—The results of the treatments against trichuris are summarized in Tables 6, 7, and 8. In the series in which the anthelmintic was given in gelatin capsules (Table 6) a reduction of almost 29 per cent in the egg count was noted and 5 per cent of the cases were negative after the treatment. In the series in which pills were administered but not followed by a purgative (Table 7), the percentages of egg reduction and apparently complete cures were 27.9 and 8.7, respectively. In the last series in which the pills were followed by sodium sulphate after twenty-four hours (Table 8), the results were 50.5 per cent for egg-count reduction and 18 per cent for the number of cases found negative after the treatment.

TABLE 9.—*Unusual trichuris egg counts before and after treatment with hexylresorcinol.*

Case No.	Egg count per cc (formed basis).		Case No.	Egg count per cc (formed basis).	
	Before treatment.	After treatment.		Before treatment.	After treatment.
72	2,800	14,400	602	52,600	92,000
116	800	3,600	616	3,000	18,000
217	2,800	6,400	623	2,000	13,000
218	1,600	4,400	632	8,800	20,800
271	2,000	5,600	640	400	4,800
390	200	2,400	682	600	4,400
392	8,800	19,800	686	3,400	18,600
536	200	4,600	689	1,400	6,800
448	3,200	7,200	690	2,400	9,600
594	3,200	8,000			

According to the above figures, the hexylresorcinol pills, if not followed by a purgative, were not superior to the gelatin capsules; but if followed by a purgative their efficiency against trichuris was almost doubled. Too much importance, however, must not be attached to these results, for, as noted by Hall (1929) and Molloy (1933), differences in trichuris egg counts before and after treatments cannot always be relied upon as an accurate index of the efficacy of an anthelmintic. Both of these investigators met with cases whose egg counts were increased after treatment in spite of the fact that female worms were expelled by some of them (Hall's cases). In our series there were forty-six such cases, in some of which, as shown in Table 9, the increases registered after treatment were so great that the differences could not have been due to technical errors. Molloy would explain these discrepancies as due to the irregular and easily upset egg laying habits of whipworms; but, according to Hall, "there is some likelihood that the contents of the cecum, where whipworm eggs are deposited, may be expelled more or less spasmodically and intermittently, and that an egg count for any given sample of feces might be a variable."

Effect on Enterobius vermicularis and Tænia saginata.—Although our observations on the effect of hexylresorcinol on these two parasites are too limited to be of much significance, we have decided to mention them briefly in order to complete our report. In most of the cases the anthelmintic was administered orally in pill form followed in twenty-four hours by sodium sulphate. In some of the enterobius cases instead of the purgative high enemata of a 1 : 1,000 solution of hexylresorcinol in water were given.

Enterobius vermicularis.—There were 17 persons who were found by microscopical examination to harbor this parasite. In view of the inability to make differential egg counts before and after treatment in pinworm infestations as practiced in the case of ascaris, trichuris, and hookworms, the determination of the efficiency of the drug consisted in finding out if due to the treatment dead worms were expelled and if the patients were relieved from the well-known symptoms of enterobius infestation. Based on these considerations our results were satisfactory in 13 out of the 17 cases treated. In two cases who were given hexylresorcinol enemata, the number of pinworms collected in the fæcal screenings of each individual was so great that there is no doubt as to the lethal effect of the drug on the parasite.

Tænia saginata.—Only two cases were found to harbor this tapeworm. In contrast to the observations reported by Lamson and Ward (1932), neither of these two cases was permanently cured, indicating that the drug was unable to cause the expulsion of the head of the parasite.

SUMMARY

Observations were made on the efficiency of hexylresorcinol against different types of human intestinal worms under field conditions in the Philippines.

The drug was given in hard gelatin capsules and in the form of sugar-coated pills, adopting the doses recommended by the manufacturers. It was administered early in the morning on an empty stomach and the patients were advised not to take food for at least four hours afterwards. Each patient received only a single treatment.

A total of 861 individuals, representing both sexes and all ages from 4 years up, were treated. No important toxic symptoms from the drug were observed. A few cases complained of slight symptoms of either gastric or intestinal irritation but these quickly disappeared without any treatment. Some presented burns in their mouths due to the breaking of gelatin capsules, but they did not materially suffer from the lesions. One woman, however, who vomited through her nostrils soon after taking the drug, suffered much inconvenience due to severe burns in the nasal passages.

Hexylresorcinol was found to suffer in anthelmintic efficiency when placed in gelatin capsules, due most probably to the reaction of the drug with the gelatin. The capsules themselves undergo rapid deterioration, especially in a hot and moist climate, as a result of which they either become unfit for use or, if they remain intact, they are easily broken in the mouth during the process of swallowing.

The sugar-coated pills, besides being more efficacious than the gelatin capsules, did not appear to be affected by climatic conditions. Their anthelmintic efficiency was appreciably increased by a saline purgative twenty-four hours after their administration.

In infestations with ascaris and hookworms the administration of single doses of hexylresorcinol pills removed from 82 to 85 per cent of the former parasite and 74 per cent of the latter. Of the ascaris cases 53 to 64 per cent were found negative after the treatment and of the hookworm cases 25.4 per cent.

In trichuris infestations hexylresorcinol was found to be apparently effective, but some doubt is expressed as to the accuracy of judging the efficiency of the drug from the results of differential egg counts before and after treatment.

Observations on a limited number of cases showed that hexylresorcinol is also effective against the human pinworm (*Enterobius vermicularis*) but not against the tapeworm (*Tænia saginata*).

ACKNOWLEDGMENT

We wish to acknowledge gratefully our indebtedness to the following: Messrs. Sharp and Dohme, through Mr. C. S. Lounsbury, for supplying us at a very much reduced price the hexylresorcinol used in our investigations; and Dr. Ismael Villarica, district health officer of Cebu, and Dr. Herminio Talusan, principal of the Magdalena Elementary School, Manila, for various courtesies extended in connection with the collection of fæcal samples.

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AVIAN MALARIA STUDIES, IX

ATABRINE AS A PROPHYLACTIC DRUG IN SPOROZOITE INFECTIONS OF AVIAN MALARIA [1]

By Paul F. Russell

Of the International Health Division of the Rockefeller Foundation

INTRODUCTION

Atabrine is a recently marketed synthetic antimalaria drug which is said to be a substituted alkylaminoalkylamino acridine derivative. It was originally called erion and as sold in some countries its name is spelled atebrin. It is a yellow powder, soluble in water. The aqueous solution has a neutral reaction. Its chemical constitution has not yet been published.

In the Philippines atabrine is obtainable by the public only in tablets of 0.1 gram each and the usual dose for malaria in an adult is 15 tablets, taken at the rate of one, three times a day. For the purposes of this experiment it was possible to obtain, through the courtesy of the Winthrop Chemical Company, ampules containing exactly 0.2 gram of atabrine powder, soluble in water.

These experiments were undertaken to test the value of atabrine as a true or "casual" prophylactic in sporozoite infections of avian malaria. That is to say, an attempt was made to find out if atabrine has a lethal or inhibitory effect on sporozoites. Avian malaria was used because it was not feasible to work locally either with human or simian malaria under existing conditions. There is no strain of simian malaria available in the Philippines and there are no facilities for malaria experimentation on humans.

[1] These studies are from the laboratory of Malaria Investigations of which the author is chief and which is jointly supported by the Bureau of Science, Manila, and the International Health Division of the Rockefeller Foundation. Mr. Andres M. Nono, Misses Capistrano and Villacorta, and Mrs. Ramos, all of the staff of Malaria Investigations, assisted at various times during the experiments. I am indebted to the Winthrop Chemical Company, Dr. G. Schwab, local manager, for the atabrine used in these experiments.

But a review of experiments in avian malaria reveals that results have never been misleading as regards human malaria. On the contrary excellent leads have come from avian studies ever since Ross, by using *Culex* mosquitoes and birds, demonstrated that malaria is a mosquito-borne disease. In the development of the synthetic drugs plasmochin and atabrine, for instance, avian malaria has been of the greatest service and the results observed in birds have invariably been significant when referred to human malaria. So, too, in testing plasmochin and quinine as prophylactics against malaria the results in birds have indicated what could be reasonably expected in humans.

For example, it was at first believed that plasmochin was a true prophylactic in human malaria, and James(1, 2) reported some human experiments which seemed to show this. But the studies of Russell and Nono(3) and of Tate and Vincent(4) showed very clearly that plasmochin will not effectively destroy or inhibit the sporozoites of avian malaria. This proved to be the case in human malaria for the cases originally believed to have been protected were found actually to have been infected. The effect of the drug had been to prevent immediate symptoms but not to prevent infection. (See James,(5, 6) Swellengrebel and de Buck,(7, 8) Russell and Holt.(9)) Here was a case where the first human experiments were definitely misleading, but the avian experiments pointed to the true situation.

ATABRINE AS A PROPHYLACTIC IN HUMAN MALARIA

There are few reports regarding the prophylactic action of atabrine in human malaria. Napier and das Gupta(10) reported one case in which atabrine seemed to protect a volunteer from mosquito-borne malaria. The treatment was begun the day before infection and was continued for five days thereafter. This case was negative for at least two months although controls became positive. The effect of atabrine here was more likely therapeutic than strictly prophylactic.

Soesilo(11, 12) reported that six among twenty-one volunteers, treated prophylactically with atabrine and bitten by infected mosquitoes, showed parasites in their blood after twelve to twenty-four days. The other fifteen remained negative for at least seven months. Ten of eleven volunteers, used as controls and not given atabrine, showed parasites in their blood after eight to thirteen days. Soesilo gave total maximum prophylactic doses of 1.4 grams and minimum of 0.6 gram. In the cases that became positive in spite of the atabrine the prepatent period was prolonged.

James(13) reported some experiments at the Devon Mental Hospital which may be summarized as follows:

A summary of James's experiments.

Group.	Case No.	Bites by infected mosquitoes (*A. maculipennis*).	Result (up to 30th day).	
			Attack.	Length of prepatent period.
				Days.
No drug	1	8	Yes	12
	2	6	Yes	10
Quinine gr. XV daily for 6 days	3	5	Yes	11
	4	4	Yes	11
	5	5	Yes	10
	6	8	Yes	12
	7	6	Yes	14
Phenoquinine 6 tablets daily for 6 days	8	5	Yes	10
	9	8	Yes	11
	10	3	Yes	11
	11	5	Yes	10
	12	5	Yes	11
Atabrine (atebrin) 3 tablets daily for 6 days	13	7	No	No parasites seen up to 30 days after infection.
	14	7	No	
	15	3	No	
	16	5	No	
	17	5	No	

In these experiments the first dose of atabrine was given four hours before the mosquitoes were allowed to bite the patient. The results indicate that atabrine certainly postponed the attacks and may have entirely prevented them. But the effect probably was therapeutic as the doses continued for five days after infection. There was no evidence in the experiments showing any action of atabrine on the sporozoites of human malaria. Yet these reports from Soesilo(12) and James(13) indicate that in a practical way atabrine may have prophylactic value.

GENERAL PROCEDURE

It is not necessary to describe the general procedure of these experiments because it has been fully discussed in previous papers.(3, 14, 15) The same strains of *Culex fatigans* (*quinquefasciatus*) and of *Plasmodium capistrani* were used, and the same technic was followed.

RESULTS OF EXPERIMENTS

Seven experiments, on sixty-five canaries, are described in this report.

EXPERIMENT I

Used twenty birds, T34 to T53. Birds T36, 37, 38, 39, and 40, each received an intramuscular injection of 0.0005 gram atabrine in 0.1 cc distilled water into pectoral muscles on February 7, 8, and 9 at 3 p. m. On February 9 at 10.30 a. m. birds T34 to T53 each received into the pectoral muscles 0.15 cc of a mixture of normal saline and macerated thorax tissue from infected mosquitoes. Thorax tissue from a total of 120 mosquitoes in 4 cc of saline had been macerated in a small mortar and pestle. Each bird therefore received approximately the equivalent of the thorax contents of 4.5 mosquitoes. An examination of this mixture after all injections had been given revealed numerous viable sporozoites. A total of twenty-eight mosquitoes from this lot had previously been dissected and 32 per cent of the salivary glands contained sporozoites.

Of the twenty birds used in this experiment fifteen died very promptly after receiving the sporozoite injection, as follows:

February 10: Birds T36, 45, 48, 50, 51, and 52.

February 11: Birds T35, 42, 43, 44, 46, 47, and 49.

February 13: Bird T40.

Birds T34, 37, 38, 41, and 53 were still alive March 22, and each of them became infected with malaria.

Bird No.	Blood-smear examinations.	
	Negative.	Positive.
T34	January 23; February 12, 13, 14, 15, 16; March 4.	February 17, 18, 19, 20, 22, 25, 26, 28; March 2.
T37	January 23; February 12, 13, 14; March 2, 4.	February 14, 16, 17, 18, 20, 22, 25, 26, 28.
T38	January 23; February 12, 13, 14, 15, 16; March 2, 4.	February 17, 18, 19, 20, 22, 25, 26, 28.
T41	February 3, 12, 13, 14, 15, 16, 17, 18	February 19, 20, 21, 23, 24, 25, 27; March 1, 3.
T53	February 3, 12, 13, 14	February 15, 16, 17, 19, 21, 23, 24, 25, 27; March 1, 3.

In this experiment two doses of atabrine were given before infection and one dose five hours afterwards. The amount given was the maximum dose that would not cause toxic symptoms in the canary. The atabrine given in this way obviously did not prevent malaria. But it apparently had a measurable lethal or inhibitory effect on the sporozoites, for although the immediate death rate in the birds receiving atabrine was 60 per cent, in the controls not protected it was 80 per cent. The prepatent periods in the two surviving birds which received atabrine were six and eight days, respectively. In the three surviving control birds these periods were six, eight, and ten days, respectively. The atabrine apparently had no effect on this period in this experiment.

EXPERIMENT II

Birds T54, 55, and 56 were used in this experiment. February 9 each received 0.15 cc of the same sporozoite-saline mixture used in Experiment I. This was injected into the right pectoral muscle. A minute or two later birds T55 and T56 received 0.0005 gram of atabrine injected into the left pectoral muscle in 0.1 cc of distilled water. These two birds that received atabrine died February 10, the day after infection. T54 died the following day. These birds were overwhelmed by the infection, as were a majority of the birds in the first experiment. The single dose of atabrine had no favorable influence.

EXPERIMENT III

In order to prove that sudden death in birds receiving large doses of sporozoites was not due to any other constituent of the macerated thorax tissue of *Culex* mosquitoes, birds T67 and T68 were given 0.2 cc of a saline-thorax mixture into pectoral muscles February 10. This mixture was prepared by macerating the thorax tissue of twenty-five mosquitoes in 1 cc of saline solution. These mosquitoes were of the same strain as those used in the first two experiments. Each bird received the equivalent of the total thorax tissue of five mosquitoes. This was as large a dose as any used in the atabrine experiments. These birds were alive and negative March 22. They showed no ill effects whatever from the injection of uninfected thorax tissue of *Culex* mosquitoes.

EXPERIMENT IV

In this experiment ten birds were used, T57 to T66. Birds T57, 58, 59, 60, and 61 each received 0.0005 gram of atabrine intramuscularly February 10 and 11 and twice February 12. Thirty minutes after the last dose February 12 each of birds T57 to T66 received intramuscularly 0.2 cc of a saline-sporozoite mixture. The thorax tissue from 75 mosquitoes had been macerated with 3 cc saline so that 0.2 cc was equivalent to the thorax contents of 5 mosquitoes. Previous dissections from this lot of mosquitoes had shown a positive gland index of 20 per cent.

The following casualties occurred:

February 15: Birds T60, 62, 63, 64, and 65 died.

February 28: Bird T58 died.

March 1: Bird T66 died.

March 11: Bird T59 died.

Birds T57 and T61 were still alive March 22. Each of the five birds surviving beyond the normal prepatent period became infected as follows:

Bird No.	Blood-smear examinations.	
	Negative.	Positive.
T57	February 10, 17, 18, 19, 20	February 21, 23, 24, 25, 26, 27, 28; March 1, 2, 3, 4, 5.
T58	February 10, 17, 18, 19	February 20, 21, 23, 24, 25, 26, 27.
T59	February 10, 17, 18, 19, 20	February 21, 23, 24, 25, 26, 27, 28; March 1, 2, 3, 4, 5.
T61	February 10, 17, 18, 19, 20, 21	February 23, 24, 25, 26, 27, 28; March 1, 2, 3, 4, 5.
T66	February 10, 15, 17, 18, 19, 20, 21	February 23, 24, 25, 26, 27, 28.

In this experiment the immediate mortality among the birds receiving atabrine was 20 per cent, but among the control birds it was 80 per cent. The four doses of atabrine received prior to infection apparently had a measurably lethal or inhibitory effect on the sporozoites. But the atabrine did not prevent infection. The prepatent periods in the atabrine birds were 8, 9, 9, and 11 days.

In the one surviving control bird this prepatent period was eleven days. The course of the infection in the atabrine birds was of normal severity and duration, uninfluenced by the atabrine received prior to infection.

EXPERIMENT V

Ten birds were used in experiment V, T96–100, and 200–204. Birds T96, 97, 98, 99, and 100 each received 0.0005 gram of atabrine intramuscularly February 22, 23, 24, and 25. February 23 these birds and the controls 200–204 each received 0.1 cc of a saline-sporozoite mixture. This dose was equivalent to the thorax contents of 2.5 mosquitoes. Dissections had shown a positive salivary gland index of 40 per cent. The only immediate casualty was bird T96 which died February 25. Bird T100 died March 20. All the other birds were alive March 22.

All of the birds, excepting T96 which died, became infected as follows:

Bird No.	Blood-smear examinations.	
	Negative.	Positive.
T97	February 21, March 1	March 3, 5, 7, 9, 11, 13.
T98	February 21, March 2	March 4, 6, 8, 10, 12.
T99	February 21	March 1, 3, 5, 7, 9, 11, 13.
T100	February 21	March 2, 4, 6, 8, 10, 12.
200	February 21	March 2, 4, 6, 8, 10, 12.
201	February 21, March 1	March 3, 5, 7, 9, 11, 13.
202	February 21, March 2, 4, 6	March 8, 10, 12.
203	February 21	March 1, 2, 5, 7, 9, 11, 13.
204	February 21, March 2	March 4, 6, 8, 10, 12.

In this experiment the birds became infected, although smaller doses of sporozoites were injected and although the atabrine was continued for two days after the infection. The prepatent periods, and the severity and duration of the disease, appeared to have been uninfluenced by the atabrine.

EXPERIMENT VI

In experiment VI ten birds were used, numbers 205–214. Birds 205–209 each received 0.0005 gram atabrine intramuscularly February 22, 23, 24, and 25. During the night of February 23–24 they were all exposed to the bites of *Culex* mosquitoes as follows:

Cage.	Birds.	Mosquitoes.				
		Put in cage.	Recovered in morning.		Dissected.[a]	
			Total.	Blooded.	Total.	Positive salivary glands.
A	205,210	20	16	1	1	0
B	206,211	20	19	7	6	6
C	207,212	20	16	2	2	2
D	208,213	20	20	8	6	3
E	209,214	20	10	4	4	1

[a] The dissection rates refer to the blooded mosquitoes. The birds devoured some of the mosquitoes—probably sluggish blooded ones.

The results of blood-smear examinations in these cases were as follows:

Bird No.	Blood-smear examinations.	
	Negative.	Positive.
205	February 21; March 1, 2, 5, 7, 9, 11	
206	February 21; March 2	March 4, 6, 8, 10, 12.
207	February 21; March 1	March 3, 5, 7, 9.
208	February 21; March 2, 4, 6	March 8, 10, 12.
209	February 21; March 1, 3, 5, 7, 9, 11	
210	February 21; March 2, 4, 6, 8, 10	
211	February 21; March 1	March 3, 5, 7, 9, 11, 13.
212	February 21; March 2, 4, 6, 8, 10	
213	February 21; March 1	March 3, 5, 7, 9, 11, 13.
214	February 21; March 2, 4	March 8, 10, 12, 14.

Bird 207 died March 10, bird 208 died March 13, and birds 206 and 214 died March 17.

Birds 205, 209, 210, and 212, which remained negative, were all proved to be susceptible birds by injection from an infected bird having the same strain of parasites.

In analyzing these results it is noted that birds 205, 209, 210, and 212 did not become infected. Of these birds, 205 and 210 were together in Cage A. Only one blooded mosquito was recovered from this cage, and it was negative on dissection. Therefore, it is not surprising that these two birds remained negative. Bird 209 had received atabrine. It was in Cage E and its control bird, No. 214, became positive. But of the four blooded mosquitoes recovered only one was found to be infected so it is possible that bird 209 was not bitten by an infected mosquito. The other negative bird was No. 212, which had not received atabrine. Two infected blooded mosquitoes were recovered from its Cage C. These may both have bitten bird 207, which shared the cage with 212 and became positive.

In other words the negative birds in this experiment have no significance as regards atabrine. But birds 206, 207, and 208 each received atabrine yet became infected. Bird 206 may have received a heavy infection as there were six infected blooded mosquitoes recovered from its cage. But birds 207 and 208 did not receive heavy infections. In these cases atabrine obviously did not prevent natural mosquito-borne infections.

