THE PHILIPPINE JOURNAL OF SCIENCE

VOLUME 19

JULY TO DECEMBER, 1921

WITH 72 PLATES AND 27 TEXT FIGURES

MANILA
BUREAU OF PRINTING
1921

183013

CONTENTS

No. 1, July, 1921

[Issued October 31, 1921.]

No. 2, August, 1921

[Issued December 9, 1921.]

No. 3, September, 1921

[Issued December 19, 1921.]

VOL. 19, NO. 1 JULY, 1921

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1921

180365

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science of the Government of the Philippine Islands

---

Manuscript intended for publication and books for review should be sent to the editor. One hundred separates of papers published in the Journal are furnished to authors without charge. Additional copies may be had at authors' expense.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

The Journal is issued twelve times a year. The subscription price is 5 dollars, United States currency, per year. Single numbers, 50 cents each.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 19 JULY, 1921 No. 1

THE EXPRESSION OF THE OCTET THEORY OF VALENCE IN STRUCTURAL FORMULAS [1]

By GRANVILLE A. PERKINS

Chemist, Bureau of Science, Manila

ONE PLATE

The science of organic chemistry, as we know it to-day, may be said to owe its very existence to the idea of structural formulas developed by Kekulé, Frankland, and Couper, sixty years ago. In the last two decades, however, the development of both organic and inorganic chemistry has been greatly retarded by the fact that Kekulé's simple "affinity units" do not represent with sufficient accuracy the actual forces which bind atoms together.

Recent attempts of physicists to apply the new knowledge of electrons to the fundamental problem of chemistry, namely, the nature of chemical affinity, met with only partial success, until Langmuir [2] finally showed that certain recent ideas of atomic structure, notably those of Lewis, [3] can be used to form a remarkably successful working hypothesis in both organic and inorganic chemistry. The conception of electron shells and shared electrons as presented by him gives one a definite picture which is undoubtedly very close to the actual nature of the union between atoms.

Langmuir's "octet theory of valence" is so simple and exact that it will be found of great value to chemists, from the over-curious student who asks his professor what makes the atoms stick together to the investigator who wishes to predict the

[1] Received for publication, February 28, 1921.

[2] Langmuir, I., Journ. Am. Chem. Soc. 41 (1919) 868, 1543; 42 (1920) 274.

[3] Lewis, G. N., Journ. Am. Chem. Soc. 38 (1916) 762.

results of a reaction which has never been performed. The method used by Langmuir in applying the theory, however, appears to the writer to be somewhat cumbersome for general use, and to obscure, by its indirectness, some of the value of the theory. The purpose of the present article is to present a system for writing structural formulas which will be as simple and direct as possible, and at the same time represent the molecules as accurately as possible in terms of modern atomic theory. It is hoped not only to furnish by this means a simple method for practical application of the theory in its present stage of advancement but even to develop certain valence relationships which have not hitherto been clearly expressed.

While it is assumed that anyone interested in the subject is already familiar with recent developments of the octet theory in the hands of Langmuir and others, for the sake of clarity the subject will be briefly reviewed.

THE STRUCTURE OF ATOMS

NUCLEUS [4]

In the light of recent physical evidence the essential portion of any atom is a minute nucleus composed of positive units of electricity (sometimes called positive electrons) and a smaller number of negative units (sometimes called negative electrons, but usually simply electrons) very closely packed together and bound by the most powerful forces known. The positive units are all identical, each having a mass of approximately 1, expressed in atomic weight units. Similarly the (negative) electrons are all identical, but have negligible mass. Each electron in the nucleus neutralizes one positive unit, so the total outside electrical effect, called the nuclear charge, is measured by the number of positive units less the number of electrons (negative units). This difference is called the *atomic number* of the nucleus.

NEUTRAL ATOM

Except under very unusual circumstances, such as when traveling with extreme velocity, a nucleus is never found alone, because it normally attracts as many electrons as its atomic number, forming an electrically neutral atom. These electrons do not enter the nucleus but arrange themselves in nearly spherical concentric shells, which vary in number from one to seven ac-

[4] Harkins, W. D., Journ. Am. Chem. Soc. 42 (1920) 1956; Rutherford, E. E., Proc. Roy. Soc. London 97A (1920) 374–401.

cording to the number of electrons. The shells are filled in the following order: First shell, 2 electrons; second, 8; third, 8; fourth, 18; fifth, 18; sixth, 32; seventh, (32?). (See Table 1). The electrons either rotate, perhaps in ring form, or revolve in small[5] orbits, so that they are powerful electro-magnets. (See Plate 1.)

TABLE 1.—*The atoms arranged according to their electron shells.*

	Hydrogen period.	First short period.	Second short period.	First long period.	Second long period.	Rare earth period.	Uranium period.	Electrons in shell.	Vacancies in shell.
Number of shells	1	2	3	4	5	6	7		
Electrons in kernel	0	2	10	18	36	54	86		
Completed shell	2	8	8	18	18	32	(32?)		
	(* O)	(He 2)	(Ne 10)	(A 18)	(Kr 36)	(Xe 54)	(Nt 86)	0	--------
	(H 1)	Li 3	Na 11	K 19	Rb 37	Cs 55	* 87	1	--------
		Be 4	Mg 12	Ca 20	Sr 38	Ba 56	Ra 88	2	--------
		B 5	Al 13	Sc 21	Yt 39	La 57	Ac 89	3	--------
				Ti 22	Zr 40	Ce 58	Th 90	4	--------
				V 23	Cb 41	Pr 59	Ux2 91	5	--------
				Cr 24	Mo 42	Nd 60	U 92	6	--------
				Mn 25	* 43	* 61	--------	7	--------
						Sa 62	--------	8	--------
						Eu 63	--------	9	--------
						Gd 64	--------	10	--------
						Tb 65	--------	11	--------
						Ho 66	--------	12	--------
						Dy 67	--------	13	--------
						Er 68	--------	14	--------
						Tm 69	--------	15	--------
						Tm2 70	--------	16	--------
						Yb 71	--------	17	--------
						Lu 72	--------	18	--------
						Ta 73	--------	19	--------
						W 74	--------	20	--------
						* 75	--------	21	--------
				Fe 26	Ru 44	Os 76	--------	(8) 22	--------
				Co 27	Rh 45	Ir 77	--------	(9) 23	--------
				Ni 28	*Pd 46*	*Pt 78*	--------	(10) 24	--------
				Cu 29	Ag 47	Au 79	--------	(11) 25	--------
				Zn 30	Cd 48	Hg 80	--------	(12) 26	--------
				Ga 31	In 49	Tl 81	--------	(13) 27	--------
		C 6	Si 14	Ge 32	Sn 50	Pb 82	--------	--------	4
		N 7	P 15	As 33	Sb 51	Bi 83	--------	--------	3
		O 8	S 16	Se 34	Te 52	RaF 84	--------	--------	2
	H 1	F 9	Cl 17	Br 35	I 53	* 85	--------	--------	1
	He 2	Ne 10	A 18	Kr 36	Xe 54	Nt 86	--------	--------	0

* Not yet discovered.

[5] Concerning the size of these rings or orbits, there is much difference of opinion among physicists. They may be much smaller, relative to the shell, than represented in Plate 1, but larger orbits than these seem to be excluded by chemical evidence.

KERNEL[6]

The completed inner shells of an atom (that is, all the shells except the outermost) together with its nucleus, constitute the kernel. This is bound together by such strong electrostatic and magnetic[6] forces that it is never disrupted in ordinary chemical reactions, but acts as an unchangeable unit except under extremely penetrating forces, such as those of X-rays.

SHELL

For brevity the outer shell is called simply the shell. Unless this is complete, as in the helium group, the neutral atom exerts forces, both magnetic and electrostatic, effective at a considerable distance. It is upon these forces that all chemical action depends.

This is, roughly, the theory of atomic structure which seems to meet with general acceptance among chemists at the present time.

CHEMICAL UNION

Two types of chemical union have been distinguished; namely, primary valence unions and secondary valence unions. The present paper deals chiefly with the primary type, which involves the main uniting forces of atoms. This has been subdivided into two kinds, which may be called *salt-forming* unions and *direct* unions.

Salt-forming unions are caused by the fact that an atom with a nearly complete shell has a strong tendency toward completing its shell, and is able to appropriate from another atom with a less complete shell one or more electrons. Both atoms thus become charged and attract each other. This type of union has often been represented as follows:

$$\overset{+}{\mathrm{Na}}\cdots\cdots\cdots\overset{-}{\mathrm{Cl}}$$

Direct unions have been a much more puzzling problem, but Lewis[7] has advanced the explanation, later developed by Langmuir, that they are brought about by the sharing of one or more pairs of electrons by two atomic shells. For such a union to take place it is necessary that both atoms have a tendency to complete their shells. Since, in such a case, neither can detach an electron from the other, they compromise by sharing 2, 4, or 6 (but not 1,

[6] Lewis, G. N., loc. cit.; cf. Bohr. N., Phil. Mag. **26** (1913) 1476; Parson, A. L., Smithsonian Misc. Coll. 65, No. 11; Milliken, R. A., Science **45** (1917) 321; Silberstein, L., Phil. Mag. **39** (1920) 46.

[7] Loc. cit.; cf. Parson's "group of fourteen," op. cit., p. 29.

3, or 5)[8] electrons, which then do duty in both shells. Thus two chlorine atoms, having incomplete shells of 7 each, can form two complete octets in which one pair of electrons is shared. This kind of union, which will be called in this paper a direct union, was represented graphically by Lewis as follows:

$$:\overset{..}{\underset{..}{\mathrm{Cl}}}:\overset{..}{\underset{..}{\mathrm{Cl}}}:$$

Langmuir has simplified the formulas, using a single line to represent a shared pair: Cl—Cl, HO—Cl—O, O=N—O—N=O, N=N=O, etc. He has shown that a large number of hitherto perplexing structures can be readily expressed in this way.

VALENCE

Chemists have always tried to make generalizations concerning the valence (that is, the quantitative combining power) of atoms. An inspection of the Langmuir formulas above tells one nothing of the true valence relations of the atoms. He calls the number of lines attached to any atom (that is, the number of pairs which it shares in that compound) its covalence, and has developed some valuable generalizations regarding this variable property. What have been considered the true valence relations, however, he consigns to the equation:[9]

$$e = 8n - 2p.$$

It seems to the writer that there are two different kinds of direct union not hitherto distinguished. By recognition of this difference it is possible to construct formulas of considerable graphic value, at the same time dispensing with the equation.

The proposed system is based on positive and negative valence, the maximum values of which are clearly expressed by Langmuir[10] as follows:

> Now the maximum positive valence is a definite conception—it represents the total number of available electrons in the shell * * * On the

[8] In the case of benzene and similar compounds, however, the writer believes that 3 electrons are shared.

[9] This equation expresses the fact that in a molecule the total number of outer shell electrons (e) exist in completed octets, which requires 8 electrons per octet ($8n$) less 2 for every pair shared ($-2p$). The interpretation of the letters is somewhat modified for the case of hydrogen, where the completed shell has 2 electrons, and the heavy atoms, whose completed shells have 18 or 32 instead of 8 electrons.

[10] Langmuir, I., Journn. Am. Chem. Soc. 41 (1919) 926.

other hand, the maximum negative valence represents the number of electrons which the atom must take up to reach a stable form like that of the inert gases.

Langmuir further brings out the facts, at least by inference, that the actual negative valence in any compound, if exhibited at all, is almost always the same as the maximum, but the actual positive valence is often less than the maximum, giving two or more classes of compounds of the same metal, such as the cuprous and cupric compounds.

It seems important to the writer to express graphically, when writing structural formulas, the actual positive or negative valence exhibited by each atom.

PROPOSED SYSTEM FOR WRITING STRUCTURAL FORMULAS

1. *Valence.*—Represent the maximum electronegative valence of an atom in the ordinary way:

$$\mathrm{H}—,\quad \mathrm{F}—,\quad —\mathrm{O}—,\quad —\underset{|}{\mathrm{N}}—,\quad —\overset{|}{\underset{|}{\mathrm{C}}}—,\quad —\overset{|}{\underset{/\ \backslash}{\mathrm{B}}}—.$$

Each line represents the organic chemist's "unsatisfied bond," the physical interpretation of which is *vacancy for one more electron in the shell.* The nitrogen atom, for example, needs three electrons to complete a shell of eight. The number of "unsatisfied bonds" for each electronegative atom can readily be found by consulting Table 1. Electropositive valence is on no account to be represented by "unsatisfied bonds" as it never causes direct union between atoms. It may be represented as follows:

$$\mathrm{Na}^{\mathrm{I}},\quad \mathrm{Ca}^{\mathrm{II}},\quad \mathrm{Al}^{\mathrm{III}}.$$

2. *The salt-forming union.*—It is evident that an atom may fill a vacancy in its shell (satisfy a bond) by simply acquiring an electron, thus becoming a negative ion.[11] It may even create more bonds by the reverse process: F— becomes F^-, —O— becomes O^{--}, H— becomes $—\overset{+}{\mathrm{H}}—$, $—\underset{|}{\mathrm{N}}—$ becomes $—\overset{|\,+}{\underset{|}{\mathrm{N}}}—$.

Negative ions having no unsatisfied bonds form stable saltlike compounds with metallic ions:

$$\mathrm{Na}^{+}\ \text{------}\ \mathrm{Cl}^{-},\quad \mathrm{Ca}^{++}\ \text{======}\ \mathrm{O}^{--}$$

It is to be noted that while the formation of ions is due to the shell-completing forces of *one* of the atoms involved, the union

[11] For the lack of a better word, this term seems to be quite generally used for a charged atom even though it may not be mobile.

between the ions is due to electrostatic attraction. This is the *salt-forming* union, and will be represented by a dotted line between the ions.

3. *The normal direct union.*—When two atoms are held together due to the fact that the shell-completing forces of *both* atoms act on a pair of electrons which is shared between them, the union may be said to be direct. Such a union is to be represented by the usual line for a "satisfied bond" if it is *normal;* that is, if one electron of the shared pair has been supplied by each atom. In this case it is evident that each shell involved has filled one electron vacancy by the process of sharing and has thus "satisfied" one "bond."

Examples: H—H, H—O—H.

4. *The borrowing direct union.*—A direct union in which one atom supplies both electrons of the shared pair may be called a *borrowing union.* In this case the borrowing atom fills two vacancies in its shell (that is, satisfies two bonds), and the lending atom neither gains nor loses electrons. A convenient way of representing such a union, whereby —A— satisfies two bonds, and B none, is A ∞ B. The sign ∞ has here neither its mathematical nor its astronomical significance, but has considerable graphic value in representing that two "valence bonds" of A and none of B, are satisfied.

$$\text{Examples:}\quad \mathrm{H - Cl \propto O} \qquad \begin{matrix} \mathrm{Cl} \diagdown & & \\ \mathrm{Cl} - & \mathrm{P} \propto \mathrm{O} \\ \mathrm{Cl} \diagup & & \end{matrix}$$

5. *Double and triple bonds.*—Each symbol for a normal union, —, or for a borrowing union, ∞, represents one shared pair of electrons. If two or three pairs are shared by two atoms each part of the total union is represented by the appropriate symbol.

Examples: $\mathrm{N \infty N = O}$, $\mathrm{H - C \equiv C - H}$.

GRADATIONS IN THE ELECTROPOSITIVE TENDENCY

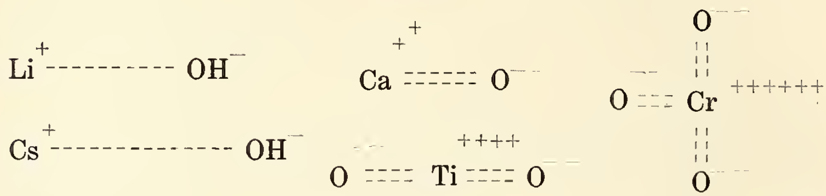
An atom which shows a tendency to become positively charged is called an electropositive atom (in the chemical sense). No atom actually repels one of its electrons to a very long distance, so this electropositive tendency is really only a comparative weakness which some atoms have in holding their electrons against any outside detaching force. In electropositive atoms the forces binding shell electrons seem to be calculable as ordinary electrostatic forces.[12] Therefore the smaller the kernel,

[12] Langmuir, I., Journ. Am. Chem. Soc. 41 (1919) 877.

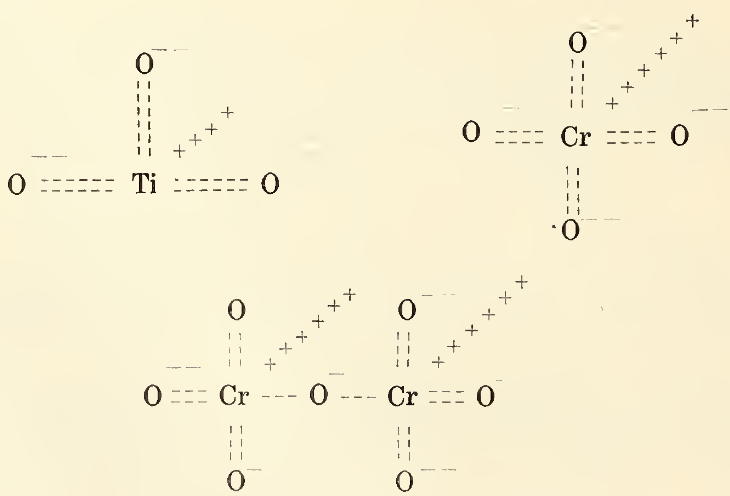
the greater the retaining force; and, in the case of two or more removable electrons, each succeeding electron is much more difficult to remove. Accordingly Cs^{I} is the most electropositive atom, and it is seldom that we find more than two or three electrons completely removed from any atom, no matter how many shell electrons it may have. Four, five, six, seven, or eight electrons may be partially removed, however, passing into the shells of other atoms, which remain closely bound to the atom in question.

Gradations in the closeness of the salt-forming union due to these differences in the electropositive tendency may be expressed roughly by varying the length of the dotted line.

EXAMPLES



Due to the closeness of union in the oxides of high valence they do not form basic hydroxides, involving rupture of the metal-oxygen union by ionization, but the central atomic kernel attracts, by its strong electrostatic field, even an excess of oxygen ions, resulting in the formation of a negatively charged aggregate as:



It is obvious that in any aggregate of an atomic kernel and $2O^{--}$, $3O^{--}$, $4O^{--}$ and in such complexes as Cr_2O_7, an octet *way* be formed around the kernel, and in many cases probably is formed. Therefore the formulas of such aggregates in which the central atom has a valence of 4, 5, 6, or 7 could be written in exactly the same manner as those of the analogous ions containing $—\overset{|}{\underset{|}{C}}—$, $—\underset{|}{N}—$, — S —, and Cl —, which also contain 4, 5, 6, and 7 electrons in the shell, respectively. The distinction, as it appears to the writer, is that in one class of cases all the known facts are as well explained on the basis of ordinary electrostatic attraction alone (subsequent to ion formation) as they are by assuming an effective tendency of the electrons surrounding the kernel in question toward octet formation, but that in another class of cases we have definite evidence that there is an effective tendency toward octet (or other stable shell) formation. The writer prefers to use the salt-forming symbol for the former class and the direct symbol for the latter.

GRADATIONS IN THE ELECTRONEGATIVE TENDENCY

An atom is called electronegative (in the chemical sense) when it shows a tendency to become negatively charged. As has just been intimated, the distinguishing characteristic of a negative atom is that it shows a definite tendency toward building up some stable arrangement, usually an octet, of electrons. A discussion of the forces involved is beyond the scope of this paper. [13] It is necessary only to point out that there are observed differences in the electronegative tendencies of atoms. Fluorine is the most strongly negative, and starting from this

[13] It is illogical to try to apply very closely to this case the laws of electrostatics as we know them. Latimer and Rodebush, Journ. Am. Chem. Soc. 42 (1920) 1425, treat electronegativity practically as an ordinary electrostatic phenomenon, arriving at the conclusion that "In one sense then, hydrogen is the most electronegative of all the elements." Langmuir, Journ. Am. Chem. Soc. 41 (1919) 908, approaches this problem more reasonably, concluding that "Hydrogen therefore can hardly be classed as an electronegative element." He proceeds, however, to apply (page 910) the inverse square law to the total force between the nucleus and the shell in the case of carbon and other atoms, although later (page 932) he suggests the fact that the whole existence of the shells depends on some such balance of forces as a discontinuous inverse square attraction opposed by an inverse cube repulsion.

It would seem necessary to use caution in applying any force laws to the shell electrons, especially regarding the attraction of the nucleus.

atom in Table 1, one finds a graded weakness in going either to the right or upward. Another observed fact is that the electronegative tendency of an atom varies according to the atoms combined with it, in a manner which shows that electrons in a shell are held by forces of an elastic nature, and that they shift their positions of equilibrium under the influence of outside electrostatic forces.

Due to these natural and acquired differences in electronegative powers, it is only in such symmetrical cases as Cl—Cl, H_3C—CH_3 that a shared pair of electrons is shared equally by two atoms. If A is more electronegative than B, in general the shared pair will be held more closely by A than by B, in such a manner that A will become negatively charged as compared to B, thus: $A^- — B^+$. Such a union has long been called a polar union, and is generally represented by an arrow indicating a partial electron transfer: A←B. There is no difficulty in introducing the arrow into the proposed system in cases where it is desired to point out polarity, as H→Cl, H→O←H. As the complete polarity of the salt-forming union has already been well represented by the sign $^-$----$^+$, the arrow will be used only to denote polarity in direct unions.

The distinction and relation between a borrowing union and a polar union should be clearly understood. The borrowing union sign A∞B indicates that both electrons of the shared pair belonged exclusively to the lending atom, B, *before* the union took place. The polar union sign A←B has in the past signified nothing as to the origin of the shared pair but only that after union there is an electrostatic dipole A^-←B^+.

There are then two cases of polar union, depending on whether the union is normal or borrowing. From the definition it is evident that the borrowing union A∞B is essentially a polar union, because the borrowing atom —A— acquires an interest in two electrons with which it originally had no connection. Therefore if —A— was originally neutral, it becomes a negative pole. In fact, A∞B can be written A^-—^+B. Nevertheless, A shows no tendency to leave B in the form of a negative ion, and the shared pair is almost always held more closely by B than by A; so the distinct symbol A∞B should be retained, and the symbol A←B used only to represent a normal polar union; that is, one in which each atom supplies one electron of the shared pair, and in which *after* union the shared pair is more closely associated with A than with B, so that an electrostatic dipole is formed. The union A∞B, when ruptured, practically always gives the products —A— and B. The union A←B may give A— and —B, but usually $\overset{-}{A}$ and $>\overset{+}{B}$.

Sometimes it is convenient for comparative purposes to express a loose, normal union by a long connecting line, and a close, strong union by a short line, as was done with salt-forming unions. A loose union is not necessarily polar:

F — F   I ———— I.

All of these distinctions of gradation are entirely unnecessary in an ordinary structural formula representing merely the outstanding valence relations, but are very valuable when attention is to be called to certain comparative characteristics.

APPLICATIONS

The mode of application of the proposed system to all of the atoms will be briefly indicated. It is believed that the relations of the chemical properties of the atoms to the present theory of atomic structure will best be seen by grouping them (except H— and the group Sa—Lu) according to the horizontal lines in Table 1.

HYDROGEN

H—.

Electrons in shell = 1.
Vacancies in shell = 1.

The hydrogen atom is unique in that its bare kernel (in this case the nucleus) can acquire a complete shell simply by attaching itself to any convenient pair of electrons not already shared by two kernels. This property accounts for the peculiar mobility of the kernel, $—\overset{+}{H}—$, in molecules, which led to perplexing controversies between organic chemists until it was finally recognized and called "tautomerism." This property also distinguishes H— radically from all the other atoms having a negative valence of 1, giving it a pseudo-electropositive character. As Latimer and Rodebush [14] point out, the ionization of acids is not direct, like that of salts, but depends on a mobile (tautomeric) union of the $—\overset{+}{H}—$ with molecules of the solvent. Thus H—Cl may be considered to give $—\overset{+}{H}— + \overset{-}{Cl}$,

[14] Latimer, W. M., and Rodebush, W. H., Journ. Am. Chem. Soc. 42 (1920) 1425.

but only because the unsatisfied bonds of $-\overset{+}{H}-$ are immediately satisfied by the formation of a solvated ion, such as $H - \underset{\substack{8 \\ H^+}}{O} - H$.

This hydrated hydrogen ion may also be written:

$$\begin{array}{c} H - \overset{+}{O} - H \\ | \\ H \end{array} \qquad (2)$$

$$\left[\begin{array}{c} H - O - H \\ | \\ H \end{array}\right]^+ \qquad (3)$$

or

$$\left[\begin{array}{c} H \rightarrow O \leftarrow H \\ \uparrow \\ H \end{array}\right]^+ \qquad (4)$$

The advantage of formula (2) is that it shows the symmetry of the compound. It is readily seen that a borrowing bond may be considered as a normal bond preceded by the transfer of an electron. Imagine $-\underset{|}{O} + -\overset{+}{H}-$ to become by transfer $-\underset{|}{\overset{+}{O}}- + -H$, which then combine by normal union. Actually the transfer does not take place first, but at the moment of union there is a distribution of the positive charge. This fact is best expressed by formula (4), but (2) is a simpler expression of valence relations.

EXAMPLES

$$\overset{+}{Na} \text{------} \overset{-}{H}, \quad H - O - H, \quad H - Cl.$$

THE HELIUM GROUP

He^0, Ne^0, A^0, Kr^0, Xe^0, Nt^0.
Electrons in shell = 0.

These atoms have zero valence, but according to the octet theory they may possibly have the power of combining with oxygen or with $-\overset{+}{H}-$ as follows:

$Xe + -O-$ giving $Xe \propto O$, $Xe + -\overset{+}{H}-$ giving $Xe \propto \overset{+}{H}$.

If so, the combination would be very unstable, as these ' inert" atoms have very weak external fields.

THE LITHIUM GROUP

$$Li^{I},\ Na^{I},\ K^{I},\ Rb^{I},\ Cs^{I}.$$

Electrons in shell = 1.

The atoms of this group have an electropositive valence of 1. Their outer shells are too incomplete for the formation of completed shells, and therefore they enter only into salt-forming unions:

$$Li^{+} \text{------} Cl^{-},\quad Li^{+} \text{------} O^{--} \text{------} Li^{+},$$

$$Li^{+} \text{------} H^{-},\quad Na^{+} \text{------} Cl^{-},\quad Cs^{+} \text{------} Cl^{-}.$$

THE BERYLLIUM GROUP

$$Be^{II},\ Mg^{II},\ Ca^{II},\ Sr^{II},\ Ba^{II},\ Ra^{II}.$$

Electrons in shell = 2.

These atoms are similar to the lithium group except that each loses 2 electrons:

$$Be^{++} \text{======} O^{--},\quad Cl^{-} \text{------} Ca^{++} \text{------} Cl^{-},$$

$$Br^{-} \text{------} Ra^{++} \text{------} Br^{-}.$$

THE BORON GROUP

$$B^{III}\ (-\overset{|}{B}-),\quad Al^{III}\ (-\overset{|}{Al}-),\quad Sc^{III},\quad Yt^{III},$$

$$La^{III},\ Ac^{III}.$$

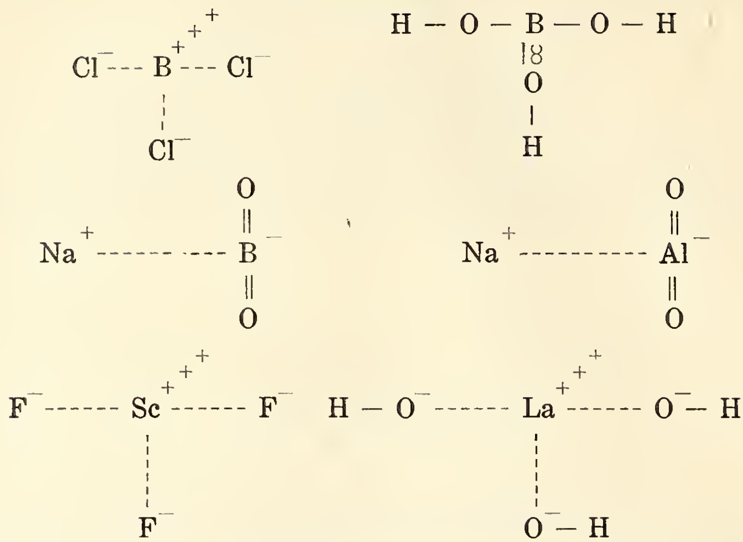
Electrons in shell = 3.

This group is predominantly electropositive. Under favorable circumstances, however, the first two members can complete their outer shells, thus exhibiting a negative valence of 5. That this property stops abruptly with Al^{III} is due to the fact that Sc^{III} would require 15 electrons, instead of 5, to complete its shell.

The compounds in which B is electropositive are not at all typical saltlike compounds. The negative ions surround the small B^{+++} kernel so completely and so closely that the external field is small and rupture of the union very difficult.[15]

[15] cf. Langmuir, ibid. p. 929.

EXAMPLES



THE REMAINING ELECTROPOSITIVE GROUPS

$Ti^{(II,\ III)\ IV}$, Zr^{IV}, $Ce^{(III)\ IV}$, Th^{IV}.

$V^{(II,\ III,\ IV)\ V}$, $Cb^{(II,\ III,\ IV)\ V}$, $Pr^{III\ (IV)}$, Ux_2.

$Cr^{(II,\ III)\ VI}$, $Mo^{(III,\ IV)\ VI}$, $Nd^{III\ (IV?)}$, $U^{(III,\ IV,\ V)\ VI}$.

$Mn^{II\ (III,\ IV,\ VI)\ VII}$.

$Sa^{(II)\ III}$, $Eu^{(II)\ III}$, Gd^{III}, $Tb^{III\ (IV?)}$, Ho^{III}, Dy^{III}, Er^{III}, Tm^{III}, Tm_2^{III}, Yb^{III}, Lu^{III}.

$Ta^{(II,\ IV)\ V}$.

$W^{(II,\ IV,\ V)\ VI}$.

$Fe^{(II)\ III\ (IV)}$, $Ru^{II,\ III\ (IV,\ VI,\ VII,\ VIII)}$, $Os^{II,\ III,\ IV,\ VI,\ VIII}$.

$Co^{II\ (III)}$, $Rh^{(II)\ III\ (IV)}$, $Ir^{II,\ III,\ IV}$.

$Ni^{II\ (III)}$, $Pd^{II,\ (III,\ IV)}$, $Pt^{II,\ IV\ (VI)}$.

$Cu^{I,\ II}$, Ag^{I}, $Au^{I,\ III}$.

Zn^{II}, $Cd^{(I?)\ II}$, $Hg^{I,\ II}$.

$Ga^{(II)\ III}$, $In^{(I,\ II)\ III}$, $Tl^{I,\ III}$.

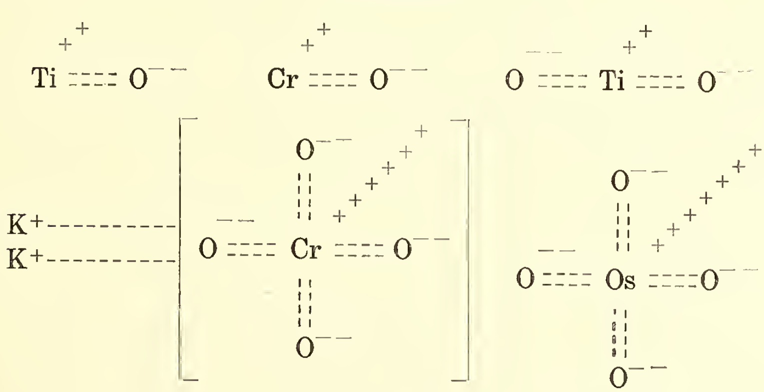
Electrons in shell = 4 to 27.

From what has been said one would expect the common valence of these atoms to be about 3, and the maximum to be 8 in Sa and all atoms below it in Table 1. The actual valences, however, have been successfully explained by Langmuir[16] on the basis of the stability of certain partly completed shells. The shells of Ni, Pd, Er, and Pt, can have a stability remotely resembling that of the inert atom shells, but only when rearranged in a form (the β form) not stable except when surrounding a kernel more highly charged than the kernels of these respective atoms. Therefore, some of the atoms somewhat below Ni, Pd, Er, and Pt in Table 1 tend to lose electrons until they have a pseudo-kernel of the form β-Ni, β-Pd, β-Er, and β-Pt. This is made possible only by the rearrangement just mentioned, and therefore does not affect any atoms above these in the table.

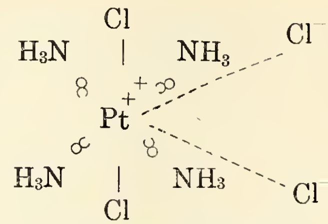
There are probably slight electronegative tendencies in some of this large number of atoms, that is, forces tending toward completion of certain stable arrangement of shell electrons. Any such forces are so weak, however, that we have no evidence of them except, perhaps, in a few compounds like Na_5ZrF_9, $[Co(NH_3)_5Cl]Cl_2$, $[Pt(NH_3)_4Cl_2]Cl_2$.

It is usual to make somewhat larger groups of the atoms, but it seems to the writer that the grouping in Table 1 shows most plainly the relations between the structure of atoms and their chemical properties. The partial relation between such groups as the chromium and sulphur groups has already been pointed out, and it is easily seen that the partial resemblance of β-Ni, β-Pd, β-Er, β-Pt to the inert atoms causes a number of partial similarities, such as those between the copper and lithium groups and the zinc and beryllium groups.

EXAMPLES



[16] Ibid. p. 876.



THE CARBON GROUP

—C—, —Si—, —Ge—, (Ge^{II}), Sn^{II} (—Sn—),

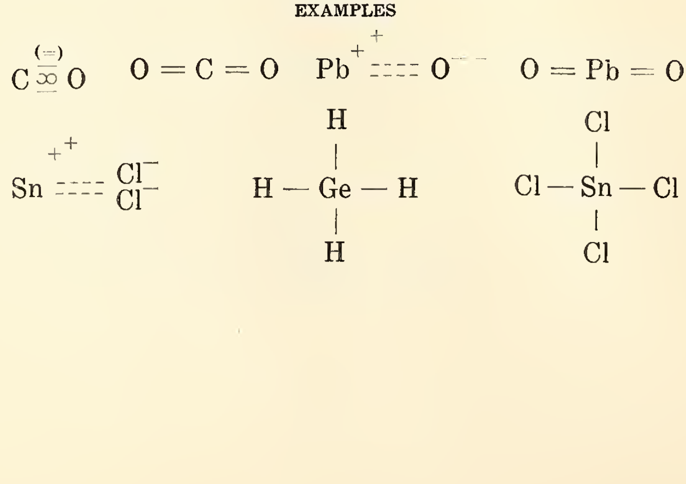
$Pb^{(I)\ II\ (III)}$ (—Pb—).

Vacancies in shell = 4.

There is unmistakable evidence that there are definitely four vacancies in the shell of each of these atoms. Sn^{II} and Pb^{II} are predominantly electropositive; but, as the relation of these atoms to the "inert group" has been established by physical evidence, each containing 4 less electrons than the corresponding inert atom, we have good reason to believe that this fact plays a large part in determining their chemical properties. This idea is substantiated by the behavior of —Sn— and —Pb— in organic compounds.

The ordinary carbon-hydrogen-oxygen compounds are expressed in the proposed system exactly in the same manner as is customary among organic chemists. The peculiar compound CO, however, has never been successfully explained except by Langmuir's hypothesis that the two kernels share 5 pairs of electrons, 1 pair being held rather closely by the kernels and the other 4 pairs in an octet external to both kernels. In this case the valence of each atom is increased by 2, because a stable arrangement of 10, instead of 8, shell electrons is formed.

EXAMPLES



$$\begin{array}{ccccccccc} & & H & & O & & & & \\ & & | & & \| & & & & \\ H & - & C & - & C & - & O & - & H \\ & & | & & & & & & \\ & & H & & & & & & \end{array} \qquad\qquad \begin{array}{l} H \diagdown \\ \qquad\quad = O \\ H \diagup \end{array}$$

THE NITROGEN GROUP

$-\overset{|}{N}-$, $-\overset{|}{P}-$, $-\overset{|}{As}-$, $-\overset{|}{Sb}-$ $(\overset{III}{Sb})$, $\overset{(II)\ III}{Bi}$ $(-\overset{|}{Bi}-)$.

Vacancies in shell = 3.

The system of structural formulas used by organic chemists has never been applied successfully to compounds containing "pentavalent" nitrogen. According to the proposed system nitrogen never shows in these compounds a valence above 3, although, as pointed out by Langmuir, the covalence is 4. The three cases where nitrogen has a peculiar valence of 5 are $N \overset{(\equiv)}{\equiv} N$, $N \overset{(\equiv)}{=} O$, and $- C \overset{(\equiv)}{=} N$ and are explained by Langmuir as being "isosteric" with $C \overset{(\equiv)}{\underline{\infty}} O$.

The cases where nitrogen has been supposed to show a high valence are explained either by the borrowing union or by the formation of a positive ion. The formation of ammonium salts is strictly analogous to the reaction between H—Cl and H—O—H, described in connection with hydrogen. The ammonium ion, however, is much more stable than OH_3

$$\left|\begin{array}{ccccc} & & H & & \\ & & |^{+} & & \\ H & - & N & - & H \\ & & | & & \\ & & H & & \end{array}\right| \cdots\cdots\cdots Cl\ .$$

In the case of nitrogen oxides and oxy-acids N has such a tendency to a covalence of 4, that it *lends* electrons, especially to — O —, as:

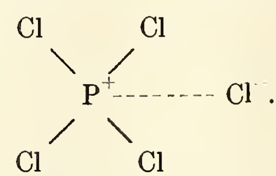
$$N \,\bar{\infty}\, N = O \qquad \begin{array}{ccccccc} & & O & & & & \\ & & 8 & & & & \\ O & = & N & - & N & = & O \end{array} \qquad \begin{array}{ccccccc} & & O & & O & & \\ & & \| & & \| & & \\ O & \infty & N & - & N & \propto & O \end{array}$$

$$\begin{array}{ccccccccc} & & O & & & & O & & \\ & & \| & & & & \| & & \\ O & \infty & N & - & O & - & N & \propto & O \end{array} \qquad \begin{array}{ccccccc} H & - & O & - & N & \propto & O \\ & & & & \| & & \\ & & & & O & & \end{array}$$

It would not be expected, however, that — N — could borrow from a strongly negative atom as — O —, forming such a compound as N $\overline{\infty}$ O $\overline{\infty}$ N.

In a few compounds the heavier atoms of this group show electropositive tendencies. The salts of Bi III are good examples of how the weak forces toward completion of a shell may be entirely overcome by some stronger shell, and electrons lost, rather than gained, by the weakly negative atom. It has often been considered that in the formation of pentahalides the atoms of this group show a positive valence of 5. A comparison with vanadium, which of all the positive atoms has the greatest similarity to the trivalent negative atoms, is of interest. The most evident difference is that the halides and oxyhalides of this group indicate valences of 3 and 5, but never 4. Vanadium, as would be expected from the consideration of electrostatic forces, shows also a valence of 4.

It is evident then, that the trihalides of this group have a stability which does not permit of the addition of one more halogen atom. When two are added they probably form a compound strictly analogous in structure to NH_4Cl in most, if not all, cases.[17] Thus, PCl_5 is tetrachlorophosphonium chloride:



THE OXYGEN GROUP

— O — — S —, — Se — — Te —, Ra F.

Vacancies in shell = 2.

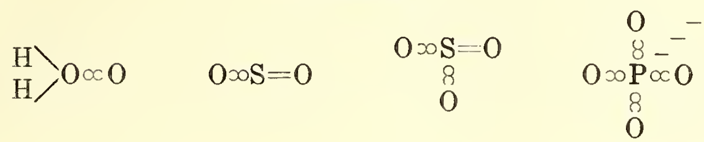
In most compounds containing borrowing unions it is found that either —O—, or —S— is the borrowing atom. This is not surprising, as of all the atoms capable of acting in this way these two are the most electronegative. It is the borrowing union which explains the fact that the number of oxygen atoms which can attach themselves to a negative atom depends more on the size of that atom than on its valence. Thus we have ClO_4^{-}, SO_4^{--}, PO_4^{---}, SiO_4^{----}, but NO_3^{-}, and CO_3^{--}.

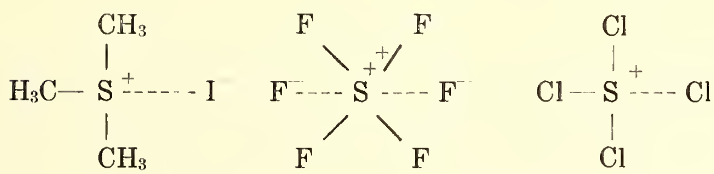
The sulphonium and oxonium salts, so familiar to organic chemists, are assigned formulas analogous to those of ammonium salts.

[17] cf. Langmuir, ibid, p. 919.

In comparing the halides of this group with those of Cr, Mo, W, and U, we find even stronger indications of definite shell-completing action than were noted in the preceding group. There seems to be no other explanation for the avoidance by S, Se, and Te of the apparent valences 3 and 5 except that they retain always their negative valence of 2, attracting halogen atoms beyond this amount only in pairs, and in the same way that NH_3 combines with HCl.

EXAMPLES



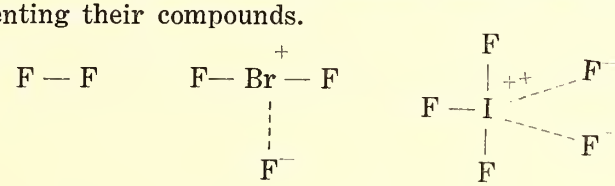


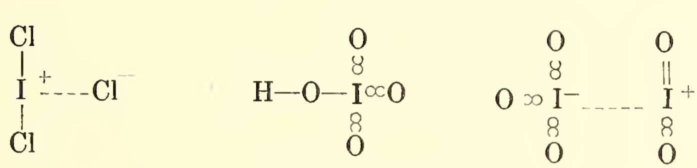
THE HALOGENS

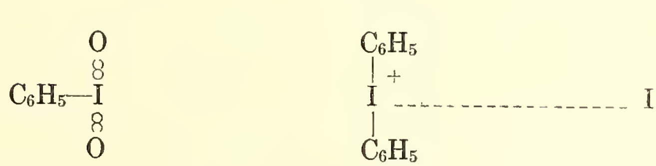
F—, Cl—, Br—, I—.

Vacancies in shell = 1.

As these are typical negative atoms, there is no difficulty in representing their compounds.







CONCLUSION

Anyone who has found it necessary to use as guides in experimental work such valuable but hazy and incomplete valence theories as those of Werner, Thiele, Friend, and Nef will welcome Langmuir's octet theory of valence as the true "key to the situation." It is hoped that the proposed system of structural formulas will be found valuable not only as a method for representing the primary valence relations of atoms in molecules but as a better basis than has been available in the past for the study of polarity, secondary valence, reactivity, selective absorption, and other phenomena depending on the shell electrons. It has enabled the writer to see certain perplexing reactions in a new light, and has led to the formulation of a theory of reaction mechanism of the direct union, which will be published in the near future.

SUMMARY

1. A system for writing structural formulas has been devised, based on the octet theory of valence as presented by Langmuir.

2. The new feature of the system is a distinction between "normal" and "borrowing" unions which enables the actual valence relations of the atoms to be represented in the formulas.

3. The borrowing union, $A \infty B$, is unique in that it is polar in the direction $A \overset{-}{—}{}^{+} B$ although the shared pair is held more closely by B.

4. The mode of application of the system to all of the known elements has been indicated.

5. The system in itself represents only the primary valence relations of the atoms, but can easily be adapted to the study of other phenomena depending on the valence electrons.

ILLUSTRATION

Plate 1. Models of the Electron Shells

As the exact forces (see p. 3) acting on shell electrons are not known, these models are to be considered only very rough approximations to the actual proportions and arrangements. The arrangements shown are based on the assumption that magnetic attraction is the determining force. The white rings represent electrons revolving in orbits, or in actual ring shape, in a direction clockwise to the observer, the black ones, counter-clockwise. Paper disks are placed inside to increase the visibility.

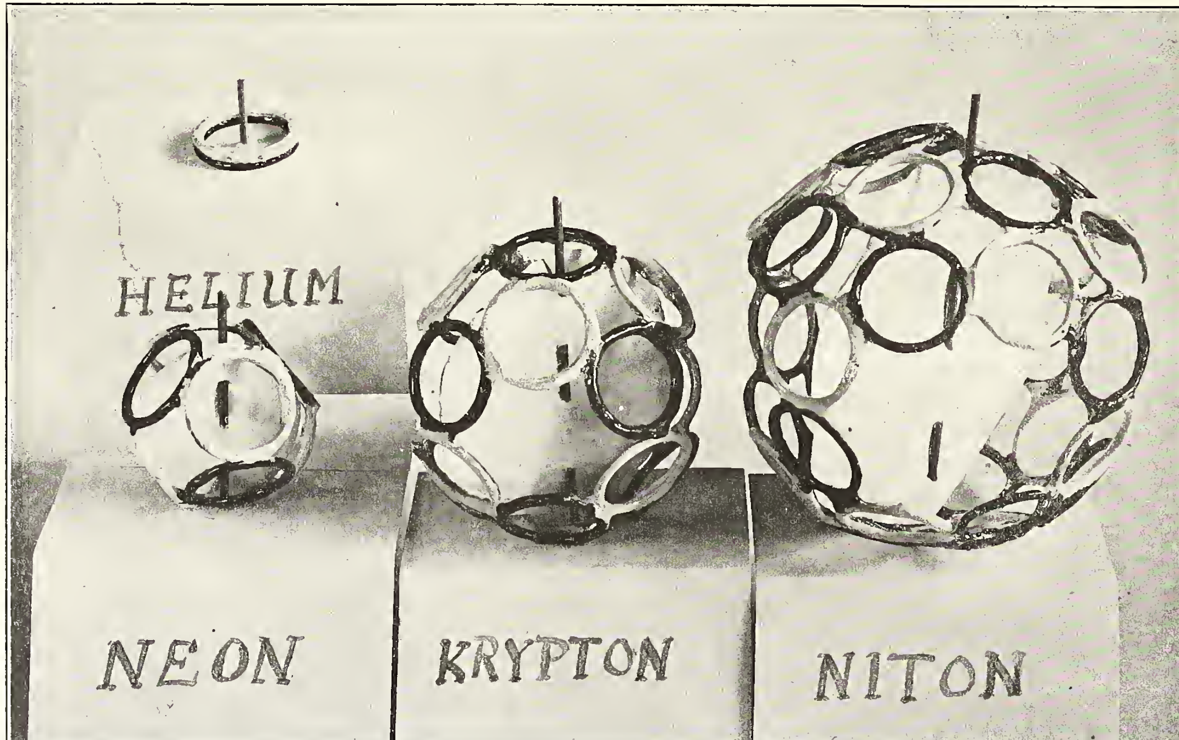


PLATE 1. MODELS OF THE ELECTRON SHELLS.