EXPERIMENT VII

In this experiment ten birds were used, 223–232. March 30 and again March 21, at about 9 a. m. birds 223–227 each received an intramuscular injection of 0.00067 gram atabrine in 0.1 cc distilled water. March 31 at about 9.15 a. m. birds 223–232 each received 0.1 cc of a mixture of saline solution and macerated thorax tissue from infected *Culex* mosquitoes. A total of 75 mosquitoes and 4 cc of saline were used, so that each bird received the equivalent of the total thorax contents of 1.85 mosquitoes. The sporozoite index of the lot of mosquitoes was only 25 per cent. An examination of the mixture remaining after injection revealed a very few motile sporozoites. April 26 birds 227 and 228 died.

The following is the record of the blood-smear examinations of these birds:

Bird No.	Blood-smear examinations.	
	Negative.	Positive.
223	March 29; April 6, 9, 11	April 13, 15, 17.
224	March 29; April 7, 10	April 12, 14, 16, 18.
225	March 29; April 6, 9, 11, 13, 15, 17	
226	March 29; April 7, 10	April 12, 14, 16, 18.
227	March 29; April 6, 9, 11, 13, 15, 17	
228	March 29; April 7	April 10, 12, 14, 16, 18.
229	March 29; April 6, 9, 11	April 13, 15, 17.
230	March 29; April 7	April 10, 12, 14, 16, 18.
231	March 29; April 6, 9, 11	April 13, 15, 17.
232	March 29; April 7, 10, 12, 14, 16, 18.	

It will be seen that of the birds receiving atabrine, three (223, 224, 226) became infected and two (225, 227) did not, while of those not receiving atabrine four (228, 229, 230, 231) became infected and one (232) did not. The three negative birds were injected April 18 with blood containing the same strain of plasmodia. Bird 227 became positive April 22, bird 232 April 25, and bird 225 April 26. All had acute infections, from which it is assumed that they were not infected by the previous sporozoite injections.

In this experiment larger doses of atabrine and smaller doses of sporozoites were used. Rozeboom and Shah(16) have recently reported that they were unable to infect canaries with injections of less than 200 sporozoites. In other words, although theoretically one viable sporozoite should, perhaps, be able to infect a canary, yet more than 200 are required. In our experiment the sporozoites were not counted but by inspection it was known that the numbers were small. Therefore, it is not surprising that some of our birds did not become infected. Moreover, it cannot be called significant that although two of the atabrine birds remained negative only one of the control birds failed to be infected.

Here then atabrine in relatively large doses given before infection failed to protect birds receiving minimal doses of sporozoites.

SUMMARY

In a series of experiments to test the prophylactic action of atabrine in sporozoite infections of avian malaria it was found that although atabrine appears to have some lethal or inhibitory action on the sporozoites of avian malaria, it is but a true casual prophylactic.

CONCLUSIONS

1. Published reports indicate that atabrine given just before and for several days after mosquito-borne infection of human malaria will postpone, and in some cases, but not in others, will prevent entirely the appearance of malaria. Whether or not the atabrine has any effect on sporozoites is not clear from any published reports. Those experiments published suggest an early therapeutic effect with clinical rather than true prophylaxis.

2. In the experiments herewith reported, atabrine did not prevent the appearance of malaria in birds receiving maximum nontoxic doses of the drug and varying doses of sporozoites injected intramuscularly.

3. Atabrine did not prevent the appearance of malaria in birds exposed to the bites of infected *Culex* mosquitoes.

4. Atabrine appeared to reduce the immediate mortality rate in birds receiving large doses of injected sporozoites.

5. A mixture of macerated thorax tissue and normal saline from uninfected *Culex* mosquitoes, in doses equivalent to the thorax tissue of five mosquitoes, is not toxic to canaries when injected intramuscularly.

6. Mixtures of macerated thorax tissue and normal saline from malaria-infected *Culex* mosquitoes, in doses equivalent to the thorax tissue of 2 to 4.5 mosquitoes, injected intramuscularly, may prove rapidly fatal to canaries.

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WEIGHTS OF VISCERAL ORGANS OF FILIPINOS IN DIFFERENT DISEASES [1]

By W. DE LEON, P. I. DE JESUS, and J. M. RAMOS

Of the School of Hygiene and Public Health, University of the Philippines

The present paper is the fifth of a series of studies on the weights of visceral organs in Filipinos. In previous papers [2] we presented the weights of normal organs classified by age, body weight, and body length in persons dying of accidents. In this paper we shall report the variations of the weights of visceral organs for a number of selected diseases. The materials used in these studies were taken from the necropsy records of the Department of Pathology and Bacteriology and the Department of Legal Medicine of the University of the Philippines.

Table 1 presents the weights of visceral organs of Filipino children in the different diseases included in our study. Due to the great variability of the weights of organs in children at different ages, we decided to classify them into four age groups; namely, 1 year and less, 2 to 5 years, 6 to 10 years, and 11 to 15 years. Furthermore, due to insufficient available data, we included in the table only the following diseases: Typhoid fever, bacillary dysentery, suppurative and tuberculous meningitis, pulmonary tuberculosis, infantile beriberi, cholera infantum, endocarditis, broncho-pneumonia, lobar pneumonia, and acute and chronic nephritis. For purposes of comparison we have also included in Table 1 the normal weights of organs in accident cases as determined in our previous studies, cited in footnote 2.

[1] Read before the Conjoint Annual Convention of the Philippine Islands Medical Association and the Philippine Public Health Association, December 13, 1933.

[2] De Jesus, P. I., and W. de Leon. Studies on the weights of visceral organs in Filipinos, Philip. Journ. Sci. 52 (1933) 97–98. De Jesus, P. I., W. de Leon, and P. Anzures. Normal weights of visceral organs in adult Filipinos, t. c. 99–109. De Leon, W., Arturo Garcia, and P. I. de Jesus. Normal weights of visceral organs in Filipino children, t. c. 111–118. De Jesus, P. I., W. de Leon, and J. M. Ramos. Normal weights of visceral organs in Filipinos in relation to length and body weight, t. c. 119–129.

The cases in Table 1 included under each of the diseases above mentioned were selected from those having only one main cause of death. Those cases having secondary causes of death or suffering from some other concomitant disease which might in any way confuse the weights of organs were not included. Thus, if the main cause of death was pulmonary tuberculosis, and the same person was also found to be suffering from endocarditis or from malaria, the case was excluded from our table. The same procedure was followed in preparing Table 2, which is presented below.

In the preparation of Table 1 we noted that in children the individual weights of organs under one age group showed a great deal of variation. This can perhaps be explained by the wide range of age groupings in our table and by the marked differences in body weights of children under one age group. We regret that due to an insufficient number of cases we were unable to classify the children into more age groups and into different body-weight groups. Consequently, no definite conclusions can be offered in the majority of diseases in Table 1.

In Tables 1 and 2 the mean weight was determined by taking the arithmetical mean of all the individual observations. The maximum and minimum weights were determined by first plotting the individual observations. In the graph the maximum and minimum weights were taken only from the group about the mean; a few observations that were found distantly separated from the majority of cases were rejected. However, in certain diseases all cases were included in the computation irrespective of the amount of deviation from the mean. This exception was made in the spleen of malaria and typhoid, where the maximum and minimum weights were obtained from the highest and lowest individual observations. The same exception was made in recording the maximum and minimum weights of the heart in endocarditis, arteriosclerosis, and chronic nephritis; and of the liver in cirrhosis.

Table 2 presents the weights of visceral organs of adult Filipinos in the following diseases: Typhoid fever, malaria, Asiatic cholera, amœbic and bacillary dysenteries, suppurative meningitis, tetanus, chronic pulmonary tuberculosis, tuberculous pneumonia, tuberculous meningitis, generalized miliary tuberculosis, beriberi, acute and chronic endocarditis, arteriosclerosis, broncho-pneumonia, lobar pneumonia, portal cirrhosis, hypertrophic cirrhosis, acute nephritis, chronic interstitial nephritis, chronic parenchymatous nephritis, and septicæmia.

As in Table 1 it can be readily seen that the weights of pathological organs in the adult vary with different diseases, the deviation being marked in some cases. Due to lack of time and help we were unable to determine by statistical methods whether these variations were significant or not.

A glance at Table 2 will show that acute diseases in general cause an absolute increase in the weight of the visceral organs with the exception of the heart. This increase is particularly notable in the spleen. The relative increases of weight, however, differ with different diseases as shown in Table 3.

Table 3 shows the percentage increase or decrease in the weights of organs from normal as affected by pathological conditions. This table was computed from the preceding table by comparing the weights of the pathological organs and the weights of the organs in accident cases.

It is interesting to note in Table 3 that the weight of the heart is markedly increased in chronic endocarditis, arteriosclerosis, beriberi, and chronic interstitial nephritis. It is only slightly increased in lobar pneumonia and chronic parenchymatous nephritis. The weight remains almost unaffected in tetanus, suppurative meningitis, acute nephritis, and septicæmia. It is markedly decreased in typhoid fever and amœbic dysentery, and only slightly decreased in chronic pulmonary tuberculosis, tuberculous meningitis, tuberculous pneumonia, malaria, bacillary dysentery, portal cirrhosis, and broncho-pneumonia. In cholera, generalized miliary tuberculosis, acute endocarditis, and hypertrophic cirrhosis, where the number of observations was less than ten in each group, no definite conclusions can be offered.

In Table 3 it will also be observed that the weight of the spleen is considerably increased in malaria, portal cirrhosis, septicæmia, beriberi, typhoid fever, lobar pneumonia, acute nephritis, broncho-pneumonia, and suppurative meningitis. It is only slightly increased in chronic pulmonary tuberculosis, chronic endocarditis, chronic interstitial nephritis, chronic parenchymatous nephritis, bacillary dysentery, and amœbic dysentery. It is slightly decreased in tuberculous meningitis, arteriosclerosis, and tetanus. In the rest of the diseases included in our study the cases were too few to warrant definite conclusions.

TABLE 1.—*Cases and weights of visceral organs of Filipino children in certain diseases.*

Cause of death.	Sex.	Age.	Heart.				Spleen.				Liver.			
			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
				Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		Yrs.		g.	g.	g.		g.	g.	g.		g.	g.	g.
Trauma	M	1 or <1	13	32.92	19	43	12	31.83	6	63	12	247.83	128	590
Do	M	2–5	45	69.58	35	105	42	47.19	22	84	36	463.14	199	834
Do	M	6–10	69	105.64	65	155	67	58.09	21	127	56	642.59	398	1,144
Do	M	11–15	76	159.32	85	330	73	86.52	40	180	60	893.55	650	1,471
Do	F	1 or <1	8	33.75	19	59	9	22.67	10	39	8	202.00	97	335
Do	F	2–5	35	64.94	42	106	37	42.51	23	80	30	418.50	267	716
Do	F	6–10	20	94.75	60	128	19	53.00	17	106	17	573.35	400	906
Do	F	11–15	17	167.00	117	232	17	104.53	57	215	15	865.60	650	1,429
Typhoid fever	M	1 or <1	1	61.00	------	------	1	31.00	------	------	1	257.00	------	------
Do	M	2–5	1	60.00	------	------	1	77.00	------	------	1	461.00	------	------
Do	M	6–10	4	106.25	87	134	3	81.00	33	125	4	757.00	585	892
Do	M	11–15	7	152.29	87	242	7	165.00	95	317	7	1,053.57	645	1,437
Do	F	1 or <1	1	50.00	------	------	1	29.00	------	------	1	277.00	------	------
Do	F	2–5	4	64.50	54	87	4	53.25	27	124	4	464.75	270	797
Do	F	6–10	7	82.86	73	94	8	82.00	37	145	7	662.00	505	752
Do	F	11–15	13	139.38	87	217	12	197.25	66	750	13	1,059.46	740	1,300
Bacillary dysentery	M	1 or <1	27	28.22	12	47	27	18.04	8	37	24	223.50	102	625
Do	M	2–5	18	49.83	30	75	18	25.89	10	40	17	341.88	127	532
Do	M	6–10	3	80.33	62	104	3	40.33	20	78	3	555.00	500	612
Do	M	11–15	2	238.00	166	310	2	208.50	80	337	2	1,482.00	1,377	1,587
Do	F	1 or <1	14	29.93	12	50	14	15.79	8	29	12	213.50	95	355
Do	F	2–5	16	51.94	35	85	15	26.80	15	43	15	365.87	185	595
Do	F	6–10	2	64.00	51	77	2	29.00	21	37	2	465.00	395	535

Do	F	11–15	4	120.50	97	135	4	62.75	21	92	4	941.00	697	1,210
Suppurative and tuberculous meningitis	M	1 or <1	17	38.12	16	64	17	22.71	7	48	16	232.50	47	365
Do	M	2– 5	7	54.71	35	72	7	36.14	24	56	7	334.00	221	471
Do	M	6–10	10	95.10	70	.130	10	49.60	26	80	10	583.30	249	706
Do	M	11–15	10	154.60	106	241	10	78.00	32	115	11	839.18	447	1,436
Do	F	1 or <1	12	32.33	16	52	12	22.33	9	44	11	222.18	110	335
Do	F	2– 5	7	56.00	42	72	7	29.71	16	39	6	414.50	287	637
Do	F	6–10	8	88.38	36	127	8	52.50	26	130	7	545.14	330	800
Do	F	11–15	3	155.33	110	236	3	88.33	47	140	3	888.33	740	1,040
Pulmonary tuberculosis	M	1 or <1	14	26.29	17	39	12	23.83	12	50	15	249.40	151	455
Do	M	2– 5	41	45.29	27	82	40	34.60	15	75	38	331.21	204	532
Do	M	6–10	4	102.75	51	180	3	49.67	46	55	4	557.00	485	613
Do	M	11–15	10	139.30	90	185	10	86.10	55	167	10	798.40	562	1,350
Do	F	1 or <1	14	30.29	12	51	15	20.73	5	42	13	198.38	92	328
Do	F	2– 5	33	38.27	22	73	34	28.79	12	124	33	308.15	132	825
Do	F	6–10	5	92.00	59	120	6	44.83	24	54	6	612.50	327	864
Do	F	11–15	5	168.40	89	279	3	74.33	55	107	5	936.00	724	1,165
Infantile beriberi	M	1 or <1	26	36.50	17	60	28	16.64	9	38	28	161.93	105	254
Do	M	2– 5	2	86.50	46	127	1	29.00	------	------	1	480.00	------	------
Do	M	6–10	------	------	------	------	------	------	------	------	------	------	------	------
Do	M	11–15	4	286.50	192	388	4	186.00	171	06	4	1,145.50	888	1,440
Do	F	1 or <1	19	34.26	23	58	17	15.29	6	57	18	160.17	28	231
Do	F	2– 5	------	------	------	------	------	------	------	------	------	------	------	------
Do	F	6–10	------	------	------	------	------	------	------	------	------	------	------	------
Do	F	11–15	1	252.00	------	------	1	209.00	------	------	1	1,375.00	------	------
Cholera infantum	M	1 or <1	27	22.59	8	40	27	13.70	5	27	27	140.56	41	249
Do	M	2– 5	1	25.00	------	------	1	24.00	------	------	1	252.00	------	------
Do	M	6–10	------	------	------	------	------	------	------	------	------	------	------	------
Do	M	11–15	------	------	------	------	------	------	------	------	------	------	------	------
Do	F	1 or <1	17	18.59	7	35	16	11.19	5	27	17	127.47	42	269
Do	F	2– 5	1	32.00	------	------	2	19.00	15	23	2	226.00	186	266
Do	F	6–10	------	------	------	------	------	------	------	------	------	------	------	------
Do	F	11–15	------	------	------	------	------	------	------	------	------	------	------	------

TABLE 1.—*Cases and weights of visceral organs of Filipino children in certain diseases*—Continued.

Cause of death.	Sex.	Age.	Heart.				Spleen.				Liver.			
			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
				Mean.	Mini-mum.	Maxi-mum.		Mean.	Mini-mum.	Maxi-mum.		Mean.	Mini-mum.	Maxi-mum.
	g.	Yrs.		g.	g.	g.		g.	g.	g.		g.	g.	g.
Endocarditis	M	1 or <1	1	52.00	------	------	1	15.00	------	------	1	182.00	------	------
Do	M	2- 5	1	66.00	------	------	1	23.00	------	------	1	370.00	------	------
Do	M	6-10	------	------	------	------	------	------	------	------	------	------	------	------
Do	M	11-15	3	472.33	300	644	3	82.00	72	94	2	1,249.50	1,150	1,349
Do	F	1 or <1	1	60.00	------	------	------	------	------	------	1	170.00	------	------
Do	F	2- 5	------	------	------	------	------	------	------	------	------	------	------	------
Do	F	6-10	2	264.50	231	298	2	99.50	76	123	2	943.00	811	1,075
Do	F	11-15	7	335.43	232	583	7	94.29	35	125	7	1,256.43	723	2,732
Broncho-pneumonia	M	1 or <1	58	27.78	10	60	57	16.91	3	56	57	182.88	52	422
Do	M	2- 5	20	51.50	30	100	19	34.26	12	101	17	370.00	201	623
Do	M	6-10	2	208.50	78	339	3	65.00	34	93	3	546.00	298	790
Do	M	11-15	1	185.00	------	------	1	52.00	------	------	1	1,197.00	------	------
Do	F	1 or <1	44	26.43	7	57	45	14.96	3	52	45	178.98	28	375
Do	F	2- 5	11	50.18	21	82	9	41.22	10	75	9	340.44	157	560
Do	F	6-10	5	96.40	60	178	5	123.60	31	382	4	735.75	450	1,320
Do	F	11-15	1	200.00	------	------	1	112.00	------	------	1	688.00	------	------
Lobar pneumonia	M	1 or <1	6	29.67	12	42	6	25.33	4	58	6	229.00	68	374
Do	M	2- 5	4	47.75	28	65	4	31.00	18	46	4	330.25	186	485
Do	M	6-10	5	97.00	84	110	5	62.40	30	92	5	671.40	497	840
Do	M	11-15	3	147.67	131	170	3	483.67	68	970	3	1,159.67	1,015	1,271
Do	F	1 or <1	11	26.55	12	41	10	18.30	8	35	9	217.78	110	340
Do	F	2- 5	3	45.33	38	54	3	23.30	19	31	3	487.67	325	705
Do	F	6-10	1	82.00	------	------	1	49.00	------	------	1	600.00	------	------
Do	F	11-15	1	135.00	------	------	1	81.00	------	------	1	1,053.00	------	------

Acute nephritis	M	1 or <1	12	31.92	19	64	11	18.82	13	35	11	207.91	160	264
Do	M	2– 5	------	------	------	------	------	------	------	------	------	------	------	------
Do	M	6–10	2	113.50	87	140	2	69.00	58	80	2	648.50	462	835
Do	M	11–15	1	204.00	------	------	1	110.00	------	------	1	1,210.00	------	------
Do	F	1 or <1	7	27.57	15	37	7	16.71	11	23	5	156.40	105	204
Do	F	2– 5	1	40.00	------	------	1	22.00	------	------	1	275.00	------	------
Do	F	6–10	------	------	------	------	------	------	------	------	------	------	------	------
Do	F	11–15	1	173.00	------	------	1	76.00	------	------	1	884.00	------	------
Chronic nephritis	M	1 or <1	------	------	------	------	------	------	------	------	------	------	------	------
Do	M	2– 5	------	------	------	------	------	------	------	------	------	------	------	------
Do	M	6–10	1	62.00	------	------	1	115.00	------	------	1	337.00	------	------
Do	M	11–15	6	237.50	92	320	6	101.67	65	140	5	917.20	760	1,150
Do	F	1 or <1	1	22.00	------	------	1	22.00	------	------	1	100.00	------	------
Do	F	2– 5	1	70.00	------	------	1	29.00	------	------	1	297.00	------	------
Do	F	6–10	1	94.00	------	------	1	215.00	------	------	1	580.00	------	------
Do	F	11–15	------	------	------	------	------	------	------	------	------	------	------	------

TABLE 1.—*Cases and weights of visceral organs of Filipino children in certain diseases*—Continued.

Cause of death.	Sex.	Age.	Pancreas.				Suprarenals.							
							Both.				Right.			
			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
				Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		Yrs.		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*
Trauma	M	1 or <1	2	11.00	7	15	8	6.50	4	11	5	3.60	3	4
Do	M	2- 5	6	26.83	17	33	18	7.06	4	12	15	3.60	2	5
Do	M	6-10	18	47.50	20	76	35	9.57	4	15	24	4.88	2	7
Do	M	11-15	15	60.27	42	100	36	10.08	5	15	22	5.36	3	8
Do	F	1 or <1	2	17.00	15	19	6	6.33	3	10	2	4.00	3	5
Do	F	2- 5	7	23.71	19	29	17	6.06	3	11	9	3.00	2	5
Do	F	6-10	7	47.00	30	57	11	8.64	4	14	9	4.44	3	7
Do	F	11-15	5	63.80	52	90	10	12.10	5	14	9	5.78	2	12
Typhoid fever	M	1 or <1	1	14.00	------	------	1	3.00	------	------	1	1.00	------	------
Do	M	2- 5	------	------	------	------	1	12.00	------	------	1	6.00	------	------
Do	M	6-10	1	54.00	------	------	1	10.00	------	------	------	------	------	------
Do	M	11-15	------	------	------	------	4	10.50	8	12	------	------	------	------
Do	F	1 or <1	------	------	------	------	1	5.00	------	------	------	------	------	------
Do	F	2- 5	1	17.00	------	------	4	8.25	5	10	1	5.00	------	------
Do	F	6-10	2	41.00	37	45	3	10.33	9	13	2	4.50	4	5
Do	F	11-15	1	87.00	------	------	9	10.22	7	14	1	6.00	------	------
Bacillary dysentery	M	1 or <1	7	7.71	5	10	16	5.06	2	9	8	2.63	2	5
Do	M	2- 5	3	22.00	14	27	13	6.46	4	10	3	4.00	2	5
Do	M	6-10	------	------	------	------	3	8.00	7	9	------	------	------	------
Do	M	11-15	------	------	------	------	1	13.00	------	------	------	------	------	------
Do	F	1 or <1	3	12.00	7	18	9	5.55	2	12	2	4.00	2	6
Do	F	2- 5	6	20.67	7	32	12	7.08	2	13	5	4.80	4	7

Do	F	6–10					1	10.00			1	5.00		
Do	F	11–15					3	12.33	11	15				
Suppurative and tuberculous meningitis	M	1 or <1	7	8.86	4	11	11	6.00	3	8	6	4.00	3	5
Do	M	2– 5	3	17.33	13	26	5	6.20	4	9	3	3.33	2	5
Do	M	6–10	4	35.25	17	52	8	9.25	5	14	3	3.67	3	4
Do	M	11–15	2	42.00	35	49	6	11.50	9	15	1	4.00		
Do	F	1 or <1	1	17.00			7	6.86	4	12	1	4.00		
Do	F	2– 5	4	23.75	14	32	5	7.00	5	12	4	3.50	2	6
Do	F	6–10	3	15.00	7	36	3	8.33	7	10	1	5.00		
Do	F	11–15					1	17.00			1	9.00		
Pulmonary tuberculosis	M	1 or <1	2	12.50	6	19	7	4.71	2	8	3	4.33	3	6
Do	M	2– 5	9	17.11	9	24	26	6.77	3	12	13	3.31	2	6
Do	M	6–10	1	62.00			2	5.00	4	6				
Do	M	11–15	1	47.00			5	12.60	10	18	1	9.00		
Do	F	1 or <1					6	4.83	2	7				
Do	F	2– 5	8	15.63	7	28	22	5.00	2	12	8	3.25	2	6
Do	F	6–10	2	33.50	4	43	4	6.00	4	8	1	3.00		
Do	F	11–15	2	51.00	2	60	2	12.00	9	15				
Infantile beriberi	M	1 or <1	7	6.86	3	11	17	4.88	2	10	8	2.63	1	5
Do	M	2– 5												
Do	M	6–10												
Do	M	11–15												
Do	F	1 or <1	3	8.67	7	10	9	6.33	3	11	3	4.67	3	7
Do	F	2– 5												
Do	F	6–10												
Do	F	11–15												
Cholera infantum	M	1 or <1	1	12.00			14	4.71	3	7	3	2.67	2	4
Do	M	2– 5												
Do	M	6–10												
Do	M	11–15												
Do	F	1 or <1	2	8.50	8	9	13	4.62	2	10	4	3.25	2	5
Do	F	2– 5												
Do	F	6–10												
Do	F	11–15												

TABLE 1.—*Cases and weights of visceral organs of Filipino children in certain diseases*—Continued.

Cause of death.	Sex.	Age.	Pancreas.				Suprarenals.							
							Both.				Right.			
			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
				Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		Yrs.		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*
Endocarditis	M	1 or <1												
Do	M	2–5	1	23.00			1	16.00			1	7.00		
Do	M	6–10												
Do	M	11–15	2	106.50	78	135	3	13.00	11	15	2	5.50	5	6
Do	F	1 or <1												
Do	F	2–5												
Do	F	6–10												
Do	F	11–15	1	86.00			5	10.80	7	14	1	7.00		
Broncho-pneumonia	M	1 or <1	12	9.58	2	20	34	5.71	2	11	13	3.31	1	6
Do	M	2–5	8	14.25	8	27	11	5.27	4	6	8	2.38	2	3
Do	M	6–10												
Do	M	11–15												
Do	F	1 or <1	13	7.54	3	14	24	4.63	2	9	10	2.40	1	4
Do	F	2–5	2	17.50	15	20	6	5.83	3	9	2	3.00	2	4
Do	F	6–10	2	40.00	34	46	4	7.00	4	11	2	3.50	2	5
Do	F	11–15												
Lobar pneumonia	M	1 or <1					3	5.00	3	6				
Do	M	2–5					3	4.67	3	6				
Do	M	6–10					3	8.33	7	9				
Do	M	11–15	1	70.00			1	17.00						
Do	F	1 or <1	1	8.00			4	5.75	5	7				

Do	F	2– 5					1	5.00						
Do	F	6–10	1	37.00			1	14.00						
Do	F	11–15	1	68.00			1	10.00			1	5.00		
Acute nephritis	M	1 or <1					3	4.33	3	5	1	2.00		
Do	M	2– 5												
Do	M	6–10	1	62.00			1	10.00			1	5.00		
Do	M	11–15					1	12.00						
Do	F	1 or <1	1	9.00			2	4.50	3	6	2	2.00	1	3
Do	F	2– 5					1	3.00						
Do	F	6–10												
Do	F	11–15	1	55.00			1	11.00			1	5.00		
Chronic nephritis	M	1 or <1												
Do	M	2– 5												
Do	M	6–10					1	7.00						
Do	M	11–15	1	112.00			4	12.75	8	22	1	10.00		
Do	F	1 or <1					1	7.00						
Do	F	2– 5												
Do	F	6–10					1	10.00						
Do	F	11–15												

TABLE 1.—*Cases and weights of visceral organs of Filipino children in certain diseases*—Continued.

Cause of death.	Sex.	Age.	Suprarenals.				Kianeys.											
			Left.				Both.				Right.				Left.			
			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
				Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		Yrs.		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*
Trauma	M	1 or <1	5	4.00	3	7	11	53.36	26	105	4	32.50	18	50	4	35.25	22	55
Do.	M	2– 5	15	3.60	2	5	36	82.78	53	137	29	39.28	23	60	29	41.59	30	77
Do.	M	6–10	24	5.21	2	9	59	121.93	75	286	40	59.48	40	143	40	60.88	35	143
Do.	M	11–15	22	6.18	3	14	66	167.58	100	294	47	81.77	39	147	47	85.66	50	147
Do.	F	1 or <1	2	4.00	3	5	8	45.25	20	67	2	28.50	25	32	2	32.50	30	35
Do.	F	2– 5	9	3.56	2	6	27	81.41	54	122	19	38.32	25	60	19	39.16	27	62
Do.	F	6–10	9	4.78	3	7	18	110.61	74	174	14	53.57	35	87	14	57.00	38	90
Do.	F	11–15	9	6.78	3	11	15	173.73	110	232	13	83.23	55	112	13	88.15	55	120
Typhoid fever	M	1 or <1	1	2.00			1	71.00			1	36.00			1	35.00		
Do.	M	2– 5	1	6.00			1	133.00			1	65.00			1	68.00		
Do.	M	6–10					4	159.00	136	189								
Do.	M	11–15					7	201.29	149	320								
Do.	F	1 or <1					1	72.00										
Do.	F	2– 5	1	4.00			4	83.50	60	132	1	30.00			1	30.00		
Do.	F	6–10	2	6.50	5	8	7	141.86	108	266	3	83.33	58	133	3	86.33	62	133
Do.	F	11–15	1	7.00			12	191.08	142	237	2	121.00	105	137	2	109.50	100	119
Bacillary dysentery	M	1 or <1	8	2.75	2	4	25	46.96	23	102	7	25.43	11	51	7	25.71	12	51
Do.	M	2– 5	3	4.00	2	5	16	70.75	35	122	1	39.00			1	40.00		

Do	M	6–10	-	-	-	-	3	111.00	103	117	-	-	-	-	-	-	-	-
Do	M	11–15	-	-	-	-	2	207.00	188	226	-	-	-	-	-	-	-	-
Do	F	1 or <1	2	4.50	3	6	15	47.80	21	82	4	22.00	11	31	4	22.75	11	31
Do	F	2– 5	5	5.40	4	9	16	94.81	55	186	7	56.57	30	91	7	59.29	30	95
Do	F	6–10	1	5.00	-	-	2	102.50	69	136	-	-	-	-	-	-	-	-
Do	F	11–15	-	-	-	-	4	167.75	131	210	-	-	-	-	-	-	-	-
Suppurative and tuberculous meningitis	M	1 or <1	6	4.00	3	5	16	54.81	24	85	6	18.67	12	27	6	21.17	12	81
Do	M	2– 5	3	3.67	3	4	6	73.17	50	92	3	31.00	27	37	3	29.00	23	37
Do	M	6–10	3	5.33	3	7	10	123.00	87	179	3	61.00	54	66	3	67.67	59	74
Do	M	11–15	1	5.00	-	-	10	180.50	113	275	1	59.00	-	-	1	54.00	-	-
Do	F	1 or <1	1	6.00	-	-	11	49.64	20	83	2	30.50	27	34	2	33.00	28	38
Do	F	2– 5	4	4.00	3	6	7	95.14	71	139	4	49.00	39	69	4	54.50	40	82
Do	F	6–10	1	5.00	-	-	6	109.67	100	122	1	51.00	-	-	1	59.00	-	-
Do	F	11–15	1	8.00	-	-	4	194.75	145	236	2	96.00	89	103	2	111.00	89	133
Pulmonary tuberculosis	M	1 or <1	3	4.33	3	6	12	46.08	24	60	3	26.33	26	27	3	28.00	26	29
Do	M	2– 5	13	3.62	2	6	34	70.79	40	117	11	31.27	25	44	11	32.73	23	45
Do	M	6–10	-	-	-	-	3	126.67	99	170	-	-	-	-	-	-	-	-
Do	M	11–15	1	9.00	-	-	9	189.33	117	236	1	103.00	-	-	1	133.00	-	-
Do	F	1 or <1	-	-	-	-	10	44.00	24	66	-	-	-	-	-	-	-	-
Do	F	2– 5	8	3.25	2	6	32	63.22	33	118	8	28.88	17	35	8	27.88	19	33
Do	F	6–10	1	3.00	-	-	7	110.00	40	140	1	59.00	-	-	1	63.00	-	-
Do	F	11–15	-	-	-	-	7	196.71	62	311	1	87.00	-	-	1	76.00	-	-
Infantile beriberi	M	1 or <1	8	2.75	1	5	28	38.54	25	55	12	17.75	12	26	12	18.83	12	26
Do	M	2– 5	-	-	-	-	1	112.00	-	-	-	-	-	-	-	-	-	-
Do	M	6–10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Do	M	11–15	-	-	-	-	2	217.50	162	273	-	-	-	-	-	-	-	-
Do	F	1 or <1	3	4.33	4	5	17	39.18	25	64	6	20.50	17	26	6	21.00	16	25
Do	F	2– 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Do	F	6–10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Do	F	11–15	-	-	-	-	1	202.00	-	-	-	-	-	-	-	-	-	-

TABLE 1.—*Cases and weights of visceral organs of Filipino children in certain diseases*—Continued.

Cause of death.	Sex.	Age.	Suprarenals.				Kidneys.											
			Left.				Both.				Right.				Left.			
			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
				Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		Yrs.		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*
Cholera infantum	M	1 or <1	3	2.33	2	3	25	35.80	15	61	2	26.00	24	28	2	25.50	22	29
Do	M	2–5					1	55.00										
Do	M	6–10																
Do	M	11–15																
Do	F	1 or <1	4	3.25	2	5	17	35.06	14	55	5	17.40	13	21	5	17.60	15	20
Do	F	2–5					2	59.00	43	75								
Do	F	6–10																
Do	F	11–15																
Endocarditis	M	1 or <1					1	45.00										
Do	M	2–5	1	9.00			1	80.00			1	40.00			1	40.00		
Do	M	6–10																
Do	M	11–15	2	6.50	6	7	3	213.33	210	216	2	103.50	101	106	2	109.50	109	110
Do	F	1 or <1																
Do	F	2–5																
Do	F	6–10					2	199.00	146	252								
Do	F	11–15	1	7.00			7	207.00	164	259	2	117.50	109	126	2	109.00	103	115
Broncho-pneumonia	M	1 or <1	13	3.38	1	5	56	39.00	13	74	17	23.00	8	37	17	21.82	7	34
Do	M	2–5	8	2.88	2	4	18	79.78	41	164	10	38.40	25	60	10	37.00	24	57
Do	M	6–10					3	110.00	60	150	1	30.00			1	30.00		
Do	M	11–15					1	205.00										
Do	F	1 or <1	10	2.80	2	5	44	37.23	10	92	9	20.67	8	30	9	21.33	8	33

Do	F	2– 5	2	3.00	2	4	9	68.67	21	93	5	38.20	28	47	5	39.00	27	48
Do	F	6–10	2	4.00	2	6	5	136.00	88	275	2	46.00	37	55	2	57.50	52	63
Do	F	11–15					1	94.00										
Lobar pneumonia	M	1 or <1					6	56.50	38	86	1	22.00			1	22.00		
Do	M	2– 5					5	74.40	47	95	1	25.00			1	22.00		
Do	M	6–10					5	132.20	120	157								
Do	M	11–15					3	201.00	154	232								
Do	F	1 or <1					9	47.22	22	68								
Do	F	2– 5					2	67.50	55	80								
Do	F	6–10					1	137.00										
Do	F	11–15	1	5.00			1	208.00			1	98.00			1	110.00		
Acute nephritis	M	1 or <1	1	3.00			11	52.27	32	115	1	22.00			1	20.00		
Do	M	2– 5																
Do	M	6–10	1	5.00			2	145.50	97	194	1	94.00			1	100.00		
Do	M	11–15					1	224.00										
Do	F	1 or <1	2	2.50	2	3	7	42.14	25	56	5	19.00	12	27	5	19.60	13	29
Do	F	2– 5					1	65.00										
Do	F	6–10																
Do	F	11–15	1	6.00			1	281.00			1	144.00			1	137.00		
Chronic nephritis	M	1 or <1																
Do	M	2– 5																
Do	M	6–10					1	110.00										
Do	M	11–15	1	12.00			5	203.40	170	282	1	135.00			1	147.00		
Do	F	1 or <1					1	45.00										
Do	F	2– 5					1	90.00										
Do	F	6–10					1	184.00										
Do	F	11–15																

TABLE 2.—*Cases and weights of visceral organs of adult Filipinos in certain diseases.*

Cause of death and sex.	Heart.				Spleen.				Liver.			
	Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
Trauma:		g.	g.	g.		g.	g.	g.		g.	g.	g.
Male	620	278.11	230	330	614	116.82	50	180	494	1,211.04	900	1,500
Female	148	237.18	170	310	147	91.84	40	140	125	1,090.64	700	1,500
Typhoid fever:												
Male	140	215.23	160	300	129	217.31	68	983	137	1,358.13	760	1,840
Female	57	193.00	150	225	56	192.73	81	515	49	1,245.96	890	1,910
Malaria:												
Male	47	263.23	200	300	45	402.00	130	1,870	46	1,262.17	1,040	2,150
Female	9	221.78	160	280	9	270.56	130	330	7	1,486.29	860	2,160
Asiatic cholera:												
Male	8	273.75	220	350	8	142.25	50	210	8	1,327.25	1,020	1,580
Female	4	266.50	205	345	5	68.20	30	130	4	1,186.25	890	1,470
Amœbic dysentery:												
Male	45	219.36	165	260	43	118.14	40	220	39	1,338.74	730	2,520
Female	18	196.17	150	260	17	95.76	45	160	17	1,344.18	880	1,830
Bacillary dysentery:												
Male	19	236.53	190	280	17	113.29	50	170	18	1,309.67	880	1,650
Female	15	229.73	160	290	15	132.33	40	170	15	1,400.20	830	2,020
Suppurative meningitis:												
Male	34	262.47	200	315	27	159.56	70	270	33	1,380.45	830	2,160
Female	19	267.16	200	350	16	123.81	40	250	19	1,272.84	870	1,650
Tetanus:												
Male	16	265.81	210	300	14	103.14	45	150	13	1,142.54	940	1,500
Female	6	257.00	200	300	6	86.17	40	150	5	1,172.60	930	1,620

Chronic pulmonary tuberculosis:												
Male	218	230.80	155	330	213	132.31	50	270	220	1,154.50	620	2,680
Female	102	203.26	140	300	92	106.24	40	210	85	1,074.60	560	1,830
Tuberculous pneumonia:												
Male	11	209.18	170	270	10	129.80	50	200	8	1,168.38	850	1,600
Female	4	205.00	180	240	3	96.33	85	120	4	1,096.75	770	1,280
Tuberculous meningitis:												
Male	13	227.08	180	280	13	89.00	30	160	13	1,015.92	830	1,440
Female	8	190.13	160	230	8	67.25	40	95	8	905.25	690	1,020
General miliary tuberculosis:												
Male	8	226.25	160	290	8	169.38	70	260	8	1,336.75	1,010	1,550
Female	3	165.00	120	230	3	135.00	100	205	3	1,137.33	840	1,530
Beriberi:												
Male	38	348.68	280	410	36	249.64	120	420	33	1,330 67	700	1,750
Female	10	316.60	240	380	10	188.00	90	300	7	1,387.86	1,160	1,770
Acute endocarditis:												
Male	3	302.33	280	320	1	288.00	--------	--------	2	1,444.50	1,389	1,500
Female	6	297.67	220	430	5	146.00	70	290	5	1,391.80	990	1,830
Chronic endocarditis:												
Male	52	405.67	270	890	46	156.59	60	290	49	1,338.88	850	1,980
Female	43	347.95	200	740	40	109.30	30	210	41	1,199.88	730	1,890
Arteriosclerosis:												
Male	41	386.12	250	750	38	115.74	50	250	35	1,329.17	800	2,140
Female	29	330.03	200	600	29	88.34	30	160	27	1,158.59	630	1,620
Broncho-pneumonia:												
Male	37	245.43	200	300	34	163.41	65	280	36	1,304.94	730	2,010
Female	25	234.80	190	290	21	121.29	60	190	23	1,170.13	580	1,550
Lobar pneumonia:												
Male	99	285.76	235	335	97	217.70	80	300	95	1,481.46	860	2,230
Female	40	261.75	190	300	36	180.94	55	260	39	1,312.64	660	2,020
Portal cirrhosis:												
Male	29	250.93	170	330	23	238.30	90	380	26	1,034.12	560	2,100
Female	7	240.71	180	310	6	202.83	85	300	7	1,078.43	660	1,720

TABLE 2.—*Cases and weights of visceral organs of adult Filipinos in certain diseases*—Continued.

Cause of death and sex.	Heart.				Spleen.				Liver.			
	Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
Hypertrophic cirrhosis:		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*		*g.*	*g.*	*g.*
Male	4	218.50	150	280	3	618.00	425	845	5	1,563.40	1,110	2,990
Female	3	253.67	170	330	3	282.33	270	295	3	1,143.00	930	1,500
Acute nephritis:												
Male	8	301.25	240	360	7	165.43	60	290	7	1,214.43	930	1,400
Female	18	234.67	165	310	16	145.38	70	250	18	1,326.11	850	2,240
Chronic interstitial nephritis:												
Male	56	336.43	200	650	53	132.75	55	230	51	1,254.25	620	2,190
Female	33	313.64	170	650	30	96.90	25	160	33	1,109.88	520	1,690
Chronic parenchymatous nephritis:												
Male	13	287.31	200	380	11	138.36	50	240	12	1,200.67	860	1,480
Female	19	279.68	215	370	16	128.13	50	250	18	1,323.22	500	1,810
Septicæmia:												
Male	33	270.00	210	340	33	206.79	100	350	31	1,492.42	1,030	2,150
Female	27	240.15	190	290	27	235.19	100	400	26	1,477.35	950	1,990

TABLE 2.—*Cases and weights of visceral organs of adult Filipinos in certain diseases*—Continued.

Cause of death and sex.	Pancreas.				Suprarenals.							
					Both.				Right.			
	Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
		Mean.	Mini-mum.	Maxi-mum.		Mean.	Mini-mum.	Maxi-mum.		Mean.	Mini-mum.	Maxi-mum.
		g.	g.	g.		g.	g.	g.		g.	g.	g.
Trauma:												
Male	121	105.88	55	155	287	15.96	12	20	187	8.35	6	11
Female	39	86.23	50	120	84	14.57	10	19	52	7.06	4	10
Typhoid fever:												
Male	27	95.37	60	130	82	15.23	7	29	27	8.11	4	17
Female	15	93.53	55	130	33	14.64	9	21	12	7.58	4	12
Malaria:												
Male	14	109.93	80	160	20	17.00	10	29	15	8.20	5	12
Female	1	97.00	--------	--------	2	12.50	12	13	1	5.00	--------	--------
Asiatic cholera:												
Male	--------	--------	--------	--------	1	10.00	--------	--------	--------	--------	--------	--------
Female	--------	--------	--------	--------	1	10.00	--------	--------	--------	--------	--------	--------
Amœbic dysentery:												
Male	6	106.50	80	150	23	13.48	10	24	5	8.00	5	12
Female	3	77.67	60	95	9	14.56	8	22	4	5.20	4	7
Bacillary dysentery:												
Male	5	79.40	70	90	10	15.30	10	27	2	5.50	5	6
Female	2	82.00	69	95	8	15.63	10	22	3	7.67	5	10
Suppurative meningitis:												
Male	8	102.38	80	140	21	17.57	10	30	8	10.75	7	17
Female	4	85.00	70	110	10	16.90	9	25	4	10.00	7	17

TABLE 2.—*Cases and weights of visceral organs of adult Filipinos in certain diseases*—Continued.