NOTES ON PHILIPPINE TERMITES, II

By S. F. Light

Professor of Zoölogy, College of Liberal Arts, University of the Philippines

SIX PLATES AND THREE TEXT FIGURES

This paper presents descriptions of six species of Philippine termites which seem to be new to science. They represent four genera (*Kalotermes*, *Cryptotermes*, *Prorhinotermes*, and *Leucotermes*) not heretofore reported from the Islands and one new genus, *Planocryptotermes*. The list of species described is as follows:

Genus *Kalotermes* Hagen sensu restricto.
    1. *Kalotermes mcgregori* sp. nov.
Genus *Cryptotermes* Banks.
    2. *Cryptotermes cynocephalus* sp. nov.
Genus *Planocryptotermes* gen. nov.
    3. *Planocryptotermes nocens* sp. nov.
Genus *Prorhinotermes* Silvestri.
    4. *Prorhinotermes luzonensis* sp. nov.
    5. *Prorhinotermes gracilis* sp. nov.
Genus *Leucotermes* Silvestri sensu restricto.
    6. *Leucotermes philippinensis* sp. nov.

These species, with the exception of *P. nocens*, belong to genera of widespread occurrence, known from Japan and Formosa to the north (except *Kalotermes*) and from the East Indies, Ceylon, and India to the south, and it might well have been predicted that such termite species would be found in our Philippine fauna. Therefore, the fact that the former collections made by Baker and by McGregor as well as my earlier collections failed to bring them to light might well cause surprise. The reasons for their not having been collected, however, are not far to seek. With exception of the *Planocryptotermes* species, they are not among our common forms. Nor are they conspicuous, since none of them builds mounds or exposed nests; nor do the first five species build exposed galleries, while the last one seems to be a rare species.

I wish to take this opportunity to thank Mr. R. C. McGregor, ornithologist of the Bureau of Science, for his never-failing in-

terest, his aid in collecting, and for affording me, while acting director, the facilities of the Bureau in making drawings, taking photographs, etc. To Dr. Sanji Hozawa, of the Japanese Imperial Plant Quarantine, and to Dr. Masamitsu Oshima, director of the Government Institute of Science of Formosa, both expert termitologists, I wish to express my gratitude for splendid sets of comparative material, including many cotypes or autotypes of Japanese and Formosan forms and, in the case of Doctor Oshima, for autotypes of many of his Philippine species. This material has been and will continue to be of great value in determining our Philippine termites.

All of the species described in this paper, like the other species of the lower families of the order, present a rich protozoan fauna within the hind gut. Prof. C. A. Kofoid, of the University of California, who has done much work with the protozoa of American termites and who with his staff is entering upon a comparative study of these specialized forms, has kindly consented to work up those found in our termites, and I am sending him material as rapidly as is practicable. The results of these studies should throw an interesting light on our classification, and a knowledge of the "parasites" may prove of real value in classifying the species and properly grouping the genera.

CLASSIFICATION

After careful study and correspondence with various students of termite classification I have decided to make those changes in generic and family names which, as Banks has recently pointed out, will be necessary if we follow strictly the international rules of zoölogical nomenclature. The necessity for having and observing such a set of rules is so obvious and has been so thoroughly discussed that I need not defend my action in this matter. The changes are inevitable, and the sooner we accept and use them the less difficulty will there be and the sooner will we arrive at a firm basis for our nomenclature. It was only after long hesitation and with great regret that I felt myself forced to adopt these changes which must for the time result in such an unfortunate confusion of generic names of long standing. I find that others of the younger workers in the group have passed through the same attitude of mind to arrive at the same conclusion.

The tendency is apparent, in most recent publications on this group, to do away with the awkward tripartite names by raising the subgenera to generic rank wherever possible. Such a change seems to me to be conducive to clearness and usableness, particularly in the older genera, *Kalotermes, Eutermes,* and *Termes,* and I shall adopt it in my work on the Philippine termites.

With the above changes Holmgren's arrangement of families and genera is an admirable one, and I shall follow it. It may be of interest to point out here that in addition to the characters already pointed out by Holmgren as separating the three higher families it is very significant that the protozoan faunæ of the guts of the three groups are characteristic. I find none of the polyflagellate protozoa (*Hypermastigina*) in the gut of any of the Termitidæ (Metatermitidæ of Holmgren), and those of the Rhinotermitidæ (Mesotermitidæ of Holmgren), while very similar in all the genera of that family, are quite different from those found in the Kalotermitidæ (Protermitidæ of Holmgren). This is significant in connection with the position which Banks [1] gives to *Leucotermes* in his classification.

MEASUREMENTS AND TERMS

While measurements made from a small range of specimens must not be considered as fixing the variational range for a species and must be used with caution, such measurements are of undoubted value in the determination of species in a group where specific lines are by no means easy to draw, and I shall as a rule accompany my descriptions by a set of such measurements.

There has been a considerable degree of carelessness on the part of some workers in furnishing the details necessary for an intelligent use of specific descriptions. Measurements are given for body length, head length, head length without mandibles, pronotum length, etc., without making it clear just what such measurements mean. If systematic work is to accomplish anything worth while the forms of animals should be so described that they may be recognized by other investigators—not only the specialist in the group, but the biologist interested in the study of animals from other points of view, or even the layman desirous of knowing the common forms of life about him. But far too many systematic descriptions seem to be written for the specialist only, and they are often of little value to him in the absence of type material. May I go further and speak from the experience gained in entering a new systematic field? The needless use of terms of limited application should be avoided.

[1] Banks, N., and Synder, T. E., Bull. U. S. Nat. Mus. 108 (1920) 75.

Such terms as are used should be made clear. References to literature should be given whenever available. Descriptions should be comparative. Specific diagnoses are often very valuable. Systematic discussions should point out which are the nearly related species and in what particulars the new species differs from these nearly related forms. All this will add little to the labor of the systematist who has such details at his immediate command, and will add immensely to the usefulness and value of his work, not only to the general student but to the systematist so unfortunate as to lack a wide range of comparative material and a complete library.

To return to our original question: Just what is the meaning of many of the measurements used? For instance, body length? Does it mean from the distal tip of the mandible to the posterior tip of the abdomen? If so, does it mean with the head extended forward or in any position in which it may chance to be, and with the mandibles crossed or extended? Or does it mean the length of the thorax and abdomen? These are not idle questions. They involve a difference of several millimeters in animals less than a centimeter in length. In the *Macrotermes* soldier, for example, the head may assume any position, from that in which it forms a line with the long axis of the body to one in which it forms a right angle with the body, making a difference of 3 millimeters or more in total length. Again, head length without mandibles or, in the nasute soldiers, without rostrum is a very indefinite measurement unless carefully defined.

To avoid the difficulties that I have experienced in using descriptions I shall define those terms and measurements which I expect to use in my future descriptions. Some changes and additions will undoubtedly be necessary as the work develops but these will be explained as they arise.

HEAD SUTURES

Frontal suture (stem of the Y suture of some authors).—A median longitudinal suture dividing the epicranium into two equal lateral halves in the region of the vertex. Absent or imperfect in most soldiers.

Transverse suture (arms of Y suture).—Separates the vertex from the frons. Absent or imperfect in most soldiers.

Clypeofrontal suture.—Separates frons and clypeus. Absent or imperfect in most soldiers.

Clypeal suture.—Divides clypeus transversely into a distal anteclypeus and a proximal postclypeus. Lacking in some forms.

Labral suture.—Between anteclypeus and labrum.

HEAD REGIONS

The head sclerites are not clearly marked, particularly in the soldier, hence the areas or regions referred to are necessarily more or less indefinite.

Labrum ("Oberlippe" of Holmgren).—Upper lip.

Lingula (Fuller, 1915).—Anterior hyaline extension of labrum found in certain soldiers (of *Macrotermes*, for example).

Anteclypeus ("Clypeoapicale" of Holmgren).—Distal region of clypeus between labial and clypeal sutures.

Postclypeus ("Clypeobasale" of Holmgren).—Proximal region of clypeus, between clypeal and clypeofrontal sutures.

Frons, front ("Transversalband" of Holmgren).—The region bounded posteriorly by the transverse suture, anteriorly by the clypeofrontal suture, and laterally by the antennal carinæ. Not at all or imperfectly defined in most soldiers.

Frontal area (Fuller, 1915).—Forehead ("Stirn"), including frons and clypeus where transverse suture and clypeofrontal suture are both obsolete, as is the case in most soldiers. Region between fontanelle and clypeal or labral suture, since fontanelle is typically located at junction of frontal and transverse sutures.

Vertex.—The top of the head corresponding to epicranial region of insects whose head sclerites are well defined.

Occiput (*occipital region*).—"An indefinite area forming the convex caudal extremity of the head." (Fuller, 1915.)

Genæ.—Sides or cheeks of head. An indefinite area not delimitated in termites.

Ventral genæ.—Ventral surfaces of the head lateral to the gula including postgenæ which are not delimitated.

Gula ("menton" of Bugnion, "submentum" of Holmgren).—A distinct median ventral sclerite, articulating anteriorly with the labium.

MISCELLANEOUS HEAD STRUCTURES

Fontanelle.—A foramen in the epicranium, usually in the frontal suture at its junction with transverse suture.

Fontanelle plate.—The region of the frontal gland marked externally as a thickened or darkened area.

Antennal fossæ ("Antennenvertiefungen" of Holmgren).—The depressed lateral areas from which the antennæ arise.

Antennal foveolæ (Fuller, 1915).—The pits from bottom of which the antennæ arise.

Margins of antennal foveolæ.—Chitinous margin of antennal pits which is usually thickened, often raised, extended, or elaborated.

Antennal carinæ ("Antennenleisten" of Holmgren).—The ridges above, that is medial to, antennal fossæ.

MEASUREMENTS

Body length.—By this I mean, unless otherwise stated, the distance in a straight line from that part of the head, with exception of the antennæ or palpi, which happens to be most distal (with soldiers usually the tips of the mandibles, and with workers or adults the clypeus or labrum) to the posterior tip of the abdomen. As this measurement varies greatly with the position of the head, method of killing, preservation, etc., it should be used with caution in differentiating species.

Body length without head.—From the anterior edge of pronotum in the midline to the posterior tip of the abdomen. In using this and other measurements of body length it should be kept in mind that specimens preserved in alcohol often undergo a very distinct swelling, heavily chitinized regions becoming widely separated, as a result of which body length becomes considerably increased over that normal for the species in life.

Head length.—In the soldier this is the distance from the posteriormost part of the head to tip of the mandibles. This distance is usually measured with the head removed from the body and lying flat, in which case it is from the most posterior visible portion of the head in the midline to the tip of the mandibles; or, if these are crossed, to a line from their anteriormost point making a right angle with the long axis of the body. It may be measured with the head lying on its side from the posterior line of the head to the distal tip of the mandibles. In the adult this is the distance from the posterior border of the head to the most distal part, usually the labrum. Here again we have a measurement which varies greatly in some species with the change in position of the mandibles, and it should therefore be used with caution.

Head length without mandibles.—Measured, in soldiers, from the posterior line of the head to the labral suture, with the head lying flat; if measured with the head on one side, from the external articulation of the mandibles to the posterior margin of the head.

Head width.—Measured at the widest point, including eyes when present. Considerable confusion has arisen from a careless use of this measurement!

Fontanelle index.—Distance from the posteriormost part of the head in the midline to the fontanelle divided by the length of the head without mandibles. I plan to use this value in certain species because of the indefiniteness which I have encountered as to the meaning of such statements as: "Fontanelle at middle of head," "Fontanelle in front of the middle of the head," etc.

Pronotum width.—Measured at the widest point.

Pronotum length.—Measured in the midline and hence the minimum length in species with notched pronotum. I suspect that this term is used by some writers, without explanation, to mean *maximum* pronotum length.

Family KALOTERMITIDÆ Banks

Protermitidæ Holmgren.

Genus **KALOTERMES** Hagen sensu restricto

Subgenus *Calotermes* sensu stricto Holmgren.

DIAGNOSIS

Adult.—Median vein of the forewing runs parallel to the cubitus and midway between it and the radial sector, simple or branched. Antennæ with 16 to 19 segments.

Soldier.—Head relatively large, elongate, arched, gradually flattened anteriorly; mandibles large, toothed but unsymmetrical, all femora enlarged. Antennæ with 13 to 18 segments, the third typically enlarged, modified, and highly chitinized. Similar to soldiers of *Neotermes*.

The species of *Kalotermes* are to be found living in the dead branches of living trees, in the dead wood of hollow or injured trees or, in some cases, in or very near the live wood. They have, therefore, the same habitat as the species of the closely related genus *Neotermes*. They form small colonies of at most a few hundred individuals consisting chiefly of larvalike "workers," a few nymphs of supplementary reproductive forms, and a few soldiers.

Kalotermes seems to have its greatest development in the Nearctic Region where Banks has reported nine species. It seems to be replaced in the main in the Oriental Region by the species of *Neotermes* and *Glyptotermes*. The species described here is the first species of the genus *Kalotermes* reported from the Philippines, and the second from the Oriental Region, the only other species being *K. indicus* (Holmgren) reported from Macassar and Siam.

Kalotermes mcgregori sp. nov. Plate 1, figs. 1 and 2, text fig. 1.

Types.—Short-headed soldiers (from No. 188 of general collection), long-headed soldiers, "workers," and nymphs (from No. 289 of general collection), No. 24 in type collection.

Cotypes.—No. 188 in general collection (*McGregor and Light*), Culi Culi, Rizal Province, Luzon, near Manila, October 3, 1920; No. 289 in general collection (*McGregor and Light*), Culi Culi, November 19, 1920, same colony as No. 188; No. 339 (*McGregor and Light*), Rosario, Batangas Province, Luzon, December 25, 1920.

DIAGNOSIS

Body of all castes broad and flat; thorax long; head and body hairy; antennæ of soldiers with 15 to 17 segments, the third heavily chitinized and twice as long as the second. Dorsal and lateral margins of antennal foveolæ projecting. Pronotum long and very broad, much broader than the head and strongly arched, deeply concave anteriorly, its anterolateral regions projecting over the head. Abdominal terga of soldier somewhat chitinized. Living in the trunk of *ipil-ipil* (*Leucaena glauca* Benth.).

DESCRIPTIONS

Adult.—Unknown. Well-developed wing pads show (March) the median to lie parallel to and midway between the radius sector and the cubitus.

Soldier.—Head shading from yellow posteriorly to chestnut anteriorly, mandibles black; antennæ brown proximally, shading into very light yellow distally. Pronotum, mesonotum, and metanotum light brown; abdominal tergites, tibiæ and tarsi of legs yellow with a faint brownish tinge or light brown, femora lighter.

Head, body, and legs covered with a dense growth of subequal microscopic hairs; head short, thick, and directed somewhat downward, flat below, rounded laterally and above, converging slightly at both ends, bluntly rounded posteriorly. Frons rather precipitate, slightly concave in central region. A few soldiers have longer heads with straight sides converging but little at either end and are marked by the apparent absence of eyes and by the presence of a hyaline spot near the antennæ (see text fig. 1). Mandibles (see Plate 1, fig. 1) short, stout, with a very distinct upcurve, and slightly incurved tips; their outer surfaces show a low basal hump, a slight concavity in the center, and a convexity near the distal end; left mandible a little longer than right, with three teeth on cutting edge; distal tooth double and extended distally, second triangular, somewhat truncated distally with a low posterior projection confined to the dorsal region of the mandible; basal tooth large and bluntly triangular; right mandible with two triangular teeth, with short distal and long proximal faces; proximal region of mandible roughened. Labrum about twice as broad as long, reaching to the anterior border of lower tooth of right mandible, parallel-sided, with slightly rounded anterolateral corners and a slightly convex anterior margin bearing a number of bristlelike hairs.

Antennæ with 15 to 17 segments, first segment large, cylindrical, and nearly hidden from above by the projecting dorsal margin of the antennal foveolæ; second short and cylindrical, third large and heavily chitinized, obconic with a proximal diameter less than that of the second segment; next six obconic but short and thick; more distal segments thickly clavate and lightly chitinized, apical segment oval, white. Eye hyaline and separated by less than its diameter from edge of antennal foveola (not discernible in long-headed soldiers) ; gula short and broad, anterior region but little less than twice as wide as narrowest portion. Legs short, femora swollen; pronotum large and considerably broader than head, much arched, making nearly a semicircle in transverse section; anterior border not notched in midline but deeply concave, the rounded anterior corners projecting far over the posterolateral regions of head; median longitudinal line distinct; broadest point of pronotum in line with the center of anterior border; lateral border receding to meet the nearly straight, weakly arcuate, posterior border; anterior margin slightly upraised and marked by a dark brown edge; mesonotum and metanotum short, mesonotum about two-thirds as long as pronotum, with notched posterior border, metanotum shorter than mesonotum. Body distinctly flattened, thoracic region as long as the abdomen in dorsal view; abdominal tergites chitinized. Practically all soldiers collected show wing pads varying in size.

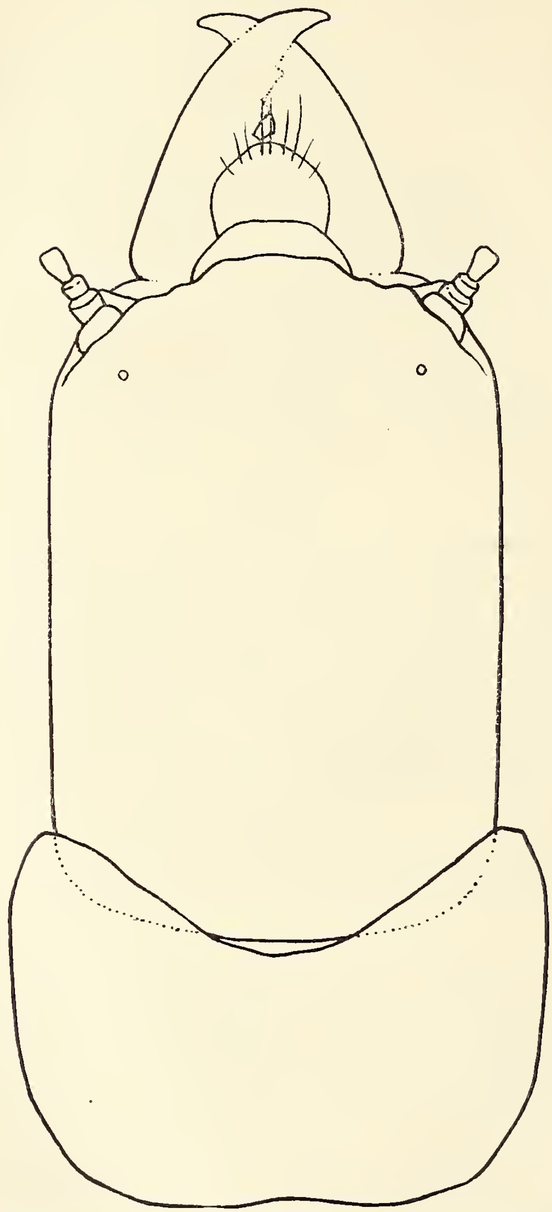


FIG. 1. *Kalotermes mcgregori* sp. nov. Outline drawing of head and pronotum of long-headed soldier. Note absence of distinct eyespots and the presence of curious hyaline spots in anterolateral region.

Measurements of Kalotermes mcgregori sp. nov., soldier.

	Short-headed soldiers.		Long-headed soldiers.
	With large wing pads.	With short wing pads.	
	mm.	*mm.*	*mm.*
Body length	7.00	6.75	9.00
Body length, without head	5.25	5.00	5.50
Head length	3.00	3.25	4.25
Mandible length, dissected:			
Left	1.35	1.25	1.50
Right	1.25		
Head length, without mandibles	2.00	2.10	2.50
Head width	1.75	1.70	1.85
Pronotum length	1.10	1.10	1.25
Pronotum width	2.25	2.00	2.25

"*Larvæ.*"—Large, broad, and thick. Antennæ with 11 to 17 segments; when 17, segments 2 and 3 incompletely separated; other segments short, thickly clavate, with thick distal and narrow proximal ends, or suborbicular.

SYSTEMATIC POSITION

While it is difficult to determine the generic position of the species of *Kalotermes* in the absence of the adult, I feel that there can be little doubt in the case of the present species. The short legs with swollen femora, the large and heavily chitinized third antennal segment, the presence of distinct wing pads and, finally, the distinct difference in shape of body, degree of chitinization, size and shape of pronotum, etc., which differentiate it from the common species of *Neotermes,* make it practically certain that we have in this species a representative of the genus *Kalotermes,* which is here reported from the Islands for the first time. Were it not for these striking differential characters one might well hesitate to report a *Kalotermes* species in the absence of the winged adult, in view of the absence of any species of this genus in the known termite fauna of Formosa and Japan to the north and the East Indies, Ceylon, etc., to the south, the only oriental species being *K. indicus* (Holmgren), known only from the adult. An examination of the venation of the wing pads of "workers" collected recently confirms my diagnosis, as the median runs parallel to and midway between the radius sector and cubitus.[2]

The protruding margin of the antennal foveolæ of the soldier, the very large, characteristically shaped pronotum, the presence of wing pads, and the characteristic toothing of the mandibles suffice to differentiate this species from other species of the genus.

I have named this distinct species in honor of Mr. R. C. McGregor, ornithologist of the Bureau of Science, who helped me to collect it and whose aid and interest have to a great extent made possible the rapid collection of local Philippine termites.

DISTRIBUTION AND BIOLOGICAL NOTES

This species was found living in tunnels very close to, if not actually within, the live wood of a small leguminous tree, *Leucaena glauca* Benth., known locally as *ipil-ipil* (Tagalog). Introduced from America, this plant is widespread about towns and country dwellings where its rapid growth, which enables it to drive out cogon grass, and its usefulness for firewood and fence posts make its propagation worth while. The very interesting question arises at once as to whether this species is found in other and native trees or is confined to this plant and, if so, whether it was introduced with the plant and is, therefore, an American species, or whether it has become adapted to this habitat since the introduction of the plant here. It seems very unlikely that plants large enough to harbor these termites were brought here, but it is by no means beyond the range of possibility. A review of the American *Kalotermes* species shows this species to be most nearly related to *K. jouteli* Banks, which it resembles in the shape of the head, the toothing of the mandible, the size of the third antennal joint, etc. It differs from it in many points, however, such as size and shape of the pronotum, shape of the third antennal joint, the projecting margins of the antennal foveolæ, etc. It appears to be a new species, therefore, whether introduced from America or not.

[2] Since writing the above I have taken two winged adult *Kalotermes* specimens in Cebu Island. Whether these belong to this or some related species cannot be determined until the series is completed in either locality. There remains the possibility that the form described here represents the soldiers and workers of *K. indicus* Holmgren known from the adult only, but the widely separated habitat makes this extremely improbable.

It was first found by Mr. McGregor and myself (No. 188) on October 3, 1920, at Culi Culi, Rizal Province, near Manila, when two soldiers and numerous "workers" were collected. Later, November 19, more extensive collections were made from the same tree, numerous soldiers and very many "larvæ" and "nymphs" being collected (No. 289). The termites were found living in channels deep in the heartwood and were apparently rapidly destroying the tree. At the first collection one side of the tree, which was dead, contained in numerous tunnels near the surface large numbers of workers and soldiers of a species of *Nasutitermes,* whose tunnels were separated internally by very thin walls from those of the *Kalotermes* colony. Such associations, whether chance relations or not, are very common. In the case of *Prorhinotermes luzonensis,* described below, three species were involved, *Prorhinotermes,* a *Hospitalitermes* species, and a *Neotermes* species. *Prorhinotermes gracilis* was also found in close association with a *Neotermes* species.

At the second collection many "nymphs" were found, some large with large wing pads, others small with but slight beginnings of wing pads but easily distinguished by their opaque white color as contrasted to the dirty white color of the posterior abdominal region of the "workers", many of which were as large as the largest nymphs but showed no wing pads. It was only at this collection that the long-headed soldiers were taken. Were it not for their presence in both colonies one might suspect that they represented a different species, so distinctly different are they from the more numerous short-headed soldiers.

A second colony, living like the first in ipil-ipil, was found by Mr. McGregor and myself on December 25, 1920, while on a collecting trip to Batangas, in the municipality of Rosario, Batangas Province, some 70 kilometers from the first colony. The finding of this second colony in the same tree species makes it seem that the species is a regular inhabitant of this tree, whether it is able to live in others or not. One or more *Neotermes* species also inhabit the ipil-ipil as they do also the guava, the *cacauate* (*Gliricidia maculata* HBK) and the *ciruelas* (*Spondias purpurea* Linn.); but many examinations of the last three trees, while producing large collections of *Neotermes,* have failed to show *Kalotermes mcgregori* or any related species.

On March 31, 1921, Mr. McGregor and I again visited the colony at Culi Culi and cut down the tree for further study in the laboratory. The termites had been driven by the dry weather to the deeper and damper portions of the tree, particularly to the heartwood, where they were running longitudinal tunnels. The forms which I had formerly distinguished as "workers" as contrasted with the nymphs all bore large wing pads, which would seem to bear out the belief that there is no definitely differentiated worker caste, and that the opaque so-called nymphs are probably early stages of supplementary reproductive forms.

I was greatly pleased on examining the venation as seen in these wing pads to find that the median runs parallel to and midway between the radius sector and the cubitus, thus confirming my diagnosis of this as a species of *Kalotermes*.

Material for a study of the protozoan fauna of this species has been sent to Professor Kofoid.

Genus CRYPTOTERMES Banks

Subgenus *Cryptotermes* (Banks) Holmgren.

DIAGNOSIS

Adult.—Median vein bends up to unite with the radial sector beyond the middle of the wing. Wing iridescent. Antennæ of 14 to 16 segments.

Soldier.—Head short, high, and thick, bilobed anteriorly, with a vertical frontal area containing a distinct cavity. Mandibles short, humped basally, bent near the middle, weakly toothed or untoothed. Antennæ of 9 to 13 segments, the third not especially long. Pronotum with strongly concave anterior margin, not toothed. Styles reduced.

The genus *Cryptotermes* comprises species from all parts of the world. They are typically house termites, living in boards, furniture, etc., in houses or, more rarely, in dead wood of trees. They are extremely ubiquitous; there is hardly a house in the Islands but harbors these little wood destroyers or those of the very closely related genus *Planocryptotermes*. Haviland points out a similar condition in Borneo, and it is probably true in the entire tropical Indian and Malayan regions. Their presence is usually manifested by the piles of little impressed fæcal pellets which they drop from apertures in the board they are attacking. There are apparently a number of Philippine species with this habit. Their collection is made difficult by the necessity of removing or destroying boards, furniture, etc., to get at the termites.

Cryptotermes cynocephalus sp. nov. Plate 2, figs. 1 and 2.

Types.—Adults, soldier, larva, and nymph, No. 25 in type collection. Soldier, larva, and nymph from No. 67 of the general collection, deälated adult, No. 433 of general collection, winged adult from No. 443 of general collection.

Cotypes.—No. 67 (*del Rosario*), Manila; No. 433 (*Light*), Manila; No. 443 (*Gamboa*), Manila; No. 448 (*Aguila*), Manila, in general collection.

DIAGNOSIS

Adult.—Very small, less than 5 millimeters long without wings; slender, dark, with narrow, dark wings; antennæ long, with 13 to 15 segments, third smallest.

Soldier.—Very short, about 3.25 millimeters long; head short, thick and high, bulldoglike, frontal region very strikingly developed with distinctly bilobed dorsal margin, anterior cavity deep; a distinct median dorsal cavity present; anterior and anterodorsal margins of the antennal foveola extended anteriorly to form a flat projection (spine) with rounded tip.

Larvæ and nymphs.—Small and slender.

DESCRIPTIONS

Adult.—Head flat, longer than broad; disregarding the eyes, nearly parallel-sided, sparsely haired; eyes not large or prominent, ocellus elongate in an anterodorsal direction, in contact with the eye in front of its middle. Antennæ more than twice as long as width of head, 13 to 15 segments, first segment large and cylindrical, second smaller and cylindrical, third smallest, thickly obconic, fourth to sixth gradually increasing in size, thicker than third, and with rounded distal ends, eighth to thirteenth (when 14) increasingly long and with thicker distal ends, last as long as thirteenth but narrow and oval in shape; antennæ with scattered larger hairs and a dense coat of short straight hairs. Labrum swollen, yellow; anteclypeus white; postclypeus brown, about as long as anteclypeus, remainder of head brown; pronotum brown, arched, narrower than the head (with eyes), concave anteriorly, sides somewhat rounded, posterolateral corners bluntly rounded, posterior margin nearly straight, slightly notched at center. Anterior wing scales brown, much longer than the posterior pair and reaching to or beyond the middle of the latter; abdominal tergites dark brown, metanotum yellow, giving the appearance of a transverse light band in dorsal view, abdominal sterna brown with a narrow median light area.

Wings slender, cloudy gray, iridescent; median and cubitus very slightly chitinized except at base in some specimens, costa and radius sector heavily chitinized, gray-brown; all veins and branches as well as areas between the veins marked by papilla-like projections; base of anterior wing twice the width of base of posterior wing; forewing with radius sector and median separate at base; radius sector sends five distinct branches, and one or more small branches to the costa; median joins radius sector beyond middle of wing usually near to origin of third branch of radius sector; cubitus with eleven to thirteen branches; hind wing with six or seven branches uniting radius sector and costa, inner three large; median and radius sector usually united for a short distance at their bases; median joins radius sector distally between points of origin of second and third branches of latter (in one specimen median runs to end of wing!); cubitus with about eleven branches which tend to be more subdivided than those of forewing; cubitus of both wings bends slightly toward radius sector near level of junction of median and radius sector; a few indefinite cross veins unite cubitus and radius sector beyond junction of latter with median.

Measurements of Cryptotermes cynocephalus sp. nov., winged adult.

	mm.
Wing length	6.25
Body, without wings	4.75
Head length	1.00
Head width	0.80
Antenna length	1.65
Pronotum width	0.75
Pronotum length	0.45

Soldier.—Mandibles and anterior region of the head black shading into a dull purplish on posterior portion of the head and lateral cervical sclerites; antennæ, palpi, and distal portions of the legs light yellow, body segments and proximal portions of legs pale purplish brown. Head directed ventrally and nearly at right angles to body, short, thick and high, broadest anteriorly, suggesting the head of a bulldog (hence the specific name); anterior surface deeply excavated and extensively roughened and sculptured; lateral and dorsal margins of this frontal area produced to form a very marked, outwardly and forwardly directed flange, deeply notched in the midline, giving the head the bilobed appearance characteristic of the genus; below, this flange runs laterally on either side to form the anteriorly extended posterodorsal margin of the antennal foveola, being separated by a groove from the anterodorsal and anterior margins of the foveola which form an anteriorly projecting, laterally flattened, scalelike spine, whose upper portion is overlapped above by the lower portion of the frontal flange; below this the ventral gena is extended to form a much smaller spine, lying over the mandibular hump.

Dorsal profile in side view high, domed posteriorly, sunken in the middle and elevated anteriorly. Seen from above there is a very distinct concavity in front of the middle of the head and behind the flange. This is narrow and elongated and, with the middorsal notch in the flange, gives the head a distinctly bilobed appearance in dorsal view. The surface of the flange and the region of the head posterior to it, particularly the sides of the dorsal cavity, are distinctly rugose.

Mandibles very short and strongly incurved, when closed protruding for a distance but little more than one-third of the anterior surface of the head; antennæ of from 9 to 12 segments, longer than the head depth; third segment smaller than the second and more heavily chitinized; pronotum strongly arched, deeply bilobed anteriorly, rounded laterally and posteriorly, the anterior and posterior regions being elevated.

Measurements of Cryptotermes cynocephalus sp. nov., soldier.

	mm.
Body length	3.25
Body length, without head	2.65
Head length (posterior margin to middorsal region of flange)	0.90
Head width	0.75
Pronotum length	0.50
Pronotum width	0.85

"Workers" and nymphs.—Small and slender. Considerably smaller than those of *Planocryptotermes nocens* g. et sp. nov. which they otherwise resemble.

SYSTEMATIC POSITION

This species is characterized by the small size of all castes (less even than that of *C. cavifrons* Banks), the strikingly developed and roughened margin of the frontal region of the soldier, and the very small mandibles. The head profile of the soldier resembles that of *C. cavifrons*, but it differs from the latter and resembles *C. brevis* (Walker) in the roughened condition of the anterior and dorsal regions of the head. From the Japanese form, *C. kotoensis* Oshima, the soldier differs, among other characters, in its small, weak mandibles. From *C. domesticus* (Haviland), its nearest neighbor geographically, it differs in its smaller body size, its smaller and narrower head, its smaller mandibles, in that the anterior surface of the head makes slightly more than a right angle with the mandibles, and in the shape and position of the spine near the antennal foveola, which in *C. cynocephalus* is simply an extension of the anterior and anterodorsal margin of the foveola. Specimens just received of the Hawaiian *Cryptotermes*-like species, kindly sent me by Mr. David T. Fullaway, entomologist of the Bureau of Agriculture, show a very striking difference among other points in their greater size. From what Mr. Fullaway has told me of the venation of the adult I am led to believe that this as yet undescribed species must be placed in another genus rather than in *Cryptotermes*.

DISTRIBUTION AND BIOLOGICAL NOTES

House termites, living in the dry, seasoned wood of planks and boards of houses, in furniture, in picture frames, etc. The specimens on which this species is based were found together with those of *Planocryptotermes nocens* sp. nov. (see below) by Prof. José I. del Rosario, of the department of chemistry, College of Liberal Arts, University of the Philippines; they were living in boards of his house and were kindly collected for me. Whether the two species were in the same boards or not I do not know since the material was collected under the impression that but one species was involved. This was true also of the second colony of this species collected which was found living in the same board with *P. nocens* sp. nov. This colony was collected by Cipriano Gamboa on March 7, 1921, and included a few winged adults (No. 443). A third, larger, colony (No. 448) was found by Paulino Aguila in the boards of a house on March 8, 1921, and contained numerous winged adults. This would seem to be very near the time for swarming, as many of the adults were fully pigmented and able to fly freely.[3] Among the hundreds of "workers" and adults, only five soldiers were found. These, like those of the colony mentioned above, were dead, as the boards had been exposed to the sun. Since

[3] Since writing the above, winged specimens of *C. cynocephalus* have been taken at various times during the months of June and July in my house in Paco, Manila, which is badly infested with house termites. These adults are never numerous and, strange to say, emerge in the early morning rather than at night, as is the habit of *Planocryptotermes* and most other termites. During the latter part of June and the early part of July a few of them were to be taken on my window curtain each morning and a deälated pair of these, our tiniest adult termites, were commonly to be seen in the early morning coursing excitedly over my washstand.

no extensive collections of house termites have been made here or elsewhere, I do not know whether *C. cynocephalus* and *P. nocens* have the same distribution; nor do we know their relative frequency. We do know that practically every house in the Islands is infested with this or other species of house termites.[4]

These termites attack isolated boards and are therefore not reached by methods which prevent the activity of the much more seriously harmful *Coptotermes, Leucotermes,* and *Eutermes* (*Microcerotermes*) species, which require a connection with the ground or a considerable moisture supply. Since the "house termites" reach their future habitat in a winged state, there is no way of preventing their presence in tropical regions where it is impossible to keep the house closed against their ingress. The only methods of combating them would be, therefore, the use of treated lumber, together with the prompt removal of any infested boards, which would presumably be prohibitive in cost. Their presence is usually demonstrated at once by the little piles of impressed pellets of fæcal matter which they throw out from their galleries: during the night, as a rule, but sometimes during the day. These little piles of yellow or orange-colored pellets (color depending upon that of the wood) are very characteristic sights in our houses in the Tropics. These termites are taken by many to be beetles because of the larvalike appearance of the worker and the curious color and shape of the soldier. Indeed they are locally known as *gorgojo* (beetle) or more commonly *bucbuc* (borer) and with the species of the genus *Planocryptotermes* are the only termites not recognized as such and given the name *anay* by Filipinos generally.

Genus **PLANOCRYPTOTERMES** novum

DIAGNOSIS

Imago.—As in *Cryptotermes* but with as many as 18 [5] segments in antennæ.

[4] Collections which I made in Cebu and Negros during April and May, and further collections in Manila, have produced no new species of house-living *Cryptotermes*. They have shown *Planocryptotermes* to be common and apparently much more prevalent than *Cryptotermes* and have produced another species of *Planocryptotermes* from Manila, one from Cebu, and apparently two from Negros, all closely related to *P. nocens*. We would seem justified in the belief, therefore, that the "house termites," whose piles of fæcal pellets are to be found in nearly every dwelling in the Philippines, belong in great part to the new genus *Planocryptotermes*.

[5] In the adult of an undescribed species from Manila.

Soldier.—Similar to *Lobitermes* Holmgren. Head broad, flat and smooth, somewhat longer than broad; forehead nearly vertical, with notch in middorsal region of border. Antennæ with 11 to 14 segments, third segment not much larger than second. Mandibles distinctly toothed.

Genotype, *Planocryptotermes nocens* sp. nov.

I have founded this new genus for the species described below (*P. nocens*) and several others from other parts of the Islands to be described later. *Calotermes pinangae* (Haviland), which Holmgren places provisionally in his subgenus *Lobitermes*, probably belongs with these species. All the data I can gather from descriptions and illustrations point to that conclusion and a study of the winged form will probably show this to be true.

I had been led to the belief that the adult of *P. nocens* would agree with that of *Cryptotermes* for the reasons that *Cryptotermes*-like adults had been taken from time to time in numerous places known to be infested with *Planocryptotermes*, and that no other Kalotermitinæ adult had been taken in these vicinities except the tiny form which I have since determined to be the adult of *C. cynocephalus*. With so many houses infested with these termites it seemed extremely unlikely that the adults had escaped notice so long and as I have pointed out above the only adults captured showed the *Cryptotermes* type of wing venation.

Very recently adults found in colonies of *P. nocens* and other species of the genus have confirmed this assumption, making it necessary to establish the new genus for the group, since the adults of *Lobitermes* do not have the *Cryptotermes* venation.

The soldiers of the new genus are characterized by a larger size than those of *Cryptotermes*, by a larger head which is flattened dorsally and is considerably broader than high and somewhat longer than broad, by a more or less pronounced notch in the projecting rim of the frontal area, and by the absence of any considerable elaboration or rugosity in the frontal area which characteristically makes more than a right angle with the mandibles, which in turn are longer and slenderer than in *Cryptotermes* and distinctly toothed. They are characteristically house termites but are sometimes found in dead limbs of trees. Like *Cryptotermes* their presence is denoted by the piles of little fæcal pellets dropped from openings in the boards they inhabit (see Plate 6).

Planocryptotermes nocens sp. nov. Plate 2, figs. 3 and 4; Plates 5 and 6.

Types.—Adult, soldier, larva, and nymph, No. 26 in type collection from No. 202 of general collection.

Cotypes.—No. 39 (*del Rosario*), Manila; No. 202 (*Light*), Manila; and No. 442 (*Gamboa*), Manila, in the general collection.

DIAGNOSIS

Adult.—Antennæ long, with 16 segments, rather sparsely haired with stiff hairs of two sizes, segments 11 to 15 thickly clavate with very slender proximal ends, terminal segment shorter and much narrower, ovate; body with wings from 8.5 to 9 millimeters long, without wings from 5 to 5.5 millimeters long; pronotum slightly narrower than head.

Soldier.—Head about 1.25 millimeters long from posterior border to middorsal margin of frontal area, about 1.50 millimeters from posterior border to labral suture; about 1.25 millimeters wide; head making more than a right angle with mandibles; margin of frontal area not strongly developed, bilobed, with one deep median dorsal and two slighter lateral dorsal notches; anterior concavity shallow; two short "antennal spines," one an extension of the anteroventral margin of the antennal foveola, the other of the anterodorsal margin. Antennæ of 13 or 14 segments. House termites.

DESCRIPTION

Adult.—General color brown above, ventral surface of thorax yellow, of abdomen light brown; wings faintly iridescent, light transparent brown, anterior border darker opaque brown; head rounded posteriorly, nearly semicircular, longer than broad, with scattered spikelike hairs; Y suture visible in center of head; labrum small, somewhat swollen, yellow; antennæ typically with 16 segments, all segments rather sparsely haired with scattered, stiff, larger hairs and more numerous smaller hairs; first segment cylindrical, second shorter, slightly swollen distally, proximally heavily chitinized; third thickly obconic, about as long as second; fourth to eighth as long as broad, increasing slightly in size and becoming more smoothly rounded; ninth larger, broadly oval; tenth to fifteenth increasingly long, clavate with very slender bases; sixteenth long-oval, shorter, and slenderer.

Measurements of Planocryptotermes nocens sp. nov., winged adult.

	mm.
Body length, with wings	8.5–9.00
Body length, without wings	5.0–5.50
Head length [a]	1.16
Head width	1.08
Pronotum width	1.01
Pronotum length	0.63

[a] Posterior margin to middorsal margin of frontal area.

Soldier.—Mandibles and frontal area of head, with its margin, black, the rest of the head shading from smoky brown in front to dirty yellow at posterior surface; thorax and legs smoky, abdomen light smoky yellow, having a faint purplish tinge. Antennæ and mouth appendages light yellow to white. Head making an angle of about 45° with the body, short, broad, and square, being only slightly longer than broad and about half as high as long and showing scattered hairs, which are smaller and more numerous toward the anterior; anterior surface making an angle of more than 90° with the mandibles; posterior border nearly straight in dorsal view, with shortly rounded corners; sides and posterior surface of head sloping inward and upward to dorsal surface from a line of maximum convexity considerably below the mid-horizontal plane of the head; sides of head nearly straight and parallel.

Eyes small, hyaline and circular, lying in a considerably larger, circular elevation of the lateral surface of the head, about one and a half times their diameter from posterior margin of the antennal foveolæ, making a distinct lateral projection in dorsal view in front of which the sides converge slightly only to diverge in the low but distinct margin of the frontal area, so that the width of the head from edge to edge of the frontal margin would about equal that through the eyes; in dorsal profile the head in side view presents a sharp rise posteriorly from the border to a point one-third the distance between the posterior border and the margin of the frontal area; from this point there is a very gentle down curve to near the frontal margin and a short but distinct rise to the anterior edge of the projecting margin; dorsal surface with a very small concavity just posterior to the middorsal region of the margin of the frontal area; frontal margin less developed in middorsal region where it shows a distinct median notch, flanked on either side by a much smaller lateral notch and a second very slight notch; the margin, slightly roughened laterally to these notches, curves anteriorly, laterally, and ventrally to end in the dorsal margin of the antennal foveola where it is laterally deflected and continuous with the posterior margin of the foveola. On either side of the mouth parts on the ventral side of the head is a dark narrow ridge (the edge of the ventral gena) running forward and laterally to culminate in a laterally flattened spinelike projection ("antennal spine") of the anteroventral margin of the antennal foveola; above this the anterior margin is reduced, giving the appearance of a deep notch internal to which the anterodorsal margin projects as a broader, still more prominent "spine."

Lying between and above the antenna and the mandible of each side is a pair of rounded elevations, the outer slightly more dorsal than the inner. Concavity of frontal area shallow and its surface smoothly rugose; mandibles distinctly thickened basally with a lateral hump, distal three-fourths slender in side view and considerably flattened dorsoventrally; left mandible less curved than right and bearing three teeth, the distal two small and the proximal one long and low; right mandible more strongly curved, with two teeth, the distal one large, with distal edge at right angles to mandible and proximal edge long, making a very obtuse angle with surface of mandible; proximal tooth of right mandible low and inconspicuous; large distal tooth of the right side fits in between the two distal teeth of left mandible when mandibles are closed, tip of the right mandible crossing under that of the left which projects beyond it; labrum white in color, projecting over the proximal half of the opened mandibles, narrow, converging distally with a distinct rounded point bearing two long, upcurved hairs at its tip with several smaller hairs just posterior to them.

Antennæ considerably longer than height of head, 13- or 14-segmented; when 13, the third obconic and nearly as long as the second; when 14, the third segment divided to form a short obconic third and a short disk-shaped fourth; first segment cylindrical, longest and thickest; first, second, and third heavily chitinized; first one or two beyond the third less so and the remainder very lightly so; first one or two segments beyond the third often nearly disk-shaped, the three beyond these become increasingly long, the proximal end more distinctly narrowed and stalked, the distal end more rounded (that is, spherical) beyond which, with exception of last, they are similar and may be described as short, thick clubs with narrow stalks and thick rounded distal regions; last two segments oval, somewhat longer and considerably narrower than preceding segments, the last only about two-thirds as wide as the next to the last. Gula small, weakly chitinized and about half as wide as long. Pronotum narrower than head, arched, about half as long as broad, and distinctly elevated anteriorly, anterior border deeply concave, thickened, edged with black and slightly rugose, anterolateral corners rounded laterally, marked anteriorly by a distinct notch and by rugosities; lateral margins nearly straight, converging toward the posterolateral corners which round into the slightly convex posterior border.

Measurements of Planocryptotermes nocens sp. nov., soldier.

	mm.
Body length [a]	4.25 –4.60
Body length, without the head	3.50 –4.10
Head length:	
Posterior margin to middorsal margin of frontal area	1.25 –1.35
Posterior margin to labral suture	1.50
With the mandibles	2.20 –2.25
Head width	1.12 –1.25
Pronotum width	1.00 –1.00
Pronotum length	0.575–0.625

[a] Made from preserved specimens. Possibly much longer in life.

"Larva."—Reaching a length of about 5 millimeters. One of 5 millimeters shows 12 segments in the antennæ. Slender, thorax much slenderer than abdomen which is long, swollen posteriorly, and colored a yellowish brown by the wood particles and protozoa of the gut. A larva of 1.85 millimeters shows antennæ of 10 segments, segments 3, 4, 5, and 6 being rudimentary.

Nymph.—Similar to "larva" in general appearance but reaching larger size, having wing pads in various stages of development and distinct, gray, compound eyes. One about 6 millimeters in length shows 17 segments in the antennæ, 4 of them still rudimentary.

SYSTEMATIC POSITION

This species differs from *Calotermes pinangae* (Haviland), the only other described species of the genus, among other points, in the toothing of the mandible and in the greater length and breadth of the head and pronotum.

DISTRIBUTION AND BIOLOGICAL NOTES

House termites, living in boards in houses, furniture, picture frames, etc. More extensive collecting is necessary to determine the relative prevalence of the different species of this genus. My collection contains several closely related new species which I plan to describe in a future number of these notes.

So far this species has been collected only in Manila and only a few times here. Adults of this species were collected by me (No. 15) in June, 1920, with numerous dried insects in a hanging lamp shade at my former house in Ermita, Manila. I had noted the appearance of this form on June 12, which points to a protracted or irregular swarming on the part of this species. The second collection was, as noted above, by Prof. José I. del Rosario from boards in his house, with *C. cynocephalus;* the third by me from boards and moulding of a case for birds' eggs hanging on a cement wall in the laboratory. The fact that no other species of the genus has been found in boards in Manila leads to the belief that it is the common species, at least in this locality.[6] *P. nocens*, like *C. cynocephalus*, forms small colonies, eating the dry wood, without any direct connection with the ground or any external source of moisture. Most of the specimens described were found living in the wood of a box containing an exhibit of birds' eggs. The box had been hanging on a cement wall surface in the laboratory for several years without being in contact with any other wood. The assistant who hung the box tells me that there were signs of termite work when it was hung. This would seem to imply that the colony found had been in the wood for some years. Since there were less than a hundred specimens collected, of which but two were soldiers, we can get some idea of how slowly such colonies develop. Since, also, the wood was by no means all destroyed we can get an idea of how slowly they work (see photographs of work, Plates 5 and 6). Since writing the above an examination of a part of this colony (March, 1921) shows that many of the "workers" as well as the white nymphs are developing wing pads. One soldier and numerous workers were found in boards of the house of Prof. José I. del Rosario, where in association with *Cryptotermes cynocephalus* they were attacking only the boards of white lauan (*Anisoptera thurifera* Blume), a comparatively soft wood, and avoiding the harder molave and ipil, which are nearly termite proof.

[6] Since writing the above a very distinct species has been taken in Manila, one of the five species yet to be described which were mentioned above. However, winged adults of *P. nocens* have been found commonly about the lights during June and July, and adults of the other species have not, and there seems no reason therefore to change our belief that *P. nocens* is by far the commonest house termite of this locality as other closely related species of the same genus seem to be in Cebu and Negros.

Family RHINOTERMITIDÆ Banks

Mesotermitidæ Holmgren.

Genus PRORHINOTERMES Silvestri

Arrhinotermes Wasmann.

DIAGNOSIS

Adult.—Head broadly egg-shaped, nearly circular. Clypeus much broader than long, swollen. Antennæ with 19 to 22 segments. Pronotum narrower than the head. Wing membrane weakly haired, strongly reticulate. The median of both wing pairs arises from the cubitus or is lacking or arises from the radial sector in hind wing (*P. luzonensis!*).

Soldier.—Head distinctly narrowed distally. Compound eyes present, distinct or vestigial. Fontanelle distinct. From the fontanelle there runs forward a more or less distinct channel. Fontanelle gland large, extending far backward into the body. Antennæ of 16 or 17 segments.

Worker.—Clypeus rather large. With or without distinct compound eyes.

SYSTEMATIC POSITION

In 1902 Wasmann described the genus *Arrhinotermes* for a new species, *A. heimi* from Ceylon, based on adults only. In an appendix to the same article he describes *A. oceanicus*, based on adults from Cocos Island. Holmgren (1911) points out that *A. heimi* Wasmann is apparently a *Coptotermes*, and Bugnion in 1910 had reported the adults described by Wasmann as *A. heimi* to be nothing else than the adults of *Coptotermes travians* (Haviland). As Holmgren points out, therefore, according to the rules of nomenclature, *A. heimi* being considered as the type, *Arrhinotermes* becomes a synonym. Banks (1920) replaces it by *Prorhinotermes* Silvestri (1909). Holmgren, however, in view of the fact that *A. oceanicus* Wasmann described in the appendix to the same article is a true *Arrhinotermes*, retains that generic name with *A. oceanicus* Wasmann as the type. If we are to follow the rules of nomenclature, *Arrhinotermes* must be considered a synonym and I am, therefore, following Banks in this matter.

The genus *Prorhinotermes* seems to be peculiarly an island genus and while widely distributed is represented by few species and those apparently closely related. So far as I am able to ascertain, no other region has yet produced two species of this genus. The American species is *P. simplex* (Hagen), found in the East Indies and Florida; the Formosan species is *P. japonicus* Holmgren; Ceylon has *P. flavus* (Bugnion and Popoff); Samoa, *P. inopinatus* Silvestri; Krakatoa, *P. krakataui* Holmgren; *P. oceanicus* Holmgren is found in Cocos Island; and *P. wasmanni* Holmgren, in Costa Rica. In view of this peculiar distribution of the genus it was to be expected that the Philippines would show at least one Luzon species and perhaps others from different islands. The facts in the case are a good example of the surprises which await the termite collector in the Philippines. This genus was not encountered until collections were made on the Manila-North Road where, near the Bulacan-Rizal boundary, three soldiers of *P. luzonensis* sp. nov. were found, without workers, in a stump. Later collections showed, within 50 meters of this, a small complete colony of *P. gracilis* sp. nov. (see below), with a deälated adult living in the hollow end of a branch of a guava tree. Still later collections produced from a similar situation, within a kilometer or two of the spot, the large colony with many winged adults on which the new species *P. luzonensis* is based living in close relation with a *Hospitalitermes* species and a *Neotermes* species. Extensive collections since that time have shown no other colonies in Luzon, although a few winged adults have been taken. [7]

Prorhinotermes luzonensis sp. nov. Plate 3, figs. 1 and 2, text fig. 2.

Types.—Winged adults, large and small soldiers, workers, and nymphs, No. 27 in the type collection (from No. 205 in the general collection).

Cotypes.—No. 97 (*McGregor and Light*), Rizal-Bulacan boundary, September 13, 1920; No. 205 and mixed with No. 209 in the general collection (*McGregor and Light*), Rizal Province, about one kilometer from the Rizal-Bulacan boundary on the Manila-North Road, October 4, 1920; No. 436, near No. 205 (*McGregor and Light*), March 27, 1921.

DIAGNOSIS

Adult.—Length, 7 to 8 millimeters, with wings, 11 to 12 millimeters; anterior wing, 9 millimeters long. Antennæ with 18 to 21 segments. Pronotum 1.50 millimeters broad by 0.75 to 0.85 millimeter long. Wings in appearance like those of *P. flavus*

[7] Collections recently made in the central islands of Cebu and Negros show one or more species of *Prorhinotermes* to be common in the former island and fairly so in the latter.

(Bugnion and Popoff) and in venation like those of *P. inopinatus* Silvestri but extremely variable. Median and cubitus more or less completely united in anterior wing, tending to separate and reunite, forming a closed cell; median of hind wing often arising from radial sector or from branches from both radial sector and cubitus. Radial sector thickened, particularly in outer third of each wing, and united with the costa by 8 or 9 short, thick, cross veins. All veins marked externally by tiny papillæ. Gula much broader than long, rounded posteriorly. Toothing of mandible like that of *P. japonicus* and *P. inopinatus*, not like that of *P. flavus*.

Soldier.—Large soldier with long head converging distinctly anteriorly, somewhat like *P. flavus* but with much longer body and longer maxillary palpi. Antennæ of 18 or 19 segments. Head with mandibles, 2.75 to 3 millimeters long; head width, 1.50 to 1.65 millimeters. Small soldier with head 2.50 millimeters long with mandibles, and about 1.40 millimeters wide.

DESCRIPTIONS

Adult.—Head, body, and legs yellow shading into brown in older individuals; head, base and anterior border of wings and posterior abdominal tergites often smoky. Wings diaphanous with the exception of costa and radial sector which are a grayish yellow becoming smoky near the base. Body more or less rounded, which, together with its light color and diaphanous wings, gives this termite an appearance quite different from that of most adult termites; 8 millimeters long, with wings 11 to 12 millimeters long, anterior wing 9 millimeters long. Head broadly egg-shaped, somewhat flattened behind and narrowed in front, slightly longer than broad (1.55 by 1.40 millimeters); posterior border rounded, surface flattened, slightly concave. Fontanelle small but distinct, frons incompletely delimitated, rising to meet the much-swollen postclypeus which is distinctly divided in the midline; postclypeus more than twice as broad as long and showing in front of fontanelle a shallow channel outlined in dark brown; anteclypeus small, white, four times as broad as long; labrum large, swollen, with four apical hairs in two lateral pairs; labrum a little longer than clypeus. Ocelli very near the compound eyes, small, indistinct, hyaline, an elongated oval, long axis nearly parallel to long axis of head. Antennæ with 18 to 21 joints, first large, cylindrical, heavily chitinized, second shorter, narrow and cylindrical, third and fourth smallest, disk-shaped, the others orbicular to broad-oval with exception of apical segment which is narrower and elongated oval. Antennæ and palpi very hairy, head with a few scattered hairs. Pronotum somewhat arched transversely and longitudinally, narrower than head, nearly twice as broad as long, anterior margin weakly concave, upturned, sides upturned, rounded, receding to form rounded posterior margin. Mesonotum and metanotum much narrower than pronotum, sharply rounded posteriorly.

Wings hyaline, veins difficult to make out, with exception of costa and radial sector which are large and a yellowish gray in color and run close together and parallel to one another to near the tip where they become much narrowed, lose their color, the radial sector soon uniting with costa; costa and radial sector joined in distal third of wing by 8 or 9 short, thick, cross veins as in *P. inopinatus.* Median of anterior wings very variable, united with cubitus through greater or less portion of wing; in many wings separating and uniting once or twice to form enclosed cells (see Plate 3, fig. 1); in other wings median arises from cubitus near distal third of wing as in *P. flavus;* median or median and cubitus when united joined to radius sector by numerous, rarely branched, cross veins; cubitus giving off numerous (12 to 18) branched or unbranched veins to the posterior margin, which are united by numerous cross branches resulting in a characteristic reticulation. Median of hind wing often arising from radial sector near base of wing or by branches from radial sector and cubitus and united by numerous cross veins to radial sector and cubitus. All veins marked externally by lines of little hairlike rugosities. Anterior wing scales much larger than posterior pair; both light brown in color with exception of oblique white line and bearing a few scattered spinelike hairs and a line of similar hairs along anterior border.

Large soldier.—Head outstretched, body long and slender, body with head and mandibles as long as adult, head yellow, mandibles reddish black, thorax and abdomen light yellow, hairs scattered on head, numerous on all other parts. Head considerably longer than broad, posterior border straight, corners rounded, broadest near posterior end, converging anteriorly, head with mandibles 2.75 to 3.00 millimeters long, without mandibles 1.80 to 1.90 millimeters long, maximum width 1.40 to 1.65 millimeters, minimum width 1.00 millimeter; head very low, flattened above; ventral genæ somewhat arched; gula much narrowed at middle, nearly as broad posteriorly as in region of articulation of maxillæ, twice as wide as at narrowest region; maxillary palpi longer than mandibles.

Fontanelle circular, aperture directed somewhat posteriorly, channel of about same diameter running forward to base of postclypeus. Antennal carinæ prominent, edged with red, projecting laterally over bases of antennæ, ending at each posterolateral corner of postclypeus in a little rounded chitinous projection, the medial articulation of the mandible; postclypeus short and narrow, more than twice as broad as long; anteclypeus very short and white; labrum short, tongue-shaped, with roundly pointed apex bearing two hairs. Mandibles as in *P. flavus* but with more gradually incurved tip; antennæ of 18 or 20 segments, much like those of adult. Compound eye distinct, hyaline, lying in midlateral line of head just behind and considerably below posterior end of antennal carina. Pronotum considerably narrower than the head, somewhat arched with a middorsal longitudinal groove, slightly concave anteriorly, with shortly rounded anterolateral corners; sides rounding broadly into the nearly straight posterior margin which is very slightly concave in its central region; pronotum 1.35 millimeters broad and 0.65 millimeter long. Pronotum broadest near anterior end, mesonotum near middle, and metanotum near posterior end; mesonotum narrower, shorter, and less heavily chitinized than pronotum.

Small soldier.—Similar to large soldier but smaller and body broader and flatter with head carried at an angle to body, broader in proportion to length and not converging anteriorly so much as in large soldier.

Measurements of Prorhinotermes luzonensis sp. nov., small soldier.

	mm.
Body length	6.00
Head length, with mandibles	2.50
Head length, without mandibles	1.60
Head width:	
Maximum	1.45
Minimum	1.00
Pronotum width	1.25
Pronotum length	0.55

Worker.—Body much like large soldier. Head like adult but much less heavily chitinized and eyes much less prominent. Head sutures not very distinct and fontanelle much larger and roughly triangular; thickened, rounded articulations at lateral ends of clypeofrontal suture distinct as in adult and soldier; antennæ and mandibles same as in adult; eyes hyaline, larger than in soldier, and in same relative position. Antennæ of 18 segments. Pronotum 1 by 0.55 millimeter, mesonotum and metanotum broader than pronotum.

Nymph.—Very numerous nymphs with swollen floatlike wing pads united in midline and similar to those described by Snyder for *P. simplex* were present in the colony. These will be studied later in connection with the findings of Thompson and Snyder.[8]

DISTRIBUTION AND BIOLOGICAL NOTES

As pointed out in the discussion under the genus, three collections of *Prorhinotermes* have been made, all in Rizal within a kilometer or two of the Rizal-Bulacan boundary. The material on which this species is based came from a single colony found in a large hollow guava tree about a kilometer from the boundary. The colony was associated with a *Hospitalitermes* species, probably *hospitalis* (Haviland) or some nearly related species such as *H. luzonensis* (Oshima). In tearing away the nest of the *Hospitalitermes* species a winged *Prorhinotermes* was seen but in the dusk was not at once recognized as a termite because of its light color, and its transparent wings and rounded body. Later, large numbers of all castes were collected, but unfortunately few data were obtained as to the relative positions and relations of the two forms. From the same place a number of specimens of *Neotermes malatensis* (Oshima) were obtained. These collections were made with Mr. R. C. McGregor on October 4, 1920, and large numbers of winged adults and nearly mature nymphs were found in the nest.[9]

Several isolated winged adults have been collected. One (No. 197) was collected by me about the lights of the University Club, San Luis Street, Manila, September 27, 1920; another (No. 212) was collected from the lights in Quiapo, Manila, October 6, 1920; and two others (Nos. 66 and 245) I found in my former house in Ermita, Manila, one on August 28, and one on October 31, 1920. As adult specimens were found in large number in the colony (No. 205) on October 4, it seems probable that the winged adults take flight during August, September, and October,[10] a few at a time probably, as the flying

[8] Thompson, C. B., and Snyder, T. E., Biol. Bull. **36** (1919) 115.

[9] Another trip to obtain more data about this colony showed the guava tree with the colony to have been destroyed, but another colony was found in another guava tree not far away (No. 436). Unfortunately it was impossible to make any extensive collections without destroying the tree.

[10] It is interesting to note in this connection that winged adults of the same or a closely related species were taken about the lights in Cebu, in May, 1921.

specimens collected were scattered individuals and I have seen no large flights. The finding of these adults in different parts of the city lends color to the belief that this species is more widespread than the limited number of colonies found would indicate. Both the house in Ermita and the University Club building are badly infested with termites, my house partly at least by *Eutermes* (*Microcerotermes*) and the club house partly at least by *Coptotermes* but possibly also by *Prorhinotermes*. These termites, being wood-dwellers and apparently building no covered galleries such as those of *Eutermes* (*Microcerotermes*) or *Coptotermes* and not dropping fæcal pellets as do many species of the Kalotermitidæ, are not easily located; hence the poverty of our collections.[11]

SYSTEMATIC POSITION

The few species of this widely separated genus have not been studied as thoroughly as might be wished. Further study of a wide range of material may show that we have a single very variable species ranging from Formosa to Samoa of which *P. japonicus*, *P. luzonensis*, *P. flavus*, and *P. inopinatus* are merely variants, or subspecies. The great variation in the wing venation of *P. luzonensis* would lend color to this belief.

From other species as now known, *P. luzonensis* differs in the following points, among others: From *P. oceanicus* Wasmann, *P. krakataui* Holmgren, and *P. simplex* Hagen in the greater size of the winged adult, and very strikingly from the soldier of *P. krakataui* in the greater number of antennal segments; from *P. wasmanni*, a description of which I have failed to find, it probably differs in its larger size, since Holmgren believes *P. wasmanni* may represent the soldiers of *P. oceanicus;* from each of the three closely related species *P. japonicus*, *P. flavus*, and *P. inopinatus* it differs in a number of minor points; from *P. flavus*, in wing venation, in toothing of mandible of adult, and in relative breadth and length of pronotum; from *P. japonicus* and *P. inopinatus*, in greater convergence of anterior end of head of large soldier, etc.

Prorhinotermes gracilis sp. nov. Text fig. 3.

Types.—Deälated adult, large soldier, small soldier, and workers, No. 28 in type collection (from No. 150 in the general collection).

[11] Through the kindness of the Bureau of Public Works I am in position to report that this species has recently been found attacking the posts on the ground floor of the Bureau of Printing building. Further inspections of public buildings will probably show them to be quite common.

Cotypes.—No. 150 of general collection (*McGregor and Light*), Rizal Province near Rizal-Bulacan boundary on Manila-North Road, September 29, 1920.

DIAGNOSIS

Adult.—Same as *P. luzonensis* but darker brown in color. Wings not known.

Soldier.—Like *P. luzonensis* but smaller, slenderer, lighter in color, head smaller, antennæ of 15 or 16 segments, segments longer and slenderer than in *P. luzonensis;* compound eyes vestigial only, not protruding as in *P. luzonensis;* pronotum much smaller than in *P. luzonensis.*

Worker.—Smaller, slenderer, lighter, antennæ of 15 segments.

DESCRIPTIONS

Adult (*deälated*).—Agrees very closely with *P. luzonensis;* color above generally darker brown, possibly due to greater age of this specimen which has made its flight while those of *P. luzonensis* were taken from the nest in the winged state. Anterior wing scales very broad, posterior ends overlapping in the midline (possibly an abnormality).

Large soldier.—In general like *P. luzonensis* but body smaller, about the size of the small soldier of *P. luzonensis,* slenderer, lighter in color, and less heavily chitinized; head smaller, pale yellow posteriorly but mandibles as dark as in *P. luzonensis;* mandibles as long as or longer than in *P. luzonensis* but slenderer; antennæ with 16 segments, third obconic, usually distinctly larger and more heavily chitinized than second or more distal segments; other segments longer and slenderer than in *P. luzonensis*; compound eye vestigial, not protruding at all, represented by a vague white area invisible except under microscope; anteclypeus extremely short; narrowest part of gula more posterior than in *P. luzonensis;* pronotum smaller in proportion than in *P. luzonensis.*

Measurements of Prorhinotermes gracilis sp. nov., large soldier.

	mm.
Body length	5.75–6.00
Head length, with mandibles	2.30–2.50
Head length, without mandibles	1.50–1.60
Head width:	
Maximum	1.25–1.30
Minimum	0.90
Pronotum width	1.00–1.05
Pronotum length	0.45–0.48

Small soldier.—Body short, flat, darker yellow, and more heavily chitinized than large soldier; head larger than in large soldier, making an angle of about 45° with body. Pronotum slightly larger. Otherwise as in large soldier.

Measurements of Prorhinotermes gracilis sp. nov., small soldier.

	mm.
Body length	4.30–5.50
Head, with mandibles	2.50–2.60
Head, without mandibles	1.45–1.50
Head width:	
Maximum	1.32–1.35
Minimum	0.90–0.95
Pronotum width	1.05
Pronotum length	0.50

Worker.—Long, slender, very lightly chitinized; thorax narrow, head light yellow, body transparent white, abdomen colored dirty salmon to brown by intestinal contents. Head flattened; posterolateral region swollen, like *P. luzonensis,* but eyes only slightly developed, projecting very slightly.

SYSTEMATIC POSITION

In view of the fact that this is the first case of two *Prorhinotermes* species found living together in the same region, and of the further fact that the two species were found in close proximity and have not been found elsewhere, it would seem an obvious inference that we are dealing here with variational forms rather than with two distinct species. A consideration of the differences between the two species makes this position untenable, however. *P. gracilis* differs much more distinctly from *P. luzonensis* than the latter differs from *P. japonicus, P. flavus,* or *P. inopinatus,* with regard to which it is indeed a possibility that we are dealing with a very variable species of wide distribution. The lighter color and lack of chitinization and the very slight development of the compound eyes might be due to a more sheltered life habit; the size difference might be a variation; but the very definite difference in number of antennal segments and their shape and size are difficult to explain as mere variations. A more detailed study would show a host of minor differences and, unless the anterior wing scales of the one adult of *P. gracilis* are abnormal, the wings of the two species must differ very greatly. For these reasons I have felt it impossible to avoid making this a new species, to which I have given the specific name *gracilis* because of the slender form of the worker and large soldier.

DISTRIBUTION AND BIOLOGICAL NOTES

Collected by McGregor and Light on September 29, 1920, from a hollow guava stub with living branches, near the Manila-North Road, in Rizal Province, about 100 meters from the Rizal-Bulacan boundary monument. This small colony was discovered while searching for *Neotermes*, one or more species of which are very common in guavas; in fact, a number of *Neotermes* specimens were collected at the same time, probably from tunnels near the surface of the wood. In this connection it is interesting to note that *P. luzonensis* was also found in association with, or at least in very close proximity to, *Neotermes*. The *P. gracilis* colony was found living in a mass of wood pulp, probably fæcal matter, similar to that used by *Neotermes* to plug up points of entry into a limb, and deposited by them also in some of their workings. At the time this was thought to be *Neotermes* waste, but I have not been able to verify this point and it seems probable that it was produced by the *Prorhinotermes* colony. In the center of this mass was a harder lump, apparently a royal chamber, in which was found a deälated adult male; the queen escaped or was overlooked.

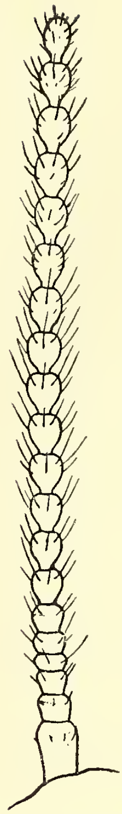


FIG. 2. *Prorhinotermes luzonensis* sp. nov. Antenna in outline for contrast with antenna of *P. gracilis* shown in next figure. × 42.

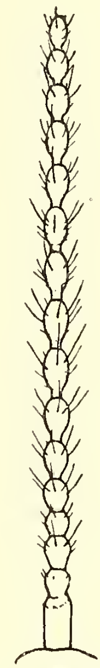


FIG. 3. *Prorhinotermes gracilis* sp. nov. Antenna in outline to contrast with that of *P. luzonensis* in preceding figure. × 42.

Genus LEUCOTERMES Silvestri sensu restricto

Subgenus *Leucotermes* sensu stricto Holmgren.

DIAGNOSIS

Adult.[12]—Yellow to brownish yellow; head oval; clypeus flat, short, and broad; labrum broad and convex; fontanelle small,

[12] From Banks and Holmgren. I have not seen the adult.

dotlike, rather far back on head. Ocelli small or lacking. Antennæ of 15 to 17 segments, segments 2, 3, and 4 very short. Gula as long as broad. Pronotum flat, concave in front and behind. Anterior wing scale much larger than hind one. Wings slightly reticulate and strongly haired. Subcosta of anterior wing not extending beyond the wing scale. Radius running near anterior border with which it is often united. Radius sector simple, parallel to the anterior border to which it is often united apically by several small branches. Median usually simple and running nearer the cubitus than the radius sector. Cubitus with 8 to 12 branches to the hind margin. Radius of hind wing separate from anterior margin only within the wing scale. Tibiæ with three apical spines. Cerci 2-segmented.

Soldier.—Head rectangular, with rather strongly inclined forehead clearly grooved in center. Clypeus short. Labrum rather long, tongue-shaped, with a sharp hyaline tip. Eyes lacking. Fontanelle in front of center of head. Mandibles with a large left and a small right basal tooth and beyond that with slight or no toothing. Pronotum flat, concave in front and behind.

Worker.—Head rounded, oval, somewhat larger than the adult. Labrum large and broad. Head sutures not distinct. Fontanelle and plate present. Antennæ with 13 to 15 segments.

Leucotermes philippinensis sp. nov. Plate 4.

Type.—No. 29 in type collection, soldier, worker, and nymph (from No. 128 of the general collection).

Cotypes.—Nos. 128 and 132 (*Miss Ursula B. Uichanco*), Manila, September 24 and 26, 1920; No. 432 (*McGregor and Light*), Manila, March 25, 1921; No. 441 (*McGregor*), Manila, April 3, 1921, in the general collection.

DIAGNOSIS

Adult.—Unknown.

Soldier.—Labrum with pointed, awl-shaped, hyaline tip, fontanelle opening from distinct reddish brown tube; antennæ of 15 segments, the first very large and strongly swollen at distal end, all segments with a dense covering of short, distally directed, incurved hairs with scattered longer hairs; coxæ and femora swollen, tibiæ slightly so, tarsi very slender and more strongly chitinized. Body slender, particularly in region of thorax, covered with a coat of hair similar to that of the antennæ, the short, incurved hairs directed posteriorly, hairing particularly heavy at posterior end of body.

Worker.—Antennæ of 15 segments, first long and curved, not distally swollen; hairs as in soldier; body slender.

Nymph.—Clypeus very greatly swollen; anterolateral corners of frons raised, projecting; antennæ of 16 or 17 segments, haired as in soldier.

DESCRIPTIONS

Adult.—Unknown.

Soldier.—Head, antennæ, and maxillary palpi pale yellow; head darker yellow anteriorly; mandibles dark, transparent, brownish red; bases of mandibles, internal mandibular articulations, margins of antennal foveolæ and "fontanelle tube" a light reddish brown; body white; anterior region of pronotum and the tarsi light yellow. Head long, parallel-sided, sides slowly rounding into rounded posterolateral corners; posterior margin straight; head dorsoventrally flattened with rounded sides ("thickly cylindrical" of Holmgren). Forehead abrupt, making angle of about 120° with the mandibles, laterally rimmed, centrally concave, dorsal rim concave; fontanelle, which is directed forward and distinctly visible internally as a brown tube, lies at posterior end of concavity; head considerably thickened anteriorly, thickest just behind level of antennæ. Mandibles short (0.825 millimeter long), strong, nearly straight, tips somewhat incurved, right untoothed, left with roughened cutting edge and two small and low but distinct teeth close together near the base. Labrum 0.45 millimeter long and 0.225 millimeter broad, tongue-shaped, ending in a very slender, awl-shaped, hyaline tip; two large hairs at base of tip, beyond which the hyaline region has a length of 0.09 millimeter. Anteclypeus very short, hyaline; medial articulations of mandibles at sides of postclypeus prominent and reddish in color.

Antennæ of 15 segments, relatively thick, much longer than mandibles, reaching about to posterior margin of head with scattered large hairs and very numerous, short, distally directed, incurved smaller hairs; basal segment very large, swollen distally; second cylindrical, larger than third; others larger than second, suborbicular to broadly oval; apical segment slightly slenderer, long-oval; margins of antennal foveolæ projecting, reddish brown. Pronotum narrower than head, more than half as long as broad, slightly concave anteriorly and less so posteriorly, broadest near anterior end, lateral margins receding gradually and rounding posteriorly into straight posterior border, slightly emarginate in center; sides depressed, anterior margin very slightly upraised; divided by middorsal longitudinal groove;

mesonotum much shorter and narrower, metanotum somewhat narrower; lateral margins of mesonotum receding, those of metanotum convex; posterior margin of each slightly emarginate in center. Coxæ, femora, and, to some extent, tibiæ swollen; tarsi very slender, strongly chitinized, yellow. Body slender, thorax particularly so, abdomen broadest near posterior end. Body and legs with scattered larger hairs and numerous smaller, incurved, posteriorly directed hairs, similar to those of the antennæ; hairing most prominent toward posterior tip of abdomen; head more sparsely haired. Cerci prominent.

Measurements of Leucotermes philippinensis sp. nov., soldier.

	mm.
Body length	4.25 –4.75
Head length	2.15 –2.25
Head, without mandibles	1.10 –1.50
Head width	0.80 –0.90
Pronotum width	0.68 –0.78
Pronotum length	0.425–0.50

Worker.—Small; body white; head very pale yellow with exception of exposed portion of mandible and mandibular articulations which are brownish yellow. Body, head, and legs covered with numerous hairs, the larger and more scattered hairs yellow, the shorter and more numerous, incurved, and posteriorly directed hairs white; body most heavily haired posteriorly, body longer than that of soldier; head broadly oval; clypeus swollen; antennæ of 15 segments, first long, curved, not distally swollen as in the soldier, apical segment slender, egg-shaped, longer than others with exception of first segment, haired as in soldier. Fontanelle and sutures not visible.

Nymph.—Much like worker but abdomen very much longer and whiter, anterior wing pads 0.10 millimeter long; head much broader behind, clypeus very greatly swollen, distinctly bilobed; anterolateral corners of frons high, projecting; compound eye projecting but little; antennæ of 16 or 17 segments, shaped and haired like worker; fontanelle and Y-suture not visible.

DISTRIBUTION AND BIOLOGICAL NOTES

The specimens on which this species are based were collected for me by Miss Ursula B. Uichanco, head of the department of biology, of the Philippine Normal School. Three soldiers, a number of workers, and several nymphs (No. 128) were collected on September 24, 1920, from galleries in cracks in the cement floor and from the door jamb of the storeroom. One soldier and a few workers (No. 132) were collected on September 26, 1920, from galleries on cement wall leading from a hole in the cement floor. On March 25, 1921, my attention was called by Mr. McGregor to termites building slender galleries on the cement supports of a porch of the Bureau of Science. These turned out to be this species, and two soldiers and numerous workers and nymphs were collected.[13] The latter showed no wing pads and it seems probable therefore that the period for emergence of the adult lies somewhere between September when the nymphs showed wing pads and March when they showed none. The species of *Leucotermes* have somewhat the same habits as *Coptotermes* but probably confine their attacks more completely to seasoned wood of buildings.[14] I hope in the future to make systematic collections in condemned buildings, which I surmise will disclose a considerably greater *Prorhinotermes* [11] and *Leucotermes* population than is at present known.

SYSTEMATIC POSITION

This species is very nearly related to *Leucotermes indicola* Wasmann. In the absence of comparative material it is impossible to be absolutely certain that we are not here dealing with a variety of that species; but from all the data available on that species (Wasmann, Holmgren) I feel satisfied that, aside from minor differences, *L. philippinensis* differs from *L. indicola* Wasmann in the much greater length of the hyaline tip of the labrum of the soldier, in the greater length of the antennæ and of the distal segments thereof, in the peculiar hairing of all castes, and in the presence of the definitely marked brown tube leading inward from the fontanelle. As the species of this subgenus are usually confined to a given region and are usually without coregional species, I have given the new species the name *philippinensis*.

[13] On March 3, 1921, Mr. McGregor brought me specimens from a colony in a house in Paco, Manila, where repairs were being made due to termite damage. Examination showed them to be *Leucotermes* and a visit to the colony furnished a large series of this species. The nest, which superficially resembled that of *Coptotermes* with its speckled yellow appearance, was much more compact with thicker walls and smaller and more rounded chambers. The nest was in the end of two floor sills. The wood attacked was not so thoroughly destroyed as in the case of attack by *Coptotermes*, particularly in the case of hardwood sills which were attacked mainly at the ends and on the sides. Pine pieces were entirely destroyed and replaced.

[14] More recently this species was found attacking growing sugar cane in an experimental plot near the Bureau of Science building. Mr. H. A. Lee, plant pathologist of the Bureau of Science, who brought this to my attention, tells me that he has frequent reports of termite damage to plants!

ILLUSTRATIONS

PLATE 1

FIG. 1. *Kalotermes mcgregori* sp. nov. Head and pronotum of short-headed soldier. Mandibles opened to show toothing. (Antennæ imperfect!) × 16.5.

2. *Kalotermes mcgregori* sp. nov. Head and thorax, showing wing pads and antennæ with 17 segments. × 16.5.

PLATE 2

FIG. 1. *Cryptotermes cynocephalus* sp. nov. Side view of head and part of thorax. × 30.

2. *Cryptotermes cynocephalus* sp. nov. Dorsal view of head and pronotum. × 30.

3. *Planocryptotermes nocens* sp. nov. Dorsal view of head and pronotum. × 30.

4. *Planocryptotermes nocens* sp. nov. Pronotum. × 30.

PLATE 3

FIG. 1. *Prorhinotermes luzonensis* sp. nov. Head and pronotum of large soldier. × 19.

2. *Prorhinotermes luzonensis* sp. nov. Winged adult. × 9.

PLATE 4

Leucotermes philippinensis sp. nov. Dorsal view of soldier. × 24.

PLATE 5

FIG. 1. A piece of picture molding attacked by *Planocryptotermes nocens* sp. nov., only a thin paperlike shell remaining.

2. Cut end of above enlarged.

3. Smaller pieces of pine eaten away, leaving extremely thin outer layer.

PLATE 6

A group of impressed fæcal pellets of *Planocryptotermes nocens* sp. nov. enlarged about three times.

TEXT FIGURES

FIG. 1. *Kalotermes mcgregori* sp. nov. Outline drawing of head and pronotum of long-headed soldier. Note the absence of distinct eyespots and the presence of curious hyaline spots in anterolateral region.

2. *Prorhinotermes luzonensis* sp. nov. Antenna in outline for contrast with antenna of *P. gracilis* shown in the next figure. ×42.

3. *Prorhinotermes gracilis* sp. nov. Antenna in outline to contrast with that of *P. luzonensis* in the preceding figure. × 42.

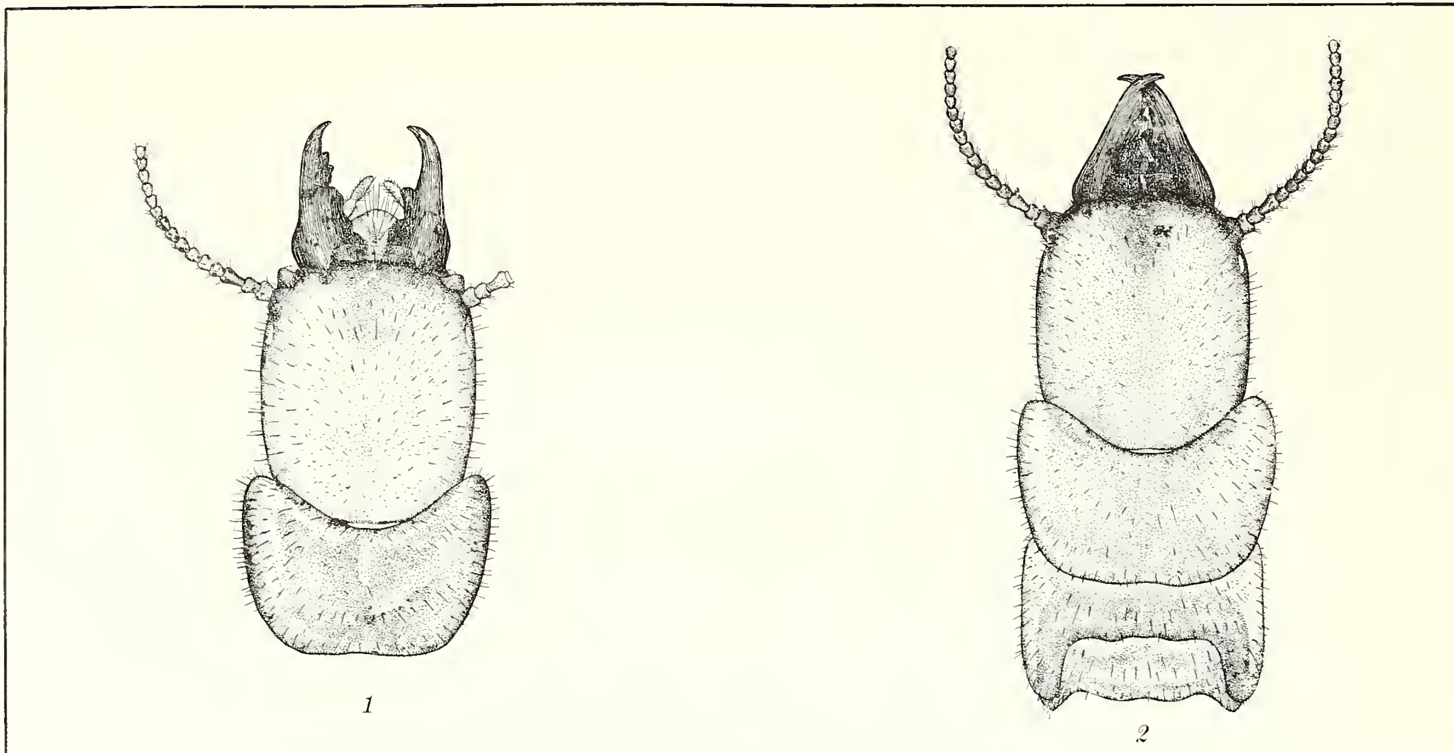
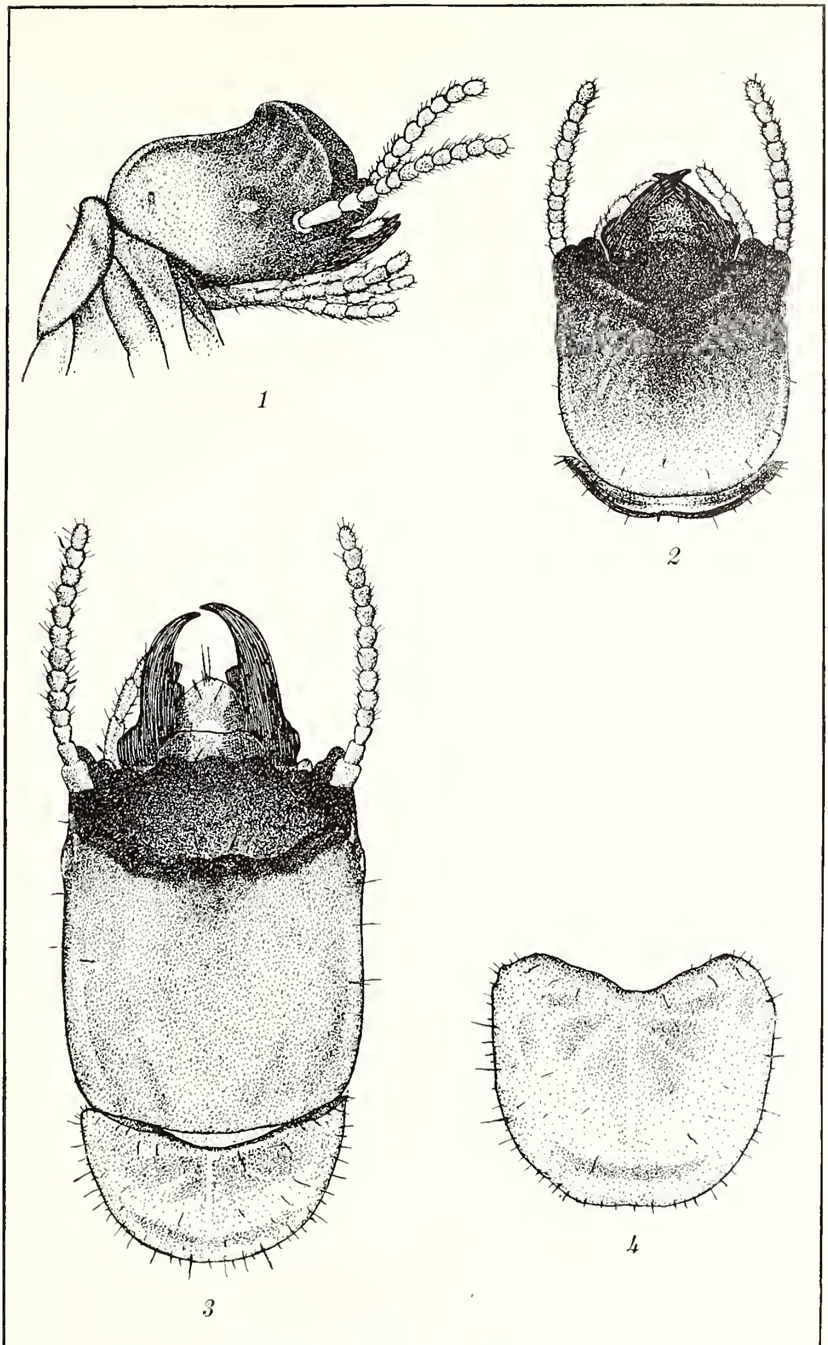


PLATE 1. CALOTERMES MCGREGORI SP. NOV.



Figs. 1 and 2. Cryptotermes cynocephalus sp. nov., head, side view and dorsal view, × 30. 3 and 4. Planocryptotermes nocens sp. nov., head and pronotum, dorsal view, × 30.

PLATE 2.

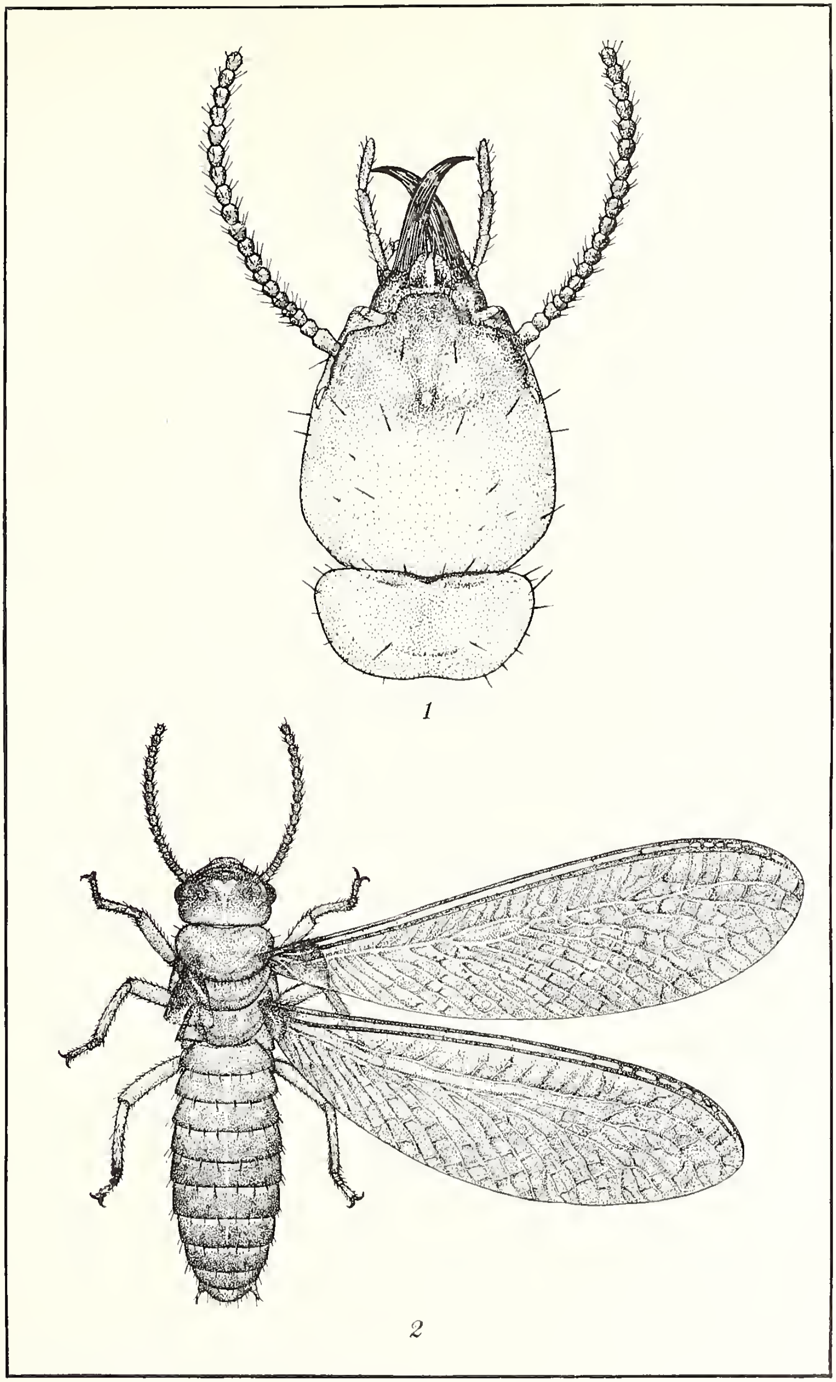


Fig. 1. Head and pronotum of large soldier, × 19. Fig. 2. Winged adult, × 9.