Cause of death and sex.	Pancreas.				Suprarenals.							
					Both.				Right.			
	Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
		Mean.	Minimum.	Minimum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
Tetanus:		g.	g.	g.		g.	g.	g.		g.	g.	g.
Male					5	17.40	16	19	5	8.20	7	9
Female	1	107.00			1	24.00			1	10.00		
Chronic pulmonary tuberculosis:												
Male	41	98.22	65	130	135	14.19	7	28	41	7.34	4	12
Female	13	79.92	60	120	55	12.76	6	26	14	7.14	4	14
Tuberculous pneumonia:												
Male	2	100.00	70	130	3	14.00	11	19	3	7.00	5	9
Female					3	14.00	12	16				
Tuberculous meningitis:												
Male	1	71.00			5	13.40	7	22	1	8.00		
Female	2	107.50	95	120	7	14.71	12	20	1	8.00		
General miliary tuberculosis:												
Male					7	14.57	11	20	1	6.00		
Female	1	70.00			2	17.00	15	19	1	7.00		
Beriberi:												
Male	11	114.82	90	140	19	14.89	10	29	11	7.18	5	12
Female	3	119.33	90	150	7	16.29	10	20	4	10.50	10	11
Acute endocarditis:												
Male	1	165.00			2	12.50	11	14	1	6.00		
Female					3	14.00	11	19				

Chronic endocarditis:												
Male	10	114.80	80	155	32	16.06	10	25	10	8.60	6	16
Female	8	108.00	75	160	19	12.84	8	25	6	6.17	5	10
Arteriosclerosis:												
Male	7	121.71	85	190	13	16.23	10	25	5	7.40	5	9
Female	3	74.67	55	105	11	12.27	7	21	3	6.67	5	9
Broncho-pneumonia:												
Male	6	92.00	60	140	14	16.50	10	26	3	7.33	6	9
Female	9	79.44	60	100	17	14.76	9	22	5	7.60	5	11
Lobar pneumonia:												
Male	17	103.59	80	130	63	16.89	10	29	19	8.95	6	14
Female	8	91.00	60	120	23	14.17	9	22	5	6.40	5	9
Portal cirrhosis:												
Male	5	183.00	150	200	10	15.10	10	20	4	7.50	6	9
Female	2	132.50	120	145	1	16.00			1	8.00		
Hypertrophic cirrhosis:												
Male					1	12.00						
Female					3	11.67	7	15	1	7.00		
Acute nephritis:												
Male	5	98.60	70	130	5	19.80	14	26	3	10.67	8	14
Female	2	115.00	100	130	5	12.40	9	18	1	8.00		
Chronic interstitial nephritis:												
Male	12	97.33	60	140	32	14.84	10	25	8	7.00	5	10
Female	1	120.00			12	13.25	10	18	1	7.00		
Chronic parenchymatous nephritis:												
Male	3	119.67	90	165	4	14.75	13	18	3	8.33	8	9
Female	7	98.86	60	120	7	15.29	10	21	6	7.83	6	10
Septicæmia:												
Male	18	110.50	80	170	24	19.25	10	31	16	9.13	5	13
Female	8	93.38	60	120	15	18.33	11	30	11	9.45	6	15

TABLE 2.—*Cases and weights of visceral organs of adult Filipinos in certain diseases*—Continued.

Cause of death and sex.	Suprarenals.				Kidneys.											
	Left.				Both.				Right.				Left.			
	Cases.	Weight.			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		g.	g.	g.		g.	g.	g.		g.	g.	g.		g.	g.	g.
Trauma:																
Male	185	9.08	7	11	556	240.13	160	320	397	117.57	70	170	394	124.14	80	170
Female	52	7.73	5	11	145	218.86	110	320	89	103.62	50	160	89	106.17	50	160
Typhoid fever:																
Male	27	8.59	5	17	128	269.34	210	340	32	134.25	80	190	32	140.75	90	200
Female	12	8.83	5	12	55	258.45	200	300	12	120.58	85	170	12	126.58	90	185
Malaria:																
Male	15	9.07	6	17	44	268.59	190	340	18	136.83	80	190	18	142.17	80	200
Female	1	8.00	-----	-----	8	286.50	180	340	2	140.00	100	180	2	148.00	96	200
Asiatic cholera:																
Male	-----	-----	-----	-----	8	265.38	190	340	-----	-----	-----	-----	-----	-----	-----	-----
Female	-----	-----	-----	-----	5	240.40	200	290	-----	-----	-----	-----	-----	-----	-----	-----
Amœbic dysentery:																
Male	5	9.20	7	12	42	262.48	185	350	9	136.89	80	190	9	151.00	100	190
Female	4	7.25	4	12	16	245.88	170	340	5	121.00	95	160	5	120.60	80	160
Bacillary dysentery:																
Male	2	8.50	8	9	18	231.50	170	310	4	106.50	90	120	4	113.75	100	140
Female	3	8.00	5	12	14	235.00	170	310	4	98.25	60	130	4	112.50	80	140
Suppurative meningitis:																
Male	8	10.50	8	17	31	261.39	200	340	9	138.22	100	180	9	136.33	90	180
Female	4	11.50	9	18	15	257.53	180	335	3	173.00	120	230	3	151.33	130	180

Tetanus:																
Male	5	9.20	8	10	15	233.80	170	280	15	112.60	90	140	15	121.20	100	150
Female	1	14.00	--	--	4	284.00	180	470	4	132.50	95	210	4	151.50	90	230
Chronic pulmonary tuberculosis:																
Male	41	7.66	4	13	197	249.97	180	315	53	125.66	95	170	53	134.64	100	190
Female	14	8.07	5	12	97	223.71	170	280	20	117.70	95	170	20	124.40	100	180
Tuberculous pneumonia:																
Male	3	7.00	5	10	9	251.78	200	310	4	106.75	80	130	4	118.50	80	150
Female	--	--	--	--	8	249.00	210	295	--	--	--	--	--	--	--	--
Tuberculous meningitis:																
Male	1	8.00	--	--	11	262.82	215	330	1	118.00	--	--	1	117.00	--	--
Female	1	11.00	--	--	7	234.57	200	275	1	119.00	--	--	1	145.00	--	--
General miliary tuberculosis:																
Male	1	7.00	--	--	9	270.44	200	335	2	109.50	97	122	2	112.50	99	126
Female	1	8.00	--	--	4	219.25	150	260	1	124.00	--	--	1	146.00	--	--
Beriberi:																
Male	11	8.73	6	17	34	268.68	200	350	12	131.33	100	160	12	134.83	110	160
Female	4	9.50	9	10	10	252.00	200	300	4	129.25	110	150	4	134.50	110	150
Acute endocarditis:																
Male	1	8.00	--	--	2	268.00	210	326	--	--	--	--	--	--	--	--
Female	--	--	--	--	6	264.00	180	350	--	--	--	--	--	--	--	--
Chronic endocarditis:																
Male	10	9.50	8	11	51	271.92	210	380	15	138.07	95	180	15	150.80	100	190
Female	6	8.33	5	14	39	230.31	165	330	10	105.00	80	150	10	107.00	90	160
Arteriosclerosis:																
Male	5	8.80	6	12	40	259.35	180	350	10	121.90	75	170	10	136.20	105	170
Female	3	8.00	5	12	29	221.59	170	300	6	107.67	90	140	6	114.17	80	160
Broncho-pneumonia:																
Male	3	8.00	7	10	35	274.20	200	380	12	133.58	80	180	12	153.42	95	200
Female	5	8.60	6	12	23	256.09	180	320	15	123.40	90	160	15	139.00	100	180
Lobar pneumonia:																
Male	19	9.53	5	15	97	285.98	200	390	30	149.60	100	200	80	159.73	110	210
Female	5	7.80	5	9	36	273.28	180	340	6	126.67	80	180	6	145.83	80	200

TABLE 2.—*Cases and weights of visceral organs of adult Filipinos in certain diseases*—Continued.

Cause of death and sex.	Suprarenals.				Kidneys.											
	Left.				Both.				Right.				Left.			
	Cases.	Weight.			Cases.	Weight.			Cases.	Weight.			Cases.	Weight.		
		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.		Mean.	Minimum.	Maximum.
		g.	g.	g.		g.	g.	g.		g.	g.	g.		g.	g.	g.
Portal cirrhosis:																
Male	4	8.00	7	9	29	265.07	200	350	9	142.56	115	190	9	145.67	110	210
Female	1	8.00	......	......	7	229.86	180	320	1	109.00	......	......	1	122.00	......	......
Hypertrophic cirrhosis:																
Male	......	......	......	......	4	241.25	180	290	1	117.00	......	......	1	107.00	......	......
Female	1	8.00	......	......	3	254.67	220	280	1	147.00	......	......	1	117.00	......	......
Acute nephritis:																
Male	3	10.00	6	12	7	303.15	210	380	4	147.00	120	190	4	140.50	70	190
Female	1	10.00	......	......	16	284.00	210	390	4	143.75	120	160	4	154.25	130	180
Chronic interstitial nephritis:																
Male	8	8.00	5	12	54	243.28	145	345	10	116.70	70	170	10	117.50	70	170
Female	1	7.00	......	......	31	217.97	130	300	6	96.17	60	130	6	101.33	70	140
Chronic parenchymatous nephritis:																
Male	3	7.00	6	9	11	295.55	210	380	4	146.75	90	220	4	128.25	70	210
Female	6	8.33	5	11	17	277.06	200	350	6	156.00	70	240	6	147.50	80	220
Septicæmia:																
Male	16	10.25	5	19	33	289.30	200	370	19	143.42	70	210	19	149.89	70	220
Female	11	10.00	5	15	21	278.62	200	360	12	138.25	100	180	12	144.50	110	200

TABLE 3.—*Cases and percentage increase or decrease of the weights of visceral organs of adult Filipinos in certain diseases.*

[+ Indicates increase, — indicates decrease, from normal.]

Cause of death and sex.	Heart.		Spleen.		Liver.		Pancreas.		Suprarenals.						Kidneys.					
									Both.		Right.		Left.		Both.		Right.		Left.	
Typhoid fever:																				
Male	140	—22	129	+86	137	+12	27	—10	82	—5	27	—3	27	—5	128	+12	32	+14	32	+13
Female	57	—19	56	+110	49	+14	15	+8	33	+0.5	12	+7	12	+14	55	+18	12	+16	12	+19
Malaria:																				
Male	47	—5	45	+244	46	+29	14	+4	20	+7	15	—2	15	—0.1	44	+12	18	+16	18	+15
Female	9	—6	9	+195	7	+36	1	+13	2	—14	1	—29	1	+3	8	+31	2	+35	2	+39
Asiatic cholera:																				
Male	8	—2	8	+22	8	+10			1	—37					8	+11				
Female	4	+12	5	—26	4	+9			1	—32					5	+10				
Amœbic dysentery:																				
Male	45	—21	43	+1	39	+11	6	+1	23	—16	5	—4	5	+1	42	+9	9	+16	9	+22
Female	18	—17	17	+4	17	+23	3	—10	9	—0.1	4	—26	4	—6	16	+12	5	+17	5	+14
Bacillary dysentery:																				
Male	19	—15	17	—3	18	+8	5	—25	10	—4	2	—34	2	—6	18	—4	4	—9	4	—8
Female	15	—8	15	+44	15	+28	2	—5	8	+7	3	+9	3	+3	14	+7	4	—5	4	+6
Suppurative meningitis:																				
Male	34	—6	27	+37	33	+14	8	—3	21	+10	8	+29	8	+16	31	+9	9	+18	9	+10
Female	19	+13	16	+35	19	+17	4	—1	10	+16	4	+42	4	+49	15	+18	3	+67	3	+42
Tetanus:																				
Male	16	—4	14	—12	13	—6			5	+9	5	—2	5	+1	15	—3	15	—4	15	—2
Female	6	+8	6	—6	5	+8	1	+24	1	+65	1	+42	1	+80	4	+30	4	+28	4	+45
Chronic pulmonary tuberculosis:																				
Male	218	—17	213	+13	220	—5	41	—7	135	—11	41	—12	41	—16	197	+4	53	+7	53	+8
Female	102	—14	92	+16	85	—1	13	—7	55	—12	14	+1	14	+4	97	+2	20	+14	20	+17

TABLE 3.—*Cases and percentage increase or decrease of the weights of visceral organs of adult Filipinos in certain diseases*—Continued.

[+ Indicates increase, — indicates decrease, from normal.]

Cause of death and sex.	Heart.		Spleen.		Liver.		Pancreas.		Suprarenals.						Kidneys.					
									Both.		Right.		Left.		Both.		Right.		Left.	
Tuberculous pneumonia:																				
Male	11	—25	10	+11	8	—4	2	—6	3	—12	3	—16	3	—23	9	+5	4	—9	4	—5
Female	4	—14	3	+5	4	+1	----	----	3	—4	----	----	----	----	8	+14	----	----	----	----
Tuberculous meningitis:																				
Male	13	—18	13	—24	13	—16	1	—33	5	—16	1	—4	1	—12	11	+9	1	+0.4	1	—6
Female	8	—20	8	—27	8	—17	2	+25	7	+1	1	+13	1	+42	7	+7	1	+15	1	+38
General miliary tuberculosis:																				
Male	8	—19	8	+45	8	+10	----	----	7	—9	1	—28	1	—23	9	+13	2	—7	2	—9
Female	3	—30	3	+47	3	+4	1	—19	2	+17	1	—1	1	+3	4	+0.2	1	+20	1	+35
Beriberi:																				
Male	38	+25	36	+114	33	+10	11	+8	19	—7	11	—14	11	—4	34	+12	12	+12	12	+9
Female	10	+33	10	+105	7	+27	3	+38	7	+12	4	+49	4	+23	10	+15	4	+25	4	+27
Acute endocarditis:																				
Male	3	+8	1	+147	2	+19	1	+56	2	—22	1	—28	1	—12	2	+12	----	----	----	----
Female	6	+26	5	+59	5	+28	----	----	3	—4	----	----	----	----	6	+21	----	----	----	----
Chronic endocarditis:																				
Male	52	+46	46	+34	49	+11	10	+8	32	+1	10	+3	10	+5	51	+13	15	+17	15	+21
Female	43	+47	40	+19	41	+10	8	+25	19	—12	6	—13	6	+8	39	+5	10	+1	10	+1
Arteriosclerosis:																				
Male	41	+39	38	—1	35	+10	7	+15	13	+2	5	—11	5	—3	40	—8	10	+4	10	+10
Female	29	+39	29	—4	27	+6	3	—13	11	—16	3	—6	3	+3	29	+1	6	+4	6	+8
Broncho-pneumonia:																				
Male	37	—12	34	+40	36	+8	6	—13	14	+3	3	—12	3	—12	35	+	12	+14	12	+24
Female	25	—1	21	+32	23	+7	9	—8	17	+1	5	+8	5	+11	23	+17	15	+19	15	+31

Lobar pneumonia:																				
Male	99	+3	95	+86	95	+22	17	—2	63	+6	19	+7	19	+5	97	+19	80	+27	80	+29
Female	40	+10	36	+97	39	+20	8	+6	23	—3	5	—9	5	+1	36	+25	6	+22	6	+37
Portal cirrhosis:																				
Male	29	—10	23	+104	26	—15	5	+73	10	—5	4	—10	4	—12	29	+10	9	+21	9	+17
Female	7	+2	6	+121	7	—1	2	+54	1	+10	1	+13	1	+3	7	+5	1	+5	1	+15
Hypertrophic cirrhosis:																				
Male	4	—21	3	+429	5	+29			1	—25					4	+0.5	1	—0.5	1	—14
Female	3	+7	3	+207	3	+5			3	—20	1	—1	1	+3	3	+16	1	+42	1	+10
Acute nephritis:																				
Male	8	+8	7	+42	7	+0.3	5	—7	5	+24	3	+28	3	+10	7	+26	4	+25	4	+13
Female	18	—1	16	+58	18	+22	2	+33	5	—15	1	+13	1	+29	16	+30	4	+39	4	+45
Chronic interstitial nephritis:																				
Male	56	+21	53	+14	51	+4	12	—8	32	—7	8	—16	8	—12	54	+1	10	—1	10	—5
Female	33	+32	30	+6	33	+2	1	+39	12	—9	1	—1	1	—9	31	—0.4	6	—7	6	—5
Chronic parenchymatous nephritis:																				
Male	13	+3	11	+11	12	—1	3	+13	4	—8	3	—0.2	3	—23	11	+23	4	+25	4	+8
Female	19	+18	16	+40	18	+21	7	+15	7	+5	6	+11	6	+8	17	+27	6	+51	6	+39
Septicæmia:																				
Male	33	—3	33	+77	31	+23	18	+4	24	+21	16	+9	16	+13	33	+20	19	+22	19	+21
Female	27	+1	27	+156	26	+35	8	+8	15	+26	11	+34	11	+29	21	+27	12	+88	12	+36

The weight of the liver is markedly increased in malaria, septicæmia, and lobar pneumonia, and slightly increased in typhoid fever, amœbic dysentery, bacillary dysentery, suppurative meningitis, beriberi, chronic endocarditis, arteriosclerosis, broncho-pneumonia, acute nephritis, chronic interstitial nephritis, and chronic parenchymatous nephritis. The weight is slightly decreased in chronic pulmonary tuberculosis, tuberculous meningitis, portal cirrhosis, and tetanus.

Our data for the pancreas were very meager in the majority of diseases studied. In the few diseases where enough observations were available, it will be noted that the weight of this organ is slightly increased in chronic endocarditis and septicæmia, while it remains almost unchanged in lobar pneumonia. It is slightly decreased in chronic pulmonary tuberculosis. In typhoid fever the weight is slightly decreased in males and slightly increased in females.

The weight of both suprarenal bodies is markedly increased in septicæmia and suppurative meningitis. It remains almost stationary in malaria, chronic endocarditis, arteriosclerosis, and lobar pneumonia. It is slightly decreased in typhoid fever, amœbic dysentery, chronic pulmonary tuberculosis, beriberi, and chronic interstitial nephritis. The weights of the individual suprarenal bodies follow more or less the same tendency as the weight of both suprarenals together.

The weight of both kidneys is markedly increased in acute nephritis, chronic parenchymatous nephritis, septicæmia, and lobar pneumonia. It is only slightly increased in typhoid fever, malaria, amœbic dysentery, suppurative meningitis, beriberi, chronic endocarditis, broncho-pneumonia, and portal cirrhosis. It remains stationary in chronic interstitial nephritis, arteriosclerosis, chronic pulmonary tuberculosis, tuberculous meningitis, bacillary dysentery, and tetanus. The weights of the individual kidneys follow the same tendency of variation as the weight of both kidneys together.

A MITE DISEASE OF TOMATO, TOBACCO, POTATO, AND OTHER PLANTS IN THE PHILIPPINES

By T. G. FAJARDO[1]

Plant Pathologist, Phytological Research Division, Bureau of Plant Industry, Manila

and

G. C. BELLOSILLO

Assistant Entomologist, National Museum Division, Bureau of Science, Manila

EIGHT PLATES

A mite disease under observation since 1930, but hitherto undescribed in the Philippines, was first noted by the senior writer in the greenhouse of the Bureau of Science to be serious on tomato, tobacco, potato, and other plants. The disease spread so rapidly and its effects were so severe that several thousand tomato and tobacco seedlings and potted potato and other plants had to be discarded. The young leaves of the terminal or axial shoots of the plants affected by this disease show a bronze discoloration and become stiff and narrow. Finally they wilt and dry up from the tip downward, leaving the older expanded leaves unaffected; or they become cupped, crimpled, thickened, or brittle and fail to develop into normal leaves or shoots. The infected plants are stunted, unproductive, and may die prematurely. These infected seedlings and plants show, especially on the underside of the young affected leaves, numerous small, oval, white to pale yellowish green mites, hardly visible to the naked eye.

Since this disease has not been reported before and since its effects are serious, this paper aims to describe it and to report the result of studies made on it thus far in the Philippines. Because of the characteristic dying or thickening, cupping, stunting, and abnormal development of the young leaves of the infected shoots, the name "top crinkle" or "necrosis" is suggested.

[1] Formerly plant pathologist, Bureau of Science. This work was started while the senior writer was connected with the Bureau of Science.

REVIEW OF LITERATURE

Rolfs(9, 10) reported a serious mite disease of tomato in Florida under the name "phytoptosis." He states that first the growing buds and then the fruiting buds of the plant are attacked, whereupon white hairs grow out of the epidermis. From his descriptions and illustrations the mite disease mentioned is different from the Philippine malady and is apparently caused by a different mite species.