PLATE 3. PRORHINOTERMES LUZONENSIS SP. NOV.

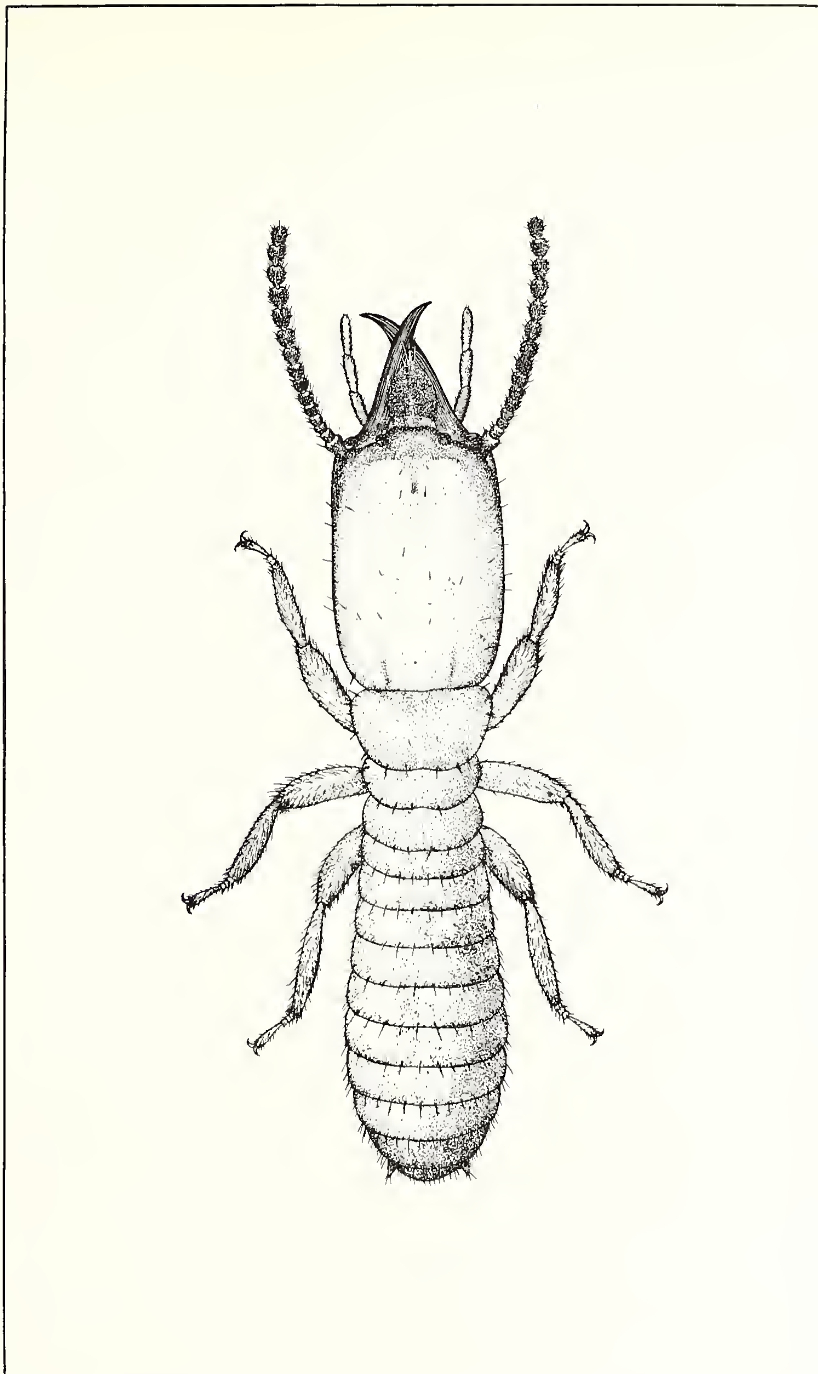


PLATE 4. LEUCOTERMES PHILIPPINENSIS SP. NOV.; DORSAL VIEW OF SOLDIER, × 24.

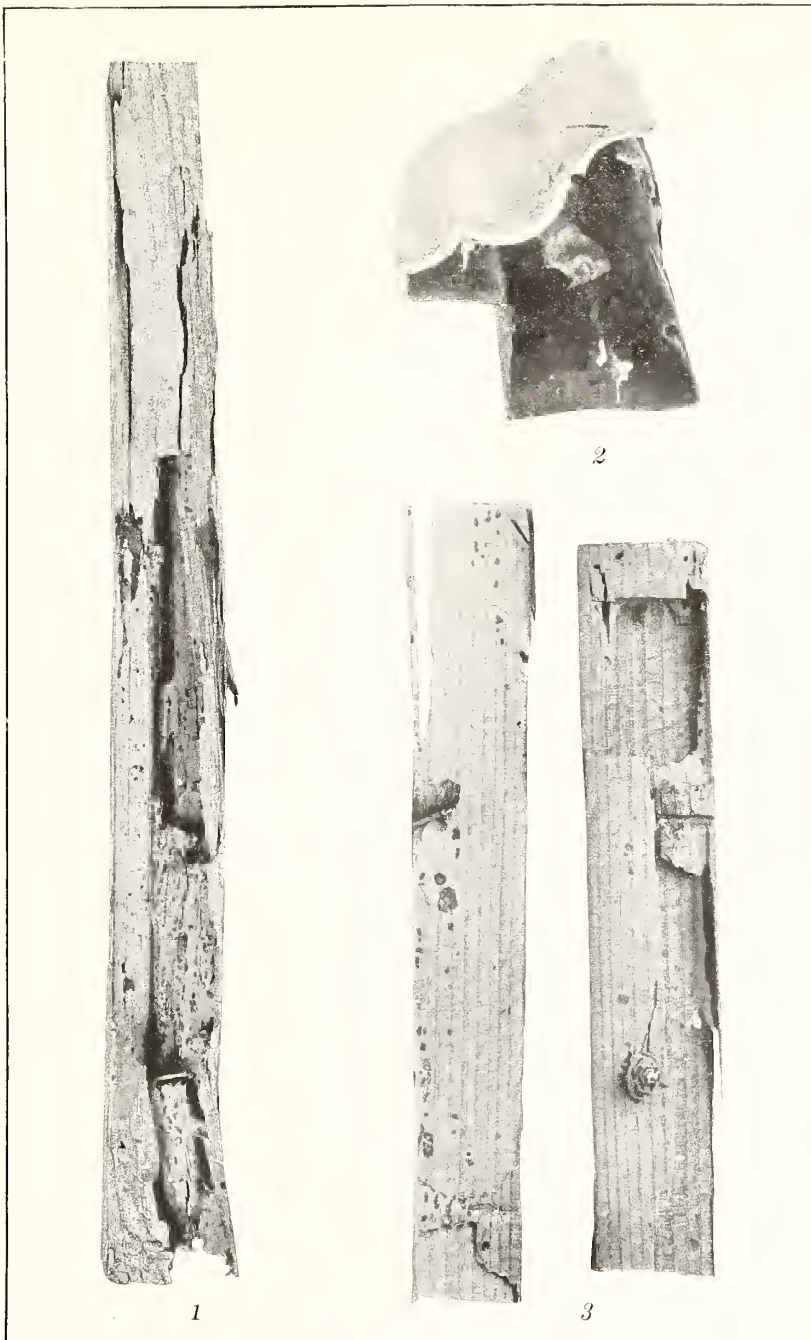


Fig. 1. A piece of picture molding attacked by Planocryptotermes nocens sp. nov., only a thin paperlike shell remaining. 2. Cut end of molding magnified. 3. Smaller pieces of pine eaten away, leaving extremely thin outer layer.

PLATE 5.

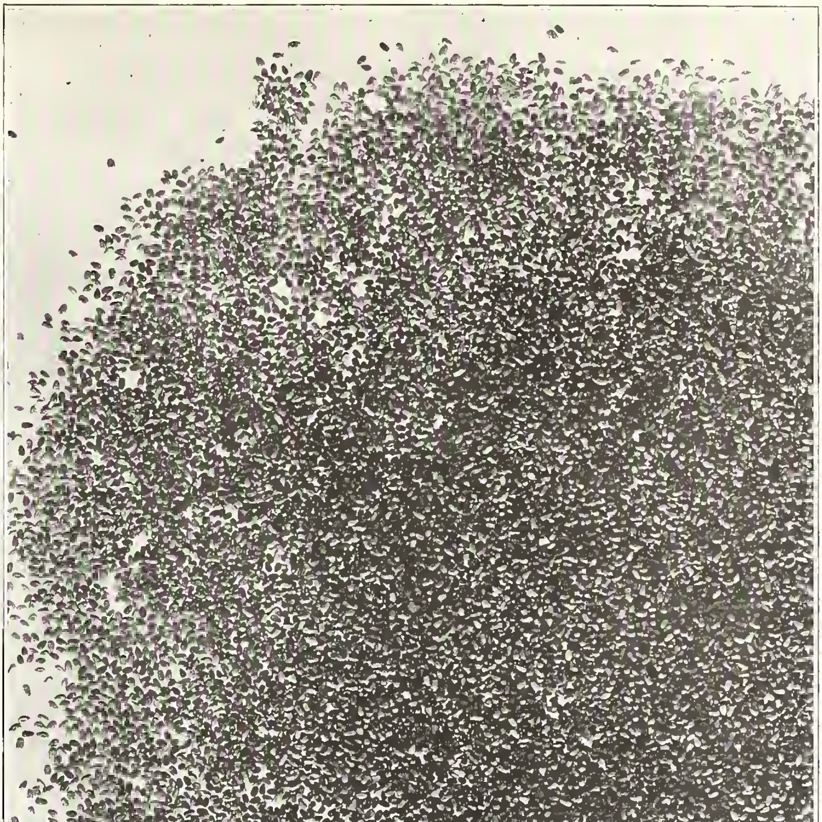


PLATE 6. A GROUP OF IMPRESSED FÆCAL PELLETS OF PLANOCRYPTOTERMES NOCENS SP. NOV.

A NEW SPECIES OF VINCENTIA FROM THE PHILIPPINES

By O. Stapf

Of the Royal Botanic Garden, Kew, England

VINCENTIA CRINITA Stapf sp. nov.

Closely allied to *V. anceps* Hk. f. (*Cladium sinclairii* Hk. f.) but differing in the 1- or 2-flowered, less compact spikelets and the wider, markedly white style-base of the ovary, slightly smaller nuts with a short pyramidal pubescent top, sharper and almost winged, broader, narrowing stipe.

Perennial, 50 cm high. Culms compressed to ancipitous, with a single leaf from halfway up to the inflorescence. Basal leaves about 9, crowded, equidistant, sheathing portion about 4 to 5 cm long, blade 15 to 22 cm by 4 to 8 mm, acute, finely striate. Panicle over 20 cm long, formed of 5 or 6 downward distant anthelae; lowest anthela supported by a bract whose sheathing portion is compressed, sharply keeled, and 2.5 cm long, whilst the ensiform, shortly acute blade is 3 cm by 4 mm; bracts of the following anthelae rapidly decreasing in size, their blades narrowly linear to subulate; branches of the lowest anthela 2, of the following 5 or more and very unequal, the longest undivided for 6 cm or more; branchlets fascicled (up to 4 in a fascicle), unequal, the longest undivided to up to 1 cm, all bearing loosely approximate clusters of spikelets; ultimate bracts ovate, cuspidate, acuminate, bright chestnut-brown to fuscous, obscurely ciliolate. Spikelets broad-ovate, laterally more or less compressed, at length more or less open with obliquely spreading glumes, about 3.5 mm long, 1- or 2-flowered, chestnut-brown to fuscous. Glumes ovate-oblong, acuminate or acute, cuspidate, 2.5 mm long, very delicately scaberulous and ciliolate, the lower 2 and the uppermost empty, the intermediate 1 or 2 fertile. Perianth none. Stamens 3, filaments much elongated at length, filiform, flexuous or in part twisted screw-fashion, remaining attached to the base of the nut. Ovary oblanceolate in outline, triquetrous, 1.2 mm long; style as long as the ovary, filiform from a thickened whitish pubescent base. Stigmas 3, slightly shorter than the style. Nut 1.6 mm long, pale brown in the center, whitish toward the ends, the top (style base) shortly pyramidal and pubescent, 0.4 mm long; stipe narrowly linear, 0.4 mm long, its angles whitish, prominent acute. Grain 0.7 by 0.5 mm.

LUZON, Albay Province, Mount Mayon, *Bur. Sci. 2935 Mearns.*

THE PREPARATION OF TIKITIKI EXTRACT FOR THE TREATMENT OF BERIBERI

By A. H. Wells

Chemist, Bureau of Science, Manila

The results of investigations by Funk,[1] Fraser and Stanton,[2] Chamberlain,[3] Wilcox,[4] and Cooper[5] have established the fact that beriberi is a deficiency disease. In the Philippine Islands, as in most tropical countries, the diet of the people is based upon rice. The investigations of the above-named authors, together with the findings of Braddon,[6] Highet,[7] Vedder,[8] and others have sufficiently demonstrated that beriberi can result from a diet consisting of polished rice, and that extracts of these polishings contain neuritis-preventing substances. The work of these authors has been of the greatest value in the Philippine Islands, where beriberi is very prevalent and is traceable in many cases to the use of polished rice, both domestic and imported.

In the preparation of rice for the market the glume or husk is first removed, then the grain is polished, and made white by the removal of the pericarp layer. This pericarp layer also constitutes the polishings, or tikitiki. In the Philippines tikitiki is sold as a cattle food, the best grades bringing about 4 pesos (2 dollars) per sack of 50 kilograms.

[1] Funk, Casimir, Journ. Phys. 43 (1911) 395; Journ. State Medicine 20 (1912) 341; Trans. Soc. Trop. Med. 5 (1911) 86.

[2] Fraser, Henry, and Stanton, A. T., Lancet 2 (1912) 1005; Lancet 1 (1909) 451; Lancet 2 (1910) 1755.

[3] Chamberlain, W. P., and Vedder, E. B., Philip. Journ. Sci. § B 6 (1911) 251.

[4] Wilcox, W. H., Brit. Med. Journ. No. 3081 (January 17, 1920) 73.

[5] Cooper, E. A., Journ. Hyg. 12 (1912) 436.

[6] Braddon, Leonard, Trans. Soc. Trop. Med. and Hyg. 11 (1909) 212; The cause and Prevention of Beriberi, London (1907).

[7] Highet, H. C., Studies on Beri-Beri and its Prevention in Siam, Gov. of Siam, Bangkok, Siam (July, 1912).

[8] Vedder, E. B., Philip. Journ. Sci. § B 7 (1912) 415.

Regarding the antineuritic bodies existing in rice polishings, Vedder and Williams [9] give the following conclusions:

(1) Undermilled rice may be stored for one year in a damp place without losing its protective powers against polyneuritis gallinarum. It is improbable, therefore, that a rice which originally affords protection against beriberi will lose this property by storage even in damp places.

(2) The neuritis-preventing substances or vitamines contained in rice polishings are only slightly soluble in cold 95 per cent alcohol, since three successive extractions, using a total of six liters of alcohol to each kilo of polishings, fail to remove all of the neuritis-preventing substances from rice polishings.

(3) Strong alkaline reagents such as sodium hydroxide, ammonia and barium hydroxide, destroy the neuritis-preventing vitamine, and the use of these reagents must be avoided in endeavoring to isolate this substance.

(4) Basic lead acetate does not precipitate the neuritis-preventing vitamine, and a considerable portion of this substance may be recovered from the filtrate.

(5) The therapeutic properties of an alcoholic extract of rice polishings are greatly altered by hydrolysis (treatment with five per cent hydrochloric or sulphuric acid). The unhydrolyzed extract is not poisonous, and is only slowly curative. The hydrolyzed extract is exceedingly poisonous in large doses and promptly curative in small doses.

(6) We have confirmed Funk's observations by isolating a crystalline base from an extract of rice polishings by Funk's method. This base in doses of 30 milligrams promptly cured fowls suffering from polyneuritis gallinarum.

(7) Funk's base or vitamine is present in rice polishings in considerable amounts, and only a very small portion of it can be obtained by Funk's method.

(8) Two groups of substances (purine bases, choline like bases) may be isolated from rice polishings in addition to Funk's base, and are capable of partly or wholly protecting fowls fed on polished rice against polyneuritis gallinarum, but are incapable of curing fowls that have already developed the disease. The chemical nature of these two groups of bases requires further investigation.

(9) We have confirmed the observation of Suzuki, Shimamura and Odake, that Funk's base may be precipitated from unhydrolyzed extract by tannic acid, but did not succeed in obtaining large amounts of this substance by this method.

(10) It is probable that this base or vitamine exists in food as a pyrimidine base combined as a constituent of nucleic acid, but that it is not present in the nucleins or nucleic acids that have been isolated by processes involving the use of alkalies, or heat.

(11) The administration of unhydrolyzed extract of rice polishings to cases of adult wet beriberi, or to cases suffering from acute cardiac insufficiency, results in the prompt dissipation of oedema, and relief of the cardiac symptoms.

(12) The administration of unhydrolyzed extract of rice polishings to

[9] Vedder, Edward B., Beriberi. New York, William Wood & Co. (1913) 403, 404.

cases of dry beriberi is followed by little or no improvement in the paralytic symptoms.

(13) The administration of Funk's base to cases of dry beriberi is followed by an immediate improvement in the paralytic symptoms. This should remove the last doubt that dry beriberi is caused by the deficiency of this substance in the diet. It also finally proves that dry beriberi of man and polyneuritis gallinarum are essentially the same disease.

(14) We have succeeded in curing a case of infantile beriberi (of the wet type) by administering that portion of the extract of rice polishings represented by the filtrate from the phosphotungstic precipitate. Since this filtrate does not contain Funk's base, this is evidence that wet beriberi is cured by some other substance.

(15) Conclusions 11, 12, 13 and 14 are striking confirmatory evidence for the hypothesis previously stated by Vedder and Clark, that wet beriberi and dry beriberi are two distinct conditions each being caused by the deficiency of a separate vitamine.

Chamberlain and Vedder [10] obtained cures of infantile beriberi by the use of extract of rice polishings made by extracting the fine powder with 90 or 95 per cent alcohol in the proportion of 3 liters of alcohol to each kilogram of polishings. Later Vedder and Williams decided to extract the polishings three times with successive portions of fresh 95 per cent alcohol, using 3 liters of alcohol to each kilogram of polishings for the first extraction and 1.5 liters of alcohol for each of the two following extractions. The extracts obtained were combined. Thus they observed a higher concentration of protective and curative substances in the final extract. The same authors later decided to reduce the percentage of alcohol to 90 per cent strength and to heat the extraction to 60° or 70°C. The final method for the preparation of extract of rice polishings, originated by Vedder and Williams,[11] is as follows:

THE METHOD OF PREPARING EXTRACT OF RICE POLISHINGS

Rice polishings or tiqui-tiqui may be obtained from any rice mill, but should preferably be from a recent milling. The finest grade of polishings should be carefully selected, since some of this product is very coarse and consists mostly of hulls. The tiqui-tiqui is first sifted to remove hulls and weevils. Gauze of about seven meshes to the centimeter is used for this purpose. This fine powder is weighed and mixed with 90 per cent alcohol in the proportion of three liters of alcohol to each kilo of polishings. It is then allowed to macerate for 24 hours. A glass jar or white enameled receptable [sic] serves for this pupose, and the mixture should be repeatedly stirred or shaken, since the tiqui-tiqui sinks rapidly to the bottom, forming a densely packed mass which the alcohol penetrates with difficulty.

[10] Chamberlain, W. P., and Vedder, E. B., Bull. Manila Medical Society, No. 2, 4 (1912) 26.

[11] Vedder, Edward B., Beriberi. New York, William Wood & Co. (1913) 405, 406.

During the extraction the alcohol becomes of a deep green color, due to the fat that has been dissolved out. At the end of 24 hours the alcohol is siphoned off and filtered until absolutely clear. Since a very considerable quantity remains in the tiqui-tiqui, this should be squeezed in a press, or washed with fresh alcohol, and the residuum filtered and added to the alcoholic filtrate already obtained. The extraction should then be repeated several times, again using three liters of alcohol to each kilo of polishings. This is necessary because the neuritis-preventing substances are only slightly soluble in cold 90 per cent alcohol, and experience has shown that if the polishings are not repeatedly extracted the full therapeutic action of the polishings is not obtained. The combined alcoholic filtrate is then placed in a water bath provided with a thermometer, and an electric fan is so arranged as to throw a strong current of air on the surface of the alcohol. As a result of the heat and the movement of air the alcohol rapidly evaporates. It is essential that the temperature of the extract should not be permitted to rise above 80°C., since extended observation has shown that greater heat is liable to decompose the active neuritis-preventing principle. Whenever the temperature of the extract approached [sic.] 80°C. the fire should be extinguished until the temperature drops. This process is continued until all the alcohol is evaporated. The residue is poured into a separating funnel and allowed to stand for about an hour, when it will be observed that the liquid has separated into two layers. The upper and larger portion is of a deep green color and consists of the fat. The lower and smaller layer is brown in color, of syrupy consistency, and contains a number of substances that have been extracted by the alcohol. This lower layer is carefully drawn off, leaving the fat behind. It varies in amount, but about 25 cubic centimeters usually will be obtained from each kilo of polishings. The brown syrupy fluid so obtained from one kilo of polishings is diluted to 60 cubic centimeters with distilled water, whereupon a heavy precipitate is formed. This precipitate consists of substances that were soluble in alcohol, but are insoluble in water. After allowing the mixture to stand for a while the precipitate settles and the clear fluid is filtered off. This filtrate constitutes the extract as we have used it. Each 60 cubic centimeters contains the substances that have been extracted by this method from one kilo of polishings.

In the latter part of 1913 the Bureau of Science commenced the manufacture of an extract of tikitiki for the cure of infantile beriberi. The method as outlined by Williams is as follows:

Take 25 kilos (half of a sack) of tikitiki and soak in 75 liters of 20 to 25 per cent alcohol overnight or longer. Put in a cheesecloth sack and press slowly until pressure reaches about 80,000 pounds. Obtain about 60 liters of extract, allow to stand and put in still and evaporate under 15 centimeters pressure or less. When concentrated to about 3 liters, remove, filter, and mix the clear liquid with an equal quantity of 90 per cent alcohol, which will cause precipitation. Let stand overnight, decant from the precipitate and evaporate under vacuum to about 1.7 liters. Filter if not clear, and bottle. Sterilize the bottles at about 60° C., for twenty minutes, for three consecutive days.

One cubic centimeter of this extract equals 15 grams of tikitiki. The strength of the recovered alcohol will be from 20 to 80 per cent by volume. This is diluted with water to make 20 to 30 per cent alcohol and is used repeatedly.

DOSE

Ordinary dose: Three (3) teaspoonfuls daily.
Serious cases: Double dose or more, according to requirement.

This method was in use in the Bureau of Science until January 1, 1916. The results obtained from the use of this product were so favorable that in 1916 it was decided to revise the method and to increase the production. During 1916 there was obtained a maximum possible production with the equipment at hand. Prior to this time one small copper still was utilized for concentration. At this time a much larger still, which had been used for essential oil work, was put in operation for the first distillation. By the use of these two stills the production was brought to 6,687 bottles during 1916. During 1917 and 1918 certain revisions in the methods of filtration made it possible to increase the production to 8,188 bottles in 1918. In 1919 one small Elyria glass-enameled still and a Sharples laboratory centrifuge were installed. By the aid of these units larger quantities were worked up with a quicker and more effective separation of the inactive substance and a greater concentration for the final product. Year by year the demand for the product has increased until, at the present time, the Bureau of Science is unable to supply more than a small fraction of the actual requirements of the distributors.

The finished product is placed in 50 cubic centimeter bottles, which are sealed, pasteurized, and labeled at the Bureau of Science prior to delivery to the various organizations for distribution. Such organizations as the Public Welfare Board, La Liga Nacional para la Proteccion de la Primera Infancia, and the Philippine Health Service regulate the distribution, in order to insure that treatment shall be administered to patients by competent physicians.

PRESENT METHOD OF MANUFACTURE

Rice polishings for use in this process must be free from insects, clean, and finely ground. The polishings from freshly milled rice of a new crop are preferable. The tikitiki (the rice polishings) is extracted for a period of forty-eight hours in a solution of alcohol of 25 per cent by weight (determined by use of the Abbé immersion refractometer). The proportion of tikitiki to alcohol is one to two. Agitation is employed to a certain extent. After decantation, the residual sludge is passed to the press. The combined extracts are then passed to the distillation plant and evaporated under a pressure of 1 centimeter with a maximum temperature of 75° C. The alcohol from this distillation is recovered and passed back to the extraction plant. This first distillation is stopped when the gravity of the extract has reached 1.18 at 70° C. The sirup at this density is allowed to stand overnight, or for a sufficient length of time for it to cool and settle completely. It is then decanted and the cloudy portion passed through a Sharples supercentrifuge.

The resulting clarified sirup is further freed of inactive substances by treating it with slightly over one-third of its volume of 95 per cent ethyl alcohol. The gummy precipitate, well formed, is separated by means of the supercentrifuge and the alcoholic solution passed to the evaporator or smaller still, where the alcohol is recovered and the sirup concentrated under the same pressure and limit of temperature as before stated. The density of this final sirup is thus brought to 1.32. Upon cooling and standing overnight a flocculent precipitate of inactive susbtances forms and this is separated by again passing the sirup through the supercentrifuge. The finished product is then heated to 65°C., bottled, pasteurized for three successive days at 62.5°C., labeled, lacquered, and delivered to distributors.

Throughout the whole process as outlined above the extract comes in contact with metal only while in two of the stills that are tin lined. One still is glass enameled, although this is not absolutely essential. The precipitation, cooling, and storage are done in glass- or porcelain-lined vessels.

Due to the tikitiki being somewhat heavy, agitation is advisable in order to gain maximum extraction. Highly efficient recovery of alcohol is not obtained under the present method of coil and water condensation.

By the method outlined a clear thick sirup of good flavor is obtained. One mil of this tikitiki extract represents the active constituents of 20 grams of tikitiki, or rice polishings.

Tikitiki that has been in storage for a long time or that shows indications of mold growth has a tendency to produce an extract which is high in acidity and which is not palatable. Also, an old tikitiki is usually highly infested with beetles and other insects. Such a product not only lacks the quality stated above but gives a much lower percentage yield of finished extract.

Also, in the evaporation of extracts made from inferior grades of polishings, foaming takes place with consequent loss of time and yield.

There are two grades of tikitiki; that from the light-colored or white rice, and that from the dark or red rice. Experimentation with the tikitiki from the red rice did not give satisfactory results; the inactive substances were not easily precipitated nor wholly separable by centrifuge, and the extract obtained was of a very dark color and harsh in flavor. Further experiments will be made with the red polishings, and favorable results are expected.

The process of the manufacture of tikitiki extract at the Bureau of Science has been well established. This extract is demonstrating by its therapeutic action that it possesses a high percentage of neuritis-preventing substances and that it is a cure for infantile beriberi.

The Public Welfare Board at present (March, 1921) requires 10,000 bottles of this extract monthly. The Philippine Health Service and other organizations are purchasing tikitiki extracts made by local druggists in order to fill their requirements. Such extracts are often made without the use of vacuum, and analysis by the Bureau of Science has shown that they contain glycerine, sugars, inactive substances, and in many cases high percentages of alcohol. Many of them give very little or no precipitate with phosphotungstic acid. The great number of these preparations made and disposed of on the local market may be taken as an indication of the prevalence of the disease.

A plant with a capacity for the production of 15,000 bottles per month would permit the carrying out of a campaign for the treatment of beriberi throughout the Philippine Islands, and within one year from the time of installation of such a plant statistics on infant mortality would show a decided decrease.

Tikitiki extract manufactured by the Bureau of Science from May 20, 1914 to December 31, 1920.

	50 cc. bottles.
May 20 to December 31, 1914	1,161
January 1 to December 31, 1915	3,997
January 1 to December 31, 1916	6,687
January 1 to December 31, 1917	8,034
January 1 to December 31, 1918	8,188
January 1 to December 31, 1919	8,593
January 1 to December 31, 1920	10,870
Total	47,530

THE PHILIPPINE WASPS OF THE SUBFAMILIES SCOLIINÆ AND ELIDINÆ

By S. A. Rohwer

Honorary Custodian of Hymenoptera, United States National Museum

Subfamily SCOLIINÆ

The wasps of the subfamily Scoliinæ can be easily distinguished from their allies by the simple claws, the deeply emarginate inner margins of the eyes, the presence of only one calcarium on the intermediate tibia, the three spines on the male hypopygidium, the highly specialized tongue, and the general appearance. All of the species whose habits have been recorded prey on soil-inhabiting larvæ of Coleoptera, and some of them (as, for example, *Scolia manilae*) have proven to be of great value in reducing these coleopterous pests.

Key to Philippine genera of Scoliinæ.

1. Front wing with only two discoidal cells, the second recurrent being entirely wanting........................ Scolia Fabricius.
   Front wing with three discoidal cells, the second recurrent present.... 2.
2. Second recurrent uniting with the first recurrent and not joining the cubitus .... Liacos Guérin.
   Second recurrent uniting with the second abscissa of the cubitus.
   Campsomeris Lepeletier.

Genus SCOLIA Fabricius

In the tabulating of the species of the genus *Scolia* I have accepted the current method of dividing the genus into two subgenera by the presence or absence of the second intercubitus (two or three closed cubital cells). This method of classifying the species often separates forms which are otherwise closely allied, and it seems that future work on the classification of these wasps will devise a more natural system by the use of body characters. The older writers paid but little attention to the structural details; and without a large collection, which contains at least most of the described species, it will be impossible satisfactorily to arrange these insects by any system other than the one they adopted. The clypeus, antennæ, pronotum, propodeum, first tergite, and pygidium offer useful characters, to say nothing of the shape of the head and the valuable suggestion of natural groups indicated by antigeny.

Key to Philippine species of Scolia.

1. Three closed cubital cells; subgenus *Triscolia* .... 2.
   Two closed cubital cells; subgenus *Scolia* .... 9.
2. Thorax and abdomen "fusco-ferrugineis;" length, 11 millimeters. S. pseudoforaminata Gribodo.
   Thorax and abdomen (mostly at least) black .... 3.
3. Apical abdominal segments clothed with reddish hair. S. rubiginosa Fabricius.
   Hair on apical segments black .... 4.
4. Scutellum and metanotum marked with yellow; large species .... 5.
   Scutellum and metanotum black .... 6.
5. Angles of pronotum and third tergite with a yellow spot. S. procer Illiger.
   Pronotum and abdomen black .... S. scutellaris Gribodo.
6. Head marked with ferruginous or rufo-ferruginous .... 7.
   Head entirely black .... 8.
7. Antennæ rufo-ferruginous; abdomen subcœruleous; less than 20 millimeters .... S. capitata Guérin.
   Antennæ black; abdomen black; over 25 millimeters. S. philippinensis sp. nov.
8. Wings purplish .... S. bella sp. nov.
   Wings bronzy .... S. bellina sp. nov.
9. Head black, flagellum reddish .... S. auripennis Lepeletier.
   Head and antennæ wholly or largely reddish .... 10.
   Head and antennæ black .... 11.
10. Propodeum shining, sparsely punctured; antennæ entirely pale, those of the male shorter than the head and thorax .... S. erratica Smith.
    Propodeum with large close punctures on the dorsal, lateral, and posterior surfaces; antennæ with scape black, those of the male fully as long as head and thorax .... S. westermanni Saussure.
11. Small species, not more than 12 millimeters long .... S. manilae Ashmead. S. modesta Smith.
    Medium-sized species, over 18 millimeters long .... 12.
12. Abdomen marked with ferruginous spots .. S. quadripustulata Fabricius.
    Abdomen entirely black .... 13.
13. Wings violaceous .... 14.
    Wings brownish hyaline .... 15.
14. Head large, posterior orbits wider than eye; propodeum black; female. S. megacephala sp. nov.
    Head not especially large, posterior orbits narrower; propodeum with a bluish reflection; female .... S. propodealis sp. nov.
15. Hair of head and thorax above black; abdomen black; female. S. luzonensis sp. nov.
    Hair of head and thorax pale; abdomen with a bluish reflection; male. S. incerta sp. nov.

Scolia (Triscolia) pseudoforaminata Gribodo.

Triscolia pseudoforaminata GRIBODO, Bull. Soc. Ent. Ital. 25 (1893) 173.

This species is not represented in the collection, but it should be easily recognized by its color which is described as "nigrofuliginoso" with thorax and abdomen as "fusco-ferrugineis."

Wings fuscous with obscure violaceous reflections. Length, 11 millimeters. Only the male is known.

Scolia (Triscolia) rubiginosa Fabricius.

Although this species has been recorded from the Islands, it is not in the collections before me. The red hair on the apical segments should make it easily recognized.

Scolia (Triscolia) procer Illiger.

This species has been recorded from the Islands, but it is not represented in the collections I have seen from there. The typical form has a yellow mark on the first tergite which a variety recorded by Gribodo (*bimaculata* Gribodo) lacks. In size and appearance this species is much like *scutellaris*.

Scolia (Triscolia) scutellaris Gribodo.

> *Triscolia scutellaris* GRIBODO, Bull. Soc. Ent. Ital. 25 (1893) 164.
> *Scolia* (*Triscolia*) *whiteheadi* BINGHAM, Ann. Mag. Nat. Hist. VI 16 (1895) 441.

There seems to be no good reason to doubt the above synonymy as both original descriptions apply well to the specimens listed below which are certainly all the same species. Besides the absence of yellow on the pronotum and abdomen the female is readily separated from *procer* by the more prominent tubercles on the pronotum.

LUZON, Laguna Province, Mount Maquiling (*Baker 2728*) 1 male: Manila, (*George C. Lewis*). NEGROS, Occidental Negros, Bacolod, June 20, 1900 (*A. T. Clifton*) 1 female. MINDANAO, Iligan (*Baker 3139*).

Scolia (Triscolia) capitata Guérin.

This species closely resembles *Scolia westermanni*, which has only two cubital cells, but the scape and entire head are reddish ferruginous.

LUZON, Manila (*W. A. Stanton*) 1 female: Bulacan Province, Baliuag (*B. Arce*) 1 male, under Bureau of Agriculture accession No. 1591.

Scolia (Triscolia) philippinensis sp. nov.

Agrees very well with the description of *Scolia alecto* Smith except the abdomen is not iridescent and the propodeum is hardly emarginate posteriorly. The absence of yellow on the thorax and abdomen will separate it from *procer* Illiger. Apparently allied to *S. intrudens* Smith, but it cannot be assigned to that species because of the color of the wings.

Female.—Length, 32 millimeters; length of anterior wing, 30 millimeters. Two strong diverging ridges between the antennæ, the area between these ridges closely punctured and divided by a low carina; head smooth, with a few distinct punctures; antennæ stout, the apical joint truncate; pronotum not swollen laterally, the surface with rather close punctures; mesoscutum smooth, with distinct punctures laterally; scutellum and metanotum smooth, with scattered punctures on disk but with rather close punctures laterally; propodeum dorsally and caudally closely punctured, the posterior face slightly emarginate and dorsally with an indistinct striation; first tergite with a median prominence basally; pygidium with distinct striæ before tip. Black, clothed with long black hair which is especially dense on pronotum, sides of thorax, propodeum, and apical margins of abdominal segments; front, vertex, and posterior orbits to top of eye emargination ferruginous; wings purplish.

Male.—Length, 28 millimeters; length of anterior wing, 24 millimeters. Antennæ slightly longer than head and thorax; hair on ferruginous part of head the color of the integument. Agrees with female except that it lacks the ridges between the antennæ.

Type locality.—Los Baños, Laguna, Luzon.

Type.—Catalogue No. 23582, United States National Museum.

LUZON, Laguna Province, Los Baños (*Baker 1432*) 1 female and 1 male; Mount Maquiling (*Baker 3188*) 1 male: Bataan Province, Lamao (*C. R. Jones*) 1 female and 2 males, under Bureau of Agriculture accession No. 850. One of the last mentioned males is slightly larger than the type.

Scolia (Triscolia) bella sp. nov.

Evidently allied to the Bornean *S. crassiceps* Cameron, but the frons is hardly "closely" punctured, the punctuation of the scutellum is different, and the mandibles are not fringed with rufous hair. *Scolia nudata* Smith is more coarsely sculptured. *Scolia kollari* Saussure is said to have the lateral dorsal area of the propodeum more sparsely sculptured than the median area. *Scolia macrocephala* Gribodo has the clypeus different and the anterior surface of the first tergite impunctate.

Female.—Length, 17 millimeters; length of anterior wing, 13 millimeters. Head large, as wide as thorax, posterior orbits wider than the greatest transverse diameter of eye; clypeus shining, with a few large punctures basally, convex medianly, apical median portion depressed and broadly rounded; an oblique, low, rounded ridge over each antennal fossa; front convex, with large, well-separated punctures; vertex and posterior orbits practically impunctate; occiput with rather close, small punctures; ocelli rather small; postocellar line somewhat less than half as long as the ocellocular line; antennæ stout, flagellar joints punctured, apical joint truncate, not as long as the two preceding; pronotum rounded, impunctate medianly, laterally uniformly rather closely punctured; scutum with sparse, large punctures except for two rather narrow, linear areas sublaterally; scutellum, metanotum, and dorsal part of propodeum (except an impunctate area on inner basal part of each lateral area) with rather large uniform punctures; tegulæ, except at extreme base, impunctate; lateral posterior areas of propodeum punctured, the median area impunctate; sides of propodeum sparsely punctured, separated from dorsal surface by a sharp carina; mesepisternum coarsely punctured; abdomen shining, very sparsely punctured; first tergite short, the anterior surface with distinct but small punctures; apical tergites with large, rather close punctures; posterior calcaria stout, short, the longer one not half as long as basitarsus; second sternite truncate basally; pygidium rounded apically, shining, sparsely punctured; hypopygidium shining, lateral angles rather small, median lobe trapezoidal in outline except for rounded apex. Black, basal tergites with a bluish reflection; hair rather sparse, black; wings uniformly deep violaceous.

Male.—Length, 14 millimeters; length of anterior wing, 11 millimeters. Head of normal size, subshining; frons with rather close, large punctures; vertex and occiput sparsely punctured; postocellar line but little shorter than the ocellocular line; clypeus convex, punctured laterally, apical margin truncate; basal flagellar joints short (antennæ wanting beyond fifth joint); scutum uniformly punctured; punctuation of scutellum, metanotum, and propodeum like female but sparser; mesepisternum very coarsely punctured; pygidium shining, sparsely punctured, obtusely angled apically; abdomen punctured like female. Colored like female except that in some lights there seems to be a sparse grayish pile on sides of thorax.

Type locality.—Puerto Princesa, Palawan.

Allotype locality.—Baguio, Luzon.

Type.—Catalogue No. 23583, United States National Museum.

LUZON, Mountain Province, Baguio (*W. Robinson*) 1 male, allotype. PANAY, Antique Province, Culasi, June, 1918 (*McGregor*) 1 female, paratype. PALAWAN, Puerto Princesa (*Baker*) 1 female.

Scolia (Triscolia) bellina sp. nov.

Closely allied to *Scolia bella*, but smaller, the wings bronzy, the longer calcarium of hind tibia half as long as basitarsus, etc.

Female.—Length, 13 millimeters; length of anterior wing, 10 millimeters. Head large, as wide as thorax, posterior orbits as broad as greatest transverse diameter of eye, shining; frons convex and together with vertex and occiput with rather small, well-separated punctures; ocelli small; postocellar line half as long as the ocellocular line; oblique ridges above antennæ narrow; clypeus shining, practically impunctate, convex medianly, the apical median margin depressed, and rounded; antennæ short, shining, apical flagellar joints punctured, apical joint truncate, shorter than two preceding; pronotum rounded, impunctate medianly, uniformly punctured laterally; tegulæ, except basally, impunctate; scutum uniformly covered with rather large punctures; scutellum, metanotum, and dorsal part of propodeum (except impunctate inner half of lateral areas) with distinct, rather large punctures; posterior face of propodeum punctured like the dorsal surface except more sparsely so; sides of propodeum with small, well-separated punctures, separated from the dorsal surface by a distinct carina, calcaria of hind tibiæ stout, the longer one-half as long as basitarsus; abdomen shining, very sparsely punctured, the apical segments more closely so; first tergite short, without carinæ or tubercules, its anterior face with small distinct punctures; pygidium shining, sparsely punctured, apical margin rounded; hypopygidium with small lateral spines, median lobe truncate. Black, basal tergites with a bluish reflection; hair sparse and black; wings uniformly deep bronzy.

Male.—Length, 11 millimeters; length of anterior wing, 9 millimeters. Agrees closely with the female. Head of normal size; ocellocular line one and one-half times as long as postocellar line; antennæ shorter than head and thorax, the apical joint obliquely truncate and but little longer than the preceding; longer calcarium of hind tibia not half as long as basitarsus; pygidium and hypopygidium shining, sparsely punctured, their apical margins obtusely angled. Color as in female, except that the legs and underparts of thorax have some of the hairs whitish.

Type locality.—Davao, Mindanao.

Type.—Catalogue No. 23584, United States National Museum.

LUZON, Tayabas Province, Malinao (*Baker 5230*) 1 male paratype. MINDANAO, Davao (*Baker 6921*) 1 female, (*Baker 6907*) 1 male.

Scolia (Scolia) auripennis Lepeletier.

Recorded from the Islands but not in the Philippine collection before me.

Scolia (Scolia) erratica Smith.

> *Scolia erratica* SMITH, Cat. Hym. Brit. Mus. 3 (1855) 88; TURNER, Ann. Mag. Nat. Hist. VIII 8 (1911) 619.
>
> *Scolia molesta* SAUSSURE and SICHEL, Cat. Spec. Gen. Scolia (1864) 111.

The specimens assigned to this species agree well with Saussure's account and are easily distinguished from *Scolia westermanni* by the sparse punctuation of the propodeum and the shorter antenna of the male.

LUZON, Laguna Province, Los Baños (*Baker 832*) 1 female; Mount Maquiling, 1 male. PANAY, Antique Province, Culasi, June 1, 1918 (*McGregor*) 1 male.

Scolia (Scolia) westermanni Saussure.

> *Scolia westermanni* SAUSSURE, Ann. Soc. Ent. France III 6 (1858) 212; TURNER, Ann. Mag. Nat. Hist. VIII 8 (1911) 619.
>
> *Scolia erratica* SAUSSURE and SICHEL, Cat. Spec. Gen. Scolia (1864) 111.

A single male collected by B. Arce and under accession No. 1591, Bureau of Agriculture, P. I.

Scolia (Scolia) manilae Ashmead.

There is practically no doubt that this species was first described by Smith under the name *Scolia modesta*, but inasmuch as none of the females before me have "a round macula" on the third segment (the mark when present being an oval or elongate spot) and none of the males agree with Smith's description in having the scutellum, metanotum, and propodeum marked with yellow, it seems desirable to delay synonymizing Ashmead's name until Smith's type can be examined.

Most of the specimens of this common species show very little variation. One female from Los Baños, however, has the abdomen entirely without yellow marks, but two other females from the same locality (one under Baker No. 1709) have the marks of the abdomen reduced to a varying degree thus connecting this single specimen with the others. The mark on the third tergite varies some in size and shape. Two males have the abdominal marks larger than usual but otherwise do not differ. One male, which may be somewhat immature, has the second and third tergites slightly reddish.

LUZON, Mountain Province, Baguio (*W. Robinson*) (*Baker*): Laguna Province, Los Baños (*Baker 1708, 1709, 1710, 1836*): Union Province, Bauang (*Baker 4963*): Manila (*W. A. Stanton*). NEGROS, May, 1911 (*C. V. Piper*). LEYTE, Tacloban (*Baker*). PANAY, Antique Province, Culasi, June, 1918 (*McGregor*). MINDANAO, Davao (*Baker 6906*); Dapitan (*Baker 3194*). PALAWAN, Puerto Princesa (*Baker*).

Scolia (Scolia) modesta Smith.

See above remarks under *Scolia manilae* Ashmead. From the description the specimens described by Smith can be separated from *manilae* in the female by "a round macula," on the third tergite, and in the male by the presence of yellow marks on the scutellum, metanotum, and propodeum.

Scolia (Scolia) quadripustulata Fabricius.

This species has been recorded from the Islands but is not in the material before me. The typical form has four ferruginous or yellowish marks on the abdomen; the wings are "nigro-chalybeis," and the head and thorax are almost impunctate. The hair is described as black. Some varieties with the abdomen entirely black have been described, and it is possible that the record of the species occurring in the Islands is based on an erroneous identification. Length, 15 to 20 millimeters.

Scolia (Scolia) megacephala sp. nov.

The large head allies this species with *Scolia cephalotes* Burmeister, but the black legs will readily distinguish it from that species. Disregarding the head it seems more closely allied to *S. redtenbacheri* Saussure. The large head seems to ally this species with the species of *Triscolia* with large heads.

Female.—Length, 21 millimeters; length of anterior wing, 17 millimeters. Head large, as wide as thorax, shining; vertex, occiput, and cheeks very sparsely punctured; posterior orbits somewhat broader than greatest transverse diameter of eye; clypeus shining, with large, separated punctures which are practically wanting on convex median portion, the apical margin depressed medianly and produced into a broad truncate lobe;

an oblique rounded ridge above and inside of each antennal fovea; front convex, with large sparse punctures; lateral ocelli small; ocellocular line one and one-half times as long as postocellar line; flagellum punctured, the apical joint truncate and not as long as two preceding; pronotum rounded, uniformly punctured; tegulæ with a few punctures; scutum shining, with large, separate punctures which are wanting in a rather small V-shaped area; scutellum and metanotum shining, uniformly punctured; propodeum emarginate posteriorly, dorsally with distinct punctures which are uniform except for polished, somewhat triangular-shaped areas at base of lateral area; posterior face of propodeum sparsely punctured, the median portion with very few punctures; sides of propodeum with small separated punctures; mesepisternum coarsely reticulate-punctate; posterior calcaria simple, the longer one not quite half as long as basitarsus; abdomen shining, very sparsely punctured; first tergite subcampanulate, without tubercules or carinæ, its anterior face rather closely punctured; second sternite subtuberculate in basal middle; pygidium rather narrowly rounded apically, with rather close, irregular punctures; hypopygidium with lateral angles rather small and narrow, median lobe trapezoidal in outline. Black, basal tergites with a distinct violaceous reflection; hair black; wings deep violaceous to apex.