Carpenter(2) in 1917 reported a serious mite disease of potato which is prevalent in Hawaii. He states that the shoot of the affected plant dies from the tip downwards, and the young leaves, both terminal and axillary, become bronzed on the lower surface, twist, and curl upon the longer axis, both leaves and shoot becoming abnormally hirsute but soon drying up and dying. He further states that tomato plants growing under similar conditions in Hawaii are also attacked by mites apparently of the same species.

In 1920 Mann, Nagpurkar, and Kulkarni(7) reported a serious "tambera" disease of potato in Poona district, India. On the basis of the symptoms of the infected plants and on their examination of the mites, they believe that the disease is identical with the mite trouble in Hawaii. In 1923 Kulkarni(6) reported a "murda" disease of chili, *Capsicum* spp., stating that the trouble is due to the same mite species as that found on potato in India. Reddick(8) in 1933 found a potato disease in Ithaca, New York, which, apart from minor variations in symptoms, he considered to be identical with the disease of potato in Hawaii(2) and India.(7) He found not only the potato but also the tomato, pepper, and other plants affected.

From the symptoms of mite-infected potato plants described by the above writers, potato plants artificially infected in the greenhouse with mites from the tomato produced symptoms identical with the potato mite disease reported in Hawaii,(2) India,(7) and in Ithaca, New York,(8) and, as will be shown later, this trouble may be caused by the same mite species.

GEOGRAPHIC DISTRIBUTION AND ECONOMIC IMPORTANCE

Because of its seriousness in the greenhouse the disease was surveyed by the senior writer immediately upon its discovery in 1930 and has been under observation ever since. It was found to be commoner in the flower and vegetable gardens in and near Manila than in nearby provinces. In the vicinity of

Manila, tomato, pepper, ampalaya, cosmos, dahlia, and zinnia plants were found commonly affected.

In 1931 a similar disease causing 100 per cent infection on cosmos plants was noted in one of the flower gardens in Los Baños, Laguna Province. In 1932 the senior writer's attention was called to a similar disease on dahlia plants in Singalong and Gagalañgin, Manila. July 4, 1933, it was found also on cosmos plants and on a weed, *Eclipta alba* (L.) Hassk., from Sañgandaan, Caloocan, Rizal, and August 10, 1933, on pepper seedlings in seed boxes and in plots in San Francisco del Monte, Rizal Province. In November, 1933, a dahlia plant affected with the same disease was noted for the first time at the Trinidad Agricultural School, Baguio, Mountain Province. In January, 1934, tomatoes and potatoes grown in a garden in San Andres, Malate, Manila, were found infested by the same mite. Examination of the leaves of the infected shoots of these plants disclosed numerous mites of the same species as that found in the greenhouse.

Whether the disease is indigenous to the Philippines or was introduced from other countries, it is now common on our economic plants. At present the disease is not widespread, but its becoming established in localities where there are commercial flower and truck gardens may add seriously to our agricultural problems.

SYMPTOMS

Since this disease is reported for the first time in the Philippines and since only slight variations of symptoms are noted on various hosts, a detailed description of these symptoms, especially on tomato, is necessary. The first sign of the disease on the infected shoot of young seedlings or on mature tomato plants is a superficial shiny bronze or brown discoloration on the surface of the succulent stem of the terminal shoot, and, more prominent, on the undersurface of the young leaves (Plate 2, fig. 1). The injury at first is limited to the browning of the epidermal cells (Plate 5), but as the disease progresses the cells of the rapidly growing tissues collapse rapidly and finally die (Plate 2, fig. 2; Plate 4, fig. 1).

Simultaneously with these symptoms the young expanding leaves become narrow, stiff, twisted, or crumpled. They fail to elongate and sooner or later wilt and dry up rapidly as if the top of the plant were scorched by flame (Plate 1, and Plate 2, fig. 2). In some cases these young expanding leaves do not dry up but continue to be narrow, thick, stiff, and crumply as if the infected shoot were suffering from a severe mosaic disease (Plate 3, fig. 4; Plate 4, figs. 2, 3, 4, 6, 7, 8, 9, and 10), while the stem of the plant and the older leaves, although showing bronzed discoloration, remain apparently unaffected (Plate 1; Plate 3, fig. 1). The leaves of the young axillary buds which are expanding at the time of infection also pass through almost the same symptoms as those mentioned above. They also cease to expand, wilt, and dry up quickly (Plate 4, figs. 1 and 2), or they become narrow, rigid, stiff, thick, and brittle and do not develop into normal leaves (Plate 2, figs. 1 and 2; Plate 4, fig. 4; Plate 5).

As soon as the top is "burned up" the succulent part of the stem of the young plant may be slightly swollen, roughened, or russetted and take on a grayish green color (Plate 3, figs. 1 to 4). Trying to recover, the plant sends out buds from the axis of the blighted leaves or from the normal leaves, but if infestation is heavy, the new buds become infected immediately, and instead of differentiating into typical leaves and stems they become thickened, fleshy, rounded, deformed or atrophied "buds" (Plate 3, figs. 2, 3, and 4; Plate 4, figs. 8, 9, and 10). In plants that are actively growing, several of these atrophied outgrowths are formed and finally crowd each other until they appear as warty protuberances from the axis of the leaves (Plate 4, fig. 9). Plants may continue in this condition for a long time without producing growth, but sooner or later they die (Plate 3, fig. 1). If infestation is light, normal buds may arise from these atrophied "buds," or from the axes of the other leaves. These buds continue to be healthy unless they are again subjected to infestation by mites, in which case the symptoms described above are produced.

Young plants which are infected and subjected to these severe symptoms are stunted and dwarfed and may die before attaining considerable size. Older plants infected in the field or in the greenhouse develop nearly all the above-mentioned symptoms, but excessive production of atrophied warty buds does not occur. These plants do not die, but their productiveness is reduced to a degree depending upon the stage of growth at the time of infection and the number of branches infected. The flowers are also attacked and drop off before they are set. If the young set fruits are attacked, they become hard and russetted and fail to develop. Fruits infested after attaining considerable size may develop to maturity with only blemishes on the skin.

ISOLATION OF THE CAUSAL ORGANISM

Many attempts were made to isolate from the bronzed or infected tips fungi and bacteria by means of the usual isolation methods, but none of these organisms is associated with the disease. In trials where infected tissues were plated without surface sterilization, yellowish bacterial colonies were isolated, but when young colonies were inoculated back by smearing or pricking on the leaves or stem of caged young healthy plants they did not produce the disease.

Experiments were also conducted to determine whether the disease may be due to a virus trouble. Juice from infected plants was injected on the stems or rubbed on the leaves of healthy tomato plants, but the disease has not yet been reproduced artificially. The fact that an infected plant freed from mites will develop new healthy buds, and that such buds will always remain healthy when mites are excluded, suggests that this disease is not a virus trouble. From these limited experiments it appears that the disease is not caused by fungus, bacteria, or virus, but is due to the mites, whose activities are localized and injurious to young leaves and succulent tissues of susceptible host plants.

TAXONOMY AND IDENTITY OF THE CAUSAL MITE

Carpenter(2) did not name the species associated with the mite disease of potato in Hawaii, but stated that it may belong to the same group as the so-called red spider, of the family Tetranychidæ. He further stated that the mite trouble in Hawaii is not the same as that causing phytoptosis of tomato in Florida, caused by *Phytoptus calcladopthora* Nal. Mann et al.(7) described the mite species associated with the serious "tambera" disease of potato in India, but did not attempt to name the mite species. Kulkarni,(6) however, in a later work in 1922 stated that the serious "murda" disease of chili (*Capsicum* spp.) is caused by the same mite species that is associated with the "tambera" disease of potato in India, but does not belong to the red-spider group Tetranychidæ as suggested by Carpenter. He states that it agrees completely with the yellow mite of the genus *Tarsonemus* described by Watt and Mann. Reddick (8) states that the mite associated with the potato disease in Ithaca, New York, is of the genus *Tarsonemus,* but does not give the specific identity of the mites.

In our examinations the mites associated with the Philippine mite disease appeared quite identical with the yellow mite described by Mann et al.(7) and by Kulkarni(6) and belong to the genus *Tarsonemus*.(1)

Egg.—The eggs are round to oval, from 73.0 to 80.3 μ by 87.6 to 102.2 μ long, on the average 75.9 wide and 93.4 μ long (Plate 8, fig. 1). They are transparent to colorless, peculiarly sculptured bodies, firmly attached to the lower surface of the leaves or to the succulent stem. The pattern of the sculpturing is formed in rows of small, opaque, thickened structures on the wall of the egg. Upon hatching the egg breaks at one end, and the egg case persists for a long time on the leaf.

The larvæ.—The larvæ are sluggish, glistening white to slightly colored. They are short oval to long oval, from 65.7 to 87.6 μ wide and from 102.2 to 167.9 μ long, the average 81.7 μ wide and 131.4 μ long (Plate 8, figs. 2 and 3). The young larva has three pairs of legs of almost equal size. The first and second pairs are located anteriorly and the third posteriorly, quite far from the second. The legs are short and composed of five segments terminating in a pulvillus. The body is segmented, soft, and beset with a few hairs.

Adult female.—The adult female is oval, almost twice as long as wide. It is shiny pale yellowish green to light amber, and sparsely beset with short hairs. It is from 87.6 to 116.8 μ wide and 146.0 to 175.2 μ long, the average 100.7 μ wide and 167.9 μ long (Plate 8, figs. 4 and 6). The head is rather prominent, with a pair of stout spines projecting from the dorsal surface. The mandibles are slender, and the palpi are minute and barely visible on the dorsal side. A little below the head is a pair of almost rounded pseudostigmata.

It has four pairs of legs, which are shorter and less developed than those of the male. The first pair is short, stout, and well developed. The second pair is longer than the first, while the third is slender and longest of all. The fourth pair is longer than the first, less developed, slender, delicate, and terminates in two long hairs, one of which is two or more times as long as the other. This pair of legs is dragged.

The tarsus of the first leg possesses a rather large and slightly curved claw and three striated olfactory setæ, the longest located near the middle of the tarsus. The tarsus of the second leg has one olfactory seta at the proximal end, shorter than the longest on the first leg.

Adult male.—The adult male is elongate, about twice as long as wide, and beset with a few hairs. It is more active and much smaller than the female, and measures from 73.0 to 95.5 μ wide and 131.4 to 175.2 μ long, the average 90.5 μ wide and 159.1 μ long (Plate 8, figs. 5 and 7). As in the female, the head is prominent, the mandibles slender, and the palpi minute. The body is widest in the region at which the posterior pair of legs are inserted, and gradually narrows toward the posterior, where a curious anal structure for grasping purposes is found.

The male has four pairs of well-developed legs. The first pair are shorter than the second, the third longest, and the fourth shortest. The first three pairs of legs are provided each with a single pulvillus at the end, while the fourth pair terminates in a short knoblike structure. On each tarsus of the first and second pair is a single olfactory seta. The fourth pair of legs is very peculiar, being more developed and stouter than the other pairs. The penultimate segment is provided with a spur, and near it is found a rather long stout bristle. The tarsus is bent or curved and at about the region of curvature is a long stout hair.

Of the reported plant parasitic species of mite, the Philippine mite belongs to the genus *Tarsonemus,* family Tarsonemidæ,(1) and is similar to, if not the same as, *Tarsonemus translucens* Green, reported on tea in Ceylon and India by Hirst,(4, 5) and the mite disease of potatoes and other plants reported by Carpenter,(2) Mann et al.,(7) Kulkarni,(6) and Reddick.(8) However, until specimens are submitted to specialists for verification, or until further work has been done in this field, for the purpose of this paper the Philippine mite is tentatively referred to as *Tarsonemus translucens* Green. Plate 8, figs. 1 to 7, shows the mite species, *Tarsonemus translucens* Green, which is responsible for the top crinkle or necrosis disease of tomato and other plants in the Philippines.

INFECTION EXPERIMENTS WITH TARSONEMUS TRANSLUCENS AND OTHER GREENHOUSE INSECTS

Methods.—In these infection experiments unless otherwise stated only healthy tomato plants raised under cover with celluloid cylinders from the time the seeds were sown were used. When the seedlings were on their second to third true leaf stage, one plant was transplanted into an 8-inch pot, covered immediately with a celluloid cylinder and then set on a table the legs of which were placed in a shallow pan filled with water.

The insects used in each experiment were taken from plants infected naturally in the greenhouse or in the field or were reared on infected plants for several days before they were transferred onto experimental healthy plants. In transfer the insects were picked one by one with a fine camel's-hair brush, or a portion of the infected leaf on which they were feeding was placed on the experimental plants. In the case of the mite species which are too small to be seen well with the naked eye, a hand lens with 14 to 20 magnification was used to facilitate picking. This method was usually resorted to when transmission was not effected by the placing of infected leaves on which the mites were feeding onto the healthy experimental plants. As controls, healthy plants of the same source and age were used but no insects were transferred. The experiments were kept under observation for twenty-five to thirty days, a period long enough for the development of the disease in question if transmission is successful.

INFECTION EXPERIMENTS WITH TARSONEMUS TRANSLUCENS GREEN

In a series of experiments it was found that *T. translucens* Green can produce the disease if allowed to infest naturally or by artificial means healthy tomato and other plants in the greenhouse. Ten mites from naturally infected plants were carefully picked one by one with a fine camel's-hair brush and placed on the expanded leaves of two caged healthy experimental plants. After eight days bronzing of the leaves and the succulent stem of the terminal shoot was observed on both of these plants. At the end of fifteen days their tops were already "burned up," while the caged healthy check plants which were of the same age and the same source as the experimental plants remained healthy.

In another trial fifteen mites from the above-mentioned infected plants were transferred to one healthy plant, and fifteen mites from naturally infected plants were transferred to each of two caged healthy tomato plants. At the end of six days bronzing was noted on these three plants, and at the end of nine days two of the plants had dead tops. One of the inoculated plants did not develop the "burned up" top until after twelve days. The two check plants, to which no mites had been transferred, were started on the same day, and remained healthy throughout the experiment. Simultaneously with these experiments infected shoots with numerous mites were placed on five caged experimental healthy young tomato plants. These plants also became infected and showed the characteristic symptoms after six to nine days.

September 9, 1930, two young tomato plants were inoculated with five mites each, and two other plants inoculated with ten mites each. After eight days one of the plants started with ten mites showed infection, while the other remained healthy. After thirteen days, however, both plants showed blighted tips. The two plants started with five mites showed no symptoms after eleven days, but after thirteen days one of them showed slight bronzing of the terminal shoot, although burning of the shoot was not noted twenty-five days after inoculation. The other plant was still healthy on this date. In the last series, conducted September 24, 1930, five plants were started with three, five, ten, and fifteen mites, and again successful infection was obtained. The percentage of infection noted was lower and the symptoms were delayed and less severe when fewer mites were used. Table 1 is a summary of results obtained.

Several other observations further confirmed the controlled experiments in the greenhouse. Tomato and tobacco seedlings in seed boxes raised outside of the greenhouse were exposed to natural infection in the greenhouse when they were 3 to 4 inches high. Before exposing the seedlings near the infected plants, the center of the seed boxes, each of which contained twenty-five plants, was covered with a 6-inch-diameter celluloid cylinder, the top of which was covered with muslin cloth. The plants in the other part of the box were left exposed. When the seedlings were examined at the end of fourteen days those covered with cylinders remained healthy, while the uncovered plants showed 20 per cent infection. At the end of twenty-five days, when the final notes were made, those plants which were exposed showed 100 per cent infection, while those inclosed with cylinders were all healthy. Table 1 is a result of one of the series of experiments conducted in the greenhouse.

TABLE 1.—*Number of mites in relation to infection.*

Tomato variety.	Mites per plant.	Plants inoculated.	Plants infected.	Infection.
				Per cent.
Series I, Native Laguna	5	2	1	50
Do.	10	2	2	100
Series II, Marglobe	3	5	2	40
Do.	5	5	4	80
Do.	10	5	5	100
Do.	15	5	5	100

In these experiments it was noted that plants, whether subjected to natural or artificial infection, show bronze discoloration within eight to ten days and that the typical "blighted top" stage develops within twelve to fifteen days. When the weather is hot and dry the bronze symptoms are usually developed within five to eight days and "burning up" of the tip appears within ten to fifteen days; this is especially true when a greater number of individuals is used to infest the experimental plants. When the weather is cool, cloudy or rainy, development of symptoms is delayed and typical "burned up" symptoms may not develop even after twenty to twenty-five days. This condition is in conformity with field observations, in that the disease is not usually serious during the rainy season and plants infected may recover and send out new healthy branches. These may become infected sooner or later as the weather becomes favorable, and mites more active.

INFECTION EXPERIMENTS WITH OTHER INSECTS IN THE GREENHOUSE

In a series of experiments, conducted along the lines of those mentioned above, the mealy-bug *Ferrisia virgata* Ckll., thrips (*Thrips* spp.), and red spider have thus far failed to transmit or cause the disease. These insects, therefore, cannot be considered as agents of the disease, even if at times they become numerous in the greenhouse.

CROSS-INFECTION EXPERIMENTS WITH MITES FROM VARIOUS HOSTS

These cross-infection studies, carried on with the method of insect transfer mentioned above, showed that the mite disease of tomato, potato, and dahlia is caused by the same mite species. Mites from tomato, potato, and dahlia, when transferred onto healthy tomato, produce the typical top crinkle or necrosis disease, and when mites from infected tomato are transferred onto dahlia, potato, and other susceptible plants, the typical symptoms are also produced on these plants. Furthermore, on microscopic examination the mites from these hosts appeared to be identical, and no doubt the mite species associated with the disease is *Tarsonemus translucens* Green.

In these experiments the symptoms on the potato began to appear within three or four days. The young leaflets of the terminal shoot or axillary buds show brownish to dark spots, and the underside of the leaves became glossy and finally bronze-colored. The leaves then became somewhat stiff, upright, or twisted. Two or three days after these symptoms were produced, the leaves gradually wilted and soon dried up, the older lower leaves still remaining green (Plate 7, figs. 1 and 2). In addition to these symptoms, the succulent stem showed bronzing, at the base of the petioles lesions were noted, and the leaves were easily detached. In almost all cases the plants died. On dahlia the young leaves also became stiff, narrow, thickened, or the lamina curled downward parallel to the veins in the same manner as observed in the field (Plate 7, fig. 3).

DISSEMINATION IN THE FIELD AND IN THE GREENHOUSE

The rate of spread of the disease in the greenhouse or in the field depends upon the distance between the plants and the prevalence of the mites. In the greenhouse, where mites are quite common, the spread is so rapid that all tomatoes in seed boxes or in pots are infected, develop "burned" shoots, and die in the course of a few days. In the field the initial infection usually comes from other infected host plants or from infected seedlings which are transplanted. Field dissemination is usually negligible when plantings are far apart, but when they are close together and touching one another, as in the seed boxes and seed beds, dissemination is very rapid.

December 1, 1930, tomato seedlings that appeared to be healthy in the greenhouse were planted about 70 cm apart at the pathological plot in Manila. This plot was newly opened and far from home and flower gardens known to be infected with the disease. December 20, diseased plants were noted at different regions of the field, and since no other plants nearby were affected the source of infection no doubt came with the tomato seedlings, which must have had mites at the time of planting but had not developed the symptoms. Since the diseased plants were found at different regions of the field, notes were made on the rate of spread of the disease. January 20, 1931, when the final notes were made, a slight increase of infection on the row was noted but the total increase of diseased plants in the field was negligible. Only the plants near the diseased plants became infected, indicating that the spread of the disease from plant to plant in the row or between rows is negligible. Table 2 contains the summary of results obtained.

Whether this disease will ever become a serious pest in the field on tomato or other economic plants in the Philippines, remains to be seen. In Hawaii and in India an identical disease has been reported widespread and very serious on potato and on chile (*Capsicum* spp.). In the Philippines it is as yet not widespread or serious, but there is great danger of its spreading further and becoming established in localities where commercial planting of tomatoes, potatoes, tobacco, and other susceptible crops is practised.