Type locality.—Mount Maquiling, Laguna, Luzon.

Type.—Catalogue No. 23585, United States National Museum.

LUZON, Mountain Province, Baguio (*Baker*) 1 female: Laguna Province, Mount Maquiling (*Baker*) 2 females (one the type). PANAY, Antique Province, Culasi, May 13, 1918 (*McGregor*).

Scolia (Scolia) propodealis sp. nov.

Evidently allied to *Scolia carbonaria* Saussure and *S. redtenbacheri* Saussure but differs from the former in having both calcaria of hind tibiæ simple and from the latter in larger size and more sparsely and finely punctured thorax.

Female.—Length, 25 millimeters; length of anterior wing, 24 millimeters. Clypeus flat, finely granular and with a few large punctures basally and an interrupted row a short distance before margin, the anterior margin broadly, roundly, slightly produced medianly; front with a transverse depression medianly, below which is a dorsoventral impressed line; head shining, not as wide as thorax, posterior orbits not swollen, as broad as greatest transverse diameter of eye; front and vertex with a few large punctures; postocellar line about half as long as the ocellocular line; antennæ stout, the apical joint truncate and as long as two preceding; pronotum rounded and with uniform punctures which are separated by a distance somewhat greater than their diameter; tegulæ with quite a few punctures; scutum polished medianly; laterally with well-separated punctures; scutellum and metanotum with rather close punctures; propodeum shining, deeply emarginate posteriorly, the central area dorsally and posteriorly and the sides of the lateral areas dorsally with rather small, well-separated punctures; sides of thorax shining, mesepisternum punctured like dorsal part of propodeum; posterior calcaria simple, the longer one somewhat more than half as long as basitarsus; first tergite without a tubercule or carina, campanulate, more closely punctured at base above; abdomen shining, very sparsely punctured; pygidium rounded, coarsely, irregularly punctured; hypopygidium sharply angled laterally, medianly produced into a broad, rounded, nearly parallel-sided lobe. Black, propodeum and basal tergites with a slight violaceous reflection; hair black; wings violaceous, beyond the venation more brownish.

Type locality.—Mount Maquiling, Laguna, Luzon.

Type.—Catalogue No. 23596, United States National Museum.

Described from one female received from C. F. Baker.

Scolia (Scolia) luzonensis sp. nov.

The paler wings and pale hair on the sides of the thorax readily separate this from other Philippine species. It is possibly allied to *Scolia melanosoma* Saussure.

Female.—Length, 22 millimeters; length of anterior wing, 17 millimeters. Head normal, not as wide as thorax and with narrow posterior orbits, closely punctured, except for a transverse impunctate area behind ocelli and the more widely separated punctures on the front; clypeus uniformly punctured, convex medianly, the apical margin depressed, rounded medianly and with transverse aciculations; a small shining tubercule between bases of antennæ; a narrow, oblique flange above each antennal fovea; front with a low, incomplete, transverse ridge which medianly is impressed by a line so as to form a broad V; area surrounding ocelli more sparsely punctured; ocelli of equal size, the postocellar line less than half as long as the ocellocular line; antennæ stout, the flagellum punctured, the apical joint truncate and not quite as long as the two preceding; pronotum rounded, closely covered with long, piceous hair which obscures the surface, the posterior margin with a fringe of short, yellowish hair; tegulæ impunctate; scutum and scutellum closely punctured laterally, medianly impunctate; metanotum uniformly, rather sparsely punctured; propodeum nearly truncate, smooth shining, with a group of close punctures at base of median area and on lateral area just before middle; sides of propodeum nearly uniformly punctured, sharply separated from dorsal and posterior aspect; posterior calcaria yellowish, simple, the longer one more than half as long as basitarsus; abdomen shining, sparsely punctured; first tergite short, without a tubercle or carina, its anterior surface sculptured like the dorsal; base of second sternite rounded; pygidium rounded apically, densely clothed with black bristles; hypopygidium broadly rounded, the lateral spines sharp, but not conspicuous. Black; tegulæ yellowish; hair long, that on head (in part), thorax above and abdomen (in part) black; hair of scape and a patch below antennal foveæ slightly yellowish, that of back of head whitish; hairs of legs, sides of thorax, first tergite, apical margin of second segment, and apical margin of third sternite whitish; tarsi piceous; wings brownish hyaline, with a faint purplish sheen; venation brown.

Type locality.—Baguio, Luzon.

Type.—Catalogue No. 23587, United States National Museum. Described from one female received from W. Robinson.

Scolia (Scolia) incerta sp. nov.

This may be the male of *Scolia luzonensis* Rohwer.

Male.—Length, 18 millimeters; length of anterior wing, 17 millimeters; length of antennæ, about 10 millimeters. Head of normal size; clypeus convex, basally with a few large punctures, the anterior margin truncate; area between the antennæ closely punctured and with a small inconspicuous tubercle; frons shining, sparsely punctured, with a transverse median depression which is angulate medianly to meet the narrow depressed area in front of anterior ocellus; vertex and occiput shining, practically impunctate; postocellar line longer than the ocellocular line; antennæ longer than head and thorax, scape shining, punctured; flagellum opaque, granular, the third joint slightly longer than fourth, apical joint slightly curved, obliquely truncate apically and somewhat longer than the preceding; thorax shining, sparsely punctured; calcaria yellowish, the longer one on the hind tibia more than half as long as basitarsus; abdomen shining, sparsely punctured; first segment subcampanulate, longer than the second, pygidium and hypopygidium triangular apically. Black, thorax dorsally with a faint bluish reflection, basal tergites cœruleous; tegulæ ferruginous; clypeus except margins, mandibles, line on pronotum laterally (interrupted in type and wanting in one paratype), anterior coxæ beneath, femora, and the four anterior tibiæ beneath yellowish; clothed with long whitish hair, sides of thorax with whitish pile in addition; wings brownish hyaline with a slightly yellowish reflection; venation brown.

In one paratype the lower inner eye margins are narrowly yellow.

Type locality.—Mount Maquiling, Laguna, Luzon.

Type.—Catalogue No. 23588, United States National Museum.

LUZON, Laguna Province, Mount Maquiling (*Baker 4962*) 1 male (type), (*Baker 3190*) 1 male: Bataan Province, Lamao (*C. V. Piper*).

Genus **LIACOS** Guérin

This genus, which in habitus closely resembles *Scolia*, is represented by one species.

Liacos (Triliacos) analis (Fabricius).

A medium-sized black species with the two apical segments densely clothed with reddish hair. Wings blackish with a faint violaceous reflection basally.

LUZON, Laguna Province, Los Baños (*Baker*) 2 females; Mount Maquiling (*Baker 1541*) 2 males: Bataan Province, Lamao (*C. V. Piper*) 1 male, (*C. R. Jones*) 1 male, under Bureau of Agriculture accession No. 849.

Genus **CAMPSOMERIS** Lepeletier

All the species of this genus which occur in or have been reported from the Islands belong to the subgenus *Campsomeris* and have only two closed cubital cells. In this genus there is a marked antigeny, and therefore it is very difficult to associate the sexes. To add to this difficulty the species have not been fully described, thus always leaving some doubt as to the correctness of the identification. It seems to me that when more material from the Oriental Region has been studied additional species will have to be described and that some of the forms which are at present treated as unnamed varieties will be found to be sufficiently distinct to deserve names.

The following key includes only species represented in the Philippine material before me, omitting the species *Campso-*

meris grossa (Fabricius) and *C. lindenii* Lepeletier which have been reported from the Islands.

Key to the Philippine species of Campsomeris.

1. Females .... 2.
   Males .... 6.
2. Abdomen, including hair, entirely black........ 3.
   Abdomen with at least pale hair bands........ 4.
3. Body, including hair, entirely black........ C. reticulata (Cameron).
   Body black, hair of pronotum and back of head ferruginous; hair of front of head whitish........ C. aureicollis Lepeletier.
4. Abdomen black, with whitish hair bands on each segment; hair of thorax white; wings hyaline, distinctly darker apically.
   C. annulata (Fabricius).
   Abdomen with apical margins of tergites yellow........ 5.
5. Hair of head, thorax, and femora reddish........ C. aurulenta (Smith).
   Hair of head, thorax, and femora whitish........ C. aurulenta variety.
6. Body entirely black........ 7.
   At least yellow markings on abdomen........ 8.
7. Dorsal surface of propodeum with dense sericeous pile; abdomen distinctly purplish; wings slightly paler........ C. luctuosa (Smith).
   Dorsal surface of propodeum without dense sericeous pile; abdomen bluish........ C. reticulata (Cameron).
8. Wings blackish; hair (not pile) of thorax black; yellow of abdomen reduced to elongate spots on second and third tergites.
   C. luctuosa (Smith).
   Wings hyaline to brownish; hair of thorax pale; yellow of abdomen forming bands .... 9.
9. Markings yellowish; wings distinctly yellowish; pubescence of thorax yellowish........ C. aurulenta (Smith).
   Markings whitish; wings dusky hyaline; pubescence of thorax gray.. 10.
10. Abdominal bands broad, that of the second (also third) with a U- or V-shaped emargination medially; clypeus black, yellow at sides.
    C. annulata (Fabricius).
    Abdominal bands narrow, that on the second (and third less distinctly) dilated at the sides; clypeus yellow, with a small black spot medially........ C. species?

Campsomeris (Campsomeris) luctuosa (Smith).

A male from Mindanao collected by Miss Ludlow and one from Mount Maquiling, Laguna, Luzon, collected by C. F. Baker. The specimen from Mindanao has narrow, elongate spots on sides of second and third tergites.

Campsomeris (Campsomeris) reticulata (Cameron).

LUZON, Mount Banahao (*Baker 2727, 6910*) males: Bataan Province, Lamao, 1911 (*C. V. Piper*) female. PANAY, Antique Province, Culasi, June, 1918 (*McGregor*) female. MINDANAO, Davao (*Baker 6909*) male: Misamis Province, Cagayan (*Baker 3796*) male.

Campsomeris (Campsomeris) aureicollis Lepeletier.

All of the Philippine specimens before me have the hair of the anterior part of the thorax reddish, and for the time being, at least, it seems advisable to use the name *aureicollis* as a specific one. Ashmead in 1904 [1] added the name *albicollis* to the list of Philippine species, but as none of the forms have the hair of the collar pale the name *albicollis* should be removed until specimens of this variety are collected in the Islands.

LUZON, Bulacan Province, Baliuag (*B. Arce*), Bureau of Agriculture accession No. 1590: Laguna Province, Mount Maquiling (*Baker*): Manila, July 14, 1901. PANAY, Antique Province, Culasi, June, 1918 (*McGregor*). MINDANAO, May, 1911 (*C. V. Piper*); Dapitan (*Baker 3187*). All females.

Campsomeris (Campsomeris) species?

A number of males, which run to *Campsomeris grossa* in Bingham's key, are much smaller and represent a species which until further study cannot be identified. They may be the male of the female considered as a variety of *aurulenta*.

LUZON, Mountain Province, Baguio (*Baker*): Laguna Province, Los Baños (*Baker*); Mount Maquiling (*Baker*); Mount Banahao (*Baker 4961*). MINDANAO, Davao (*Baker 6908*). All males.

Campsomeris (Campsomeris) annulata (Fabricius).

LUZON, Pangasinan Province, Rosales (*C. R. Jones*), Bureau of Agriculture accession Nos. 379, 380: Laguna Province, Los Baños (*Baker 1431*) male. PANAY, Antique Province, Culasi, June, 1918 (*McGregor*). LEYTE, Tacloban (*Baker 3794*) male. MINDANAO, Iligan (*Baker*) female; Davao (*Baker 6912*) female, male; Cagayan (*Baker 3795*) male.

Campsomeris (Campsomeris) aurulenta (Smith).

This species is evidently allied to *Campsomeris iris* Lepeletier where both the female and male run in Bingham's key to the species of British India.

LUZON, Mountain Province, Baguio (*W. Robinson, C. V. Piper*) females: Bataan Province, Lamao (*C. R. Jones*), Bureau of Agriculture accession No. 1750; Laguna Province, Los Baños (*Baker 522, 1834*) female, male; Mount Maquiling (*Baker 1835, 1363*) female, male; Mount Banahao (*Baker*) male. PANAY,

[1] Proc. U. S. Nat. Mus. 28 (1905) 152.

Antique Province, Culasi (*McGregor*) female, male. MINDANAO, Davao (*Baker*) male.

Campsomeris (Campsomeris) aurulenta Smith variety.

A single female from Baguio, Benguet (*Baker*) is smaller than the typical form and has the hair of the head, thorax, and femora whitish and much sparser. The abdominal bands are somewhat broader, that of the third segment being broadly produced medianly and with a wide angulate emargination. It may be that more material will make it desirable to name this form.

Campsomeris (Campsomeris) lindenii Lepeletier.

This species, which has usually been considered as a synonym of *Campsomeris quadrifasciata* (Fabricius), has been reported from the Islands by Ashmead. It is not represented in any of the material I have seen from there, and the following characters are taken from the description by Bingham in the Fauna of British India:

Female.—Length, 17 to 22 millimeters. Head and thorax sparsely punctured, disk of mesonotum smooth; black, pubescence fulvous to white; wings flavo-hyaline, with a fuscous spot at apex.

Male.—Length, 17 to 22 millimeters. Black; apical margin of clypeus, posterior margin of pronotum, two spots on the scutellum, and transverse fasciæ on the posterior margins of the first four or five tergites yellow; abdominal fasciæ emarginate anteriorly; wings light flavo-hyaline.

Campsomeris (Campsomeris) grossa Fabricius.

This species has been recorded from the Islands but is not in the collections received from there. The female is 25 to 30 millimeters long; black with the pubescence on the head and thorax fuscous, the abdomen with narrow, whitish hair bands. The wings are fusco-hyaline. The male is about 23 millimeters long, with broad transverse bands on the apical margins of the first four tergites yellow; the clypeus is black except for the narrow apical margin and a median spot which are yellow.

Subfamily ELIDINÆ

Only one representative of this subfamily is known from the Islands. The subfamily is readily separated from the Scoliinæ by the cleft claws; the entire (or nearly entire) eyes; the presence of a single spine, which curves dorsally, at the end of the male abdomen; the two calcaria on the intermediate tibia; the simple tongue; and the characteristic habitus. Many of the species of this subfamily lack the long hair that is characteristic of the Scoliinæ.

Elis (Mesa) tricolor longiceps Turner.

The black thorax and abdomen, red head, and dark wings make it very easy to recognize this striking species.

The females agree exactly with Turner's description of the subspecies, and the males differ from his description of *Mesa crassepunctata* as follows: Head distinctly narrowed behind the eyes; pronotum without obscure transverse striæ, but polished and very sparsely punctured; first tergite longer than the second; abscissa of radius not one-fourth shorter than the third; first recurrent received by the second cubital just before the middle; length, 16 millimeters. The males may have been described by Bingham under the name *Myzine dimidiaticornis*, but the second abscissa of the radius is hardly as long as the third.

LUZON, Mountain Province, Baguio (*W. Robinson*) 1 male, (*Baker*) 1 male: Laguna Province, Mount Maquiling (*Baker*) 2 females.

HIGHER BASIDIOMYCETES FROM THE PHILIPPINES AND THEIR HOSTS, V

By Otto A. Reinking

Plant Pathologist of the College of Agriculture and the Agricultural Experiment Station, Los Baños

Numbers I to IV of this series, on Higher Basidiomycetes from the Philippines and their hosts, show that a large amount of the destruction to forest trees and construction timber is due to fungi. Heretofore, the general belief has been that termites and other insects caused the greatest damage to woods in the Malay Archipelago. Fungi are widespread and are continually working under a variety of conditions. The destruction caused by them is greatest in damp situations and is particularly severe during the rainy season. The ravages of termites, on the other hand, occur only under certain conditions and in definite localities. According to the published lists, individual hosts may be attacked by at least ten different fungi. The damage done to certain structural timbers has been great. The proper kinds of wood to be used for building purposes will consequently depend upon the locality and the use to which they are to be put. As an example, guijo, *Shorea guiso* (Blanco) Blume, because it is attacked by a variety of fungi, should not be used for planking on a bridge which is exposed to rain and to high moisture conditions. Molave, *Vitex parviflora* Juss., is much better for this purpose, as under the same conditions it is not so severely invaded by fungi. It seems probable, because of this fungus attack, that a preservative treatment of all woods used in exposed places would be beneficial.

The following list of fungi is a continuation of the identifications of the higher Basidiomycetes collected on Mount Maquiling, in the vicinity of Los Baños, Laguna Province, Luzon, and in Mindanao. The collections have been made either by me or by students under my direction. I am indebted to Messrs. E. E. Schneider, J. M. Pascual, A. Barros, and L. Adona of the Bureau of Forestry for wood identifications. The majority of the determinations of fungi given in this list were made by C. G. Lloyd, of Cincinnati, Ohio. The species of fungi are grouped according to the classification of Engler and Prantl, with the host and the collector under each. The numbers refer to the College of Agriculture fungus herbarium.

AURICULARIACEAE

AURICULARIA Bulliard

AURICULARIA AURICULA-JUDAE (Linn.) Schroet.

Annona muricata Linn., college ground, Los Baños, *Collado 5256*, on dead branches.

Annona reticulata Linn., college farm, Los Baños, *Reinking 6400*, on dead branches.

Artocarpus sp., Mount Maquiling, *Soriano 5616*, on dead branches.

Bixa orellana Linn., Mount Maquiling, *Reinking 3928*, on dead branches.

Clerodendron minahassae Teysm. et Binn., Mount Maquiling, *Reinking 4078*, on dead branches.

Ficus sp., Mount Maquiling, *Paulino 5671*, on decaying wood.

Gliricidia sepium (Jacq.) Steud., Mount Maquiling, *Reinking 6254*, on decaying wood.

Hibiscus sp., Mount Maquiling, *Reinking 4297*, on dead twigs.

Jatropha curcas Linn., Mount Maquiling, *Reinking 4283*, on dead branches.

Lansium domesticum Correa, Mount Maquiling, *Sulit 5089*, on dead branches.

Leucaena glauca Benth., Mount Maquiling, *Reinking 6427*, on dead branches.

Mangifera indica Linn., college ground, Los Baños, *Hernandez 957*, on dead branches.

Manihot utilissima Pohl, college ground, Los Baños, *Goco 4072*, on dead wood.

Parameria sp., Mount Maquiling, *Reinking 3915*, on dead branches.

Pterocarpus indicus Willd., Mount Maquiling, *Reinking 6481*, on dead branches.

Streblus asper Lour., Mount Maquiling, *Reinking 4417*, on dead twigs.

Strychnos nux-vomica Linn., Mount Maquiling, *Reinking 6448*, on dead branches.

Triumfetta bartramia Linn., Mount Maquiling, *Reinking 3951*, on dead branches.

AURICULARIA BRASILIENSIS Fr.

Prosopis vidaliana Naves, Mount Maquiling, *Reinking 6494*, on dead branches.

AURICULARIA CORNEA Ehrenb.

Aglaia sp., Mount Maquiling, *Reinking 3923*, on dead branches.

Albizzia acle (Blanco) Merr., Mount Maquiling, *Reinking 4218*, on dead twigs.

Aleurites moluccana (Linn.) Willd., Mount Maquiling, *Pañganiban 5130*, on dead branches.

Allaeanthus luzonicus (Blanco) F.-Vill., Mount Maquiling, *Reinking 4279*, on dead branches.

Annona muricata Linn., Los Baños, *Reinking 3779*, on dead wood.

Annona reticulata Linn., college ground, Los Baños, *Reinking 4232*, on dead twigs.

Clerodendron minahassae Teysm. et Binn., Mount Maquiling, *Reinking 4340*, on dead twigs.

Eriobotrya japonica Lindl., Mount Maquiling, *Reinking 6163*, on dead branches.

Erythrina fusca Lour., college ground, *Reinking 4402*, on dead twigs.

Ficus hauili Blanco, Mount Maquiling, *Reinking 4425*, on dead twigs.

Jatropha curcas Linn., Mount Maquiling, *Reinking 4097*, on dead wood.

Melochia arborea Blanco, Mount Maquiling, *Reinking 4236*, on dead twigs.

Mussaenda philippica Rich, Mount Maquiling, *Reinking 4438*, on dead twigs.

Psidium guajava Linn., college ground, Los Baños, *Reinking 4021*, on dead wood.

Pterocarpus echinatus Pers., Mount Maquiling, *Reinking 4292*, on dead branches.

Sapindus saponaria Blanco, Mount Maquiling, *Reinking 4247*, on dead twigs.

Solanum grandiflorum Ruiz et Pav., Mount Maquiling, *Reinking 4322*, on dead twigs.

Solanum verbascifolium Linn., Los Baños, *Reinking 3766*, on dead wood.

Streblus asper Lour., Los Baños, *Reinking 3772,* on dead wood.

Tecoma stans (Linn.) Juss., Mount Maquiling, *Reinking 6441,* on dead branches.

Theobroma cacao Linn., Los Baños, *Reyes 3907,* on dead branches.

Trema amboinensis (Willd.) Blume, Mount Maquiling, *Reinking 4098,* on dead wood.

Urena lobata Linn., Mount Maquiling, *Reinking 4039,* on dead branches.

Voacanga globosa (Blanco) Merr., Mount Maquiling, *Reinking 6498,* on dead branches.

AURICULARIA MOELLERI Lloyd.

Anisoptera sp., Mount Maquiling, *Reinking 3313,* on dead wood.

Ficus sp., Mount Maquiling, *Baybay 3404,* on dead wood.

AURICULARIA POLYTRICHA (Mont.). Sacc.

Annona squamosa Linn., college ground, Los Baños, *Pañganiban 5511,* on dead branches.

Leucaena glauca Benth., Mount Maquiling, *Soriano 5625,* on dead branches.

TREMELLACEAE

TREMELLA Dillenius

TREMELLA sp.

Probably *Ficus* sp., Mount Maquiling, *Cazeñas 3307,* on dead wood.

TREMELLA FUCIFORMIS Berk.

Caesalpinia pulcherrima (Linn.) Sw., Mount Maquiling, *Reinking 6373,* on dead branches.

Shorea guiso (Blanco) Blume, Manila, *Reinking 9701,* on dead wood.

TREMELLA SAMOENSIS Lloyd.

Mount Maquiling, *Reinking 9803,* on dead wood.

DACRYOMYCETACEAE

GUEPINIA Fries

GUEPINIA FISSA Berk.

Cassia siamea Lam., Davao, *Ademesa 6059,* on rotten trunk.

Sapium merrillianum Pax et K. Hoffm., Mount Maquiling, *Marilao 9720,* on dead wood.

Vitex parviflora Juss., Los Baños, *Moncerate 6021,* on railway ties.

GUEPINIA SPATHULATA Schw.

Bambusa sp., Mount Maquiling, *Reinking 5069,* on dead culms.

Gliricidia sepium (Jacq.) Steud., Mount Maquiling, *Reinking 6253,* on decaying wood.

Leucaena glauca Benth., Mount Maquiling, *Reinking 6266,* on dead branches.

THELEPHORACEAE

CORTICIUM Persoon

CORTICIUM sp.

Bambusa sp., college campus, Los Baños, *Marquez 3389,* on dead culms.

Gliricidia sepium (Jacq.) Steud., Los Baños, *Fello 9716,* on dead wood.

Leucaena glauca Benth., Mount Maquiling, *Nano 9342,* on dead wood.

Polyalthia sp., Mount Maquiling, *Serrano 9772,* on dead wood.

Shorea guiso (Blanco) Blume, Mount Maquiling, *Ferrer 9765,* on dead wood.

HYMENOCHAETE Léveillé

HYMENOCHAETE ROSEA Lloyd.

Quercus sp., Mount Maquiling, *Marilao 9634,* on dead wood.

STEREUM Persoon

STEREUM sp.

Bambusa sp., Mount Maquiling, *Habaluyas 9620,* on dead culms.

STEREUM AURISCALPIUM Lloyd.

Mount Maquiling, *Reyes 9656,* on the ground.

STEREUM ELEGANS Meyer.

Mount Maquiling, *Sison 9715,* on the ground.

STEREUM FELLOI Lloyd.

Sapium merrillianum Pax et K. Hoffm., Mount Maquiling, *Fello 9738,* on dead wood.

STEREUM INVOLUTUM Kl.

Probably Annonaceae, college campus, Los Baños, *Pañganiban 3356.*

STEREUM NIGROPUS Lloyd.

Ficus sp., Mount Maquiling, *Pañganiban 3379,* on dead wood.

STEREUM OSTREUM Nees.

Probably *Leucaena glauca* Benth., Mount Maquiling, *Mendoza 3396,* on dead wood.

STEREUM PUSILUM Berk.

Los Baños, *Abisamis 9694,* on the ground.

STEREUM SPECTABILE Kl.

Probably *Quercus* sp., San Antonio, Los Baños, *Esguera 375,* on dead wood.

CLADODERRIS Persoon

CLADODERRIS INFUNDIBULIFORMIS Kl.

Ficus sp., Mount Maquiling, *Reyes 749,* on dead wood.

CYPHELLA Fries

CYPHELLA FULVODISCA Cooke.[1]

Ficus sp., Mount Maquiling, *Sanches 9749,* on dead wood.

SOLENIA Hoffman

SOLENIA GLOBOSA Lloyd.

Ficus sp., Mount Maquiling, *Reinking 9784,* on dead wood.

CLAVARIACEAE

PISTILLARIA Fries

PISTILLARIA sp.

Alstonia sp., Mount Maquiling, *Mendoza 3301,* on dead wood.

PTERULA Fries

PTERULA ACICULAE Lloyd.

Ficus sp., Mount Maquiling, *Reinking 3330,* on dead wood.

PTERULA INCISA Lloyd.

Mount Maquiling, *Obias 9687,* on dead wood.

PTERULA MANNII Lloyd.

Mount Maquiling, *Sanches 9795,* on soil.

PTERULA TAXIFORMIS Mont.

Bambusa sp., Los Baños, *Habaluyas 9691,* on dead culms.

LACHNOCLADIUM Léveillé

LACHNOCLADIUM GENICULATUM Lév.

Mount Maquiling, *Sanches 9798,* on dead wood.

HYDNACEAE

PHLEBIA Fries

PHLEBIA REFLEXA Berk.

Zizyphus sp., Mount Maquiling, *Fello 9737,* on dead wood.

[1] Incorrectly spelled as Cyphella fusco-disca Cooke in Reinking, Otto A., Higher Basidiomycetes from the Philippines and their hosts, II, Philip. Journ. Sci. 16 (1920) 170.

IRPEX Fries

IRPEX sp.

Probably *Ficus* sp., college campus, Los Baños, *Reinking 3308,* on dead wood.

IRPEX FLAVUS Kl.

Bambusa vulgaris Schrad., college campus, Los Baños, *Reyes 4137,* on dead culms.

Leucaena glauca Benth., Mount Maquiling, *Sarmiento 5174,* on dead branches.

GRAMMOTHELE Berkeley et Curtis.

GRAMMOTHELE MAPPA Berk.

Ficus sp., Mount Maquiling, *Cazeñas 991,* on dead wood.

POLYPORACEAE

MERULIUS Haller

MERULIUS CONSIMILIS Lloyd.

Bambusa sp., Los Baños, *Habaluyas 9768,* on dead culms.

PORIA Persoon

PORIA sp.

Delonix regia Raf., Mount Maquiling, *Nacion 9777,* on dead wood.

Ficus sp., Mount Maquiling, *Ferrer 9642,* on dead wood.

Leucaena glauca Benth., Mount Maquiling, *Caray 9631,* on dead wood.

Mallotus sp., Mount Maquiling, *Abisamis 9728,* on dead wood.

Parkia timoriana (DC.) Merr., Mount Maquiling, *Bacol 9800,* on dead wood.

Probably *Shorea* sp., college campus, Los Baños, *Baybay 3342,* on dead wood.

PORIA ESPIMILTINA Berk.

Possibly *Shorea* sp., Mount Maquiling, *Sanches 9781,* on dead wood.

PORIA FULIGO Berk.

Mallotus sp., Mount Maquiling, *Rocafort 9751,* on dead wood.

PORIA SETULOSA P. Henn.

Mallotus sp., Mount Maquiling, *Ricafort 9751,* on dead wood.

FOMES Fries

FOMES APPLANATUS Pers.

Anisoptera sp., Kuruan, Zamboanga, *Babao 450,* on decaying wood.

Cocos nucifera Linn., Santa Cruz, *Reyes 2955*, on dead trunk.

Dipterocarpus, Mount Banahao, *Reinking 4187*, on decaying wood.

Leucaena glauca Benth., Mount Maquiling, *Ferrer 9713*, on dead branch.

Shorea sp., Zamboanga, *Tecson 456*, on decaying wood.

Tamarindus indica Linn., San Antonio, Los Baños, *Reyes 4130*. on dead trunk.

FOMES CINEREUS Rick.

Los Baños, *Abisamis 9711*, on dead wood.

FOMES GIBBOSUS Nees.

Sandoricum koetjape (Burm. f.) Merr., Santa Cruz, *Reyes 5110*, on dead stump.

FOMES KERMES Berk.

Mount Maquiling, *Caray 9782*, on dead wood.

FOMES LAMAENSIS Murr.

Mount Maquiling, *Malabanan 9802*, on dead wood.

FOMES NIGROLACCATUS Cooke.

Mount Maquiling, *Reyes 9683*, on dead wood.

POLYPORUS Micheli

POLYPORUS ANEBUS Berk.

Mount Maquiling, *Marilao 9636*, on dead wood.

POLYPORUS ANNULATUS Jungh.

Gliricidia sepium (Jacq.) Steud., Los Baños, *Zabella 9712*, on dead wood.

POLYPORUS (GANODERMUS) ASPERULATUS Murr.

Mount Maquiling, *Ferrer 9767*, on the ground.

POLYPORUS CALIGNOSUS Berk.

Possibly Euphorbiaceae, Mount Maquiling, *Libunao 9615*, on dead wood.

Mallotus sp., Mount Maquiling, *Malabanan 9801*, on dead wood.

POLYPORUS CONCHOIDES Mont.

Probably Guttiferae, Mount Maquiling, *Nantes 3395*, on dead wood.

POLYPORUS CYSTIDIOIDES Lloyd.

Mount Maquiling, *Nacion 9669*, on dead wood.

POLYPORUS (or FOMES) GIBBOSUS Nees.

Gliricidia sepium (Jacq.) Steud., Los Baños, *Abisamis 9710,* on dead wood.

POLYPORUS GRAMMOCEPHALUS Berk.

Alstonia sp., Mount Maquiling, *Reinking 3314,* on dead wood.

POLYPORUS LICNOIDES Mont.

Mount Maquiling, *Dadufalsa 9717,* on dead wood.

POLYPORUS MASTOPORUS Lév.

Zizyphus sp., Mount Maquiling, *Collado 9682,* on dead wood.

POLYPORUS OBOVATUS Jungh.

Probably *Alangium* sp., Mount Maquiling, *Malabanan 9610,* on dead wood.

POLYPORUS PERVERSUS Copel.

Probably Rubiaceae, Mount Maquiling, *Reinking 3442,* on dead stem.

POLYPORUS RHINOCEROTIS Cooke.

Mount Maquiling, *Bagui 5119,* on the ground.

POLYPORUS RHIZOPHORAE Reichard.

Los Baños waterfalls, Los Baños, *Serrano 6169,* on dead log.

POLYPORUS RIGIDUS Lév.

Annona squamosa Linn., Santa Cruz, Laguna, *Reyes 6097,* on dead bark.

Bambusa sp., college campus, Los Baños, *Paulino 5669,* on dead culms.

Cordia myxa Linn., Mount Maquiling, *Sarmiento 5656,* on dead branches.

Gliricidia sepium (Jacq.) Steud., college campus, Los Baños, *Bagui 6627,* on old post.

Mangifera indica Linn., Davao, Davao, *Ademesa 6063,* on rotten trunk.

Shorea guiso (Blanco) Blume, Mount Maquiling, *Ferrer 9765,* on dead wood.

Vitex sp., Mount Maquiling, *Reinking 6623,* on dead branches.

POLYPORUS RUGOSUS Nees.

Mount Maquiling, *Reinking 6087,* on soil.

POLYPORUS SEMILACCATUS Berk.

Celtis sp., Mount Maquiling, *Nantes 661,* on dead wood.

Lagerstroemia speciosa (Linn.) Pers., Mount Maquiling, *Manza 6598*, on dead wood.

POLYPORUS TABACINUS Mont.

Tabernaemontana pandacaqui Poir., Mount Maquiling, *Reinking 6133*, on dead branches.

POLYPORUS (GANODERMUS) WILLIAMSIANUS Murr.

Possibly Burseraceae, Mount Maquiling, *Malabanan 9698*, on dead wood.

POLYPORUS ZONALIS Berk.

Bambusa sp., Mount Maquiling, *Bagui 5107*, on dead stump.

Bambusa spinosa Roxb. (*B. blumeana* Schultes), Los Baños, *Ocfemia 4123*, on old bamboo posts.

Ficus sp., Mount Maquiling, *Reinking 3432*, on dead wood.

Leucaena glauca Benth., Mount Maquiling, *Pañganiban 5122*, on dead stump.

Mallotus sp., college campus, Los Baños, *Navera 1065*, on dead wood.

Palmae, college campus, Los Baños, *Divinagracia 3390*, on dead stem.

Polyalthia sp., Mount Maquiling, *Libunao 9769*, on dead wood.

Pterocarpus sp., Mount Maquiling, *Aquino 6636*, on dead branches.

Probably Rubiaceae, Mount Maquiling, *Baybay 3372*, on dead stem.

POLYSTICTUS Fries

POLYSTICTUS AFFINIS Nees.

Mallotus sp., Mount Maquiling, *Reinking 9679*, on dead wood.

POLYSTICTUS CERVINO-GILVUS Jungh.

Probably Burseraceae, Mount Maquiling, *Baybay 979*, on dead wood.

POLYSTICTUS CRYPTOMENIAE P. Henn.

Ficus sp., Mount Maquiling, *Baybay 751*, on dead wood.

Pometia pinnata Forst., Mount Maquiling, *Mendoza 3385*, on dead wood.

POLYSTICTUS FLAVIDUS Jungh.

Mallotus sp., Mount Maquiling, *Nacion 9780*, on dead wood.

POLYSTICTUS (or IRPEX) FLAVUS Jungh.

Acacia farnesiana (Linn.) Willd., Mount Maquiling, *Peña 5684*, on dead branches.

Bauhinia tomentosa Linn., Mount Maquiling, *Reinking 4307,* on dead twigs.

Citrus sp., Lamao experiment station, Bataan, *Reinking 5898.*

Cordia myxa Linn., Los Baños, *Babao 9793,* on dead wood.

Euphorbiaceae, Mount Maquiling, *Corrales 6617,* on dead log.

Gliricidia sepium (Jacq.) Steud., Mount Maquiling, *Reinking 6248,* on dead branches.

Mangifera indica Linn., college ground, Los Baños, *David 6109,* on dead branches.

Tamarindus indica Linn., college ground, Los Baños, *Cuzner 6475,* on dead log.

Vitex sp., Mount Maquiling, *Piquing 6567,* on dead branches.

POLYSTICTUS MELEAGRIS Berk.

Koordersiodendron pinnatum (Blanco) Merr., Mount Maquiling, *Nano 9599,* on dead wood.

POLYSTICTUS MEYENII Kl.

Aleurites moluccana (Linn.) Willd., Mount Maquiling, *Collado 5219,* on dead branches.

Possibly *Vitex* sp., Mount Maquiling, *Sison 9766,* on dead wood.

POLYSTICTUS OCCIDENTALIS Kl.

Albizzia saponaria Blume, Cabantian, Davao, *Ademesa 6042,* on dead trunk.

Gliricidia sepium (Jacq.) Steud., Mount Maquiling, *Collado 5217,* on dead branches.

Mangifera indica Linn., Los Baños, *Reyes 3910,* on dead branches.

Pithecolobium sp., Mount Maquiling, *Reinking 2970,* on dead wood.

Tamarindus indica Linn., Mount Maquiling, *Paulino 5274,* on dead wood.

POLYSTICTUS PERSOONII Mont.

Mount Maquiling, *Malabanan 9626,* on dead wood.

POLYSTICTUS SANGUINEUS Linn.

Annonaceae, Los Baños, *Piquing 5961,* on railway ties.

Bambusa sp., Mount Maquiling, *Lacson 5619,* on dead culms.

Bambusa spinosa Roxb. (*B. blumeana* Schultes), Anos, Los Baños, *Collado 5155,* on dead culms.

Cassia siamea Lam., Davao, Davao, *Ademesa 6044,* on dead branches.

Diospyros discolor Willd., college campus, Los Baños, *Reinking 4136*, on old flagpole.

Dipterocarpus sp., college campus, Los Baños, *Morada 5928*, on board.

Myristica sp., Mount Maquiling, *Mariano 9744*, on dead wood.

Neonauclea sp., Pangasinan, *Soriano 6020*, on railway ties.

Parashorea plicata Brandis, college campus, Los Baños, *Cuzner 3663*, on old board.

Pterocarpus sp., college campus, Los Baños, *Pañganiban 6650*, on old board.

Shorea philippinensis Brandis, Manila, *Barros 10499*, on piling.

POLYSTICTUS SETULOSUS (P. Henn.) Lloyd.

Ficus sp., college campus, Los Baños, *Pañganiban 3397*, on dead wood.

POLYSTICTUS SPADICEUS Bres.

Areca catechu Linn., Los Baños, *Reyes 4135*, on dead stem.

POLYSTICTUS STYRACICOLA Lloyd.

Mount Maquiling, *Malabanan 9635*, on dead wood.

POLYSTICTUS TABACINUS Mont.

Probably *Dipterocarpus* sp. or *Anisoptera* sp., Mount Maquiling, *Cazeñas 610*, on dead wood.

POLYSTICTUS VERSATILIS Berk.

Eucalyptus sp., Los Baños, *Miñano 6013*, on railway ties.

Hopea sp., Los Baños, *Iang 6030*, on railway ties.

Intsia bijuga O. Ktze., Los Baños, *Reinking 5627*, on railway ties.

Shorea guiso (Blanco) Blume, Los Baños, *Limbo 6008*, on railway ties.

Terminalia comintana (Blanco) Merr., Los Baños, *Goco 5951*, on railway ties.

Vatica sp., Los Baños, *Corrales 6027*, on railway ties.

POLYSTICTUS XANTHOPUS Fr.

Psidium guajava Linn., college ground, Los Baños, *Collado 5461*, on decaying branch.

Probably *Shorea* sp., Mount Maquiling, *Corcino 9794*, on dead wood.

POLYSTICTUS ZELANICUS Berk.

Probably *Celtis* sp., college campus, Los Baños, *Reyes 2951*, on dead wood.

TRAMETES Fries

TRAMETES ACUTA Lév.

Bambusa sp., college campus, Los Baños, *Reinking 3428*, on dead culms.

Cocos nucifera Linn., Los Baños, *Reyes 3597*, on dead trunk.

TRAMETES MEYENII Kl.

Cordia myxa Linn., Mount Maquiling, *Novero 6009*, on dead branches.

Intsia bijuga O. Ktze., Mount Maquiling, *Catalan 5681*, on decaying timber.

Leucaena glauca Benth., Mount Maquiling, *Reinking 3443*, on dead wood.

TRAMETES PERSOONII Mont.

Euphorbiaceae, Mount Maquiling, *Corrales 6614*, on dead log.

Gliricidia sepium (Jacq.) Steud., Los Baños, *Reyes 5164*, on dead trunk.

Pterocarpus indicus Willd., Mount Maquiling, *Sarmiento 5183*, on dead log.

Theobroma cacao Linn., Los Baños, *Reyes 4143*, on dead branches.

TRAMETES SERPENS Fr.

Aleurites sp., Mount Maquiling, *Reinking 9753*, on dead wood.

DAEDALEA Persoon

DAEDALEA FLAVIDA Lév.

Bambusa sp., Mount Maquiling, *Bagui 5231*, on dead stump.

Lansium domesticum Correa, Los Baños, *Reyes 3578*, on decaying wood.

Parashorea plicata Brandis, college campus, Los Baños, *Cuzner 3664*, on old board.

Terminalia comintana (Blanco) Merr., college campus, Los Baños, *Collado 2996*, on old board.

LENZITES Fries

LENZITES ACUTA Berk.

Zea mays Linn., Los Baños, *Ocfemia 3938*, on dried ears.

LENZITES DEPLANATA Klotz.

Mount Maquiling, *Manza 6074*, on dead branches.

LENZITES REPANDA Pers.

Acacia farnesiana (Linn.) Willd., Mount Maquiling, *Mangonon 5223*, on dead branches.

Bambusa spinosa Roxb. (*B. blumeana* Schultes), college campus, Los Baños, *Reyes 4138*, on dead culms.

Celtis sp., Mount Maquiling, *Catalan 5664*, on decayed log.

Probably Euphorbiaceae, college campus, Los Baños, *Reyes 2937*, on dead wood.

Gliricidia sepium (Jacq.) Steud., Mount Maquiling, *Sulit 5617*, on dead trunk.

Leucaena glauca Benth., Mount Maquiling, *Reinking 6265*, on dead branches.

Parashorea plicata Brandis, Sirio, Lami, Zamboanga, *Tecson 457*, on decaying wood.

Parkia timoriana (DC.) Merr., Mount Maquiling, *Piquing 5577*, on dead log.

Persea gratissima Gaertn., Mount Maquiling, *Ocfemia 5523*, on decaying branches.

Pithecolobium sp., Mount Maquiling, *Reyes 2972*, on dead wood.

Prosopis vidaliana Naves, Mount Maquiling, *Reinking 6496*, on dead branches.

Tamarindus indica Linn., college campus, Los Baños, *Collado 5140*, on dead branches.

LENZITES STRIATA Swartz.

Pterocarpus indicus Willd., college campus, Los Baños, *Reinking 6477*, on painted board.

Strombosia philippinensis Rolfe, Los Baños, *Aquino 6010*, on railway ties.

HEXAGONA Fries

HEXAGONA ALBIDA Berk.

Probably *Celtis* sp., Mount Maquiling, *Santos 3454*, on dead wood.

Euphorbiaceae, Mount Maquiling, *Corrales 6616*, on dead log.

HEXAGONA TENUIS Hooker.

Rapanea philippinensis (A. DC.) Mey., Mount Maquiling, *Reinking 6513*, on dead branches.

FAVOLUS Fries

FAVOLUS ALBUS Lloyd.

Ficus sp., Mount Maquiling, *Catalan 5682*, on living stump.

FAVOLUS BRASILIENSIS Fr.

Mount Maquiling, *Reyes 9690*, on dead wood.

FAVOLUS PLATYPORUS Berk.

Alstonia sp., Mount Maquiling, *Cazeñas 3423,* on dead wood.

FAVOLUS SPATHULATUS Jungh.

Diplodiscus paniculatus Turcz., Mount Maquiling, *Nacion 9665,* on dead wood.

Ophioliaceae, Mount Maquiling, *Collado 9681,* on dead wood.

FAVOLUS TENUISSIMUS Lév.

Mount Maquiling, *Sarmiento 5622,* on dead branches.

AGARICACEAE

CAMPANELLA P. Hennings

CAMPANELLA CUCULLATA Jungh.

Bambusa sp., Los Baños, *Reyes 9605,* on dead culm.

CANTHARELLA (Adans.) Linnaeus

CANTHARELLUS BUCCINALIS Mont.

Ficus sp., Mount Maquiling, *Habaluyas 9721,* on dead wood.

CANTHARELLUS INFUNDIBULIFORMIS Berk.

Ficus sp., college campus, Los Baños, *Reinking 3452,* on dead wood.

SCHIZOPHYLLUM Fries

SCHIZOPHYLLUM COMMUNE Fr.

Acacia farnesiana (Linn.) Willd., Mount Maquiling, *Catalan 5588,* on dead branches.

Aleurites moluccana (Linn.) Willd., Mount Maquiling, *Peña 5090,* on dead branches.

Anacardiaceae, college campus, Los Baños, *Pereira 5925,* on post of house.

Annona glabra Linn., college ground, Los Baños, *Corrales 5479,* on dead wood.

Bambusa sp., college campus, Los Baños, *Reinking 6648,* on dead culms.

Bambusa spinosa Roxb. (*B. blumeana* Schultes), college ground, Los Baños, *Reinking 6078,* on dead culms.

Probably Burseraceae, college campus, Los Baños, *Reinking 3409,* on dead wood.

Calamus sp., Mount Maquiling, *Ocfemia 5678,* on dead culms.

Cassia sp., Mount Maquiling, *Collado 4466,* on dead roots.

Celtis sp., Mount Maquiling, *Catalan 5664,* on decayed log.

Cordia myxa Linn., Mount Maquiling, *Salva Cruz 5191,* on dead bark.

Ficus sp., Mount Maquiling, *Reinking 6125*, on dead branches.

Ficus nota (Blanco) Merr., Mount Maquiling, *Manza 5249*, on dead branches.

Intsia bijuga O. Ktze., Manila, *Adona 10497*, on railway ties.

Probably *Koordersiodendron pinnatum* (Blanco) Merr., college campus, Los Baños, *Reyes 2935*, on dead wood.

Morus alba Linn., college farm, Los Baños, *Palo 3813*, on dead branches.

Persea gratissima Gaertn., Mount Maquiling, *Ocfemia 5532*, on dead branches.

Pterocarpus indicus Willd., Manila, *Adona 10495*, on railway ties.