TABLE 2.—*Rate of spread of the disease in the pathological plot in Manila during the 1930 season.*

Variety.	Number of plants.		
	Observed.	Infected.	
		Dec. 20, 1930.	Jan. 31, 1931.
AMERICAN VARIETIES.			
1. Burpee's Dwarf Giant	17	4	6
2. Dwarf Stone	17	1	1
3. Earliana	32	2	8
4. Greater Baltimore	15	3	5
5. John Baer	16	0	0
6. Marglobe	16	2	8
7. Marglobe (Stokes)	17	0	2
8. Matchless B. P. I.	28	4	4
9. Maule's Columbia Wilt Proof	17	3	8
10. Maule's Success	16	2	3
11. Norton Wilt Resistant	15	1	7
12. Ponderosa	15	2	4
13. Ponderosa, Giant	17	1	1
14. Ponderosa, Yellow	17	1	1
15. Perfection	28	1	2
NATIVE VARIETIES.			
19. Laguna	17	1	1
27. Tarlac	10	0	0
25. San Isidro (1)	17	3	8
26. San Isidro (2)	33	1	1
16. Calumpit 1	37	1	1
17. Calumpit 3	14	0	0
18. Calumpit 4	74	3	10
24. San Carlos, Pangasinan (1)	14	2	4
24. San Carlos, Pangasinan (2)	17	1	2

RELATIVE SUSCEPTIBILITY OF VARIOUS TOMATO VARIETIES

As far as can be determined, many American and native tomato varieties are susceptible to top crinkle or necrosis. In these trials, 35-day-old tomato seedlings of each variety are planted in 8-inch pots and exposed to natural infection in the greenhouse for thirty days. Among the American varieties tested which were found susceptible are Burpee's Dwarf Giant, Dwarf Stone, Earliana, Greater Baltimore, John Baer, Marglobe, Matchless, Maule's Columbia Wilt Proof, Maule's Success, Norton Wilt Resistant, Ponderosa, Giant Ponderosa, Yellow Ponderosa, Perfection, Sunnybrook Earliana, Red Pear, Yellow Pear, Burpee's Matchless, Golden Dwarf Champion, Red Cherry, Burpee's Self Pruning, Sparks Earliana, Acme, True Giant Ponderosa, Stone, The Burpee, Yellow Plum, June Pink, Trucker's Favorite, Early Detroit, Bonny Best, Whole Salad, Penn. State Earliana, Livingstone Globe, Gulf State Market, Beefsteak and Burpee's, Fordhook First. Among the native varieties infected are those from Muñoz, Calumpit (Selections 1, 2, 3, 4), Pangasinan (Selections 1 and 2), Batangas, Tarlac (Selections 1 and 2), and the Lemery Wild Cherry tomato. The results, therefore, indicate that many of the common varieties grown in the United States and in the Philippines are susceptible, and none of the varieties show a high degree of resistance to the disease.

HOST RANGE

From available literature, *Tarsonemus translucens* Green has been reported attacking tea in Ceylon and India.(4, 5) A mite species of *Tarsonemus*, probably *T. translucens*, has been reported on potato, and tomato in Hawaii by Carpenter;(2) on potato and "guvar" *Cyamopsis psoralipides* in India by Mann, Nagpurkar, and Kulkarni;(7) on chili (*Capsicum*), zinnia, dahlia, tagetes, *Mirabilis jalapa*, Cape gooseberry, *Amaranthus polygonus* and *Physalis minima* in India by Kulkarni;(6) on a number of domestic varieties of potatoes, *Physalis* spp., *Nicandra physaloides, Datura stramonium, Capsicum* spp., and tomato in Ithaca, New York, by Reddick.(8)

In the Philippines, tomato, potato, pepper, "ampalaya," dahlia, cosmos, zinnia, and a weed plant, *Eclipta alba* (Linn.) Hassk., are naturally affected. In a series of inoculation experiments in the greenhouse the above-mentioned hosts, and tobacco, cowpea, "mungo," "sitao," papaya, pechay, Chinese cabbage, radish, mustard, and mango seedlings are equally susceptible to the mite trouble, while sincamas, rice, onion, and corn appeared to be more resistant. The result shows that many of our economic plants are susceptible. Since the scope of this work is limited, other host plants may eventually be added to the list.

It is interesting to note that the symptoms produced vary with the different hosts. In general, however, the characteristic bronzing, stiffening, thickening, narrowing, and curling of the young leaves of the shoot and dying of the tip occur. In susceptible plants with wide leaves, such as tobacco, dahlia, pechay, radish, etc., the blade may be severely cupped laterally, thickened, brittle, and much reduced in size (Plate 7). In some hosts, such as cosmos, the leaves as a result of the disease become so reduced in size, thickened, and deformed, as to appear filiform. They are bunched up or crowded on the infected shoot which in turn fails to elongate normally (Pate 7, fig. 4).

CONTROL MEASURES

Rolfs(9) in his studies on the tomato mite disease in Florida found flowers of sulphur sprinkled on the plants as efficacious as sulphur spray. When "phytoptosis" was the only disease to be treated, he found that flowers of sulphur was more economical. Carpenter(2) recommends spraying with lime-sulphur as an effective means of controlling the potato-mite disease in Hawaii. In India Mann et al.(7) showed that spraying with lime-sulphur wash or dusting with sulphur, giving all together three dressings, beginning at the time when the potato plants are three weeks old, produced excellent results in the field. Kulkarni(6) also recommends lime-sulphur as an effective control in the field for the "murda" disease of chili. Reddick(8) suggested the use of naphthalene for the fumigation of mites in the greenhouse.

Our control experiments in the greenhouse with infected dahlia and tomato plants showed that the disease can be checked quite effectively by spraying with an aqueous solution of 1 : 1,000 or 2 : 1,000 nicotine sulphate to which 5 grams of white Chinese soap have been added. Tests with an aqueous solution of 2 : 1,000; 3 : 1,000, or 4 : 1,000 nicotine sulphate alone did not give satisfactory results. Soap solutions with concentrations of from 0.4 to 0.6 per cent gave fairly good results but are more effective when nicotine sulphate has been added. These soap solutions, therefore, are recommended in places where nicotine sulphate cannot be obtained.

Lime sulphur (33° Baumé) diluted with water in proportion of 1 : 75 and 1 : 100 was found very effective and more satisfactory than the nicotine sulphate-soap solution combination. Dilutions 1 : 25 and 1 : 50 were also tried and proved very effective but they cause serious burning of the leaves. Good results were also obtained by spraying with the Sherwin Williams dry lime-sulphur made into 0.5, 0.75, and 1 per cent solutions or by dusting with the dry lime-sulphur while the plants are not moist or wet. Since very effective control was obtained with lime-sulphur (33° Baumé) diluted to 1 : 75 and 1 : 100 and with Sherwin Williams dry lime-sulphur, these solutions or the dry lime-sulphur dust should be also used. Plate 8, fig. 10, shows the recovery of an infected tomato plant which has been sprayed with 1 : 100 lime-sulphur, and a dahlia plant sprayed with an aqueous solution of 2 : 1,000 nicotine sulphate to which 5 grams of soap were added.

Success was also obtained by fumigation of the infected plants with "cyanogas" at the rate of about one teaspoonful or more of the powder to about a cubic meter of space. Naphthalene was recommended by Hartzell and Wilcoxon(3) for certain greenhouse insects. In fumigating the plants should be placed in air-tight chambers or covered with canvas for five to fifteen minutes.

The success in the control of this mite, obtained either by spraying, by dusting, or by fumigating, largely depends on the thoroughness and frequency of application. In spraying, although not so very necessary, more effective results can be obtained by directing the solution to the underside of the leaves as the mites are more numerous there. Rogueing and burning of infected plants, cleanliness in the garden or field and isolation of sprayed or fumigated potted plants to avoid reinfestation, are precautions to be observed in order to minimize the spreading of the disease.

SUMMARY

1. A mite disease serious in the greenhouse on tomato and other economic plants is reported for the first time in the Philippines.

2. Because of the characteristic drying up or cupping and crumpling of the young leaves of the shoots and of the axillary buds, the name "top crinkle" or "necrosis" is suggested.

3. The disease is still limited in its distribution in the Philippines, having been found in Manila, Los Baños, Laguna, and in the Trinidad Agricultural School, Baguio, Mountain Province, naturally affecting tomato, pepper, ampalaya, dahlia, cosmos, zinnia, and a weed plant, *Eclipta alba* (L.) Hassk.

4. From available literature the Philippine mite disease appears to be caused by the mite species that is serious on potato, chili (*Capsicum* spp.), and other plants reported in Hawaii, India, and New York.

5. The symptoms of the disease on tomato are described in detail. Crinkling or "burning up" of the top of young shoots are characteristic symptoms of the disease.

6. Attempts to isolate a fungus or bacterium from the infected areas showed that the malady is not due to any of these.

7. Controlled cage experiments in the greenhouse showed that the disease is caused by a small yellowish green mite, which in all morphological characteristics is similar to, if not the same as, the yellow mite on tea, *Tarsonemus translucens* Green, described in Ceylon and India. The Philippine mite species is tentatively identified as *Tarsonemus translucens* Green.

8. A species of a mealy-bug, a thrips, and a red spider, which are very common greenhouse insects, failed to produce the disease.

9. The plants which became infected naturally or artificially by mites in the greenhouse showed the bronze symptoms within eight to ten days, and the "burned up top stage" is usually developed within twelve to fifteen days. A larger number of mites transferred to each plant, under favorable condition, hastens the appearance of these symptoms.

10. Cross-infection experiments in the greenhouse and microscopical examination of the causal mites showed that the disease of tomato, potato, pepper, dahlia, and other plants in the Philippines is possibly due to the same mite species, *T. translucens* Green.

11. The dissemination of the disease in the field is slow when the plants are far apart; but in the greenhouse, especially in seed boxes and in beds where plants are sown closer together, the spread is very rapid.

12. Tests on the susceptibility of the different American and Philippine native tomatoes indicated that all of them are susceptible to the disease.

13. Artificial and natural infection showed that the mite affects a number of economic plants. The tomato, tobacco, potato, pepper, eggplant, pechay, mustard, cowpea, mungo, sitao, ampalaya, papaya, mango, dahlia, cosmos, zinnia, and a weed plant, *Eclipta alba* (Linn.) Hassk., are susceptible to the disease and may serve as host plants for the mite. Sincamas, rice, and corn were found not seriously affected.

14. Experiments on control showed that spraying infected plants with 1 : 1,000 or 2 : 1,000 nicotine sulphate plus 5 grams Chinese laundry soap; or spraying with lime-sulphur (33° Baumé) diluted 1 : 75 or 1 : 100; or 0.50, 0.75, and 1 per cent solution of Sherwin Williams dry lime-sulphur; or dusting plants with dry lime-sulphur, gave very good results. Fumigating them with "cyanogas" also gave satisfactory results.

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ILLUSTRATIONS

Plate 1

Native tomato seedling affected with the top blight, or necrosis disease. Note the "dried up" young expanding leaves of the terminal shoot, leaving the top as if scorched by flame. The lower older leaves remain unaffected.

Plate 2

Young tomato plants naturally infected in the greenhouse, showing different stages of the disease.

FIG. 1. Plant showing the early but marked bronzing or browning of the young leaves and of the succulent part of the shoot. Note also that the youngest leaflets are somewhat narrow, stiff, and rather upright.

2. The same plant shown in fig. 1, but now it has developed more advance symptoms of the disease. The leaves of the terminal shoot are now wilted and dried up. (Five days older.)

Plate 3

A "wild" tomato plant (Cherry variety) naturally infected with top blight in the greenhouse, showing the effect of the disease on the flowers, young fruits, and terminal shoots.

FIG. 1. Infected terminal shoot showing symptoms on young fruits and leaves.

2. Enlarged picture of the infected shoot shown in fig. 1. Note the typical russetting or cracking of the skin of the fruit. These fruits became hard, failed to enlarge, and finally dropped off.

3. Infected shoot showing the russetting and swelling of the succulent stem. Killing of the terminal bud, and the dropping off of the flowers before they are set are also characteristic symptoms of the disease.

4. A shoot of an infected plant, showing the various malformations and the atrophied leaflets of the infected terminal shoot. Note that the leaflets are much thickened, crumply, and greatly reduced in size.

Plate 4

FIGS. 1 to 4. Tomato plants naturally infected in the field. Earliana variety showing severe symptoms. The leaflets narrowed, thickened, crumpled, and failed to expand normally. The tip of the shoot wilted and dried up. The compound leaf on the extreme right also shows severe symptoms on the lower young leaflets.

5 to 8. Greater Baltimore variety showing symptoms almost identical with those in figs. 1 to 4. Note the stunted growing tip of the shoot. The compound leaf on the extreme left is healthy, taken just below the infected leaves.

FIG. 9. Shoot of infected young seedling in the greenhouse showing crowded and stunted buds from the axes of infected and healthy leaves. The leaves were removed in order to make more visible the deformed or atrophied buds.

10. Terminal shoot of the infected seedling in the greenhouse showing the atrophied leaflets and petioles of the young compound leaves of the terminal shoot. Note also that the axillary buds are stiffened, thickened, and crumpled due to infection.

11. Compound leaf from the seedling illustrated in fig. 10 taken from the lower part of the stem.

PLATE 5

Microphotograph showing the extent of injury of an infected young stem.

FIG. 1. Cross section made from the region just a few centimeters below the tip of the shoot.

2. An enlarged section from fig. 1. Note that the browning of tissues is at first limited only to the epidermal layer. In very young and rapidly growing tissues collapse of the cells takes place rapidly.

PLATE 6

Photographs showing symptoms of top crinkle or necrosis on tobacco seedlings.

FIGS. 1, 2, and 5. Infected plants with typical bronzing and cupping symptoms. Note the lateral cupping of the leaves and drying of the young expanding leaves of the terminal shoot. The plants are stunted and failed to grow normally.

3 and 4. Healthy plants.

PLATE 7

Photographs showing the symptoms of top crinkle or necrosis on potato plants naturally infected in the greenhouse.

FIG. 1. Healthy leaves.

2. Infected leaves showing the typical symptoms. These plants developed typical bronzing of the stems and leaves, which later became stiff and crumply, and finally wilted and dried up. The "drying up" of the leaves generally starts from the top downward.

3. Photograph of one of the shoots of an infected dahlia plant from Mrs. de Santos's flower garden showing the severe lateral curling, twisting, or cupping of the young leaves. These leaves are thickened, stiff, narrow, and very brittle. They failed to develop normally. Note the older lower leaves which remain unaffected.

4. A shoot of an infected cosmos plant from Sañgandaan, Caloocan, Rizal Province, showing the typical symptoms. Note the atrophied, thickened leaves and excessive bud development on the shoot. As a result of infection the shoot also failed to elongate, thus acquiring a "bunched up" or crowded appearance.

PLATE 8

The tarsonemid mite and sprayed and unsprayed dahlia and tomato plants.

FIG. 1. Egg.
2. Larva, dorsal view.
3. Larva, ventral view.
4. Adult female, dorsal view.
5. Adult male, dorsal view.
6. Adult female, ventral view.
7. Adult male, ventral view.
8. Potted infected dahlia plant from a flower garden. This plant was sprayed with an aqueous solution of 2:1,000 nicotine-sulphate to which 5 grams of soap were added. The other infected shoots were removed.
9. Infected tomato plant showing dried tops. The axial buds which developed also became infected and are now badly crumpled.
10. Infected tomato sprayed once with lime-sulphur (33° Baumé) diluted 1 : 100. At X is the terminal shoot which was "burned up" twenty-two days ago. The axial buds which developed are all healthy, showing complete recovery from disease (twenty-two days after treatment).
11. The same dahlia shoot as in fig. 8 showing complete recovery and development of a new healthy shoot with normal leaves. Note the infected leaves at the lower part of the stem before treatment.

PLATE 1.

1

2

PLATE 2.

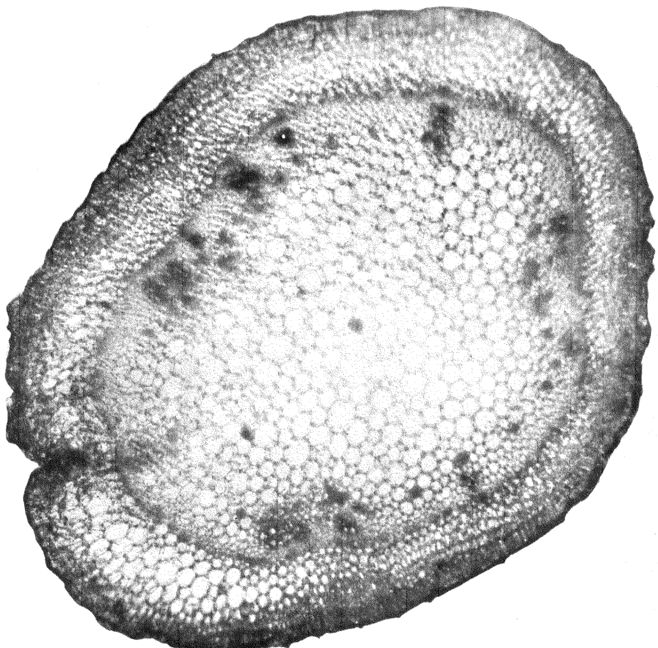
1

2 *3*

4

PLATE 3.

PLATE 4.



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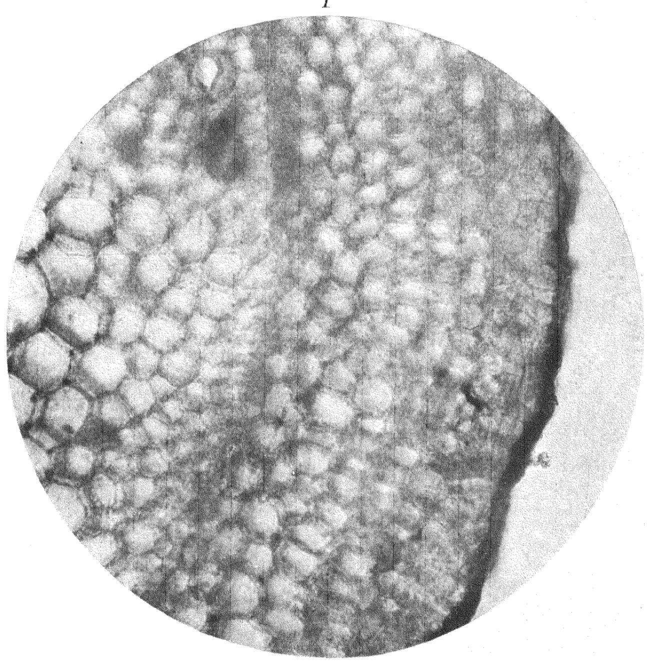

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PLATE 5.

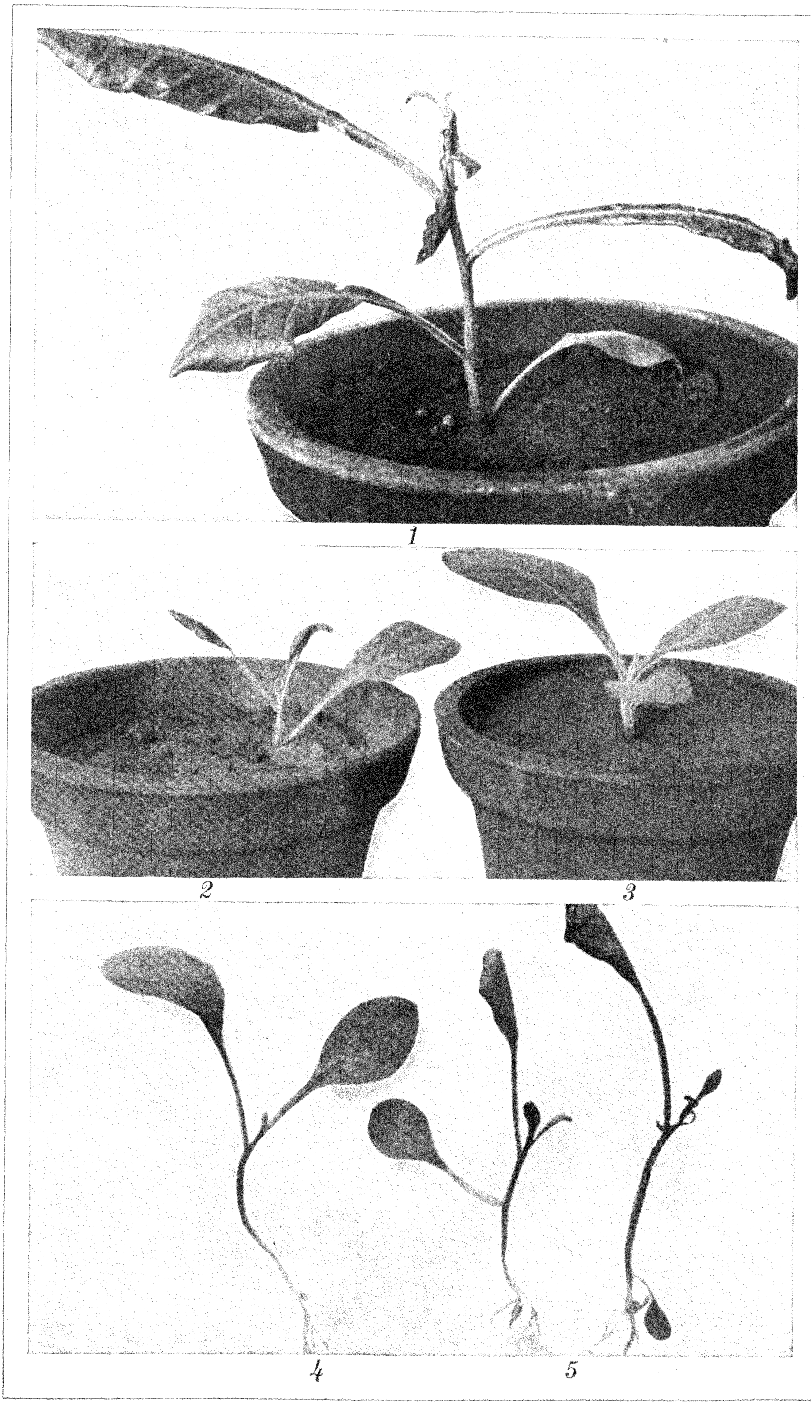

PLATE 6.

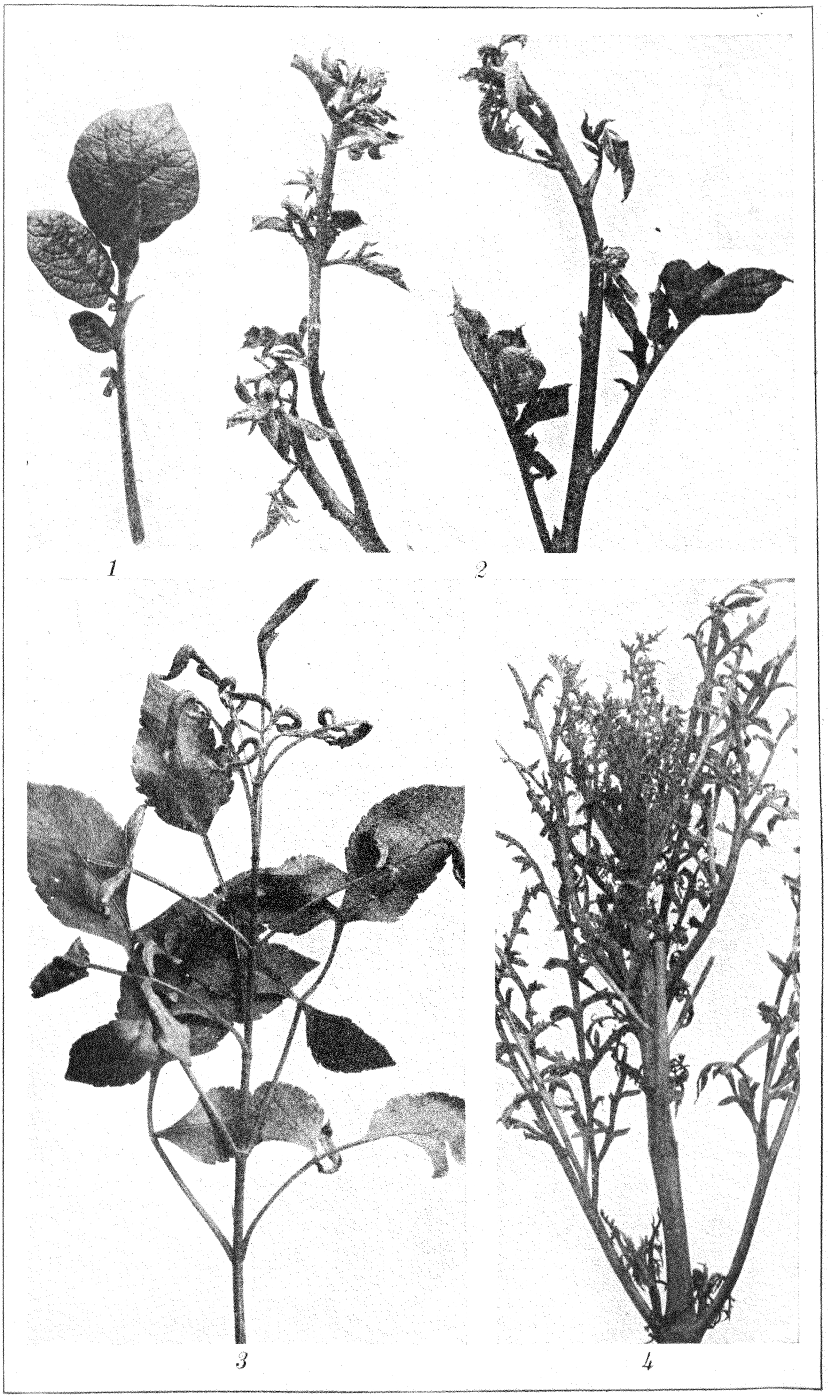

PLATE 7.

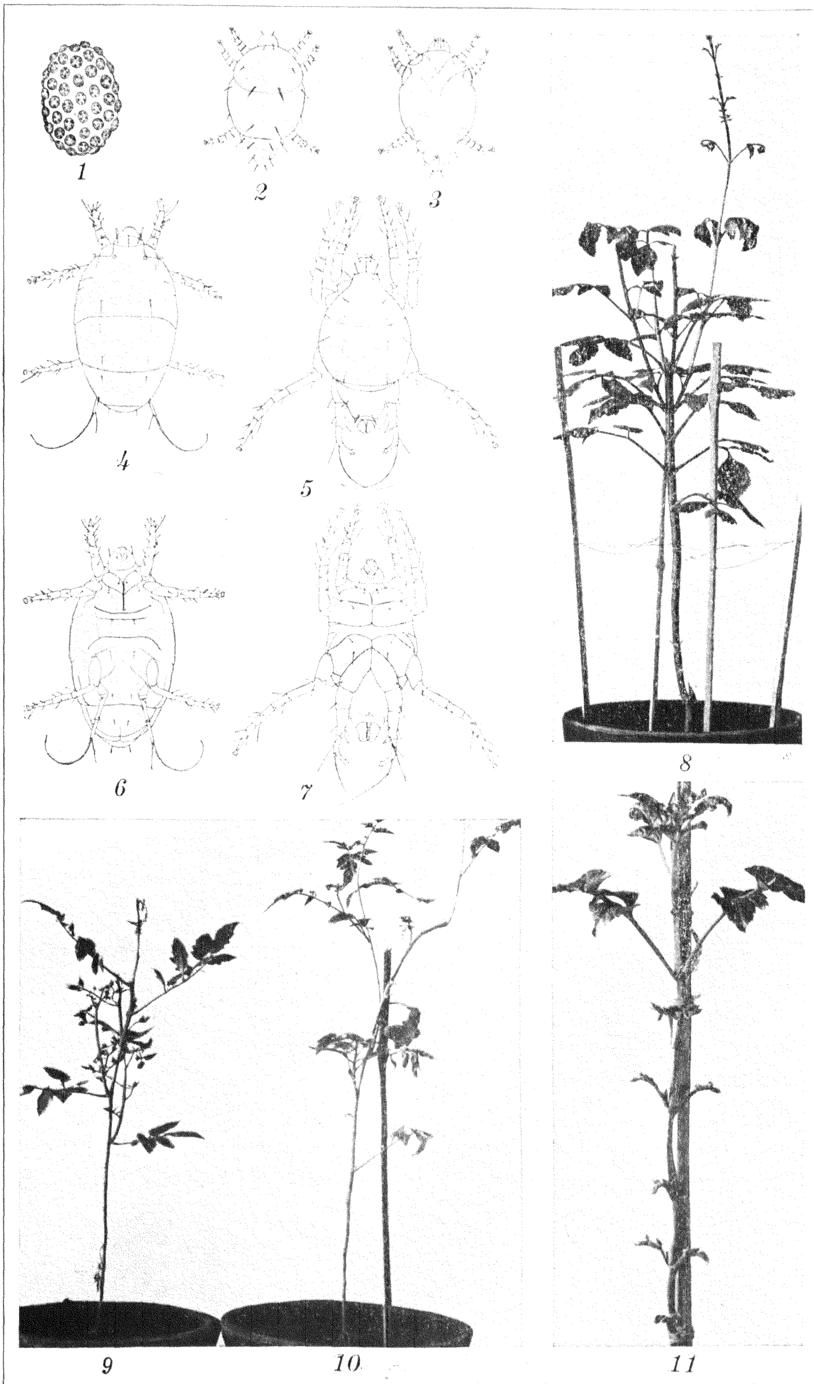

PLATE 8.

KANDULI FISHERIES OF LAGUNA DE BAY PHILIPPINE ISLANDS

REMEDIAL AND REGULATORY MEASURES FOR THEIR REHABILITATION [1]

By DEOGRACIAS V. VILLADOLID

Of the Fish and Game Administration, Department of Agriculture and Commerce, Manila

The most conservative estimate of the value of the *kanduli* [2] fisheries of Laguna de Bay, made in 1928, placed it at about 1,000,000 pesos a year; at present (1934), it is doubtful if the annual harvest is worth one-half that sum. The fall in yield may be traced to the apparent depletion of the fisheries in question, due principally to the indiscriminate catching of the fish by the *pukot* (drag seine).

FACTORS OF DEPLETION

On the basis of more than ten years' observation, the following may be mentioned as important factors of depletion:

1. *The pukot.*—The pukot (drag seine) withdraws the bulk of fish from Laguna de Bay, and therefore is very destructive to the fisheries, especially to the kanduli, the spawning and brooding seasons of which coincide with the best fishing season of the pukot. Laguna de Bay is too shallow a body of water, being only from 3 to 6 meters deep in the open, to withstand the severe effect of the pukot, the thorough working gear of which does not allow the fish in the lake much chance of escape. Moreover, the operation of this drag seine disturbs the ecology of the bottom of the lake, destroying both plants and animals growing there. These demersal forms are the principal source of food for the food fish, especially the kanduli, which is a bottom-feeder.

[1] Contribution No. 10 from the Fish and Game Administration, Department of Agriculture and Commerce.

[2] The kanduli of Laguna de Bay belongs to the catfish group, *Arius* species, family Ariidæ.

Our studies on the composition of the catch of the important commercial fishing gear in Laguna de Bay, operated during 1931 and 1932, showed that pukot withdrew about 99 per cent of the total catch of kanduli; about 94 per cent of the *biyang-puti, Glossogobius giurus* (Buchanan-Hamilton); about 97 per cent of the *ayuñgin, Therapon plumbeus* (Kner); and about 99 per cent of the *dalag, Ophicephalus striatus* Bloch, taken from the lake during that period.

Increase in the number of fishermen and greater effort naturally tend to deplete a given fishery. The Bureau of Commerce and Industry of the Philippine Islands is authority for the following figures: In 1918, 177 fishing establishments were catching fish in Laguna de Bay. By 1925 the number of such establishments was 1,045, an increase of 868, or an average increase of 124 a year. Within the last five or six years, moreover, the pukot fishermen of Laguna de Bay began to employ motor boats in operating their drag seines, which markedly accelerated the coverage of fishing areas.

2. The dominance of young and immature kanduli in the local markets.—Large quantities of immature fish are sold in the local markets. This is especially true of the kanduli, the major bulk in the fish baskets being composed of *tiguiti* (Tagalog name for small, young, and immature kanduli).

3. Large market demand for prawns, snails, and small fish.—There is a large demand for prawns, snails, and small fish, all of which serve as food for commercial fish. This demand naturally gives rise to ruthless methods of catching these animals. Depletion of the food of fish naturally will tend to decrease the number of fish. The duck industry in Laguna de Bay regions, which requires a large amount of protein food, is extensive. In has been found in the College of Agriculture that the best protein food for chickens, swine, and other domestic animals is prawns and snails. The demand for this protein feed in the Laguna de Bay regions is so large that local sources alone cannot meet it, and a considerable portion has to be imported.

4. Periodic occurrence of masamang tubig (bad water) in Laguna de Bay.—It was observed that periodic occurrence of *masamang tubig* is responsible for the wholesale death of fish and other animals in localities through which the bad water passes. It is believed that this water, which occurs at certain times of the year, originates from the salt water of Manila Bay. This water is further polluted with decaying algæ (locally known as *lia*). Chemical examinations of this water in the laboratory of agricultural chemistry, College of Agriculture, showed that it is almost devoid of oxygen, and highly charged with poisonous gases. Its chlorine content is much higher than that of the ordinary lake water. This bad water is a factor of depletion since it kills fish. Even the hardy snails and other mollusks succumb to its effect.

POSITIVE SIGNS OF DEPLETION

The following are some of the positive signs of the depletion of kanduli in Laguna de Bay.

1. Increased percentage of young in the catch from 1927 to 1932 per unit of effort or gear.—The percentage of young in the catch is a useful indicator of the condition of the fisheries. An increase in the percentage of young in the catch is a sign that the fish are getting scarcer. In 1927 and 1928 a series of determinations at weekly intervals was made to ascertain the composition of the catch of two nonselective gears which catch kanduli on a commercial scale. The average monthly catch of *baklad-laot* or *baklad-alañgan* was 60 per cent immature kanduli, and 50 per cent immature kanduli for the pukot. (In the case of the pukot, 50 per cent of the immature kanduli contained in the catch did not include the countless eggs, embryos, and fry that were destroyed during the spawning and brooding season.) Our 1931–1932 determinations showed that the pukot had a monthly average catch of 60 per cent of immature kanduli; the baklad had 63 per cent. The foregoing determinations were based upon the sampling method. Fortunately we also have records of similar determinations of the catch of the baklad, but based upon treatment of the entire catch. This was made possible by the establishment of two fish corrals (baklad) under the management of the College of Agriculture limnological station, where we had control over the disposal of the catch. Because of the completeness of these data, we think that the results therefrom are more representative than those obtained from the two methods of determination. We found that they agree fairly well as to the percentage of young in the catch, as recorded in Table 1.

TABLE 1.—*Percentage of immature kanduli. Monthly average from the year's determinations.*

Period.	Immature kanduli.	
	By sampling.	By treatment of entire catch.
	Per cent.	*Per cent.*
1927–1928	60	----------
1931–1932	63	----------
1931	----------	59.3
1932	----------	69.2

2. Gradual reduction of kanduli in the catch, and its replacement by biyang-puti.—Another significant indication of the depletion of the kanduli fishery is the gradual replacement of kanduli in the catch by biyang-puti. About five years ago the bulk of the catch of baklad in Laguna de Bay was made up of kanduli, biyang-puti forming only a minor portion. From 1931 to 1932, however, biyang-puti began to dominate the catch. The kanduli gradually decreased until it represents only a minor portion, while the biyang-puti forms the dominant constituent of the catch of the fish corrals. The record of the total catch of the two baklad run by the College of Agriculture limnological station for 1931 and 1932 shows the ratio between the kanduli and the biyang-puti found in the catch. Table 2 presents the monthly average taken from records of the daily catch.

TABLE 2.—*Monthly catch of two baklad, showing the relation between kanduli and biyang-puti during 1931 and 1932.*

Month.	1931		1932	
	Kanduli.	Biyang-puti.	Kanduli.	Biyang-puti.
January	--------	----------	1	3.09
February	--------	----------	1	0.66
March	1	1.89	1	1.53
April	1	2.06	1	2.93
May	1	0.86	1	3.36
June	1	1.24	1	2.33
July	1	0.88	1	1.50
August	1	1.88	1	1.50
September	1	0.46	1	1.21
October	1	0.42	1	2.78
November	1	1.06	1	1.80
December	1	2.89	1	2.77
Average	1	1.38	1	2.12

It may be seen from these figures that the kanduli represented on an average only 1 part as compared to 1.4 parts of biyang-puti in the catch of the baklad in 1931; in 1932 the kanduli decreased further until the ratio was 1 part kanduli to 2.12 parts biyang-puti, whereas about five years ago the kanduli formed the bulk of the catch of the baklad. The replacement of the kanduli in the catch by the biyang-puti is an indication of the rapid depletion of the former in Laguna de Bay.

3. Destruction of immature fish by fishing gear which are suitable for catching fry and very young kanduli.—An examination of the composition of the catch of fishing gear other than baklad and pukot in Laguna de Bay showed the following:

(*a*) *Baklad-siid* or *baklad-guilid* (small, shallow fish corrals) catch at all times almost 100 per cent undersized kanduli, largely because this type of corral is set in shallow water where young kanduli feed.

(*b*) *Sakag,* or scissors nets, catch only very young kanduli, biyang-puti, bañgayñgay (*Ophiocara aporos* Bleeker), and dalag fry.

(*c*) *Seket* (modified type of sakag, or scissors net) is the gear by far most destructive to immature kanduli, biyang-puti, bañgayñgay, and other fishes. These young fish are frequently found schooling in shallow waters where this gear is used. They are driven into the net by dragging along the bottom of the lake an iron chain feathered with banana or buripalm leaves.

(*d*) *Pukot-dalag* also catch kanduli, almost 100 per cent of which are immature.

REMEDIAL AND REGULATORY MEASURES

The obvious depletion of the kanduli in Laguna de Bay changes the problem of its conservation into one of rehabilitation. The following regulative and remedial measures are recommended:

1. The absolute prohibition of the use of pukot-laot or pukot-alañgan (drag seines used in deep water) in Laguna de Bay for at least five years. Five years of study at the College of Agriculture limnological station indicate that the kanduli becomes sexually mature in the second or third year after hatching, and reaches a fair marketable size at the age of about five years.

However, there is a serious objection to the foregoing measure, and that is the question of the pukot to be laid off. Certainly, such a restriction would cause the pukot owners great financial loss. In view of this objection, the following substitute measure is proposed: Every owner or operator of pukot in Laguna de

Bay should be required to register each pukot (drag seine) in the municipality where the owner or operator resides and to pay a yearly license fee for each pukot registered. The following schedule of fees is recommended:

(*a*) For a first-class pukot, 100 pesos a year. A first-class pukot is a drag seine, locally known as pukot-laot or pukot-alañgan, and is operated by at least thirty persons and pulled by a motor boat.

(*b*) For a second-class pukot, 75 pesos a year. A second-class pukot is a drag seine operated by at least thirty persons but propelled solely by man power.

(*c*) For a third-class pukot, 50 pesos a year. A third-class pukot is a drag seine manned and operated by at least fifteen persons, but not more than twenty.

(*d*) For a fourth-class pukot, 25 pesos a year. A fourth-class pukot is a drag seine manned and operated by at least five persons, but not more than ten.

(*e*) For a fifth-class pukot, 10 pesos a year. A fifth-class pukot is a drag seine, known in Laguna de Bay as "pukot-dalag," operated and manned by less than five persons.

Registration of newly made or repaired pukot should not be allowed till five years after the pukot has ceased to be useful. In this way it should be possible to give the kanduli fishery a rest of five years with the least loss to the owners and operators of the pukot. This sacrifice would be well compensated for by the conservation of the kanduli fishing industry.

2. At the expiration of the five-year period the further use of the pukot in Laguna de Bay as a gear for catching fish should be restricted in order to allow for the gradual replacement of the marketable size by the young kanduli. Such restriction of the use of the pukot in Laguna de Bay may be accomplished by the enactment of the following regulatory measures:

Enforcement of a closed season against the use of the pukot in Laguna de Bay during the peak of the brooding activity of the kanduli for the following reasons:

(*i*) The greatest destruction of the eggs, embryos, and larvæ of the kanduli by the pukot occurs during the brooding season as the brooders at this time are very irritable and a slight entanglement in the net causes the nurses to expel the broods from their mouths. The peak of brooding activity takes place from April 15 to June 15.

(*ii*) Closed season against the use of the pukot during the period of heavy spawning, which takes place from March to April, will also undoubtedly help to prevent the unnecessary destruction of eggs, embryos, and young kanduli. However, it must be borne in mind that during this time and about a month prior to the commencement of the spawning season, the kanduli are fat and at their best for human consumption. For a month after the brooding season the kanduli are lean and not commendable for the table.

3. Discouraging the catching of the young, immature kanduli and taking them to the markets, by making it illegal to capture, possess, purchase, or offer for sale, young, immature kanduli, locally known as tiguiti (kanduli measuring 16 centimeters or less from the tip of the mouth to the end of the caudal fin, or tail), and making legal only the sale of kanduli measuring 16.5 centimeters or more in length. The enforcement of the foregoing law would be comparatively simple as the market inspectors, members of the municipal police force, and other deputized persons authorized to enforce such laws could easily check the size of the kanduli offered for sale in public places or in the possession of any person.

4. Ruthless methods of catching prawns, snails, and small fishes in Laguna de Bay, which serve as the major food supply of the kanduli, should be regulated in order to prevent their depletion by unnatural and artificial means.

5. The use of the seket should be entirely prohibited in Laguna de Bay. This gear has proved to be very destructive to the immature kanduli which feed along the shallow shores of the lake. The seket is a type of scissors net (sakag in Tagalog) used in conjunction with an iron chain feathered with buri-palm or banana leaves. The iron chain is dragged by two men along the bottom of the shallow waters towards the scissor net which is set at some distance from a point where the dragging of the chain starts.

CONCLUDING REMARKS

It is apparent from the discussion of the foregoing program of conservation and rehabilitation of the apparently depleted kanduli fisheries of Laguna de Bay, that there is a need for discouraging or even prohibiting the use of the pukot (drag seines) in Laguna de Bay, as this gear has been found most destructive to the kanduli fishery, as shown by the following:

1. At the commencement of and during the breeding season the kanduli have the habit of schooling together. Obviously

during this time the kanduli are caught in large numbers in any single haul of the pukot.

2. In the study of the composition of the catch of the pukot it has been shown that this gear withdrew 60.04 ± 0.41 per cent of the total number of kanduli taken from Laguna de Bay in the 1931–1932 period. Likewise, during the same period, the pukot caught 57.90 ± 2.185 per cent of immature kanduli. This percentage of immature kanduli does not include the countless eggs, embryos, and larvæ that are destroyed by the pukot during the spawning and brooding seasons.

3. Laguna de Bay is a shallow sheet of water, its depth in the open ranging from 8 to 16 feet. The efficiency of the drag seine in catching large numbers of kanduli is very great at this depth, and Laguna de Bay is too shallow a body of water to withstand the severe effects of efficient fishing gear such as the pukot.