Shorea mindanensis Desp., Manila, *Barros 10498*, on piling.

Spondias lutea Linn., Mount Maquiling, *Ocfemia 5476*, on dead branches.

LENTINUS Fries

LENTINUS sp.

Myristica sp., Mount Maquiling, *Marilao 9752*, on dead wood.

LENTINUS BADIUS Berk.

Bambusa sp., Los Baños, *Collado 9714*, on dead stump.

LENTINUS CRINITUS Swartz.

Barringtonia sp., Mount Maquiling, *Abisamis 9677*, on dead wood.

LENTINUS STRIGOSUS Schw.

Mallotus sp., Mount Maquiling, *Corcino 9662*, on dead wood.

Pterocymbium tinctorium (Blanco) Merr., Mount Maquiling, *Dadufalsa 9725*, on dead wood.

PANUS Fries

PANUS CLADOPHORA Berk.

Mount Maquiling, *Aquino 6632*, on dead log.

PLEUROTUS Fries

PLEUROTUS sp.

Polyscias nodosa (Blume) Seem., Los Baños, *Abisamis 9770*, on dead stem.

NIDULARIACEAE

CYATHUS Haller

CYATHUS MONTAGNEI Tul.

Agathis alba (Lam.) Foxw., Mount Maquiling, *Reinking 9700*, on dead wood.

Annonaceae, Mount Maquiling, *Habaluyas 9622*, on dead wood.

Gliricidia sepium (Jacq.) Steud., Los Baños, *Zabella 9756,* on dead wood.

CYATHUS PLICATULUS Poep.

Bambusa sp., Mount Maquiling, *Reyes 9646,* on dead culm.

Probably *Polyalthia* sp., college campus, Los Baños, *Reinking 3445,* on dead wood.

SCLERODERMATACEAE

SCLERODERMA Persoon

SCLERODERMA CEPA Pers.

College campus, Los Baños, *Reinking 6069,* on nest of termites.

FUNGI LISTED ACCORDING TO HOSTS

ACACIA FARNESIANA (Linn.) Willd.
- *Lenzites repanda* Pers., on dead branches.
- *Polystictus* (or *Irpex*) *flavus* Jungh., on dead branches.
- *Schizophyllum commune* Fr., on dead branches.

AGATHIS ALBA (Lam.) Foxw.
- *Cyathus montagnei* Tul., on dead wood.

AGLAIA sp.
- *Auricularia cornea* Ehrenb., on dead branches.

ALANGIUM sp.
- *Polyporus obovatus* Jungh., on dead wood.

ALBIZZIA ACLE (Blanco) Merr., on dead twigs.
- *Auricularia cornea* Ehrenb., on dead twigs.

ALBIZZIA SAPONARIA Blume.
- *Polystictus occidentalis* Kl., on dead trunk.

ALEURITES sp.
- *Trametes serpens* Fr., on dead wood.

ALEURITES MOLUCCANA (Linn.) Willd.
- *Auricularia cornea* Ehrenb., on dead branches.
- *Polystictus meyenii* Kl., on dead branches.
- *Schizophyllum commune* Fr., on dead branches.

ALLAEANTHUS LUZONICUS (Blanco) F.-Vill.
- *Auricularia cornea* Ehrenb., on dead branches.

ALSTONIA sp.
- *Favolus platyporus* Berk., on dead wood.
- *Pistillaria* sp., on dead wood.
- *Polyporus grammocephalus* Berk., on dead wood.

ANACARDIACEAE.
- *Schizophyllum commune* Fr., on post of house.

ANISOPTERA sp.
- *Auricularia moelleri* Lloyd, on dead wood.
- *Fomes applanatus* Pers., on decaying wood.

ANNONA GLABRA Linn.
Schizophyllum commune Fr., on dead wood.

ANNONA MURICATA Linn.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.
Auricularia cornea Ehrenb., on dead twigs.

ANNONA RETICULATA Linn.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.
Auricularia cornea Ehrenb., on dead twigs.

ANNONA SQUAMOSA Linn.
Auricularia polytricha (Mont.) Sacc., on dead branches.
Polyporus rigidus Lév., on dead bark.

ANNONACEAE.
Cyathus montagnei Tul., on dead wood.
Polystictus sanguineus Linn., on railway ties.
Stereum involutum Kl., on dead wood.

ARECA CATECHU Linn.
Polystictus spadiceus Bres., on dead stem.

ARTOCARPUS sp.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.

BAMBUSA sp.
Campanella cucullata Jungh., on dead culms.
Corticium sp., on dead culms.
Cyathus plicatulus Poep., on dead culms.
Daedalea flavida Lév., on dead stump.
Guepinia spathularia Schw., on dead culms.
Lentinus badius Berk., on dead stump.
Merulius consimilis Lloyd, on dead culms.
Polyporus rigidus Lév., on dead culms.
Polyporus zonalis Berk., on dead stump.
Polystictus sanguineus Linn., on dead culms.
Pterula taxiformis Mont., on dead culms.
Schizophyllum commune Fr., on dead culms.
Stereum sp., on dead culms.
Trametes acuta Lév., on dead culms.

BAMBUSA SPINOSA Roxb. (*B. blumeana* Schultes).
Lenzites repanda Pers., on dead culms.
Polyporus zonalis Berk., on old bamboo posts.
Polystictus sanguineus Linn., on dead culms.
Schizophyllum commune Fr., on dead culms.

BAMBUSA VULGARIS Schrad.
Irpex flavus Kl., on dead culms.

BARRINGTONIA sp.
Lentinus crinitus Swartz, on dead wood.

BAUHINIA TOMENTOSA Linn.
Polystictus flavus Jungh., on dead twigs.

BIXA ORELLANA Linn.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.

BURSERACEAE.
Polyporus (*Ganodermus*) *williamsianus* Murr., on dead wood.
Polystictus cervino-gilvus Jungh., on dead wood.
Schizophyllum commune Fr., on dead wood.

CAELSALPINIA PULCHERRIMA (Linn.) Sw.
Tremella fuciformis Berk., on dead branches.

CALAMUS sp.
Schizophyllum commune Fr., on dead stems.

CASSIA sp.
Schizophyllum commune Fr., on dead roots.

CASSIA SIAMEA Lam.
Guepinia fissa Berk., on rotten trunk.
Polystictus sanguineus Linn., on dead branches.

CELTIS sp.
Hexagona albida Berk., on dead wood.
Lenzites repanda Pers., on decayed log.
Polyporus semilaccatus Berk., on dead wood.
Polystictis zelanicus Berk., on dead wood.
Schizophyllum commune Fr., on decayed log.

CITRUS sp.
Polystictus flavus Jungh., on dead branches.

CLERODENDRON MINAHASSAE Teysm. et Binn.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.
Auricularia cornea Ehrenb., on dead twigs.

COCOS NUCIFERA Linn.
Fomes applanatus Pers., on dead trunk.
Trametes acuta Lév., on dead trunk.

CORDIA MYXA Linn.
Polyporus rigidus Lév., on dead branches.
Polystictus flavus Jungh., on dead wood.
Trametes meyenii Kl., on dead branches.
Schizophyllum commune Fr., on dead bark.

DELONIX REGIA Raf.
Poria sp., on dead wood.

DIOSPYROS DISCOLOR Willd.
Polystictus sanguineus Linn., on old flagpole.

DIPLODISCUS PANICULATUS Turcz.
Favolus spatulatus Jungh., on dead wood.

DIPTEROCARPUS sp.
Fomes applanatus Pers., on decaying wood.
Polystictus sanguineus Linn., on board.
Polystictus tabacinus Mont., on dead wood.

ERIOBOTRYA JAPONICA Lindl.
Auricularia cornea Ehrenb., on dead branches.

ERYTHRINA FUSCA Lour.
Auricularia cornea Ehrenb., on dead twigs.

EUCALYPTUS sp.
Polystictus versatilis Berk., on railway ties.

EUPHORBIACEAE.

Hexagona albida *Berk.*, on dead log.
Lenzites repanda Pers., on dead wood.
Polyporus calignosus Berk., on dead wood.
Polystictus flavus Jungh., on dead log.
Trametes persoonii Mont., on dead log.

FICUS sp.

Auricularia auricula-judae (Linn.) Schroet., on decaying wood.
Auricularia moelleri Lloyd, on dead wood.
Cantharellus buccinalis Mont., on dead wood.
Cantharellus infundibuliformis Berk., on dead wood.
Cladoderris infundibuliformis Kl., on dead wood.
Cyphella fulvodisca Cooke, on dead wood.
Favolus albus Lloyd, on living stump.
Grammothele mappa Berk., on dead wood.
Irpex sp., on dead wood.
Polyporus zonalis Berk., on dead wood.
Polystictus cryptomeniae P. Henn., on dead wood.
Polystictus setulosus (P. Henn.) Lloyd, on dead wood.
Poria sp., on dead wood.
Pterula aciculae Lloyd, on dead wood.
Schizophyllum commune Fr., on dead branches.
Solenia globosa Lloyd, on dead wood.
Stereum nigropus Lloyd, on dead wood.
Tremella sp., on dead wood.

FICUS HAUILI Blanco.

Auricularia cornea Ehrenb., on dead twigs.

FICUS NOTA (Blanco) Merr.

Schizophyllum commune Fr., on dead branches.

GLIRICIDIA SEPIUM (Jacq.) Steud.

Auricularia auricula-judae (Linn.) Schroet., on decayed wood.
Corticium sp., on dead wood.
Cyathus montagnei Tul., on dead branches.
Guepinia spathulata Schw., on decaying wood.
Lenzites repanda Pers., on dead trunk.
Polyporus annulatus Jungh., on dead wood.
Polyporus gibbosus Nees, on dead wood.
Polyporus rigidus Lév., on old post.
Polystictus flavus Jungh., on dead branches.
Polystictus occidentalis Kl., on dead branches.
Trametes persoonii Mont., on dead trunk.

GUTTIFERAE.

Polyporus conchoides Mont., on dead wood.

HIBISCUS sp.

Auricularia auricula-judae (Linn.) Schroet., on dead branches.

HOPEA sp.

Polystictus versatilis Berk., on railway ties.

INTSIA BIJUGA O. Ktze.

Polystictus versatilis Berk., on railway ties.
Trametes meyenii Kl., on decaying timber.

JATROPHA CURCAS Linn.
- *Auricularia auricula-judae* (Linn.) Schroet., on dead branches.
- *Auricularia cornea* Ehrenb., on dead wood.

KOORDERSIODENDRON PINNATUM (Blanco) Merr.
- *Polystictus meleagris* Berk., on dead wood.
- *Schizohpyllum commune* Fr., on dead wood.

LAGERSTROEMIA SPECIOSA (Linn.) Pers.
- *Polyporus semilaccatus* Berk., on dead wood.

LANSIUM DOMESTICUM Correa.
- *Auricularia auricula-judae* (Linn.) Schroet., on dead branches.
- *Daedalea flavida* Lév., on decaying wood.

LEUCAENA GLAUCA Benth.
- *Auricularia auricula-judae* (Linn.) Schroet., on dead branches.
- *Auricularia polytricha* (Mont.) Sacc., on dead branches.
- *Corticium* sp., on dead wood.
- *Fomes applanatus* Pers., on dead branches.
- *Guepinia spathulata* Schw., on dead branches.
- *Irpex flavus* Kl., on dead branches.
- *Lenzites repanda* Pers., on dead branches.
- *Polyporus zonalis* Berk., on dead stump.
- *Poria* sp., on dead wood.
- *Stereum ostreum* Nees, on dead wood.
- *Trametes meyenii* Kl., on dead wood.

MALLOTUS sp.
- *Lentinus strigosus* Schw., on dead wood.
- *Polyporus zonalis* Berk., on dead wood.
- *Polystictus affinis* Nees, on dead wood.
- *Poria* sp., on dead wood.
- *Poria fuligo* Berk., on dead wood.
- *Poria setulosa* P. Henn., on dead wood.

MANGIFERA INDICA Linn.
- *Auricularia auricula-judae* (Linn.) Schroet., on dead branches.
- *Polyporus rigidus* Lév., on rotten trunk.
- *Polystictus flavus* Jungh., on dead branches.
- *Polystictus occidentalis* Kl., on dead branches.

MANIHOT UTILISSIMA Pohl.
- *Auricularia auricula-judae* (Linn.) Schroet., on dead branches.

MELOCHIA ARBOREA Blanco.
- *Auricularia cornea* Ehrenb., on dead twigs.

MORUS ALBA Linn.
- *Schizophyllum commune* Fr., on dead branches.

MUSSAENDA PHILIPPICA Rich.
- *Auricularia cornea* Ehrenb., on dead twigs.

MYRISTICA sp.
- *Lentinus* sp., on dead wood.
- *Polystictus sanguineus* Linn., on dead wood.

NEONAUCLEA sp.
- *Polystictus sanguineus* Linn., on railway ties.

OPHIOLIACEAE.
Favolus spathulatus Jungh., on dead wood.

PALMAE.
Polyporus zonalis Berk., on dead stem.

PARAMERIA sp.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.

PARASHOREA PLICATA Brandis.
Daedalea flavida Lév., on old board.
Lenzites repanda Pers., on decayed wood.
Polystictus sanguineus Linn., old board.

PARKIA TIMORIANA (DC.) Merr.
Lenzites repanda Pers., on dead log.
Poria sp., on dead wood.

PERSEA GRATISSIMA Gaertn.
Lenzites repanda Pers., on decaying branches.
Schizophyllum commune Fr., on dead branches.

PITHECOLOBIUM sp.
Lenzites repanda Pers., on dead wood.
Polystictus occidentalis Kl., on dead wood.

POLYALTHIA sp.
Corticium sp., on dead wood.
Cyathus plicatulus Poep., on dead wood.
Polyporus zonalis Berk., on dead wood.

POLYSCIAS NODOSA (Blume) Seem.
Pleurotus sp., on dead stem.

POMETIA PINNATA Forst.
Polystictus cryptomeniae P. Henn., on dead wood.

PROSOPIS VIDALIANA Naves.
Auricularia brasiliensis Fr., on dead branches.
Lenzites repanda Pers., on dead branches.

PSIDIUM GUAJAVA Linn.
Auricularia cornea Ehrenb., on dead wood.
Polystictus xanthopus Fr., on decaying branches.

PTEROCARPUS sp.
Polyporus zonalis Berk., on dead branches.
Polystictus sanguineus Linn., on old board.

PTEROCARPUS ECHINATUS Pers.
Auricularia cornea Ehrenb., on dead branches.

PTEROCARPUS INDICUS Willd.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.
Lenzites striata Swartz, on painted board.
Schizophyllum commune Fr., on railway ties.
Trametes persoonii Mont., on dead log.

PTEROCYMBIUM TINCTORIUM (Blanco) Merr.
Lentinus strigosus Schw., on dead wood.

QUERCUS sp.
Hymenochaete rosea Lloyd, on dead wood.
Stereum spectabile Kl., on dead wood.

RAPANEA PHILIPPINENSIS (A. DC.) Mey.
Hexagona tenuis Hooker, on dead branches.

RUBIACEAE.
Polyporus perversus Copel., on dead stem.
Polyporus zonalis Berk., on dead stem.

SANDORICUM KOETJAPE (Burm. f.) Merr.
Fomes gibbosus Nees, on dead stump.

SAPINDUS SAPONARIA Blanco.
Auricularia cornea Ehrenb., on dead twigs.

SAPIUM MERRILLIANUM Pax et K. Hoffm.
Guepinia fissa Berk., on dead wood.
Stereum felloi Lloyd, on dead wood.

SHOREA sp.
Fomes applanatus Pers., on decaying wood.
Polystictus xanthopus Fr., on dead wood.
Poria sp., on dead wood.
Poria espimiltina Berk., on dead wood.

SHOREA GUISO (Blanco) Blume.
Corticium sp., on dead wood.
Polyporus rigidus Lév., on dead wood.
Polystictus versatilis Berk., on railway ties.
Tremella fuciformis Berk., on dead wood.

SHOREA MINDANENSIS Desp.
Schizophyllum commune Fr., on piling.

SHOREA PHILIPPINENSIS Brandis.
Polystictus sanguineus Linn., on piling.

SOLANUM GRANDIFLORUM Ruiz et Pav.
Auricularia cornea Ehrenb., on dead twigs.

SOLANUM VERBASCIFOLIUM Linn.
Auricularia cornea Ehrenb., on dead wood.

SPONDIAS LUTEA Linn.
Schizophyllum commune Fr., on dead branches.

STREBLUS ASPER Lour.
Auricularia auricula-judae (Linn.) Schroet., on dead wood.
Auricularia cornea Ehrenb., on dead wood.

STROMBOSIA PHILIPPINENSIS Rolfe.
Lenzites striata Swartz, on railway ties.

STRYCHNOS NUX-VOMICA Linn.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.

TABERNAEMONTANA PANDACAQUI Poir.
Polyporus tabacinus Mont., on dead branches.

TAMARINDUS INDICA Linn.
Fomes applanatus Pers., on dead wood.
Lenzites repanda Pers., on dead branches.
Polystictus flavus Jungh., on dead log.
Polystictus occidentalis Kl., on dead wood.

TECOMA STANS (Linn.) Juss.
Auricularia cornea Ehrenb., on dead branches.

TERMINALIA COMINTANA (Blanco) Merr.
Daedalea flavida Lév., on old board.
Polystictus versatilis Berk., on railway ties.

THEOBROMA CACAO Linn.
Auricularia cornea Ehrenb., on dead branches.
Trametes persoonii Mont., on dead branches.

TREMA AMBOINENSIS (Willd.) Blume.
Auricularia cornea Ehrenb., on dead wood.

TRIUMFETTA BARTRAMIA Linn.
Auricularia auricula-judae (Linn.) Schroet., on dead branches.

URENA LOBATA Linn.
Auricularia cornea Ehrenb., on dead branches.

VATICA sp.
Polystictus versatilis Berk., on railway ties.

VITEX sp.
Polyporus rigidus Lév., on dead branches.
Polystictus flavus Jungh., on dead branches.
Polystictus meyenii Kl., on dead wood.

VITEX PARVIFLORA Juss.
Guepinia fissa Berk., on railway ties.

VOACANGA GLOBOSA (Blanco) Merr.
Auricularia cornea Ehrenb., on dead branches.

ZEA MAYS Linn.
Lenzites acuta Berk., on dried ears.

ZIZYPHUS sp.
Phlebia reflexa Berk., on dead wood.
Polyporus mastoporus Lév., on dead wood.

THE PERMEABILITY OF CITRUS LEAVES TO WATER

By F. T. McLean

Professor of Botany, College of Agriculture, Los Baños

ONE TEXT FIGURE

The resistance of leaves to injection has been little investigated. In most of the physiological studies thus far reported, leaves have been treated mainly as instruments for gaseous interchange with the air and for photochemical reactions. A few ecological studies have been made of the relation of the form of leaves to the removal of water, and the opinion has been expressed that certain structures are beneficial in preventing the clogging of the stomata with water and the flooding of the leaf tissues. So far as the writer is aware, there have been no studies of the pressures required to cause flooding. The resistance of leaves to the penetration of water may be important not only to prevent waterlogging of the tissues but also to prevent the entrance of certain leaf-disease organisms. Thus *Pseudomonas citri* Hasse, the cause of citrus canker, may be dependent mainly for its spread upon the permeability of the citrus leaves to water, as is suggested by McLean.[1] He found that the differences in the structure of the stomata of a disease-resistant mandarin orange variety and a susceptible grapefruit were of such a character that water could enter the stomata of the former more easily than those of the latter. The structure and behavior of the canker bacteria are such that infection most probably takes place by means of continuous water columns, either through the stomata or through wounds. Whether infection will take place in this manner through the stomata or not depends upon the amount of pressure necessary to force water through the stomata. There appears to be need for more data on this particular point.

There has been little study of the infiltration of the leaves of terrestrial plants with water, except in the case of a few epiphytic plants with special absorbing structures on the leaves. The infiltration of leaves with other liquids having a lower

[1] McLean, Forman T., A study of the structure of the stomata of two species of Citrus in relation to citrus canker, Bull. Torr. Bot. Club 48 (1921) 101–106.

surface tension than water, such as alchohol, benzol, etc., was employed by Molisch [2] as an index of the openness of the stomata. He studied the rate of infiltration of these liquids without employing pressure, and found that water was unsuitable for his purpose.

The study here reported was undertaken to ascertain what pressures are necessary to cause infiltration of water through the stomata of Citrus leaves. A satisfactory method of causing water to enter the leaves through the stomata and of observing the place and manner of entrance was devised and is here described. It was also found that penetration of water through the stomata can be easily induced under certain conditions, and that there are apparently differences in the amount of pressure required to cause penetration into the leaves of different varieties. Three varieties of Citrus were used in these tests: Washington navel orange, Szinkom mandarin orange, and Pernambuco grapefruit.

APPARATUS

The equipment employed is shown in figure 1. It consists of a flat gas chamber *g c* of metal with a tube connection at each end. The bottom is of glass; the metal top has a circular aperture in it about 1.5 centimeters in diameter, over which the leaf *l* is placed. The gas chamber is mounted on the stage of a compound microscrope *m*, in position to examine the leaf surface under the low power (16-millimeter objective). The right-hand tube of the gas chamber is connected to a mercury pressure gauge *p*, which is fitted with a scale *s* and mirror *n* to facilitate the rapid reading of the height of the mercury column by the observer seated at the microscope. The left-hand tube of the gas chamber is attached to an aspirator *e*, arranged to draw air from the gas chamber, the rate being controlled by means of the valve *v*.

PROCEDURE

A piece of convenient size, usually about 3 centimeters in diameter, was cut from the leaf to be tested, and the upper epidermis and palisade tissues were shaved off with a sharp razor from a small area in the center about 2 millimeters in diameter. Then the cut outer edges of the leaf were coated with paraffin (melting point, 45° C.), and it was then sealed on to the aperture of the gas chamber with paraffin, the intact lower surface

[2] Molisch, H., Opening and closure of stomata as shown by the method of infiltration, Zeitschr. Bot. 4 (1912) 106–122.

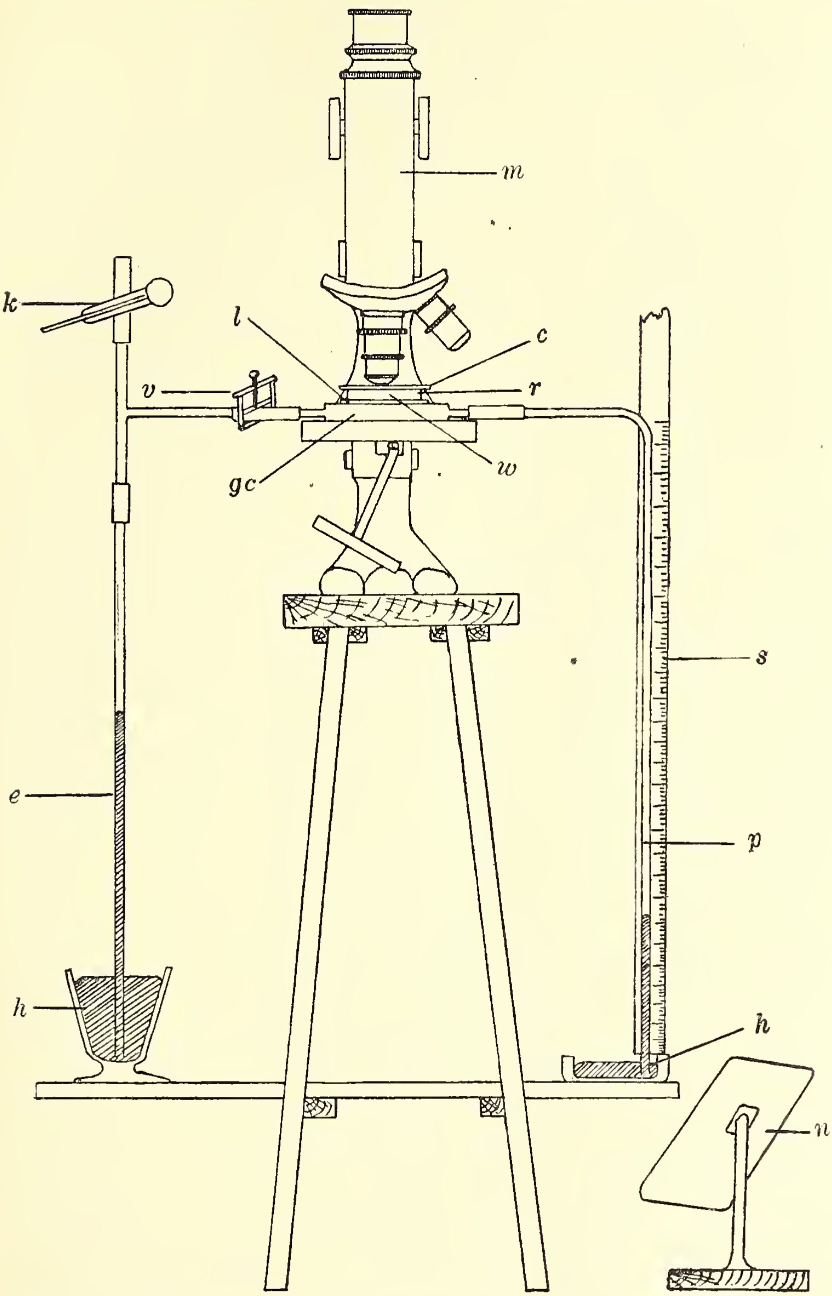


FIG. 1. Diagram of the apparatus used for measuring the pressures required to force water through the stomata of citrus leaves.

of the leaf uppermost and the shaved thin portion in the center of the aperture. A glass ring was then fastened over the leaf with paraffin, and the small reservoir formed by the leaf and the glass ring was filled with tap water and covered with a microscopic cover glass. The gas chamber was then connected with the pressure gauge and aspirator, and the leaf surface under water was examined with the low power of the microscope (16-millimeter objective) before any air was withdrawn from the gas chamber. In all cases the thinned portion of the leaf appeared opaque, due to the presence of air in the intercellular spaces, expect at the spots over oil glands, which were translucent. The stomata had their outer chambers filled with large air bubbles.

Air was then gradually withdrawn from the gas chamber under the leaf section by means of the aspirator. The partial vacuum in the chamber and consequent pull on the water tending to draw it into the leaf tissues were indicated by the height of the mercury in the pressure gauge. The condition of the leaf was closely watched meanwhile, until the appearance of new translucent spots indicated that the leaf tissues were flooded, or until drops of water were observed by their shadows to be forming on the thinned portion of the leaf. Then the height of the mercury in the pressure gauge was recorded, the water reservoir was removed from the leaf, and the portions where water penetration had occurred were carefully examined. Actual breaks in the epidermis were observed in only two cases, and both of these were due to rapid and excessive application of pressure to the leaf. These two tests were valueless and were therefore discarded. In most cases it was clear, from the slow rate of infiltration and from subsequent examination of the spot where the water had entered, that it had entered through the intact stomata. An effort was made to locate the particular stoma through which it first penetrated, but this could not be clearly distinguished because of the low magnification, and in several cases the penetration first occurred through the thick tissues at the edge of the thinned portion, where the stomata could not be clearly seen. While examining the flooded portions of the leaf, a few measurements of the width of the ridge of entrance of the larger stomata in this portion were made, because the width of the stomatal aperture is thought to be the controlling factor in preventing the entrance of water.

It was necessary to bring the leaves from the field to the laboratory for testing, and it was found that the preliminary treatment of the leaves had a great effect upon the injection pressure observed. Therefore, several different treatments were tried, and the results of these are presented in Tables 1, 2, 3, and 4. All of these tables are arranged in the same manner. An arbitrary number is given to each test for convenience in designation. Pressure, causing penetration of water, was measured by means of the height, in centimeters, of the mercury column in the pressure tube. The averages of the width of the ridge of entrance of the stomata on the injected parts of the leaf are based on few measurements—usually ten and sometimes fewer—because the injected areas of the leaves were themselves small. The stomata varied considerably in size and only the larger ones were measured, as they were the ones through which the water would pass the most readily.

RESULTS

The earlier tests were made on leaves which had been kept in the comparatively dim light of the laboratory for varying lengths of time before testing. The results of these tests are assembled in Tables 1 and 2, those of Table 1 including those which had been in the laboratory for one-half day or less, and those of Table 2 for a longer time.

TABLE 1.—*Tests of the pressure required to inject water into freshly gathered Citrus leaves, detached from twigs and kept in water for a short time.*

Test No.	Date.	Hour.		Kind of leaf.	Pressure.	Width of ridge of entrance of stoma.	
						Maximum.	Average.
		a. m.	*p. m.*		*cm. Hg.*	μ	μ
1	April 3		4.00	Young Pernambuco grapefruit	6.5	8.3	7.8
2	April 3		4.30	Young Kishiu mandarin orange	11.5	4.0	2.0
3	April 3		4.50	Young Szinkom mandarin orange	23.0	3.8	3.0
4	April 4	9.00		Old Washington navel orange	15.0	9.0	7.3
5	April 4	9.00		Medium Washington navel orange	22.5	7.7	7.3
6	April 4	9.00		Young Washington navel orange	12.0	7.7	6.3
7	April 4	11.30		Half-grown Washington navel orange	10.3	6.0	4.8
8	April 5	10.45		Medium Pernambuco grapefruit	12.0	9.7	6.0
9	April 5		12.00	Young Pernambuco grapefruit	12.5	8.0	6.3

TABLE 2.—*Tests of pressure required to inject water into Citrus leaves, detached from twigs and kept with their petioles in water in the diffused light of the laboratory for one-half day longer.*

Test No.	Date.	Hour.	Kind of leaf.	Pressure.	Width of ridge of entrance of stoma.	
					Maximum.	Average.
		a. m. p. m.		*cm. Hg.*	μ	μ
10	April 4	3.10	Medium Washington navel orange	21.5	9.7	7.3
11	April 4	3.35	Half-grown Szinkom mandarin orange	31.5	3.0	2.6
12	April 4	4.10	Old, yellow Szinkom mandarin orange	31.0	6.3	4.0
13	April 4	4.50	Old Pernambuco grapefruit	6.0	10.0	9.0
14	April 4	5.25	Young Szinkom mandarin orange	31.5		
15	April 5	3.45	Young Pernambuco grapefruit	25.6		
16	April 7	11.45	do	9.5		
17	April 5	4.50	do	14.0	7.2	4.7

A comparison of the leaves of different apparent ages of the three different varieties showed no clear relationship between age and injection pressure. The individual variations between tests were so great that, in order to eliminate one possible variant, subsequent tests were confined to comparatively young leaves. Therefore, no conclusion can be drawn from these observations concerning the effect of age of the leaves upon the injection pressure. All of the above tests show exceedingly variable and generally high injection pressures, probably due to the unfavorable conditions to which they were subjected in the laboratory.

Several tests were made on leaves which had been immersed in water and placed in the window in bright diffuse light previous to testing. The results of these are assembled in Table 3. Some of these were tested before placing them in the window, and are thus entered in Table 2. These repeated tests on the same leaves are particularly valuable for comparison and to show the effect of conditions of exposure on the leaf properties.

The injection pressures shown in Table 3, in which the leaves were immersed in water and kept in bright light before testing, are generally lower than those in Tables 1 and 2. Thus the values in Table 3 range from 2 and 5 millimeters in tests 23 and 29 for Pernambuco grapefruit, to 15.5 and 18.0 centimeters in tests 27 and 28 for Szinkom mandarin. Further, a comparison of the same leaf, tested in each of the two series, is illuminat-

TABLE 3.—*Tests of pressure required to inject water into Citrus leaves, detached from the plant, immersed in water, and placed in bright light in the laboratory window.*

Test No.	Date.	Hour.	Kind of leaf.	Pressure.	Width of ridge of entrance of stoma.	
					Maximum.	Average.
		p. m.		*cm. Hg.*	*μ*	*μ*
18	April 5	2.30	Medium Pernambuco grapefruit	9.5		
19	April 5	3.40	do	2.0	7.5	6.2
20	April 5	4.00	Young Pernambuco grapefruit	5.5	9.7	7.0
21	April 6	2.00	Medium Pernambuco grapefruit	3.0	10.0	7.9
22	April 6	2.40	Young Szinkom mandarin orange	5.0	6.0	4.8
23	April 6	3.45	Young Pernambuco grapefruit	0.2		
24	April 6	4.07	do	5.5	9.3	7.7
25	April 6	4.42	Young Szinkom mandarin orange	12.5	6.7	3.5
26	April 7	3.10	do	1.6	7.3	5.6
27	April 7	3.40	do	15.5		
28	April 7	4.20	do	18.0	5.7	4.3
29	April 7	4.30	Young Pernambuco grapefruit	0.5	9.3	8.7

ing. Thus a medium Pernambuco grapefruit leaf in the first series (No. 8, Table 1) gave an injection pressure of 12.0 centimeters, while the same leaf, under the more favorable treatment in the second series (Nos. 18, 19, and 21, Table 3), gave values of 9.5, 2.0, and 3.0 centimeters successively. The lowest pressures obtained in this series, as shown in Table 3 for Pernambuco, are of such magnitude as might easily occur in leaves on the trees, due to changes of temperature when the leaves are wet, or even to rapid expansions and contractions of the air chambers when the leaves are bent in being blown about by the wind. The combination of abundant moisture and light provided in these tests appears to have caused the stomata to open and make the entrance of water easy.

The tests in Tables 1, 2, and 3 do not nearly approach the normal conditions to which the leaves on the trees are subjected during bright sunny weather. Therefore, a third lot of leaves were left attached to twigs, which were put in water and placed so as to be fully exposed to the sun. These were tested at intervals during the day, and the results are tabulated in Table 4.

The young leaves on twigs and exposed to full insolation show great variations in the pressures required to inject them with water. Using similar Szinkom leaves for all tests, the values varied from 5.5 to more than 38.0 centimeters. Since these leaves were fully exposed to sunlight, these differences may have been caused by variations in the rates of transpiration.

TABLE 4.—*Tests of pressure required to inject water into Citrus leaves, attached to twigs and standing in water, fully exposed to the sun before testing them.*

Test No.	Date.	Hour.	Kind of leaf.	Pressure.	Width of ridge of entrance of stoma.	
					Maximum.	Average.
		a. m. p. m.		*cm. Hg.*	μ	μ
30	April 7	8.26	Young Szinkom mandarin orange	5.5	6.0	4.3
31	April 7	10.35	do	20.5		
32	April 7	11.25	do	29.5	4.7	4.2
33	April 7	2.15	do	7.5		
34	April 7	2.40	do	17.0	7.0	4.1
35	April 7	4.10	do	38.0+		

With the small number of data presented, and these of such a highly variable character, it is obviously unsafe to make any more than the most general sort of conclusions. The effects of the different treatments employed appear to be quite evident from the foregoing comparisons of results. Less satisfactory conclusions can be reached regarding the differences between the different varieties, and the possible correlation between the width of the ridge of entrance of the stoma and the injection pressure. Certain generalities are allowable from the data shown. Thus a consideration of the lowest values obtained, as shown in Table 3, indicates that Pernambuco grapefruit is usually more easily injected than Szinkom mandarin, since of the five injection pressures below 5 centimeters four, including the two lowest values (2 and 5 millimeters), are for Pernambuco and only one (1.6 millimeters) is for Szinkom. Further, the average injection pressure for Pernambuco is 7.9 centimeters, while for Szinkom (taken from the first three tables only, for those in Table 4 are not considered to be at all comparable to the others) it is 18.3 centimeters. Likewise, the average width of the ridge of entrance of the stomata of Pernambuco is 7.0 μ and of Szinkom, 4.1 μ. Thus the average values for the two varieties indicate that Pernambuco grapefruit is more easily injected and has wider stomatal apertures than Szinkom mandarin.

Another more extensive series of tests of the injection pressures of Citrus leaves is being made on leaves attached to the trees in the field, using a different technic. The results of these will be the subject of a later contribution. The data thus far obtained on the leaves on the trees bear out in a general way the tentative conclusions stated above.

SUMMARY

1. A method is described for determining the pressure required to force water through the stomata of leaves.

2. The pressure required to inject leaves of the same variety seems to vary greatly in accordance with the treatment before testing, and seems to be lowest when the leaves are exposed to bright diffused light and well supplied with moisture.

3. Apparently Szinkom mandarin orange leaves require on the average more than twice as much pressure to inject them with water as is required for the leaves of Pernambuco grapefruit.

4. The conclusion stated in 3 seems to be correlated with the average width of the stomatal aperture through the epidermis, that of Szinkom mandarin orange being a little more than half as wide as that of Pernambuco grapefruit.

ILLUSTRATION

TEXT FIGURE

FIG. 1. Diagram of the apparatus used for measuring the pressures required to force water through the stomata of citrus leaves.

REVIEWS

Introduction | **General Chemistry** | an exposition of the principles of | modern Chemistry | by | H. Copaux | [two lines of titles] | translated by | Henry Leffmann, A.M., M.D. | [two lines of titles] | with 30 illustrations | Philadelphia | P. Blakiston's Son & Co. | 1012 Walnut Street | Cloth, pp. i–x + 1–195 including index. Copyright, 1920.

TRANSLATOR'S NOTE

Professor Copaux's work presents in compact, yet clear form a large amount of information on the principles of chemistry as recognized today by the leaders in the science. I have endeavored to render the text into standard English, and thus make it available to a wider group of readers, to whom it will be a valuable guide.

Those who, like myself, began the study of chemistry just after the middle of the last century, will find many points of difference between this book and the manuals of the early days, yet the fundamental features of the science remain unchanged. The atom is still the unit of chemical action, and the balance is still, as in the laboratory of Lavoisier, the chemist's main reliance.

While the translation was in progress, Professor Copaux kindly sent a copy of the book with notes of corrections of a few typographic errors, and some changes in phraseology adding to the explicitness or comprehensiveness of the text. These suggestions have been given attention.

French-English | **Medical Dictionary** | by | Alfred Gordon, A. M., M. D. (Paris) | [seven lines of titles] | Philadelphia | P. Blakiston's Son & Co. | 1012 Walnut Street | Cloth, $3.50 net, pp. 1–161. Copyright, 1921.

Priestley | **in** | **America** | **1794–1804** | by | Edgar F. Smith | University of Pennsylvania | Philadelphia | P. Blakiston's Son & Co. | 1012 Walnut Street | Cloth, $2 net, pp. 1–173. Copyright, 1920.

Types | **of** | **Mental Defectives** | by | Martin W. Barr, M.D. | [two lines of titles] | and | E. F. Maloney, A.B. | Professor of English, Girard College | with 31 plates containing | 188 illustrations | Philadelphia | P. Blakiston's Son & Co. | 1012 Walnut Street | Cloth, $3 net, pp. i–ix + 1–179 including index. Copyright, 1920.

FOREWORD

The information most eagerly sought by those entering upon the work among the feeble-minded is naturally how to easily recognize the various forms of mental defect, in order that they may define, and meet promptly, the special needs of those with whom they are brought in daily contact.

To this end, types of various grades are useful as sign-posts pointing the way to successful diagnosis of defect—mental, moral and physical. In defining types many points, such as have been indicated by tests, as well as by the stigmata of degeneration noted in the individual, are to be considered.

Appended herewith will be found the educational classification, which, as the outgrowth of a close study of cases and careful adaptation to needs—indorsed by both physicians and teachers—has proven in a long experience the best one as simplifying the tasks of all engaged in the work.

This classification is arrived at by first separating broadly the *untrainable idiot* from the *trainable imbecile* in asylum, custodial, and school division; next by dividing the imbeciles into grades of mentality for the awakening and further development of power along lines suited to the capacity of each; and finally by indicating possible training for life work in industrial or manual lines according to individual proclivity.

CONTENTS

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.

VOL. 19, NO. 2 AUGUST, 1921

THE PHILIPPINE JOURNAL OF SCIENCE

BUREAU OF SCIENCE
MANILA

MANILA
BUREAU OF PRINTING
1921

180732

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science of the Government of the Philippine Islands

---

Manuscript intended for publication and books for review should be sent to the editor. One hundred separates of papers published in the Journal are furnished to authors without charge. Additional copies may be had at authors' expense.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

The Journal is issued twelve times a year. The subscription price is 5 dollars, United States currency, per year. Single numbers, 50 cents each.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 19 AUGUST, 1921 NO. 2

CITRUS-CANKER CONTROL: A PROGRESS REPORT OF EXPERIMENTS

By H. ATHERTON LEE[1]

Mycologist, Bureau of Science, Manila[2]

TWO PLATES

INTRODUCTION

Field investigations on citrus canker in the continental United States have been impossible in the past because of the regulations which have been promulgated to make eradication work possible. For this reason, investigations on citrus-canker control were undertaken in the Philippine Islands in the summer of 1917. The primary purpose of these experiments was to determine whether citrus canker could be controlled by means other than total eradication; that is, by the use of fungicides and cultural methods. It was believed that, even though such control methods should not prove successful, methods and ideas might arise which would be of value in aiding citrus-canker eradication in the southern United States.

[1] The writer wishes to express appreciation to Col. Adriano Hernandez, director, and Mr. S. Apostol, chief of the plant industry division of the Philippine Bureau of Agriculture, for the great assistance and the many facilities afforded him. It is to them that thanks are due for the use of the citrus collection at Lamao, Philippine Islands. Similar deep appreciation is expressed to Prof. C. F. Baker, dean of the College of Agriculture, University of the Philippines, for the use of the citrus collection at Los Baños during these experiments and for assistance in many other ways. Thanks are also due to Father M. Selga, of the Weather Bureau, for very kindly assistance in supplying climatological data.

[2] The work was begun while the writer was under the direction of the United States Department of Agriculture, and credit is due to that institution for the inauguration of this work.

The writer wishes this paper to be considered as merely a progress report, since past work has been of value mainly in indicating the great differences in susceptibility of the commercial *Citrus* species and varieties and the differences in effort necessary for the control of canker on such different species and varieties. Such methods of control as have been successful to some extent are also reported here.

DISTRIBUTION OF CANKER IN THE PHILIPPINES

The citrus industry in the Philippines consists for the most part in the production of mandarin oranges (*Citrus nobilis*) from seedling trees; a few seedling sweet-orange trees (*Citrus sinensis*), a few pummelo trees (*Citrus maxima*), and calamondin (*Citrus mitis*) trees are also grown. The largest center of production of citrus fruits is Batangas Province, south of Manila.

In some of the outlying islands citrus canker has not been found as yet, which has given rise to the suggestion of Mackie (14) that canker has not existed in the Philippines for a great period of time. Although Wester(20) has shown the presence of citrus canker in the isolated Batanes (the small islands lying between Luzon and Formosa) as early as 1909, he has found it to be entirely absent from certain regions of Mindanao and Sulu Archipelago. This, then, would corroborate the suggestion of Mackie. For the purpose of this paper, in any case. it is sufficient to note that canker is distributed throughout Batangas and Laguna Provinces and the citrus plantings of the Manila Bay region where the experiments were carried on.

The main control work was begun at two places; in the orchards of the Lamao agricultural experiment station of the Philippine Bureau of Agriculture, and in the citrus plantings, in Los Baños, of the College of Agriculture of the University of the Philippines. Control work was not attempted on the plantings of private holders since they consisted for the most part of mandarin orange trees which are in most cases resistant to citrus canker.

CLIMATIC CONDITIONS OF THE REGION SURROUNDING MANILA

An understanding of the climatic conditions at Lamao and Los Baños is essential before undertaking a discussion of the control work.

Briefly, at Lamao and Los Baños, the year is divided into two seasons; the wet season, beginning generally about the middle of May and ending in November, and the dry season, beginning the latter part of November or early December and lasting until the early part of May. Table 1, compiled from the reports of the Philippine Weather Bureau, shows the monthly rainfall in detail during 1914, 1915, and 1916 at Manila. The rainfall at Lamao is, sometimes at least, slightly less than that at Manila, while that at Los Baños may be said to be usually slightly greater.

TABLE 1.—*Rainfall recorded by the Central Observatory at Manila of the Philippine Weather Bureau.*

Month.	1914			1915			1916		
	Total.	Daily maximum.	Rainy days.	Total.	Daily maximum.	Rainy days.	Total.	Daily maximum.	Rainy days.
	mm.	*mm.*		*mm.*	*mm.*		*mm.*	*mm.*	
January	3.5	1.7	3	5.6	3.5	5	38.2	20.8	7
February	7.3	3.3	4	3.8	3.8	1	23.6	20.7	4
March	6.1	5.1	2	3.3	2.4	4	29.1	16.8	5
April	53.4	26.2	8	0.5	0.5	1	46.2	33.8	5
May	84.0	43.8	11	50.4	13.5	9	39.8	9.3	15
June	367.9	109.7	13	126.7	53.6	10	224.6	72.9	17
July	399.3	71.2	23	276.3	80.0	20	179.9	46.0	25
August	492.3	96.6	25	413.8	63.2	23	282.3	43.7	24
September	887.7	234.7	21	478.7	103.3	21	372.6	74.2	25
October	40.2	18.0	12	165.4	27.5	19	223.6	43.0	25
November	41.0	29.8	7	208.1	105.4	15	106.5	21.6	15
December	52.4	15.0	14	182.3	68.7	13	76.0	16.2	13

A study of this table will give an idea of the time and amount of rainfall throughout a normal year.

TABLE 2.—*Temperatures recorded by the Central Observatory at Manila of the Philippine Weather Bureau.*

Month.	1914			1915			1916		
	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.
	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.	°C.
January	23.7	32.7	14.5	24.8	32.6	17.5	24.8	32.8	17.4
February	24.2	33.1	16.3	25.7	34.2	17.3	25.3	33.2	16.9
March	26.5	35.7	17.6	26.8	36.4	18.9	26.4	34.9	20.0
April	28.0	36.9	19.2	28.7	38.0	20.6	27.3	35.0	20.4
May	28.5	37.7	21.4	29.2	38.6	22.6	27.4	35.5	22.0
June	27.4	35.5	22.7	28.8	36.9	23.3	27.1	35.1	22.3
July	27.0	33.5	22.7	27.6	36.3	22.1	26.9	34.1	22.4
August	27.0	34.1	22.1	26.9	32.9	22.5	27.2	33.5	22.0
September	26.2	34.1	22.2	26.8	33.4	22.4	26.0	33.3	22.3
October	25.9	33.4	20.0	26.6	33.9	22.4	25.9	33.8	21.6
November	26.0	33.7	19.7	26.0	33.6	21.4	25.7	32.0	19.5
December	25.3	33.4	18.4	25.4	32.2	19.8	34.9	32.2	17.4

The temperatures at either Lamao or Los Baños are fairly high, with comparatively slight seasonal variations. The table of temperatures (Table 2) is also taken from the reports of the Weather Bureau of the Philippine Government, and represents Manila temperatures.

The temperatures at Manila may be taken as an index of the temperatures at both Los Baños and Lamao. The temperatures at Lamao and at Los Baños, therefore, are probably favorable at all times for the dissemination and the development of citrus canker.

The humidity remains fairly high throughout the months of the dry season as is shown by Table 3.

TABLE 3.—*Relative humidity at Manila, compiled from the annual reports of the Philippine Weather Bureau.*

Month.	1914			1915			1917		
	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
January	76.2	98.0	48.5	78.6	99.0	50.5	77.9	97.0	44.0
February	73.8	95.0	42.0	69.5	96.0	35.5	78.1	99.0	47.0
March	68.6	94.0	32.0	70.9	97.0	37.0	73.4	97.0	39.0
April	70.8	97.0	34.0	66.0	96.0	32.0	75.0	98.0	47.0
May	72.6	100.0	38.0	75.1	99.0	39.0	77.8	97.0	45.0
June	81.7	99.0	54.0	75.5	100.0	36.0	83.5	99.0	50.0
July	85.4	99.0	60.0	83.5	99.0	51.0	85.0	99.0	59.0
August	83.0	99.0	50.0	87.3	100.0	60.0	84.0	100.0	57.5
September	87.3	98.0	58.0	86.4	99.0	59.0	88.4	99.0	61.0
October	79.7	99.0	42.0	85.9	99.0	56.5	87.6	99.0	56.0
November	78.4	99.0	44.0	85.3	98.0	52.0	83.9	99.0	47.0
December	82.0	99.0	48.0	83.5	98.0	51.5	84.3	99.0	48.0

Although the humidity and the temperature are favorable throughout the dry months, it is apparent that canker development is inactive and passive during these months. The explanation for this inactivity, corroborated by close field observation, is that citrus canker apparently is dependent for its dissemination upon free moisture on the leaves, in the form of either rain or dew. The dry season from December to May, therefore, is a limiting factor in the development of citrus canker in the Philippines. The long days of steady, direct sunlight during the dry season are also apparently a limiting factor to the spread of the canker organism.

The dry season is correlated more or less with a steady northeast monsoon, while the wet season is correlated with a southwest monsoon. The velocity of these winds can be judged from Table 4, also compiled from the reports of the Philippine Weather Bureau.

TABLE 4.—*Representative wind velocities in Manila, expressed in kilometers per hour, compiled from the annual reports of the Philippine Weather Bureau.*

Month.	1914			1915			1916		
	Daily mean.	Hourly maxi-mum.	Daily mini-mum.	Daily mean.	Hourly maxi-mum.	Daily mini-mum.	Daily mean	Hourly maxi-mum.	Daily mini-mum.
	km.	*km.*	*km.*	*km.*	*km.*	*km.*	*km.*	*km.*	*km.*
January	158.9	28.0	82.5	116.0	27.5	39.0	214.1	36.0	100.5
February	187.7	26.0	104.0	172.5	27.5	66.0	166.0	25.5	68.5
March	204.6	28.5	105.5	190.7	28.0	100.0	188.8	24.0	125.5
April	197.4	34.0	90.5	227.8	31.0	150.0	186.4	26.0	118.5
May	198.0	34.0	92.0	235.4	35.0	128.0	180.7	31.0	122.5
June	223.8	64.0	70.5	174.6	43.0	84.5	185.4	39.5	84.5
July	348.1	53.0	70.5	209.2	36.5	79.0	169.3	32.5	29.0
August	360.4	53.0	44.5	258.7	42.0	98.5	328.0	43.0	52.0
September	244.7	41.0	73.0	184.4	36.0	38.0	186.1	42.0	76.0
October	124.6	22.0	67.0	206.6	58.0	65.0	110.8	22.0	52.0
November	126.2	23.0	65.5	156.6	68.0	64.5	139.7	25.0	84.5
December	108.0	18.0	50.5	167.5	68.0	62.5	145.0	23.5	90.0

During the summer season cyclonic disturbances are frequent, when wind velocities of 60 or more kilometers an hour are not unusual, and even a velocity of 195 kilometers an hour has been recorded by the Weather Bureau. Such winds are usually accompanied by rainfall and are a serious handicap in combating citrus canker, in as much as they disseminate the canker organism at a time when all conditions favor the development of canker. More extensive data and references upon the climate of the Philippines may be obtained in the publication of Father Coronas,(4) of the Philippine Weather Bureau.

PREVIOUS LITERATURE UPON CONTROL METHODS FOR CITRUS CANKER

The available literature on investigations upon the control of citrus canker is not extensive. The first note of the effect of spraying against citrus canker is that of Wester,(18) who, in the dry season of 1912 in the Philippines, was able, by application of Bordeaux mixture, to control a disease which he regarded as citrus scab. In the wet season, however, he reports his spraying methods to have been unsuccessful against the disease. He later identified the disease as citrus canker instead of citrus scab. Stevens(16, 17) has reported spraying conducted by growers and nurserymen against canker in Florida to be impracticable, but has not described the spraying methods employed. Wolf(21) described control methods using variations of Bordeaux mixture against the disease on grapefruit trees in

Alabama. His conclusions are best obtained by a direct quotation from his publication:

> All visible signs of canker were carefully removed from the trees prior to the application of the mixtures. Bordeaux mixture, Bordeaux mixture and bichlorid of mercury (12 tablets in 3 gallons), Bordeaux mixture and formaldehyde (1:100), and a Bordeaux and lead arsenate mixture were employed. Applications were made on March 26, April 29, and May 14, and no new infections had developed on any of the sprayed or unsprayed trees by the last named date. On May 27, however, new infections were apparent and were equally numerous on sprayed and check trees.

These results of course apply only to the grapefruit, the most susceptible host.

Doryland(6) has reported successful results of spraying experiments against citrus canker upon seedling trees of calamondin, mandarin, and sweet-orange varieties in nursery rows at the Singalong experiment station in Manila, Philippine Islands. He found that spraying with Bordeaux mixture 4–6–50 met with little or no success when used in the rainy season, but later he obtained favorable results by using formalin in a 1 to 100 solution at ten-day intervals. Doryland does not give his dates of spraying, but a survey of his statements as to time of application leads to the conclusion that his favorable results with formalin were obtained in the dry season, when active dissemination of citrus canker is limited. His later report(7) states that applications at ten-day intervals of Bordeaux mixture 4–6–50, plus formalin to make a 0.4 per cent solution, were able to rid the plants of canker in four months. His spraying was begun January 29; therefore, four months would bring his experiments to a conclusion on May 29. January, February, March, April, and May are dry months in the Manila Bay region, as Table 1 has shown. By using creolin-formalin emulsion, Doryland was able to decrease canker during the first four months, but during the fifth month there was a bad increase in canker. The fifth month would be June, which has a very heavy rainfall. Thus it would seem as if Doryland's data may be taken to show that canker can be controlled in the dry months, but that his results do not apply to the rainy season when canker dissemination and development are active. This conclusion would bear out Wester's result.

Doidge(5) reports that citrus canker was controlled with Bordeaux mixture 4–4–50 under conditions in the Transvaal, where there is a long dry season. She does not give the host upon which the control was obtained.

Kellerman(8) advised spraying healthy trees with a 1 per cent formalin solution to avoid infection, but the recommendation apparently was not based upon experimental evidence.

Spraying experiments upon Washington navels in Japan have been reported by several Japanese investigators and were apparently successful to some degree as practiced by the investigators. Growers of Washington navels in Japan at present, however, have given up such spraying as unsuccessful in a number of cases. A more detailed review of the Japanese literature will be presented in a later publication.

THE CONTROL EXPERIMENTS OF THE PRESENT INVESTIGATIONS

DESCRIPTION OF METHODS

Lime sulphur solution, Bordeaux 4–4–50 mixture, and Burgundy 3–3$\frac{5}{8}$–50 mixture [3] are so commonly used that no discussion as to the methods of preparation is necessary. During the spraying experiments it seemed desirable to attempt to render the copper more readily available for action against the canker organism, following the theory [4] of Bedford and Pickering; (1, 2) in the case of Bordeaux mixture the excess of lime was, therefore, reduced to just the amount sufficient entirely to precipitate all of the copper. This was called neutral Bordeaux mixture. A similar neutral Burgundy mixture was employed in which the sodium carbonate added was just sufficient to precipitate the copper with no excess remaining. Ammoniacal copper carbonate solution, when used, was made up to contain: Copper carbonate, 5 ounces; concentrated ammonium hydroxide, 3 pints; and water, 50 gallons. The methods of preparation are, of course, well known. Formalin as a preventive was used as a simple solution, easy to prepare; neutral lead arsenate is also so commonly used as to need no discussion.

Two different oil-emulsion preparations were used in checking scale-insect increases following the fungicide applications. An oil emulsion described by Yothers(22) was commonly used. This consisted of soft soap, 4 pounds; paraffin oil (25° Baumé), 1 gallon; and water, 1 gallon. The preparation was made up in the ratio of 1 gallon of the mixture to 50 gallons of water. Another oil emulsion consisted of a mixture of a cresylic soap liquor with kerosene or distillate. This emulsion was prepared

[3] The spraying experiments reported here were begun and carried to a conclusion before the work upon the phenol coefficients of fungicides(11) with the canker organism had been completed.

[4] These references have not been available in Manila but are quoted from their reviews.

as follows: *Liquor cresolis compositus*, 1 quart; kerosene, 3 quarts; and water, to make 50 gallons.

A sticker was used in many instances in an attempt to cause the copper sprays and lime sulphur to adhere to the foliage for the greatest length of time possible. This sticker consisted of 2 pounds of resin, dissolved with heat in a solution of 1 pound of sodium carbonate in 1 gallon of water. The sticker was used in these experiments in the ratio of 1 quart of the mixture to 50 gallons of the spray mixture.

The removal of the sources of canker infection was obtained in some cases by pruning out twig and limb cankers. Another, somewhat drastic method was used in a few cases of trees with heavy foliage infections. A solution of formalin was prepared which would partially burn the citrus foliage; leaves with canker infections were sometimes already weakened, and these dropped after such a drastic spray, while normal leaves in many cases would survive this treatment. A 1 to 80 formalin solution was used for this purpose on sweet orange, grapefruit, and mandarin orange trees with some degree of success. Such a concentration was, however, too strong for lime and lemon trees, and almost complete defoliation would follow on those hosts. The use of formalin solutions for this procedure was closely related to the sunlight conditions; on rainy days or toward nightfall the formalin would not evaporate as rapidly as in direct sunlight and greater injury would result. The use of a spray solution for this purpose was called a clean-up spray, in contradistinction to the term preventive spray.

It was also attempted to secure the growth of new foliage during climatic seasons unfavorable to the development or dissemination of citrus canker. Such growth was secured by employing the pruning procedures at the end of the rainy season so that new growth stimulated by the pruning came out in the dry season. Maintenance of foliage growth was also secured in the dry season by irrigation.

The test of spray mixtures was made along two lines; namely, in connection with the pruning and the stimulation of growth measures, at Lamao, Bataan, Philippine Islands; and the efficacy of spraying alone, without pruning or other measures, was tested at Los Baños, Laguna, Philippine Islands.

THE SPRAYING EXPERIMENTS AT LOS BAÑOS

DESCRIPTION OF ORCHARD CONDITIONS

The orchard at Los Baños is maintained by the College of Agriculture of the University of the Philippines and consists of rows of native sweet oranges, calamondins, lemons, Kusaie limes, citrons, and pummelos. With the exception of the Kusaie limes, these trees are largly native to the Philippines, without classification into horticultural varieties. The trees were, for the most part, five years old at the beginning of the experiment, and although varying considerably in size were commonly 3 to 5 meters in height and, with a few exceptions, in good growing condition. The trees were in orchard formation upon level land, protected but partially from the strong and sometimes violent winds. The orchard was clean cultivated at all times of the year; no irrigation was practiced during the dry season.

The orchard was divided into six plats, so arranged that each plat cut across the rows of similar species at right angles; each species was thus represented in each plat. It may seem unfortunate that the experiments were not carried on in orchards of a single uniform susceptible species, having plats consisting of but one variety; however, this was impossible in as much as no such mature orchard existed at that time in the Philippines.

The use of the specific name *Citrus maxima* (*C. grandis*, *C. decumana*) as pointed out by Merrill (15) has been followed in this paper.

PLAT I, AT LOS BAÑOS

The treatment of this plat consisted of an application of lime sulphur (32° Baumé) in a 1 to 40 solution. It was found that lime sulphur washed off very easily during the heavy rains at Los Baños.[5] In as much as the rains are normally very heavy in the wet season in Los Baños, it was apparent that lime sulphur could not be used against canker in this locality and its use on this plat was, therefore, abandoned.

PLAT II, AT LOS BAÑOS

Plat II consisted of two rows running parallel with rows of Plats I, III, IV, V, VI, and was left entirely untreated as a check upon the rows that were treated. The amounts of canker

[5] In this connection various methods were attempted to cause lime sulphur to adhere to the foliage for a longer period. Powdered casein in the ratio of 4 ounces to 50 gallons was sifted into the solution; compared with an application of lime sulphur without casein, made at the same time, no advantage was gained. Casein in the form of condensed milk was added to lime sulphur and similarly gave no advantage. The resin salsoda sticker was added in the ratio of 1 quart to 50 gallons of the lime sulphur. This mixture was applied to a plat of trees while at the same time lime sulphur with no such sticker was applied to a similar plat of trees. The foliage of both plats tested for sulphur at the end of two weeks was entirely negative.

on each tree in August, 1917, at the beginning of the experiments, and in August, 1918, when the experiments were completed, are shown in Table 5.

TABLE 5.—*Showing degree of canker affection of trees in untreated plat, Plat II, of the College of Agriculture citrus planting at Los Baños.*[a]

Species.	Leaves affected.			
	August, 1917.		August, 1918.	
	Per cent.	*Number.*	*Per cent.*	*Number.*
Citrus maxima	20		50	
Do	95		([b])	([b])
Do	0	0		8
Citrus sinensis	5		2	
Do	3		1	
Do	5		1	
Do	0	0	1	
Citrus mitis		10		10
Do		2		5
Citrus limonia	1		1	
Do	5		5	
Do	5		5	
Do	2		1	
Do	1		1	
Do	2			10
Citrus hystrix	0	0	0	0
Citrus aurantifolia	1		5	
Do	2		5	
Do	1		([b])	([b])
Do	2		10	
Citrus medica		10		5
Do		7		4
Do	0	0		9
Do		7		11
Do	1			15
Citrus maxima	65		10	
Do	50		100	
Citrus nobilis	0	0	0	0
Citrus maxima	5		1	
Citrus hystrix		6	1	
Citrus maxima	25		1	
Do	20		1	
Do	3		50	
Citrus species	40		5	
Citrus limonia	0	0	1	
Do	0	0	0	0
Citrus sinensis		28		9
Do		18		5

[a] The determination of the species mentioned in this and subsequent tables is taken from a chart of the college orchard at Los Baños made available through the kindness of Mr. Mariano G. Medalla, instructor in the College of Agriculture, University of the Philippines. The measurement of the amount of canker on the leaves at Los Baños in August, 1918, is also largely to be credited to Mr. Medalla. For this and for much other assistance the writer wishes to express his sincere thanks to Mr. Medalla.

[b] Dead.

It can be seen from this tabulation, that the amount of canker in this plat at the end of the experiment in August, 1918, was quite as great as it was in August, 1917, when the work was undertaken. The criticism may be raised that the estimation of the amounts of foliage cankered could not be accurate. This is, of course, a valid criticism, but no other method of measuring the amounts of canker was available in as much as few or no fruits were formed in the orchard during this season. The amounts of canker were determined only after long and careful examination and, in the case of the affected leaves expressed numerically, is from actual count.

PLAT III, AT LOS BAÑOS

The treatment of this plat was as follows:

August 24, 1917. Cresol-kerosene emulsion, plus mercuric bichloride to make a 1 to 1,500 solution.

September 14, 1917. Burgundy 3–$3\frac{5}{8}$–50 mixture.

October 11, 1917. Burgundy 3–$3\frac{5}{8}$–50 mixture.

November 12, 1917. Burgundy 3–$3\frac{5}{8}$–50 mixture, plus powdered neutral lead arsenate to make a 1–50 mixture.

December 20, 1917. Burgundy 3–3–50 mixture.

January 5, 1918. Yothers's oil emulsion.

May 17, 1918. Neutral Burgundy mixture, plus formalin 1–100.

June 14, 1918. Neutral Burgundy mixture, plus formalin 1–100 and cresol-kerosene emulsion.

July 13, 1918. Neutral Burgundy mixture.

TABLE 6.—*Showing degree of canker affection of trees in Plat III of the College of Agriculture citrus planting at Los Baños.*

Species.	Leaves affected.			
	August, 1917.		August, 1918.	
	Per cent.	*Number.*	*Per cent.*	*Number.*
Citrus maxima	3		0	0
Do	1			1
Do	10		1	
Citrus sinensis	10			2
Do	8		0	0
Do	1		0	0
Do	0	0	0	0
Do	10			12
Do	0	0		4
Do	20		0	0
Do	5		0	0
Citrus mitis	0	0	0	0
Do	0	0	0	0
Do		2	0	0
Do		5	0	0
Citrus limonia	5		2	
Do	1			10

TABLE 6.—*Showing degree of canker affection of trees in Plat III of the College of Agriculture citrus planting at Los Baños*—Continued.

Species.	Leaves affected.			
	August, 1917.		August, 1918.	
	Per cent.	*Number.*	*Per cent.*	*Number.*
Citrus limonia—Continued.				
Do	5			5
Do	5		0	0
Do	2		0	0
Do	2		0	0
Do	2			5
Do	1			4
Do		20		2
Do		20	0	0
Do		30		9
Do		25		5
Citrus hystrix	0	0	0	0
Do	0	0	0	0
Do	0	0	0	0
Do		8	0	0
Citrus aurantifolia	3		0	0
Do	2		0	0
Do	1		0	0
Do	3		0	0
Do	2			16
Do	1			25
Do	2		1	
Do	1			11
Citrus medica	0	0		6
Do	0	0	0	0
Do		4	0	0
Do	0	0	0	0
Citrus maxima	40		0	0
Do	50			9
Do	50		1	
Do	50		1	
Do	0	0	0	0
Citrus medica	0	0	0	0
Citrus hystrix	2			8
Do	5			17
Do	40			11
Do		5	1	
Citrus maxima	25			25
Do	2			4
Do	5			27
Do	0	0		7
Do	34		0	0
Do	5			3
Do	30		0	0
Do	3			5
Do	2			27
Do	2			7
Citrus limonia		5	0	0
Do	0	0	0	0
Do	0	0	0	0

Cresol-kerosene emulsion plus mercuric bichloride 1 to 1,500 was used as an insecticide at the beginning of the experiment, to check the increase of scale insects. It was found that the addition of bichloride to make a 1 to 1,500 solution was much too strong a mixture, and defoliation of many of the normal as well as cankered leaves resulted. The neutral Burgundy mixture was employed under greatly varying weather conditions; upon the citrus trees no evidence of burning of the foliage or fruit was ever observed in these experiments.

The foregoing tabulation shows that a reduction in the amounts of citrus canker was obtained in this plat. The most noteworthy cases are those of the Kusaie limes and the trees of *Citrus limonia*, both of which species were reduced from a condition of fairly general infection to a condition of fairly satisfactory control.

PLAT IV, AT LOS BAÑOS

The treatment of this plat was as follows:

August 24, 1917. Bordeaux 4–4–50 mixture plus sugar (sugar, 15 per cent by weight of the copper sulphate in the mixture) and plus 1 quart of resin, sal-soda sticker.

September 13, 1917. Bordeaux 4–4–50 mixture plus sugar (sugar, 15 per cent by weight of the copper sulphate in the mixture) and plus 1 quart of resin, sal-soda sticker.

October 11, 1917. Bordeaux 4–4–50 mixture plus sugar (sugar, 15 per cent by weight of the copper sulphate in the mixture) and plus 1.25 quarts of resin, sal-soda sticker.

November 12, 1917. Bordeaux 4–4–50 mixture plus sugar (sugar, 15 per cent by weight of the copper sulphate in the mixture) and plus 1.25 quarts of resin, sal-soda sticker. To this was also added for this application powdered, neutral, lead arsenate to make a 1–50 mixture.

December 20, 1917. Neutral Bordeaux mixture.

January 3, 1918. Yothers's oil emulsion.

May 16, 1918. Neutral Bordeaux mixture plus formalin 1–100.

June 14, 1918. Neutral Bordeaux mixture plus formalin 1–100 and cresol-kerosene emulsion.

July 13, 1918. Neutral Bordeaux mixture.

The use of sugar in Bordeaux mixture is described by Bourcart(3) as having been first suggested by Perret. It was said to make the copper more easily available and to cause the Bordeaux to adhere better to the foliage. Lutman(13) states that the addition of sugar to the lime before preparing Bordeaux mixture also weakens the precipitation membranes, causing the precipitation to go more nearly to completion and increasing the covering power of the mixture.

TABLE 7.—*Degree of canker affection of trees in Plat IV of the College of Agriculture citrus planting at Los Baños.*

Species.	Leaves affected.			
	August, 1917.		August, 1918.	
	Per cent.	*Number.*	*Per cent.*	*Number.*
Citrus maxima	50	----		----
Do	50	----		----
Do	25	----	2	----
Do	1	----	0	0
Citrus sinensis	1	----	0	0
Do	2	----	0	0
Do	20	----	----	1
Do	20	----	0	0
Do	2	----	----	
Do	5	----	----	1
Do	15	----	----	6
Citrus mitis	----	3	0	0
Do	----	4	0	0
Do	0	0	0	0
Do	----	10	0	0
Citrus limonia	15	----	----	4
Do	10	----	----	2
Do	5	----	0	0
Do	5	----	0	0
Do	2	----	0	0
Do	1	----	----	5
Do	5	----	0	0
Do	5	----	----	5
Do	1	----	0	0
Do	2	----	0	0
Do	2	----	0	0
Do	1	----	----	3
Citrus hystrix	0	0	0	0
Do	0	0	0	0
Do	0	0	0	0
Do	5	----	0	0
Citrus aurantifolia	2	----	0	0
Do	2	----	0	0
Do	1	----	0	0
Do	----	20	([a])	([a])
Do	2	----	----	6
Do	3	----	----	15
Do	2	----	----	9
Do	2	----	----	35
Citrus medica	25	----	1	----
Do	50	----	1	----
Do	25	----	1	----
Do	25	----	2	----
Citrus maxima	50	----	5	----
Do	----	15	----	6
Do	50	----	5	----
Do	50	----	5	----
Do	0	0	0	0

[a] Dead.

TABLE 7.—*Degree of canker affection of trees in Plat IV of the College of Agriculture citrus planting at Los Baños*—Continued.

Species.	Leaves affected.			
	August, 1917.		August, 1918.	
	Per cent.	*Number.*	*Per cent.*	*Number.*
Citrus hystrix	40			10
Do	50		1	
Do	40		1	
Citrus maxima	50		25	
Do	5			16
Do	1			5
Do	2			21
Do	2			18

It is apparent that some reduction in the amounts of canker infection was accomplished in the foregoing plats.

PLAT V, AT LOS BAÑOS

The trees in this plat were of the same species and varieties as those represented in Plats I, II, III, and IV. This plat was left entirely untreated, as a check upon the sprayed plats.

TABLE 8.—*Degree of canker affection of untreated trees in Plat V, of the College of Agriculture citrus planting at Los Baños.*

Species.	Leaves affected.			
	August, 1917.		August, 1918.	
	Per cent.	*Number.*	*Per cent.*	*Number.*
Citrus maxima	25			40
Do	20		2	
Do	20			1
Do	25			37
Citrus mitis	0	0	0	0
Do	0	0	0	0
Citrus limonia	5		5	
Do	5		5	
Do		22		10
Do	5			37
Do	1		1	
Do	1		1	
Do		12	0	0
Citrus hystrix		10	0	0
Citrus aurantifolia	5			5
Do	5			20
Do	2		2	
Do	1		0	0
Citrus maxima	50			21
Do	1		1	

Table 8 shows that in this plat canker, even though untreated, decreased to some extent from what it was at the beginning of the experiment. Although there are possible explanations for this they will not be entered into in detail here; granted that seasonal differences permitted some reduction in canker, it is apparent that considerably more reduction was obtained on the sprayed plats.

PLAT VI, AT LOS BAÑOS

It was intended to run this plat entirely as a test of formalin against citrus canker. It became evident a few weeks after the first application, however, that new infections were appearing and that applications of formalin as a preventive would be necessary much too often to be feasible. The spraying with formalin solution was therefore abandoned as a preventive but was subsequently used on other plats for clean-up work.

DISCUSSION OF RESULTS AT LOS BAÑOS

The comparative value of the sprays which were tried is briefly summarized as follows: Cankers recurred after the application of formalin 1 to 100 without any reduction in number or distribution; the results at Los Baños are therefore taken to indicate that formalin has little value as a preventive spray. In the heavy tropical rains in the Philippines lime sulphur did not adhere well to the foliage, although it is possible that in regions of more moderate rainfall lime sulphur would be of great value. Burgundy and Bordeaux mixtures, when freshly prepared, adhered to the foliage very well and no difficulty was experienced with the washing of such copper sprays from the foliage. The determination of the length of the periods between spraying depended, therefore, chiefly upon the amount of new growth which came out and was unprotected by coatings of spray. As to the comparative merits of Burgundy and Bordeaux mixtures as preventives, little or no difference showed in the results.

From Tables 6 and 7, showing the results of plats sprayed with Burgundy and Bordeaux mixtures, it is apparent that the amounts of citrus canker in most cases were reduced to some extent; Table 5, showing an untreated plat, shows no decrease in canker; Table 8, also untreated, destroys some of the value of the results on the treated plats, since it also in some cases shows a decrease in the amount of canker affection. There are possible explanations for this; but, regardless of such explanations, it is apparent that the reduction in the amounts of canker in the treated plats is greater than in either of the untreated plats.

It would seem, then, that such preventive sprays have, to some extent, reduced the amounts of infection. In the light of the writer's disinfectant tests (11) it is difficult to ascribe the cause for this reduction unless it be to the excesses of copper precipitants applied, or even possibly to the mechanical effects of the spray deposits on the foliage.

The criticism of the results, from a commercial viewpoint, would be of course that nine spray applications are not economically feasible. It should be noted however that, theoretically, control should more nearly approach the absolute, year after year, since with the gradual prevention of canker infection by preventive coatings there is also a gradual reduction in the sources of infection. This would reduce to some extent the necessity for such frequent spray applications. It would seem probable also that, with greater knowledge of the climatic peculiarities of the locality and the growth periods of the different varieties, the number of spray applications would be reduced somewhat. This can only be determined by a continuation of the experiments, which will be reported upon in further publications.

THE CONTROL EXPERIMENTS AT LAMAO

DESCRIPTION OF ORCHARD CONDITIONS

In these experiments no effort was made to compare the value of the different spray mixtures used, the main purpose being to determine whether or not canker control was feasible by any and all means. The experiments were carried on in three orchards of the Lamao experiment station of the Philippine Bureau of Agriculture. These orchards consist of collections of the common horticultural varieties of *Citrus* species grown in the United States and Japan, usually two individuals representing each variety.[6]

The division of these orchards into spray plats in such a way as to include individuals of each species in each plat was difficult; however, an attempt was made to make each plat representative.

[6] These collections are mainly the work of Mr. P. J. Wester, agricultural advisor, Philippine Bureau of Agriculture. The collections are very extensive and contain a great number of the commonly grown citrus varieties of America as well as many Japanese-grown varieties. In addition, Mr. Wester has introductions from India, Siam, China, and Australia, as well as a very extensive collection of the native Philippine fruits. The writer is greatly indebted to Mr. Wester for his very hearty coöperation in the identification of obscure varieties, the use of his card indexes, and all matter relating to his collections.

It is unfortunate that plats of uniformly susceptible varieties could not be employed; but, as stated previously, there were no such mature orchards in the Philippines.

The trees, except in a few instances, were in good growing condition, planted in orchard formation on level, clean-cultivated land. The trees were for the most part five years old at the beginning of the experiment. The orchards were surrounded by dense thickets of bamboo, 10 to 14 meters high, and these bamboo thickets formed very efficient windbreaks.

All plats at Lamao underwent entirely the same treatment in regard to irrigation, fertilization, and cultural operations. Only treated plats underwent pruning, and no pruning of the control plats was made.

All spraying mentioned here was carried on with a hand-power pump equipped with a pressure tank, and all spray applications were made with the pressure maintained at from 120 to 140 pounds. Operations for the removal of infected parts and the stimulation of new growth were identical in all the treated plats.

The detailed reports will not be presented from all of the plats, in as much as the general conclusions from each plat were much the same. Several of the plats, however, contained varieties, the susceptibility and resistance of which may be of interest in America; these plats have been selected for presentation not only to show the effect of the canker-control methods but also to show comparative susceptibility.

PLAT I, ORCHARD A, LAMAO

September 3, 1917. Lime sulphur (32° Baumé) 1–40 solution.
September 20, 1917. Bordeaux 4–4–50 mixture.
September 21, 1917. Trees pruned for twig cankers.
October 23, 1917. Bordeaux 4–4–50 mixture.
November 20, 1917. Formalin 1–80 solution.
November 21, 1917. Trees pruned for twig cankers.
November 28, 1917. Lime sulphur 1–50 solution plus formalin 1–100, and powdered, neutral lead arsenate to make 1–50 mixture.
December 7, 1917. Kerosene-lysol emulsion, plus formalin 1–70.
January 10, 1918. Neutral Bordeaux mixture plus resin, sal-soda sticker and formalin 1–100. Trees carefully pruned for twig cankers.
May 31, 1918. Lime sulphur 1–40 solution.
June 25, 1918. Neutral Bordeaux mixture plus kerosene-lysol emulsion, plus formalin 1–100.
August 1, 1918. Lime sulphur 1–35 solution.

The condition of the trees in regard to canker may be followed through the different seasons in Table 9.

Work on this plat was begun by spraying with lime sulphur, but it became apparent, as at Los Baños, that the lime-sulphur solution was easily washed from the leaves by the beating, driving rains. Thereafter a change was made to Bordeaux mixture, except in seasons when the rainfall was less intense. In such seasons of less rainfall, because of the increase of scale insects following the successive use of copper sprays, lime sulphur was used whenever possible for its action as a scalecide as well as for its action against canker.

PLAT II, ORCHARD A, LAMAO

This plat consisted of three rows of trees adjacent to the rows of Plat I; the character of the trees and degree of canker infection throughout the season are shown in Table 10. All trees in this plat were left entirely untreated. Unfortunately these trees are for the most part varieties different from those that appear in the sprayed plats; nevertheless, they may afford some basis for comparison between the treated and the untreated plats.

Although some of the trees in this untreated plat show reductions in the amount of canker infection, some show increases. As a whole, then, this plat, serving as a control, can be used as a basis for comparison with the treated plats. The trees being untreated also afford something of an idea of the susceptibility of the species represented in this plat.

PLAT III, ORCHARD A, LAMAO

This plat consisted of three rows of trees, the character of which is shown in the tabulation of the degree of canker infection during the various stages of control experiments. The treatment of the plat was as follows:

September 1, 1917. Lime sulphur 1–40 solution.

September 20, 1917. 4–4–50 Bordeaux mixture. Trees pruned for twig cankers.

October 23, 1917. 4–4–50 Bordeaux mixture.

November 20, 1917. Formalin 1–80 solution as a clean-up spray.

November 28, 1917. Formalin 1–100 solution plus powdered, neutral, lead arsenate to make 1–50 mixture.

December 6, 1917. Lime sulphur 1–40 solution plus formalin 1–80.

January 9, 1918. Neutral Bordeaux mixture plus formalin 1–100 and Yothers's oil emulsion. Trees pruned for twig cankers.

May 31, 1918. Lime sulphur 1–30 solution.

June 24, 1918. Lime sulphur 1–35 solution plus formalin 1–100.

August 1, 1918. Lime sulphur 1–35 solution plus resin, sal-soda sticker.

The complete reversal from Bordeaux mixture to lime-sulphur solution in 1918 was necessitated by severe attacks of scale insects following the Bordeaux applications.

TABLE 9.—*Canker condition of the citrus trees in Plat I, Orchard A, Lamao, at the different seasons.*[a]

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 30, 1917.		January 12, 1918.		May 25, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Valencia	*Citrus sinensis*	-----	1	0	0	0	0	0	0	0	0
Do	do	-----	11	-----	6	0	0	-----	1	0	0
Tizon	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Ruby	*Citrus sinensis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Valencia	do	0	0	0	0	0	0	0	0	0	0
Do	do	-----	5	50	-----	-----	1	0	0	0	0
Ladu	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Native orange	*Citrus sinensis*	50	-----	-----	7	0	0	0	0	0	0
Messina	*Citrus limonia*	30	-----	-----	1	0	0	(b)	(b)	-----	-----
Murrill orange	*Citrus* species	100	-----	10	-----	2	-----	-----	56	-----	(c)
Do	do	50	-----	10	-----	2	-----	-----	10	0	0
Native fruit	*Citrus excelsa*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Sampson	*Citrus* hybrid-tangelo	100	-----	15	-----	-----	2	0	0	0	0
Do	do	100	-----	-----	8	-----	1	(b)	(b)	-----	-----
Rough lemon	*Citrus limonia*	0	0	0	0	0	0	0	0	0	0
Seedless pummelo	*Citrus maxima*	10	-----	10	-----	-----	10	0	0	0	0
Do	do	50	-----	10	-----	-----	20	0	0	0	0
White seedless pummelo	do	100	-----	5	-----	-----	1	0	0	0	0
Do	do	50	-----	50	-----	-----	15	-----	1	0	0
Cabuyao	*Citrus hystrix*	-----	1	50	-----	50	-----	2	-----	1	-----
Do	do	-----	11	50	-----	25	-----	5	-----	1	-----
Oblong pummelo	*Citrus maxima*	100	-----	-----	23	-----	7	0	0	0	0

West Indian lime	*Citrus aurantifolia*	100	----------	25	----------	10	----------	5	----------	1	----------
Do	do	100	----------	15	----------	10	----------	5	----------	1	----------
Do	do	100	----------	10	----------	10	----------	5	----------	1	----------
Chinese lime	*Citrus limonia*	100	----------	90	----------	10	----------	1	----------	0	0
Do	do	100	----------	75	----------	5	----------	2	----------	1	----------
Native cajel	*Citrus sinensis*	30	----------	5	----------	----------	11	----------	1	0	0
Do	do	100	----------	10	----------	10	----------	0	0	0	0
Ellen	*Citrus maxima*	100	----------	5	----------	5	----------	----------	10	0	0
Do	do	100	----------	20	----------	20	----------	----------	7	0	0
Washington navel	*Citrus sinensis*	100	----------	0	0	0	0	(b)	(b)	----------	----------
Pernambuco	*Citrus maxima*	100	----------	60	----------	50	----------	10	----------	1	----------
Do	do	100	----------	25	----------	----------	20	0	0	0	0

[a] At the beginning of the work an attempt was made to get an actual count of infected leaves upon each tree; this, of course, moved very slowly and was necessarily abandoned. However, the initial work in counting afforded an excellent basis for the later estimates of the percentages of leaves affected as entered in this and following tables. The estimates were in each case made after detailed examination; the statement "0" is an exact observation.

[b] Dead.

[c] Five twigs cankered.

TABLE 9.—*Canker condition of the citrus trees in Plat I, Orchard A, Lamao, at the different seasons.*[a]

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 30, 1917.		January 12, 1918.		May 25, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Valencia	*Citrus sinensis*		1	0	0	0	0	0	0	0	0
Do	do		11		6	0	0		1	0	0
Tizon	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Ruby	*Citrus sinensis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Valencia	do	0	0	0	0	0	0	0	0	0	0
Do	da		5	50			1	0	0	0	0
Ladu	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Native orange	*Citrus sinensis*	50			7	0	0	0	0	0	0
Messina	*Citrus timonia*	30			1	0	0	(b)	(b)		
Murrill orange	*Citrus* species	100		10		2			56		(c)
Do	do	60		10		2			10	0	0
Native fruit	*Citrus excelsa*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Sampson	*Citrus* hybrid-tangelo	100		15			2	0	0	0	0
Do	do	100			5		1	(b)	(b)		
Rough lemon	*Citrus limonia*	0	0	0	0	0	0	0	0	0	0
Seedless pummelo	*Citrus maxima*	10		10			10	0	0	0	0
Do	do	50		10			20	0	0	0	0
White seedless pummelo	do	100		5			1	0	0	0	0
Do	do	50		50			15		1	0	0
Cabuyao	*Citrus hystrix*		1	50		50		2		1	
Do	do		11	50		25		5		1	
Oblong pummelo	*Citrus maxima*	100			23		7	0	0	0	0
West Indian lime	*Citrus aurantifolia*	100		25		10		5		1	
Do	do	100		15		10		5		1	
Do	do	100		10		10		5		1	
Chinese lime	*Citrus limonia*	100		90		10		1		0	0
Do	do	100		75		5		2		1	
Native cajel	*Citrus sinensis*	30		5			11		1	0	0
Do	do	100		10		10		0	0	0	0
Ellen	*Citrus maxima*	100		5		5			10	0	0
Do	do	100		20		20			7	0	0
Washington navel	*Citrus sinensis*	100		0	0	0	0	(b)	(b)		
Pernambuco	*Citrus maxima*	100		60		50		10		1	
Do	do	100		25			20	0	0	0	0

[a] At the beginning of the work an attempt was made to get an actual count of infected leaves upon each tree: this, of course, moved very slowly and was necessarily abandoned. However, the initial work in counting afforded an excellent basis for the later estimates of the percentages of leaves affected as entered in this and following tables. The estimates were in each case made after detailed examination; the statement "0" is an exact observation.

[b] Dead.

[c] Five twigs cankered.

TABLE 10.—*Canker condition of the untreated citrus trees of Plat II, Orchard A, Lamao, at the different seasons.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 30, 1917.		January 12, 1918.		May 25, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Sampson	*Citrus* hybrid tangelo	100		50		50		25		25	
Do	do	100		50		50		15		15	
Marsh	*Citrus maxima*	100		80		80		50		25	
Do	do	100		80		80		50		80	
Triumph	do	100		60		50		25		90	
Do	do	100		25		25		10		75	
Pink pummelo	do		6		10		11	5		0	0
Do	do	100		100		15			10	0	0
Lemon variety	*Citrus limonia*	0	0		4	(a)	(a)	0	0	0	0
Do	do	0	0	0	0	0	0	(b)	(b)		
Pineapple	*Citrus sinensis*	50		50		50		15		50	
Do	do	80		10		10		5		5	
Washington navel	do	20		5		5		5		10	
Do	do	1		1		1		2		50	
Jaffa	do		13	50		10		20		30	
Do	do	0	0	25		5		5		5	
Mandarin	*Citrus nobilis*		5		6		2		6	0	0
Do	do	0	0	0	0	0	0	0	0	0	0

[a] Cankered fruit.

[b] Dead.

Table 11 shows that in all cases of susceptible trees, a considerable reduction in the amounts of citrus canker took place during the year.

The behavior of the trees of the Tahiti lime is noteworthy. Both of these trees were in actively growing condition and well exposed to infection; however, they exhibited a very moderate susceptibility to canker, and control was very easily obtained. Other trees of the Tahiti lime have been under observation at Lamao and have exhibited the same slight susceptibility to canker. This is all the more peculiar, as Wester(19) also has pointed out, since for the most part lime varieties are extremely susceptible.

The behavior of the Triumph grapefruit is also noteworthy; as grown at Lamao, it apparently has a less degree of susceptibility to canker than have the other American-grown grapefruit varieties. The lemon varieties as shown in the table are but moderately susceptible and they responded readily to the control methods employed.

PLAT IV, ORCHARD A, LAMAO

The treatment and results were much the same on this plat as on plats I and III.

Of interest from this plat was the ease of control of the Limon Real, a Philippine, lemonlike fruit. Of greater interest in the United States is the behavior of the Mediterranean sweet orange varieties, the Jaffa, St. Michael, and Ruby. The susceptibility of these varieties is very slight, and they responded very quickly to the control methods employed.

PLAT VI, ORCHARD B, LAMAO

It was intended that this plat should be sprayed continuously with ammoniacal copper carbonate solution as a test of that spray as compared with other mixtures.

At the beginning of October, after two applications, it was apparent that this spray was having little effect upon citrus canker, in as much as new infections were appearing continuously. Spraying was abandoned, therefore, and the plat became a check upon the other plats in Orchard B, for the next spraying season.

Table 12 shows that on a few trees in this plat the amounts of canker decreased; on the other hand, there was an equal number of cases where the amounts of canker increased. Examination of the table enables one to compare the canker condi-

TABLE 11.—*Canker condition of the trees in Plat III, Orchard A, Lamao, at various seasons of the year.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 30, 1917.		January 14, 1918.		May 28, 1918.		August 2, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Japanese orange [a]	*Citrus aurantium*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Ruby	*Citrus sinensis*	0	0		2	0	0		4	0	0
Do	do		9	0	0	0	0		6	0	0
Clarke	*Citrus limonia*		2		1	0	0		1	0	0
Do	do	0	0	0	0		3	0	0	0	0
Holdfast	*Citrus sinensis*	10		10		5			2	0	0
Do	do	1		1		0	0	0	0	0	0
Villa Franca	*Citrus limonia*	1		1		1		0	0	0	0
Do	do	0	0	0	0		6		2	0	0
Lisbon	do	0	0	0	0	0	0	0	0	0	0
Bengal	do	0	0	0	0	0	0	0	0	0	0
Mediterranean	*Citrus sinensis*	50			11		7		1	0	0
Do	do	20		1			14		6	0	0
Valencia	do	1		1			80		6		1
Do	do	1			6		13		2	0	0
Marsh	*Citrus maxima*	100		5		20		40		30	
Do	do	100		5		5		10		20	
Tahiti	*Citrus aurantifolia*	50		50			2		3	0	0
Do	do		1		3	0	0	0	0	0	0
Sicily	*Citrus limonia*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Washington navel	*Citrus sinensis*		2		6	0	0	0	0	0	0
Do	do		1	0	0	0	0	0	0	0	0
Thornless	*Citrus limonia*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0		2	0	0	0	0	0	0

Triumph	*Citrus maxima*	80	----------	15	----------	----------	5	----------	13	0	0
Do	do	50	----------	5	----------	----------	2	0	0	0	0
Larrantta	*Citrus sinensis*	50	----------	50	----------	1	----------	----------	15	0	0
White Silletta	do	50	----------	50	----------	1	----------	----------	7	0	0
Do	do	50	----------	10	----------	1	----------	----------	8	----------	4
Citron	*Citrus medica*	1	----------	----------	2	0	0	0	0	0	0
Do	do	50	----------	0	0	0	0	0	0	0	0
Calamondin	*Citrus mitis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Jaffa	*Citrus sinensis*	----------	12	1	----------	----------	10	----------	3	0	0
Do	do	----------	10	----------	1	----------	5	----------	1	0	0
Bahia	do	0	0	0	0	----------	5	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0

[a] According to Doctor Tanaka, a specialist on Japanese citrus fruits, residing at Nishi Suma, Hyogo Ken, Japan, this "Japanese orange" is identical with the Japanese-grown *Daidai*, a form of *Citrus aurantium*.

TABLE 11.—*Canker condition of the trees in Plat III, Orchard A, Lamao, at various seasons of the year.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 30, 1917.		January 14, 1918.		May 28, 1918.		August 2, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Japanese orange [a]	*Citrus aurantium*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Ruby	*Citrus sinensis*	0	0	...	2	0	0	...	4	0	0
Do	do	...	9	0	0	0	0	...	6	0	0
Clarke	*Citrus limonia*	...	2	...	1	0	0	...	1	0	0
Do	do	0	0	0	0	...	3	0	0	0	0
Holdfast	*Citrus sinensis*	10	...	10	...	5	...	...	2	0	0
Do	do	1	...	1	...	0	0	0	0	0	0
Villa Franca	*Citrus limonia*	1	...	1	...	1	...	0	0	0	0
Do	do	0	0	0	0	...	6	...	2	0	0
Lisbon	do	0	0	0	0	0	0	0	0	0	0
Bengal	do	0	0	0	0	0	0	0	0	0	0
Mediterranean	*Citrus sinensis*	50	...	...	11	...	7	...	1	0	0
Do	do	20	...	1	...	...	14	...	6	0	0
Valencia	do	1	...	1	...	...	80	...	6	...	1
Do	do	1	...	...	6	...	13	...	2	0	0
Marsh	*Citrus maxima*	100	...	5	...	20	...	40	...	30	...
Do	do	100	...	5	...	5	...	10	...	20	...
Tahiti	*Citrus aurantifolia*	60	...	60	...	...	2	...	3	0	0
Do	do	...	1	...	3	0	0	0	0	0	0
Sicily	*Citrus limonia*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Washington navel	*Citrus sinensis*	...	2	...	6	0	0	0	0	0	0
Do	do	...	1	0	0	0	0	0	0	0	0
Thornless	*Citrus limonia*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	...	2	0	0	0	0	0	0
Triumph	*Citrus maxima*	80	...	15	...	...	5	...	13	0	0
Do	do	60	...	5	...	...	2	0	0	0	0
Larrantta	*Citrus sinensis*	50	...	60	...	1	...	...	15	0	0
White Silletta	do	50	...	50	...	1	...	...	7	0	0
Do	do	60	...	10	...	1	...	...	3	...	4
Citron	*Citrus medica*	1	...	...	2	0	0	0	0	0	0
Do	do	50	...	0	0	0	0	0	0	0	0
Calamondin	*Citrus mitis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Jaffa	*Citrus sinensis*	...	12	1	...	...	10	...	3	0	0
Do	do	...	10	...	1	...	5	...	1	0	0
Bahia	do	0	0	0	0	...	5	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0

[a] According to Doctor Tanaka, a specialist on Japanese citrus fruits, residing at Nishi Suma, Hyogo Ken, Japan, this "Japanese orange" is identical with the Japanese-grown *Daidai*, a form of *Citrus aurantium*.