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ORIGIN OF EMBRYOS IN THE STRAWBERRY MANGO [1]

By José B. Juliano

Of the College of Agriculture, University of the Philippines, Los Baños

THREE PLATES

February 22, 1913, seedlings of several varieties of Indian mangos were received by the College of Agriculture from Moanalua Agricultural Experiment Station, Oahu, Hawaii, through the courtesy of Mr. J. E. Higgins,[2] now director of the Panama Canal Zone Experiment Gardens but at that time on the Hawaii Experiment Station staff. One of these varieties was the strawberry mango, which was planted in the college orchard near the Protestant Chapel, and has been bearing fruit (Plate 2) for the last few years. A full description of the fruit is given by Higgins(4) and Wester.(13)

April 11 and May 11, 1933, one hundred fruits were collected and their seeds germinated in seed boxes in the department of plant physiology, College of Agriculture; ninety-nine germinated. Twenty-four seeds gave rise to one plant each; twenty-five, two plants each; thirty-eight, three plants each; and twelve, five plants each (Plate 3, fig. 1).

Because of the development of more than one plant from a single seed of this strawberry mango, a feature very uncommon in the Indian mangos, two questions have arisen. Do these embryos develop vegetatively or apogamously, and from what tissue or tissues of the young seed are they formed? Does the megagamete, or egg, whether fertilized or not, take an active part in the formation of any or all of the embryos within a single seed? The answers to these queries are, in the writer's opinion, necessary adjuncts in the hybridization of the mango.

Material was collected during April, 1933, when the blooming period was at its height, with the hope of finding out the probable origin of these multiple embryos in the mature seeds of

[1] College of Agriculture Experiment Station contribution, No. 976.

[2] Thanks are here expressed to Mr. J. E. Higgins, director of the Panama Canal Zone Experiment Gardens, for identifying this mango.

this particular Indian strawberry mango imported from Hawaii. Collection of early stages of the development of the flower were not then possible, so only mature flowers and fruits at different stages of development were gathered. These were killed and fixed in the laboratory with the use of formalin-acetic-alcohol (70 per cent) prepared according to the formula given by Chamberlain.(2) The material was dehydrated and infiltrated as usual, embedded in paraffin, and cut into sections 6 to 10 microns thick. The sections were stained in Heidenhain's iron-alum-hæmatoxylin with orange G dissolved in clove oil as a counterstain.

OBSERVATIONS

The youngest stage obtained in the development of the megagametophyte is the binucleate stage (Plate 1, fig. 1) in which the embryo sac has considerably elongated and the two daughter nuclei lie at both ends; between the two nuclei is the large central vacuole. Stages earlier than this were not available, but the writer is of the opinion that they are perhaps identical with that reported by Juliano and Cuevas(5) for the pico mango from the Philippines. The two nuclei described above undergo the usual divisions, and a normal seven-celled megagametophyte already described for the pico mango(5) is formed. According to Maheswari(6) Dudgeon in 1929 found degenerations in the carpels of mangos in India, beginning as early as the megaspore mother-cell stage. As a result of these degenerations only a few of the flowers are physiologically bisporangiate, and these are towards the apex of the inflorescence. Towards the close of the flowering season the flowers are often completely sterile and fall off in large numbers. As a consequence, the greater percentage of the flowers formed never produce fruits at all as is true of the pico(5) and the carabao(11) mangos in the Philippines.

That pollination is necessary for the production of mango fruits is well shown by the results obtained by Popenoe(8) working in Florida and Juliano and Cuevas(5) in the Philippines.

After fertilization the synergids and the antipodal cells degenerate. The primary endosperm nucleus (Plate 1, fig. 2) then enlarges and becomes rhomboid. Its nucleolus is large and conspicuous and takes the stains very heavily. The zygote, which contains a small oblong to oblong-ovate nucleus embedded in a thin peripheral cytoplasm, is found just below the primary endosperm nucleus. At its center is a large vacuole.

From this stage on the embryo sac experiences rapid enlargement and elongation. Concomitant with this enlargement of the embryo sac, the nucellar cells abutting it become conspicuously engorged with dense cytoplasm, especially at the micropylar end of the nucellus. Absorption and destruction of the nucellus by the embryo sac is so extensive that at times the latter nearly comes in contact with the testa at the micropylar end of the young seed (Plate 3, fig. 2). This is epecially true at the time the embryos are quite visible in the embryo sac.

Endosperm.—The primary endosperm nucleus may remain in the vicinity of the zygote (Plate 1, figs. 2 and 3) and usually becomes enlarged before entering active divisions. The endosperm is of the nuclear type, and its development follows very closely that which has been reported for the pico mango.(5) The nucellus is totally destroyed by the endosperm, and the endosperm is completely absorbed by the embryos in the mature seed.

Zygote.—The zygote remains undivided for a long time after fertilization, and may never show any signs of activity at all, even after endosperm formation has long been under way. Usually, long before the primary endosperm nucleus initiates its first division, the zygote (Plate 1, fig. 3) starts to degenerate. Its nucleus becomes densely stained, and loses its regular outline. It actually sinks into a structureless mass preparatory to complete degeneration. In some cases the zygote may persist a little longer (Plate 1, fig. 4), although showing distinct signs of degeneration; at this time there can be found numerous free endosperm nuclei in the embryo sac. In a very few cases, even after the seed has attained a length of about 2.75 millimeters and numerous free endosperm nuclei are present in the embryo sac, the zygote may remain undivided (Plate 1, fig. 5). Its cytoplasm is greatly plasmolyzed, and its nucleus undergoes degeneration. At any rate, even if the zygote does not degenerate soon after fertilization and may stay in the embryo sac unchanged in this strawberry mango, it does completely disappear and does not take any active part in the formation of any of the embryos in the mature seed.

In the polyembryonic No. 11 mango from Florida, Belling(1) also found that the megagamete, whether fertilized or not, never gave rise to any of the embryos in the sac. On the contrary, as is true in the pico mango from the Philippines,(5) the zygote which may hibernate for a long while in the embryo sac, does persist and is easily distinguishable. This zygote divides transversely later and gives rise to an elongated basal cell and a rounded apical cell. In the pico mango, therefore, one of the embryos in the mature seed is normally the result of fertilization. Sometimes the zygote in the pico mango may actually degenerate, so that the resulting embryos in the seed are all apogamic in nature, an instance similar to that being reported for the strawberry mango in this paper. In other words, the strawberry mango cannot very well be utilized as pistillate material for hybridization work, because of the fact that its zygote degenerates and never gives rise to an embryo in the mature seed. It can, however, be used perhaps as a pollinizer. The pico mango, however, may be utilized as a pistillate plant to some extent. Nothing can be said as to the suitability for hybridization purposes of the other Philippine varieties of mango until a thorough study of the exact nature and behaviour of their zygotes and their extra embryos is made.

Adventive embryos.—The enlargement of the embryo sac and destruction of the nucellar tissue after fertilization occur simultaneously. As the destruction of the nucellar tissue proceeds, the nucellar cells directly abutting the embryo sac become filled with dense cytoplasm. Certain among them, especially those around the micropylar region of the nucellus, became greatly enlarged (Plate 1, fig. 6) and these enlarging cells are easily distinguished from their surrounding cells by their specially larger nuclei, denser cytoplasm, and also by their response and behavior to stains. These differentiating cells are usually deep-seated at first, and as their surrounding nucellar cells are absorbed and destroyed by the embryo sac, they begin to enlarge. They usually round off first, and then start to divide forming adventive proembryos (Plate 3, fig. 2). Numerous nucellar cells may show signs of greater development at nearly the same time, but only a few of them actually divide and form adventive embryos. In fact, a majority of these differentiating nucellar cells never divide at all and eventually degenerate (Plate 1, fig. 6). Adventive embryos of nucellar origin are also reported in *Citrus trifoliata,*(8) *Funkia, Nothoscordon, Citrus aurantium, Euonymus, Coelebogyne, Clusia,* and *Opuntia,*(3) and in pico mango(5) and No. 11 Florida mango.(1)

Examination of hundreds of slides of sections of young seeds reveals the fact that numerous adventive embryos may start to grow simultaneously (Plate 3, fig. 2), but the maximum number which usually attain maturity and actually germinate from a seed is five (Plate 3, fig. 1). Belling(1) observed as many as half a dozen adventive embryos developing in the nucellus of the polyembryonic No. 11 mango in Florida, while three to four are commonest in the pico mango.(5) These adventive embryos project themselves into the embryo sac and exhibit irregularity in shape. Because of the irregularity in the mode of divisions of the cells of the proembryos (Plate 1, figs. 8 and 9), the writer was not able to follow very closely their development in their early stage. These adventive embryos are devoid of well-developed suspensors, and display also a great variety of sizes.

Adventive embryos in the strawberry mango are not only formed from those nucellar cells directly abutting the micropyle of the seed, but also from those nucellar cells on the side of the sac opposite the funiculus (Plate 1, fig. 7). Such origin of adventive embryos was also noted in the pico mango.(5)

Wester(12) states that as the Indian mangos fruited in Florida it was noted that the seeds were monoembryonic, and with one exception subsequent observations in Florida and the West Indies have shown this to be a constant character in all Indian mangos that have fruited there. Rolfs(10) observes that polyembryony is only true in Cambodiana, No. 11 Florida, and the Bombay. Amini on the other hand, produced many fruits without seeds in 1914 in Florida, a small number with one embryo each, and two seeds appeared to be polyembryonic. Wester(12) cites Kinman as having concluded that the Indian mangos Amini, Bulbulchasm, Sandersha, and Totapari are adapted for propagation by seeds, because of their variability. Cambodiana is the only exception. Mr. Hartless, of India, in a letter to Wester(12) stated that Indian mangos in his locality were all monoembryonic, thus confirming the conclusion arrived at in Florida. According to Mendiola,(7) Popenoe, and Burns and Prayag stated that, practically speaking, in India where there are probably some five hundred mango varieties, there is no known polyembryonic mango. In other words, polyembryony in Indian mangos is of rare occurrence, while of the six varieties described by Wester(12) from the Philippines, only the dudul mango was reported not polyembryonic.

In a letter from Mr. J. E. Higgins, of Panama Canal Zone, to the writer the statement is made that "none of these varieties [among which is the strawberry] which you mention reproduce themselves with absolute accuracy, and the seedlings of most of them are quite variable." This is to be expected if the mango variety is of the monoembryonic type like most of the Indian mangos. If the embryos are all apogamous, and the zygote, whether fertilized or not, never gives rise to any of the embryos in the mature seed, as is true of this strawberry mango and the No. 11 race of Florida mango, then the seedlings from them ought to receive and reproduce the indisputable stamp of the parent; that is, if no cytological change in the constitution of any of the adventive embryos takes place during their development. Experience shows that seedlings from this strawberry mango usually come true to type in the College of Agriculture.

The writer was informed that in Hawaii the strawberry mango has not gained much popularity compared with the other Indian mango varieties, because of its inferior fruit.[3] This mango is propagated vegetatively rather than by seed, consequently people have very little occasion to observe any action of its seedlings and learn its embryonic habits. It is known that an Indian mango variety, the Mulgoba,(12) which is monoembryonic, has reverted to polyembryony in its first generation when planted in Florida. It is probable that this strawberry mango has behaved in the Philippines in a manner similar to this other Indian mango in Florida.

SUMMARY

An occurrence of polyembryony in the strawberry mango, an Indian mango variety imported from Hawaii to the Philippines in 1912, is herein reported.

The embryo sac is normal and the endosperm is of the nuclear type.

The megagamete or the egg after fertilization, may persist for a long time in the embryo sac, but it ultimately degenerates and does not take any active part in the production of the embryo or embryos in the mature seed.

All of the embryos found in the mature seed arise from the nucellus just surrounding the micropyle and on the side opposite the funiculus. Many nucellar cells may exhibit that characteristic growth, of which many may only degenerate and fail to form adventive embryos. Numerous adventive embryos may

[3] Information was furnished by Mr. W. T. Pope, senior horticulturist of the Hawaiian Agricultural Experiment Station, Honolulu, Hawaii.

start to grow, but of these only five or less have been actually observed to develop to maturity in the seed.

Because of the fact that all of its embryos are apogamic in nature, this Indian mango cannot be used as suitable pistillate material in hybridization work. It can, perhaps, be used as a pollinizer.

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ILLUSTRATIONS

PLATE 1. STRAWBERRY MANGO

FIG. 1. A binucleate megagametophyte; × 540.

2. Showing the primary endosperm nucleus (*pen*) and the zygote (*zy*); × 540.
3. An older embryo sac showing degeneration of the zygote (*zy*) and enlargement of the primary endosperm nucleus (*pen*); × 1060.
4. A persistent zygote (*zy*) showing degeneration; × 540.
5. A still more persistent zygote (*zy*) on its way to degeneration; note the free endosperm nuclei (*en*); × 540.
6. Portion of the nucellus (*n*) at the region near the micropyle (*m*) showing embryo initials and young adventive embryos (*aem*); note the free endosperm nuclei (*en*); × 540.
7. Portion of the nucellus (*n*) at the side of embryo sac opposite the funiculus showing an adventive embryo (*aem*); × 540.

FIGS. 8 and 9. Young embryos; × 540.

PLATE 2

Mature fruits and a seed of the strawberry mango, reduced to one-third natural size. Photographed May 26, 1933.

PLATE 3

FIG. 1. Five plants arising from a single seed of the strawberry mango, reduced to about one-half natural size.

2. Photomicrograph showing proembryos (dark bodies) arising from the nucellus near the micropyle of the young seed of the strawberry mango; × 93.

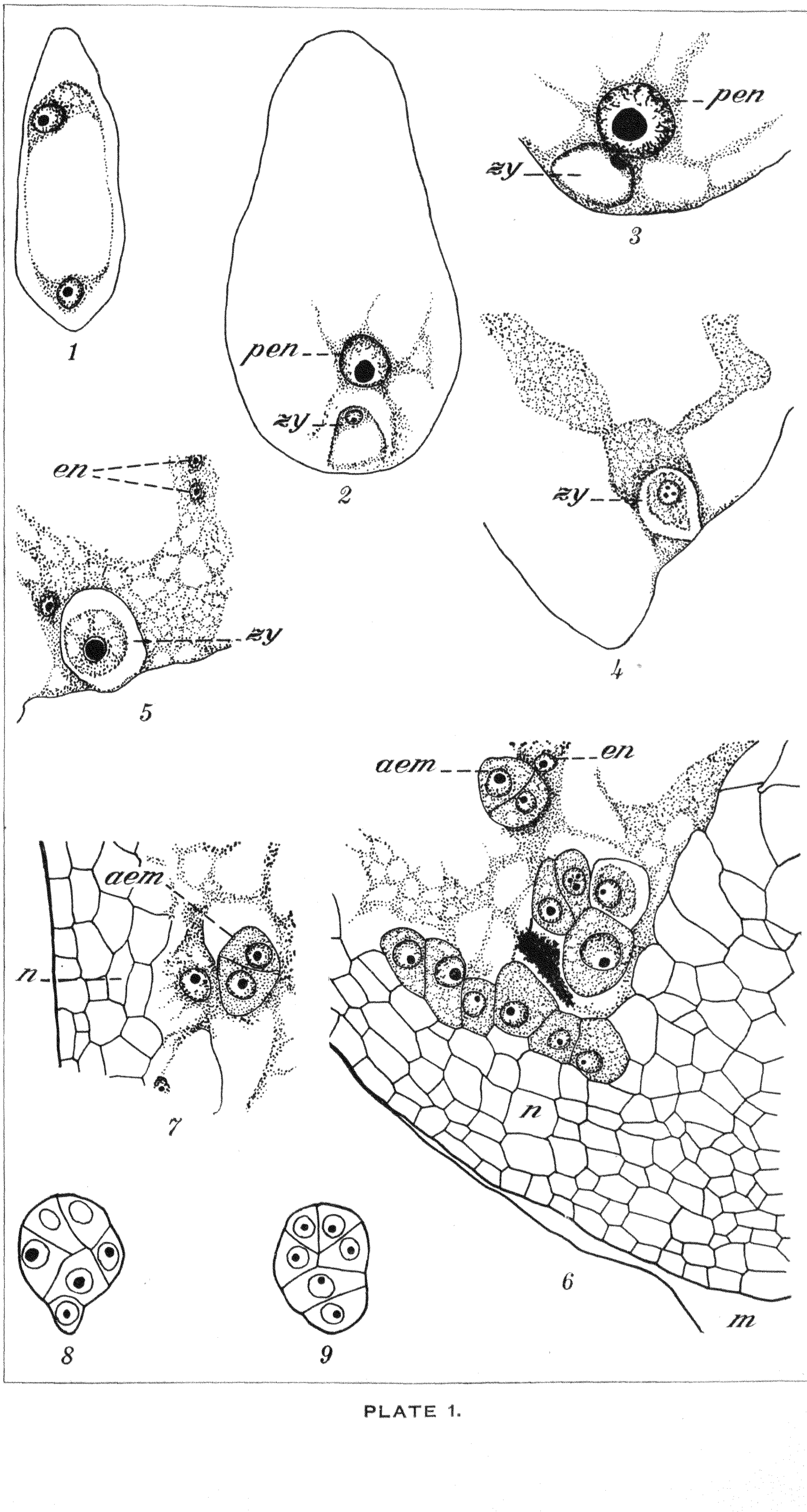

PLATE 1.

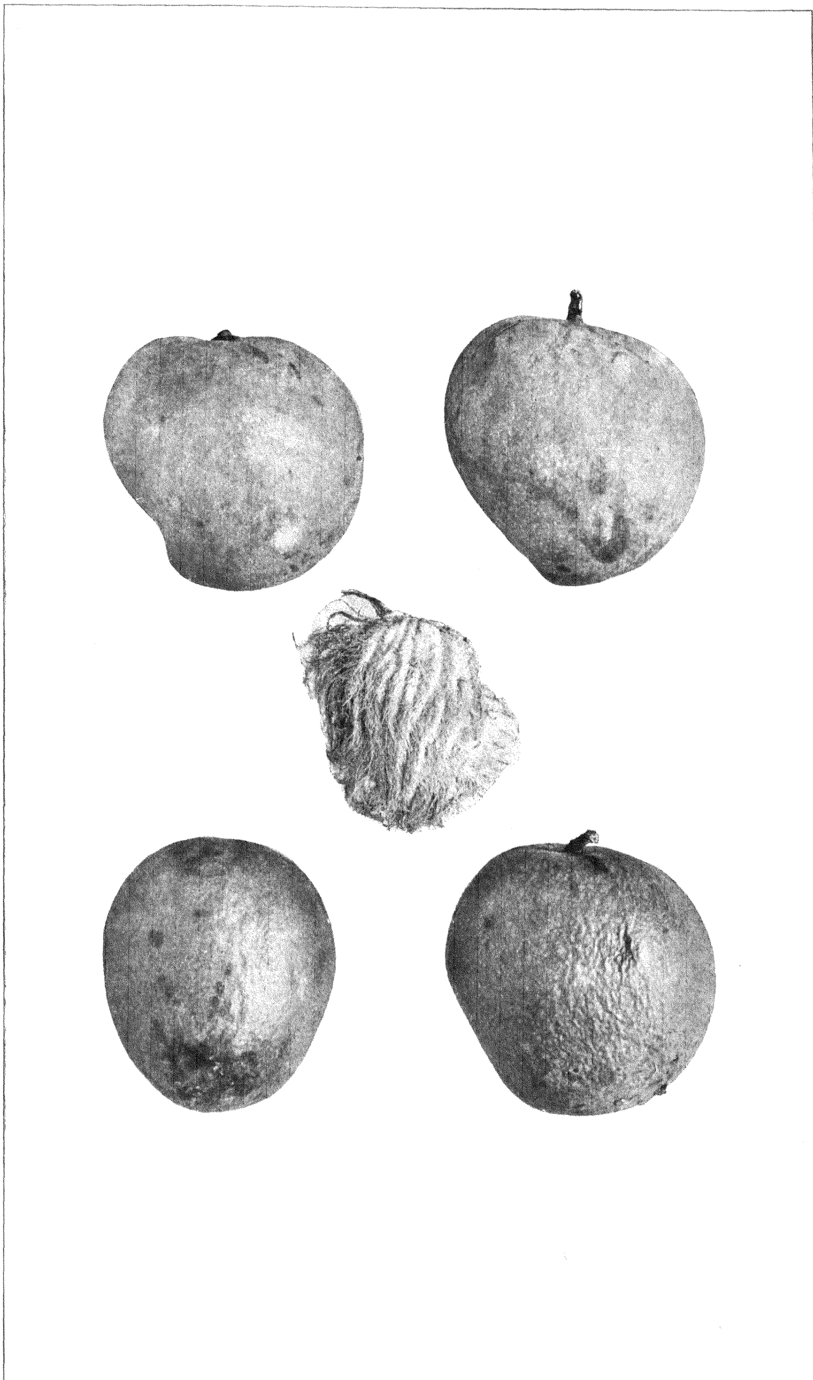

PLATE 2.

1

2

PLATE 3.

ERRATA

VOLUME 53

Page 374, 8th line from bottom, *for* $\frac{35 \text{ p.m. minutes}}{\text{a.m. minutes}}$ *read* $\frac{35 \text{ p.m. minutes}}{17 \text{ a.m. minutes}}$.

Page 375, 5th line from bottom, and page 376, 5th line from top, *for* Table 14 *read* Table 13 in each case.

INDEX

[New names and new combinations are printed in **boldface.**]

A

B

D

L

M

o