TABLE 12.—*Degree of canker affection of the trees in Plat VI, Orchard B, Lamao, at various seasons of the year.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 31, 1917.		January 18, 1918.		May 29, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Sampson	*Citrus* hybrid tangelo	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0		1	0	0
Colo colo	*Citrus hystrix*	50	0	50		25		30		50	
Do	do	50	0	50		50		50		90	
Calamondin	*Citrus mitis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Sour orange	*Citrus aurantium*	35		35			7		2		1
Native fruit	*Citrus pseudolimonum*	80		80		40		50		80	
Do	do	50		50		50		10		100	
Sour orange	*Citrus aurantium*		1		8		10		2	0	0
Do	do		1	0	0	0	0	0	0		3
Native orange	*Citrus sinensis*		2	1		0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Valencia	do		12	50		25			20	30	
Do	do		8	50		10			2	(a)	(a)
Cabuyao	*Citrus hystrix*		2	0	0		3		3		2
Do	do	0	0	0	0	0	0	0	0	0	0
Citron	*Citrus medica*	80		50		50		50		90	
Szinkom	*Citrus nobilis*		2	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Sour orange	*Citrus aurantium*		4	0	0	0	0	0	0	0	0
Do	do	50		5		1			10		2
Pineapple	*Citrus sinensis*	80		80		10		20		80	
Do	do	50		50		10		5		10	
King	*Citrus nobilis*	0	0	0	0		2	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0

Native fruit	*Citrus maxima*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Majorca	*Citrus sinensis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	1	----	1	----	2	----	2	----	1
Maltese	do	25	----	25	----	----	4	----	3	----	2
McCarty	*Citrus maxima*	100	----	100	----	90	----	50	----	100	----
Everbearing	*Citrus sinensis*	25	----	25	----	25	----	10	----	10	----
Siamese	*Citrus maxima*	75	----	75	----	----	7	----	2	----	3
Do	do	----	2	----	2	----	2	----	11	0	0
Suntara	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Cabuyao	*Citrus hystrix*	10	----	10	----	0	0	0	0	0	0
Do	do	25	----	40	----	([a])	([a])	----	----	----	----
Du Roi	*Citrus sinensis*	0	0	0	0	0	0	([a])	([a])	----	----
Native orange	do	80	----	80	----	10	----	10	----	60	----
Do	do	40	----	40	----	1	----	10	----	75	----
Homosassa	do	0	0	0	0	0	0	0	0	0	0
Biasong	*Citrus micrantha*	1	----	25	----	10	----	10	----	50	----
Parson Brown	*Citrus sinensis*	40	----	40	----	----	6	----	8	75	----
Do	do	50	----	50	----	75	----	25	----	40	----
Pati China	*Citrus aurantifolia*	40	----	----	2	----	2	----	16	50	----

[a] Dead.

TABLE 12.—*Degree of canker affection of the trees in Plat VI, Orchard B, Lamao, at various seasons of the year.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 31, 1917.		January 18, 1918.		May 29, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Sampson	*Citrus* hybrid tangelo	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	....	1	0	0
Colo colo	*Citrus hystrix*	50	0	50	....	25	....	30	....	50	....
Do	do	50	0	50	....	50	....	50	....	90	....
Calamondin	*Citrus mitis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Sour orange	*Citrus aurantium*	35	....	35	....	....	7	....	2	....	1
Native fruit	*Citrus pseudolimonum*	80	....	80	....	40	....	50	....	80	....
Do	do	50	....	50	....	50	....	10	....	100	....
Sour orange	*Citrus aurantium*	....	1	....	8	....	10	....	2	0	0
Do	do	....	1	0	0	0	0	0	0	....	3
Native orange	*Citrus sinensis*	....	2	1	....	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Valencia	do	....	12	50	....	25	....	....	20	30	....
Do	do	....	8	50	....	10	....	....	2	(a)	(a)
Cabuyao	*Citrus hystrix*	....	2	0	0	....	3	....	3	....	2
Do	do	0	0	0	0	0	0	0	0	0	0
Citron	*Citrus medica*	80	....	50	....	50	....	50	....	90	....
Szinkom	*Citrus nobilis*	....	2	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Sour orange	*Citrus aurantium*	....	4	0	0	0	0	0	0	0	0
Do	do	50	....	5	....	1	....	....	10	....	2
Pineapple	*Citrus sinensis*	80	....	80	....	10	....	20	....	80	....
Do	do	50	....	50	....	10	....	5	....	10	....
King	*Citrus nobilis*	0	0	0	0	....	2	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Native fruit	*Citrus maxima*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Majorca	*Citrus sinensis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	1	....	1	....	2	....	2	....	1
Maltese	do	25	....	25	....	....	4	....	3	....	2
McCarty	*Citrus maxima*	100	....	100	....	90	....	50	....	100	....
Everbearing	*Citrus sinensis*	25	....	25	....	25	....	10	....	10	....
Siamese	*Citrus maxima*	75	....	75	....	....	7	....	2	....	3
Do	do	....	2	....	2	....	2	....	11	0	0
Suntara	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Cabuyao	*Citrus hystrix*	10	....	10	....	0	0	0	0	0	0
Do	do	25	....	40	....	(a)	(a)	....	....	....	....
Du Roi	*Citrus sinensis*	0	0	0	0	0	0	(a)	(a)	....	....
Native orange	do	80	....	80	....	10	....	10	....	60	....
Do	do	40	....	40	....	1	....	10	....	75	....
Homosassa	do	0	0	0	0	0	0	0	0	0	0
Biasong	*Citrus micrantha*	1	....	25	....	10	....	10	....	50	....
Parson Brown	*Citrus sinensis*	40	....	40	....	....	6	....	8	75	....
Do	do	50	....	50	....	75	....	25	....	40	....
Pati China	*Citrus aurantifolia*	40	....	....	2	....	2	....	16	50	....

a Dead.

tion of the untreated trees with the amounts of canker of the other, treated plats.

The trees of this control plat also afford a fair idea of the susceptibility of the horticultural varieties represented. The Parson Brown, Homosassa, and Pineapple, sweet orange varieties of Florida origin, show a considerably greater susceptibility than do the Valencia, Majorca, Maltese, and Du Roi, which are Mediterranean varieties. The King, Suntara, and Szinkom, varieties of the mandarin orange, illustrate the almost entire freedom from canker of that class of hosts. The great susceptibility of the American-grown grapefruit varieties is illustrated by the trees of the McCarty variety in this plat.

PLAT VII, ORCHARD B, LAMAO

The rows of trees of this plat paralleled and were contiguous to those in Plat VI; treatment was as follows:

September 4, 1917. Cresol 1–80 solution.
September 20, 1917. Trees pruned for citrus canker.
September 22, 1917. Lime sulphur 1–40 solution plus formalin 1–80.
October 22, 1917. 3–3$\frac{5}{8}$–50 Burgundy mixture plus resin, sal-soda sticker.
November 21, 1917. Formalin 1–80 solution plus powdered, neutral, lead arsenate to make a 1–50 mixture.
December 1, 1917. Formalin 1–80 solution plus powdered, neutral, lead arsenate to make a 1–50 mixture.
December 4, 1917. Trees pruned for twig cankers.
December 7, 1917. Lime sulphur 1–40 solution plus formalin 1–100.
January 10, 1918. 3–3–50 Burgundy mixture plus Yothers's oil emulsion.
January 17, 1918. Trees pruned for twig cankers.
June 1, 1918. Lime sulphur (25° Baumé) 1–30 solution.
June 26, 1918. 3–3–50 Burgundy mixture plus cresol-kerosene emulsion and formalin 1–100.
July 30, 1918. 3–3–50 Burgundy mixture plus cresol-kerosene emulsion.

Cresol solution was used at the beginning of the work as a clean-up spray; however, it had no value in this respect when used at a dilution of 1–80 and its use was abandoned. In the succeeding spray applications, lime-sulphur solution was used at different times to check the increase of scale insects, but the plat was in the main sprayed with Burgundy mixture.

Table 13 indicates that citrus canker has been materially reduced in amount upon all affected varieties and species. As evidenced in the table, the difficulty of control of the Duncan, the Marsh, and the McCarty grapefruits and the Everglade and the Trinidad limes is noteworthy. This can be compared with the relative freedom from canker and ease and quickness of control of the Mediterranean sweet orange varieties, the Du Roi and Hart's Late.

Plat VIII, in Orchard B, yielded much the same conclusion and need not be presented in detail here. In this plat the Paper Rind and the Maltese, varieties of the sweet orange, showed slight susceptibility and responded readily to the control measures. These varieties are of interest since they are usually also classed with the Mediterranean group of sweet-orange varieties.

DISCUSSION OF METHODS AND RESULTS AT LAMAO

From the foregoing it is apparent that canker has been reduced in the treated plats to a degree at which it may be said that a reasonable control has been obtained. Untreated plats have shown no reduction in canker. Of course, the number of spray applications must be considered, ten fungicide applications having been made on those plats and a considerable expenditure of labor incurred in pruning. Although such procedure would immediately appear prohibitive as an orchard practice, to arrive at the correct conclusion as to its feasibility consideration must be taken of the different citrus species as hosts, of the different degrees of their susceptibility and the bearing such susceptibility has upon the ease or difficulty of control, and of the cost of control. The spray applications and other methods used on these plats sufficed to decrease the amounts of canker, to a degree that could be considered a control, upon the most susceptible hosts, the lime and grapefruit varieties, as well as upon the more moderately susceptible hosts. Upon less susceptible hosts, such as the sweet orange, the lemon, and the mandarin orange, these control measures apparently could be much simplified and, consequently, of course be made cheaper.

The correct conclusion from these experiments would seem to be that control has been obtained, but that upon the grapefruit and limes such control is not economically feasible by the methods employed; upon the less susceptible hosts control has also been obtained, though the treatments applied apparently exceeded actual requirements for the efficient control of canker. Therefore, no conclusions as to the practicability of control upon such hosts can be drawn as yet. Further experiments are now in progress to make possible definite conclusions on the control of such moderately susceptible hosts.

TABLE 13.—*Degree of citrus canker affection of trees in Plat VII, Orchard B, Lamao, at various seasons of the year.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 31, 1917.		January 14, 1918.		May 29, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Duncan	*Citrus maxima*	50		50		35			44		4
Do	do	50		50			20		29	0	0
Pineapple	*Citrus sinensis*	50		10			2	0	0		11
Marsh	*Citrus maxima*	50		50		90			11		12
Enterprise	*Citrus sinensis*	50		50		0	0	0	0	0	0
Do	do	0	0		20	0	0	0	0	0	0
Hart's late	do	0	0	0	0	0	0	0	0	0	0
Do	do	20			3		7	0	0	0	0
Saagkam	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Native fruit	*Citrus madurensis*	25		5			10	0	0	0	0
Do	do	75		75		10		0	0	0	0
Native orange	*Citrus aurantium*	0	0		10	0	0	0	0	0	0
Do	do		10		1		1	0	0	0	0
Native fruit	*Citrus maxima*	0	0		10		8	0	0	0	0
Do	do		4		30		50		1	0	0
Du Roi	*Citrus sinensis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
McCarty	*Citrus maxima*	50		50			12		2	0	0
Do	do	25		50			100	0	0	0	0
Le Nestour	*Citrus medica*	25		10		0	0	0	0	0	0
Do	do	75		10			1	0	0	0	0
Native fruit	*Citrus maxima*		9		2	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Cabuyao	*Citrus hystrix*	0	0	0	0	0	0	0	0	0	0
Do	do		6		5	0	0	0	0	0	0

Native orange	*Citrus sinensis*	50		50			25		3		2
Do	do	50		50			33	0	0	0	0
Trinidad	*Citrus aurantifolia*	40		40			12		30		1
Do	do	25		25		5			25	0	0
Tamisan	*Citrus longispina*	25		25			2	0	0		5
Do	do	40		40		0	0	0	0	0	0
Native fruit	*Citrus maxima*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0		0	0	0	0
Everglade	*Citrus aurantifolia*	80		80		5		5		10	
Do	do	50		50			10		15		15
Finger citron	*Citrus medica*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Canci	*Citrus hystrix*	50		50			1		1	0	0
Do	do	25		10		0	0	0	0	0	0
Parson Brown	*Citrus sinensis*	40		40		0	0	0	0		10
Do	do	25		5		0	0	0	0		1

TABLE 13.—*Degree of citrus canker affection of trees in Plat VII, Orchard B, Lamao, at various seasons of the year.*

Variety.	Species.	Leaves affected.									
		September 1, 1917.		October 31, 1917.		January 14, 1918.		May 29, 1918.		August 1, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Duncan	*Citrus maxima*	50	----------	50	----------	35	----------	----------	44	----------	4
Do	do	50	----------	50	----------	----------	20	----------	29	0	0
Pineapple	*Citrus sinensis*	50	----------	10	----------	----------	2	0	0	----------	11
Marsh	*Citrus maxima*	50	----------	50	----------	90	----------	----------	11	----------	12
Enterprise	*Citrus sinensis*	50	----------	50	----------	0	0	0	0	0	0
Do	do	0	0	----------	20	0	0	0	0	0	0
Hart's late	do	0	0	0	0	0	0	0	0	0	0
Do	do	20	----------	----------	3	----------	7	0	0	0	0
Szagkam	*Citrus nobilis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Native fruit	*Citrus madurensis*	25	----------	5	----------	----------	10	0	0	0	0
Do	do	75	----------	75	----------	10	----------	0	0	0	0
Native orange	*Citrus aurantium*	0	0	----------	10	0	0	0	0	0	0
Do	do	----------	10	----------	1	----------	1	0	0	0	0
Native fruit	*Citrus maxima*	0	0	----------	10	----------	8	0	0	0	0
Do	do	----------	4	----------	30	----------	50	----------	1	0	0
Du Roi	*Citrus sinensis*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
McCarty	*Citrus maxima*	50	----------	50	----------	----------	12	----------	2	0	0
Do	do	25	----------	50	----------	----------	100	0	0	0	0
Le Nestour	*Citrus medica*	25	----------	10	----------	0	0	0	0	0	0
Do	do	75	----------	10	----------	----------	1	0	0	0	0
Native fruit	*Citrus maxima*	----------	9	----------	2	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Cabuyao	*Citrus hystrix*	0	0	0	0	0	0	0	0	0	0
Do	do	----------	6	----------	5	0	0	0	0	0	0
Native orange	*Citrus sinensis*	50	----------	50	----------	----------	25	----------	8	----------	2
Do	do	50	----------	50	----------	----------	33	0	0	0	0
Trinidad	*Citrus aurantifolia*	40	----------	40	----------	----------	12	----------	30	----------	1
Do	do	25	----------	25	----------	5	----------	----------	25	0	0
Tamisan	*Citrus longispina*	25	----------	25	----------	----------	2	0	0	----------	5
Do	do	40	----------	40	----------	0	0	0	0	0	0
Native fruit	*Citrus maxima*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	----------	0	0	0	0
Everglade	*Citrus aurantifolia*	80	----------	80	----------	5	----------	5	----------	10	----------
Do	do	50	----------	50	----------	----------	10	----------	15	----------	16
Finger citron	*Citrus medica*	0	0	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0	0	0
Canci	*Citrus hystrix*	50	----------	50	----------	----------	1	----------	1	0	0
Do	do	25	----------	10	----------	0	0	0	0	0	0
Parson Brown	*Citrus sinensis*	40	----------	40	----------	0	0	0	0	----------	10
Do	do	25	----------	5	----------	0	0	0	0	----------	1

The observations presented in the tables were supplemented by a less complete and thorough observation, made in October, when it was found that, although some slight increase in canker had taken place in the case of the grapefruit varieties, the varieties of sweet orange and less susceptible species had maintained their comparative freedom from canker. The control obtained, therefore, cannot be criticized as having been secured during seasons unfavorable to the activities of the citrus-canker organism, although advantage was taken of such an unfavorable period (the dry season, December to May), to minimize the dangers of reinfection during favorable periods (the wet season, June to November). Such control as was obtained, in other words, was secured in the dry season and, except in the case of some of the grapefruit varieties, was maintained through the wet season, from June to October.

Preventive sprays.—As to the comparative value of the different spray mixtures as preventives, little can be concluded from the work at Lamao, because of the varied program for each plat. However, certain other factors developed which would eliminate or qualify the value of some of the mixtures. Thus copper sprays, if unaccompanied by scalecides, caused a great increase in scale insects; lime sulphur probably could be used in regions of less intense rains, and in such cases would be of the greatest value because of its additional function as a scalecide; formalin 1 to 100 apparently was of little or no value as a preventive.

The foregoing being the conclusions derived from the experiment, it also seems desirable to offer several suggestions for control procedures that became evident and that may be of value in future work.

Clean-up sprays.—In many cases of heavily infected trees, a spray of formalin 1 to 80 caused a large proportion of the previously weakened cankered leaves to drop; in other words, formalin 1 to 80 to some extent seemed to be successful as a selective, clean-up spray. On trees already well infected such a clean-up spray, followed by careful pruning out of canker, materially hastened control.

Stimulation of growth at climatic periods unfavorable for canker development.—Another more important point was the stimulation of new growth at periods in the year when the lack of moisture limited the activity of the canker organism. At Lamao such new growth was stimulated in the early part of the dry season, with the result that such foliage matured and hardened during the dry season without incurring danger from reinfection. This matured foliage then entered the rainy season with the danger of infection very much minimized, and only in the case of the grapefruit and lime varieties was difficulty encountered in the infection of such foliage.

Control of insects to prevent dissemination of canker.—Along the edges of leaves where chewing insects have bitten, cankers are very often found (Plate 1). Cankers also often appear in definite trails following the work of leaf miners (Plate 2). This emphasized the need for thorough control of such insects, and the addition of lead arsenate to the spray mixtures was frequently made. In canker-control work on all varieties of *Citrus* species at Lamao, then, it has been evident that insect control is also an essential factor.

Windbreaks to aid in prevention of canker dissemination.—From field evidence it was apparent that another agent which contributes to the dissemination of citrus canker is the wind. This aid to canker development is due not alone to the spread of the canker organism by the wind, although that is of course a considerable factor, but also to the fact that a strong wind, whipping the twigs and foliage, causes spine wounds and surface injuries to the leaves resulting in infection by the canker organisms under conditions in which they would not develop on unwounded tissue. It has been shown in unpublished experiments on the moderately susceptible species that canker will develop at a wound on a mature or nearly mature leaf, while infection will not take place, or at least will not develop, on uninjured surfaces of the same leaf. The prevention of the whipping and stabbing of the branches and foliage by the wind is therefore also an essential point. The windbreaks at Lamao consisted of dense thickets of bamboo, 10 to 15 meters high and almost impenetrable. Such windbreaks were very efficient and very materially aided citrus-canker control work.

At Lamao it has been observed that, by attention to such apparently minor points as the control of chewing insects, the utilization of windbreaks, and the regulation of the growing periods, much can be done to minimize the development of canker on the moderately susceptible hosts. The comparison of results at Los Baños with results at Lamao supports this conclusion and would point to these indirect methods of control as being fully as important, if not more so, as prevention of the disease by spraying.

180732——3

DIFFERENCES IN SUSCEPTIBILITY OF CITRUS SPECIES AND VARIETIES IN THE EXPERIMENTS

It became apparent at Lamao that there are wide differences in the susceptibility to canker(9) of the different species of *Citrus* which necessitate a separate consideration for each species when working with, or discussing, such subjects as the control of canker, the injuries resulting from canker, and the eradication of canker. Many of the contradictory statements with regard to various phases of citrus canker would seem to be due to a confusion of the species or, in some cases, to the failure to connect such statements with the host under observation. A consideration of the susceptibility of the different species at Lamao in connection with the feasibility of control methods has been possible and therefore is briefly presented here.

At the beginning of these experiments the trees of the mandarin orange varieties had little or no canker. Very few infections were found, and it was a carefully recorded observation that more than 33 per cent of the few infections that were found upon mandarin orange varieties occurred at very evident wounds, either spine wounds or insect injuries. Under such conditions, as shown in the foregoing tables, complete elimination of citrus canker upon the mandarin orange varieties was very prompt and there were no recurrences of infection; also, the operations were simple and inexpensive. Many of the citrons (*C. medica*) were also slightly susceptible and very easily freed from canker. The mature calamondin trees were never observed in the writer's experience to be cankered, and control measures for citrus canker on this host were entirely unnecessary. These species, the mandarin oranges (*C. nobilis* var. *deliciosa*), the citron (*C. medica*) together with the calamondins (*C. mitis*) and, of course, the round kumquats (*Fortunella japonica*), constitute a class of commercially grown citrus fruits upon which control is simple and very often unnecessary, at least when trees are mature. These varieties might be classed as a group, class 1, the members of which are so slightly susceptible that they can mature and produce fruits with no injury from citrus canker, even in the absence of control treatments.

At Lamao almost complete elimination of canker was obtained very quickly on the American-grown lemon varieties (*C. limonia*) and the so-called Mediterranean varieties of the sweet oranges (*C. sinensis*), such as the Valencia, Jaffa, Mediterranean Sweet, Ruby, St. Michael, and Du Roi. In this class should also be placed the Tahiti lime (*C. aurantifolia*). In as much as all the other limes under observation were found to be highly susceptible, the relative freedom from canker of the Tahiti lime is very striking and should be taken advantage of in commercial growing. The species and varieties enumerated might be considered as class 2, all of which showed such a quick elimination of canker at the beginning of the control attempts that such measures would seem to be economically feasible. The Unshiu varieties known in America as Satsuma oranges (*C. nobilis* var. *unshiu*), at least the Ikiriki, Owari, Zairai, Ikeda, and Wase, although not shown in these Lamao plats, from later experiments would also seem to belong in this class of susceptible but easily controlled fruits.

A third class would contain many of the varieties of the sweet orange originating in Florida, such as the Pineapple, Homosassa, Magnum Bonum, Whittaker, and Parson Brown. This class of sweet oranges is more susceptible than the varieties of the Mediterranean group and would be more difficult to control. In this class would also be placed the Natsumikan of Japan and many of the pummelos, or East Indian type of *C. maxima* (*grandis*). Several of the strains of navel oranges would probably also be put in this class. The strains of the navel orange exhibit a considerable range of susceptibility; that is, some navel orange trees have been observed which were but very slightly affected, although exposed to infection for a number of years, while other strains, after exposure to infection for only one month, showed large percentages of affected fruits and foliage. The determination of the susceptibility of these various strains of navel oranges is an important problem to be solved. To this class may be also added the Triumph grapefruit. The Triumph is the only variety that has been under observation which has shown any modification from the extreme susceptibility of the American-grown grapefruit varieties. It is by no means resistant, but its lesser degree of susceptibility to canker would perhaps make it of more value for commercial growing, and it might possibly serve as a basis for breeding toward resistance.

Upon the varieties given above in what may be called the third class, it has been shown at Lamao that canker can be controlled. It is a question, however, as to whether this control is economically feasible. The control obtained on these species and varieties, as has been shown, was obtained only after very careful pruning and a very large number of spray applications. The experiments have been continued in Japan and it is hoped that a report can be made on the economic feasibility of such control in one or two years.

The fourth class would include the extremely susceptible grapefruit and lime varieties. Good control has been obtained on a few of these varieties, while on others the amounts of canker have at least been reduced. Such reductions however have been secured only after the application of an uneconomical number of sprays and much time in the careful pruning out of twig cankers. Under Philippine conditions, it is easily apparent that control methods on the American-grown grapefruit varieties and on the West Indian lime varieties is not economically practical by the methods employed. With this class of citrus varieties therefore the results are similar to those obtained by Wolf.(21)

TOTAL ERADICATION BY PRUNING AND SPRAYING

The following experiment is presented to show the results obtained by another method of attack. An attempt was made on a small isolated citrus planting at Singalong, Manila, entirely to remove all leaf, twig, and branch cankers, thus eliminating all sources of reinfection, in the endeavor to determine whether or not eradication of citrus canker could be effected without the total destruction of trees.

The planting consisted of two rows of nursery trees which had been allowed to mature in place, without removal to the orchard. The lime trees were from four to five years old at the beginning of the experiment; some of the mandarin trees were three years old, while others of the same species, and the calamondin trees, were one year old. This planting was fairly well isolated from other sources of infection. The trees were cultivated, irrigated, and cared for entirely according to the usual American orchard practices. The treatment of this planting was as follows:

August 19, 1917. Formalin 1–80 solution.
September 1, 1917. Formalin 1–80 solution.
September 10, 1917. Formalin 1–80 solution.
September 16, 1917. Trees pruned for the removal of twig cankers.
September 17, 1917. 4–4–50 Bordeaux mixture plus resin, sal-soda sticker.
October 9, 1917. 4–4–50 Bordeaux mixture plus resin, sal-soda sticker.
November 9, 1917. Neutral Bordeaux mixture plus powdered, neutral, lead arsenate to make 1–50 mixture.
December 17, 1917. Neutral Bordeaux mixture plus cresol-kerosene emulsion.

December 29, 1917. Yothers's oil emulsion plus formalin 1–100.
February 6, 1918. Cresol-kerosene emulsion.
May 20, 1918. Neutral Bordeaux mixture.
June 10, 1918. Neutral Bordeaux mixture.
July 6, 1918. Neutral Bordeaux mixture plus cresol-kerosene emulsion.

The plan of this spray campaign was to use several applications of strong formalin solution as clean-up sprays at first, in order to reduce the amounts of citrus canker infection and so lessen the work of pruning out the cankered twigs and foliage. The trees were in many cases partially defoliated by these strong formalin sprays, but for the most part the cankered leaves were the ones to fall. The formalin sprays were followed by an extremely careful pruning out of all twig cankers. Having attempted entirely to remove all the sources of infection in this way, prevention of new infection was attempted by the application of Bordeaux mixture. No spraying of the soil was carried on in as much as it had been shown by the present writer(10) that the canker bacteria are quickly killed out in Philippine orchard soils. The character of the trees and the results of these treatments are shown in Table 14.

From the viewpoint of total eradication it is to be seen that this experiment yielded negative results. After the initial careful removal of all sources of infection there were recurrences of canker in a number of cases. In the small planting employed in this experiment such recurrences were noted promptly and removed; in a large commercial planting of susceptible trees such close observation could not be maintained with financial profit.

In this connection, however, consideration should also be given to the susceptibility of the host under treatment. Thus, although it is evident that such attempts at eradication were unsuccessful on the very susceptible lime varieties, a very exhaustive experiment would be necessary upon a planting exclusively of trees of the mandarin orange or Satsuma orange varieties before a similar conclusion could be adopted for such a host.

To avoid confusion it should be made clear that, although calamondin and mandarin orange trees when mature are considered resistant to citrus canker, they will exhibit a considerably greater degree of susceptibility when young in nursery rows. This has been pointed out more in detail previously by the present writer.(12)

TABLE 14.—*Degree of citrus canker affection of trees in the citrus planting at Singalong during various stages of attempted eradication work.*

Variety.	Species.	Leaves affected.							
		August 17, 1917.		January 3, 1918.		May 20, 1918.		June 16, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Native mandarin orange	*Citrus nobilis*		20	0	0	0	0	0	0
Do	do		20	0	0	0	0	0	0
Do	do		18	0	0	0	0	0	0
Do	do	100			1	0	0	0	0
Do	do		20	0	0	0	0	0	0
Do	do	2		0	0	0	0	0	0
Do	do	50		0	0	0	0	0	0
Calamondin	*Citrus mitis*	100		0	0	0	0	0	0
Do	do	1		0	0	0	0	0	0
Do	do		19	0	0	0	0	0	0
Do	do	100		(a)	(a)		1	0	0
Do	do	50		0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Do	do		10	0	0	0	0	0	0
Do	do		1	0	0	0	0	0	0
Do	do		5	0	0	0	0	0	0
Do	do	95			2	0	0	0	0
Do	do		5	0	0	0	0	0	0
Do	do		1	0	0	0	0	0	0
Do	do		20	0	0	0	0	0	0
Do	do	50		0	0	0	0	0	0
Do	do	50		0	0	0	0	0	0
Do	do	10		0	0	0	0	0	0
Native lime	*Citrus aurantifolia*	10		0	0	0	0	0	0
Do	do		3	0	0	0	0	0	0

Do	do	5	--------	0	0	0	0	0	0
Do	do	50	--------	0	2	0	0	0	0
Native pummelo	*Citrus maxima*	--------	3	0	0	0	0	0	0
Native mandarin	*Citrus nobilis*	0	0	0	0	0	0	0	0
Do	do	50	--------	0	0	0	0	0	0
Do	do	--------	5	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Native lime	*Citrus aurantifolia*	50	--------	0	0	0	0	0	0
Do	do	50	--------	([b])	([b])	--------	20	([b])	([b])
Do	do	50	--------	0	0	--------	5	0	0
Do	do	50	--------	--------	9	0	0	0	0
Do	do	25	--------	--------	4	0	0	0	0
Hybrid	*Citrus* species	0	0	0	0	0	0	0	0
Do	do	5	--------	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0

[a] Two twigs cankered.

[b] One twig, leaves cankered.

TABLE 14.—*Degree of citrus canker affection of trees in the citrus planting at Singalong during various stages of attempted eradication work.*

Variety.	Species.	Leaves affected.							
		August 17, 1917.		January 3, 1918.		May 20, 1918.		June 16, 1918.	
		Per cent.	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*
Native mandarin orange	*Citrus nobilis*	--------	20	0	0	0	0	0	0
Do	do	--------	20	0	0	0	0	0	0
Do	do	--------	18	0	0	0	0	0	0
Do	do	100	--------	--------	1	0	0	0	0
Do	do	--------	20	0	0	0	0	0	0
Do	do	2	--------	0	0	0	0	0	0
Do	do	50	--------	0	0	0	0	0	0
Calamondin	*Citrus mitis*	100	--------	0	0	0	0	0	0
Do	do	1	--------	0	0	0	0	0	0
Do	do	--------	19	0	0	0	0	0	0
Do	do	100	--------	(a)	(a)	--------	1	0	0
Do	do	50	--------	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Do	do	--------	10	0	0	0	0	0	0
Do	do	--------	1	0	0	0	0	0	0
Do	do	--------	5	0	0	0	0	0	0
Do	do	95	--------	--------	2	0	0	0	0
Do	do	--------	6	0	0	0	0	0	0
Do	do	--------	1	0	0	0	0	0	0
Do	do	--------	20	0	0	0	0	0	0
Do	do	50	--------	0	0	0	0	0	0
Do	do	50	--------	0	0	0	0	0	0
Do	do	10	--------	0	0	0	0	0	0
Native lime	*Citrus aurantifolia*	10	--------	0	0	0	0	0	0
Do	do	--------	3	0	0	0	0	0	0
Do	do	5	--------	0	0	0	0	0	0
Do	do	50	--------	0	2	0	0	0	0
Native pummelo	*Citrus maxima*	--------	3	0	0	0	0	0	0
Native mandarin	*Citrus nobilis*	0	0	0	0	0	0	0	0
Do	do	50	--------	0	0	0	0	0	0
Do	do	--------	5	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Native lime	*Citrus aurantifolia*	50	--------	0	0	0	0	0	0
Do	do	50	--------	(b)	(b)	--------	20	(b)	(b)
Do	do	50	--------	0	0	--------	5	0	0
Do	do	50	--------	--------	9	0	0	0	0
Do	do	25	--------	--------	4	0	0	0	0
Hybrid	Citrus species	0	0	0	0	0	0	0	0
Do	do	5	--------	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0
Do	do	0	0	0	0	0	0	0	0

[a] Two twigs cankered.

[b] One twig, leaves cankered.

DISCUSSION OF RESULTS AND THEIR APPLICATION

In the Philippines it would seem to be possible, by the selection of the proper varieties and the use of the methods described previously, to raise citrus fruits free from citrus canker. However, in other countries, as in Florida, where the susceptible grapefruit and lime varieties are already planted and very largely grown, control of such very susceptible varieties by the methods employed here would be very expensive and apparently not economically feasible. It seems safe to conclude that the practical control or the prevention of citrus canker by the present known methods on very susceptible hosts, such as the American-grown grapefruit varieties and the West Indian limes, can only be accomplished by the total exclusion of the disease from entire localities; this conclusion possibly would not apply to arid or semiarid countries. An alternative would be the securing of resistant varieties of these species, either by breeding or from among the little-known, already existing varieties of the East Indies and Southern Asia.[7]

In regions of the United States where the very susceptible lime and grapefruit varieties are not grown, control upon the less susceptible varieties by these methods would be possible, but the economic feasibility of these methods is not yet proven. In some regions, as in Alabama and Mississippi, where only slightly susceptible varieties such as the Satsuma strains are grown commercially, control methods would be practicable or even unnecessary.

SUMMARY

1. The development of the experiments has shown that in addition to preventive sprays the following factors contributed very largely to minimizing canker infection: Removal of sources of infection by pruning and drastic "clean-up" sprays; stimulation of foliage growth to occur at periods of the year unfavorable to canker dissemination or development; the control of violent winds by windbreaks and orchard situation; and the control of chewing insects.

[7] The writer has obtained pummelos in Hongkong, imported from Saigon and Bangkok, which were entirely free from citrus canker; they were commercially seedless and possessed the desirable flavor and texture of the American-grown grapefruit.

2. The preventive sprays used with any degree of success were Bordeaux mixtures and Burgundy mixtures of various concentrations. Lime sulphur, formalin, and ammoniacal copper carbonate solutions were unsuccessful under Philippine rainy season conditions. Copper sprays were not wholly successful, although they effected tangible reductions in canker infections.

3. The work has made apparent, and it has been one of the principal objects in the presentation of this paper to point this out, that the most important consideration in discussing the feasibility of control, the seriousness of citrus canker, and such subjects, is a knowledge of the reaction to the disease of the different species and horticultural varieties. The wide range in the susceptibility of the *Citrus* species necessitates the separate discussion of canker-control possibilities for each host or class of hosts.

4. The conclusion is apparently safe that control upon the very susceptible lime and grapefruit varieties is not economically feasible by the methods employed. Upon the sweet oranges of Florida origin and such varieties of less susceptiblility, control may be practicable; further work is now in progress upon this point. The sweet orange of the so-called Mediterranean varieties, some of the lemons, and the Unshiu orange varieties comprise a class of fruits of very moderate susceptibility; control apparently would be economically practicable on such varieties. Control was very easily obtained and was hardly necessary upon the mandarin orange varieties, the calamondins, and the citrons. Attention has been called to several exceptions from the extreme susceptibility of the lime and grapefruit varieties; such exceptions may be of value for cultivation in regions of universal distribution of citrus canker.

5. An attempt to obtain complete eradication of citrus canker without the total destruction of the trees was conducted on a small isolated plat of calamondin, mandarin orange, and lime trees. From the viewpoint of total eradication, negative results were obtained on this plat. In this case, as in others, the results must be considered in connection with the *Citrus* species used as hosts in the experiment. Thus these results, although applicable to the limes, and probably to the grapefruits, should not be considered applicable to the less susceptible varieties, such as the mandarin and Satsuma oranges, until more ex-

haustive experiments have been carried on with a planting exclusively of such a slightly susceptible host.

6. In a district or region in which the extremely susceptible varieties such as the limes and grapefruits constitute the important, commercial orchards, either complete eradication of the affected host plants or substitution of less susceptible hosts is apparently the only means of preventing severe losses from this disease. From the results presented in this paper such is not the case, however, with the less susceptible species.

LITERATURE CITED

1. BEDFORD, DUKE OF, and PICKERING, S. U. Bordeaux mixture. 8th Rept. Woburn Exp. Fruit Farm (1908).
2. IDEM. Copper Fungicides. 11th Rept. Woburn Exp. Fruit Farm (1910).
3. BOURCART, E. Insecticides, fungicides and weedkillers. Translated from the French by Donald Grant. Scott, Greenwood and Son, London (1913) 282–284.
4. CORONAS, JOSÉ. The climate and weather of the Philippines, 1903 to 1918. Bureau of Printing, Manila, Weather Bureau Pub. (1920) 195.
5. DOIDGE, ETHEL M. The origin and cause of citrus canker in South Africa. Union of S. Africa Dept. of Agr. Science Bull. **8** (1916) 17.
6. DORYLAND, E. D. Citrus canker investigations at the Singalong Experiment Station. Philip. Agr. Rev. **9** (1916) 133–135.
7. IDEM. Effects of formalin-Bordeaux mixture on citrus canker. Philip. Agr. Rev. **10** (1917) 51–54.
8. KELLERMAN, K. F. Cooperative work for eradicating citrus canker. Yearbook U. S. Dept. Agr. (1916) 270.
9. LEE, ATHERTON. Further data on the citrus canker affection of the citrus species and varieties at Lamao. Philip. Agr. Rev. **11** (1918) 200–206.
10. IDEM. The behaviour of the citrus canker organism in the soil. Journ. Agr. Res. **19** (1920) 189.
11. IDEM. Action of some fungicides on the citrus canker organism. Philip. Journ. Sci. **17** (1920) 325.
12. IDEM. The increase in resistance to citrus canker with the advance in the maturity of citrus trees. Phytopathology **11** (1921) 70.
13. LUTMAN, B. F. The covering power of the precipitation membranes of Bordeaux mixture. Phytopathology **2** (1912) 32.
14. MACKIE, D. B. Observations on the distribution of citrus canker. Philip. Agr. Rev. **9** (1916) 278.
15. MERRILL, E. D. An Interpretation of Rumphius's Herbarium Amboinense. Bureau of Printing, Manila, Bur. Sci. Pub. **9** (1917) 296.
16. STEVENS, H. E. Citrus canker, II. Bull. Fla. Agr. Exp. Sta. **124** (1914) 42.
17. IDEM. Citrus canker, III. Bull. Fla. Agr. Exp. Sta. **128** (1914) 19.

18. Wester, P. J. A serious disease on citrus fruits. Philip. Agr. Rev. **7** (1914) 423.
19. Idem. Additional observations on the citrus fruits in the Philippines. Philip. Agr. Rev. **10** (1917) 105.
20. Idem. Notes on Philippine citrus fruits. Philip. Agr. Rev. **12** (1919) 69.
21. Wolf, Frederick A. Citrus canker. Journ. Agr. Res. **6** (1916) 95.
22. Yothers, W. W. Spraying for whiteflies in Florida. Circular U. S. Dept. Agr. Bur. Ent. **168** (1913).

ILLUSTRATIONS

Plate 1

Citrus leaves showing cankers following attacks of leaf-chewing insects.

Plate 2

Citrus leaves showing cankers following trail of leaf miners.

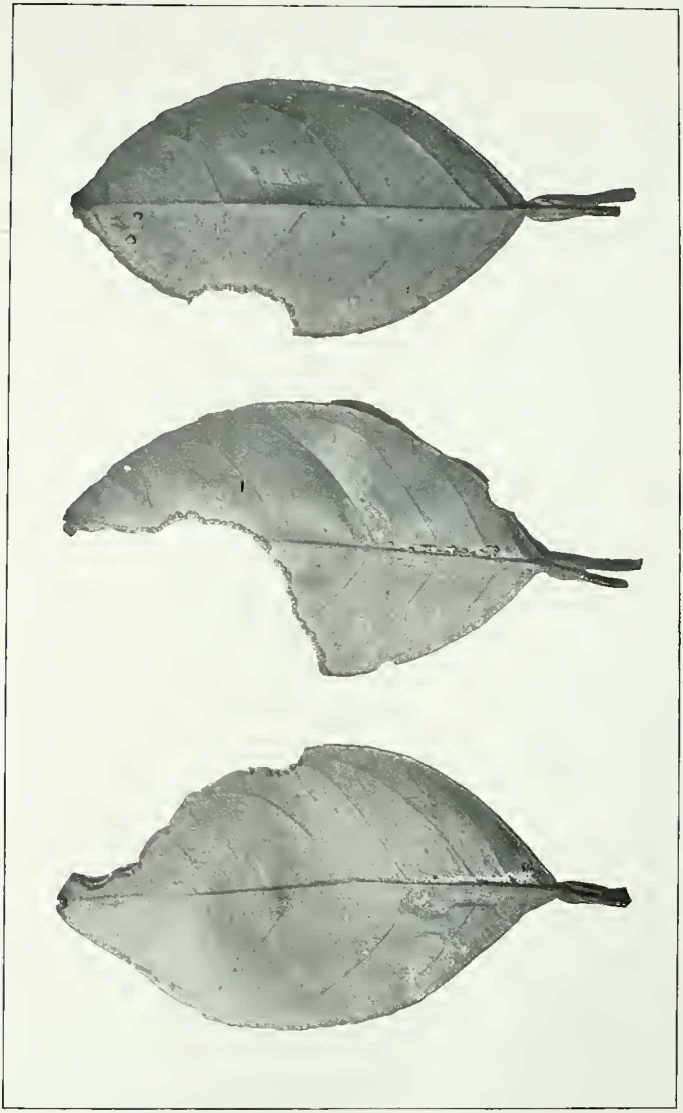


PLATE 1. CITRUS LEAVES SHOWING CANKERS FOLLOWING ATTACKS OF LEAF-CHEWING INSECTS.

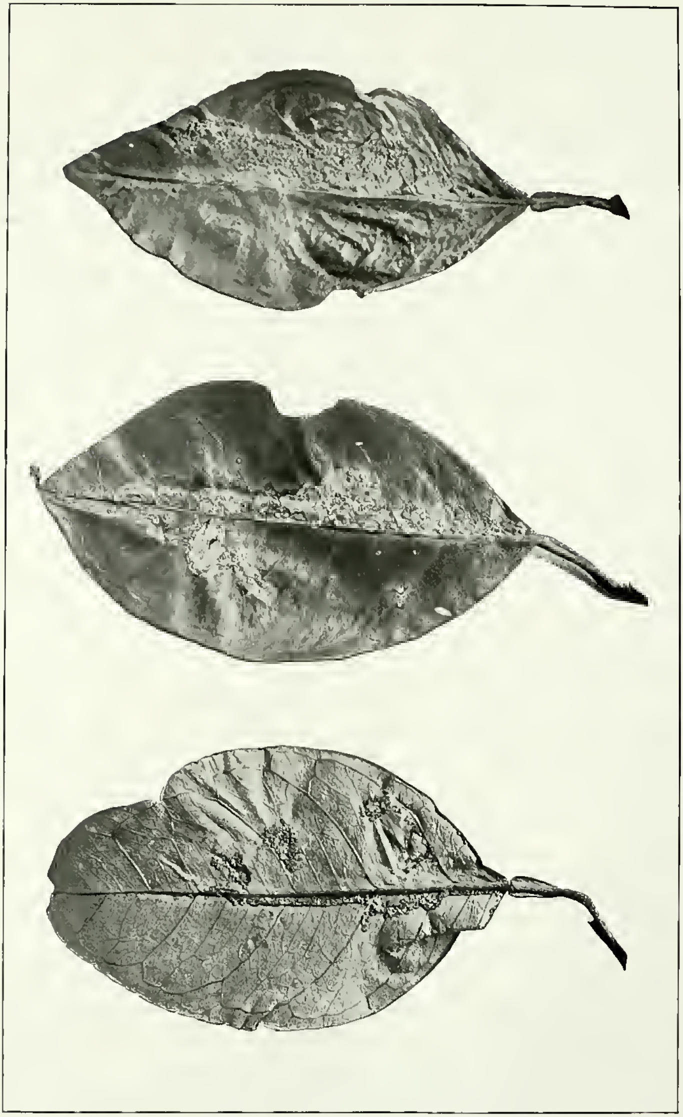


PLATE 2. CITRUS LEAVES SHOWING CANKERS FOLLOWING TRAIL OF LEAF MINERS.

KALINGA TEXTS FROM THE BALBALÁSANG-GINÁANG GROUP[1]

By Otto Scheerer

ONE TEXT FIGURE

LOCATION

The people at present officially designated as Kalinga occupy a central position in the interior of northern Luzon. They have for neighbors in the north the Apayao, in the west the Itneg (Kal. *Itnog*), in the south the Ibontok, and in the east the Ibanák and Gaddang. Their country consists, in the main, of a portion of the high ridge of the Cordillera Central and of the lower sierras which from this backbone stretch forth toward the east, sending their waters in numerous streams to the Rio Chico de Cagayan. On the upper course of this river is situated the town of Lubuagan, the capital of the political subdivision of the Mountain Province known as the subprovince of Kalinga. The accompanying sketch will show the general disposition of the Kalinga territory. (See page 177.)

NAME

Individuals of this tribe spoken to by me called themselves *Kalingga* or, more idiomatically, *Kalingka*. Since *kaling-á* in Ibanák and *kalinga* in Gaddang (the latter in the spelling of P. Malumbres) both mean "enemy," it may be surmised that the name in question was orginally bestowed upon the people from outside.

SUBDIVISIONS

In spite of the Kalinga having merited up to recent times the fame of bold warriors and inveterate head-hunters, their territory appears to be almost nowhere demarcated by sharply drawn ethnic boundary lines such as those antecedents might lead us

[1] The texts here published are the first coherent records made of the speech of some little-known dialect groups of northern Luzon. While hardly more than raw material, their publication must be considered as opportune since, with the profound and rapid changes now going on in the Islands, it becomes a matter of doubt if dialects like the present will still be in existence when a systematic investigation may become possible at some time in the future.

to expect. Almost on all sides zones of transition are reported, peopled by the offspring of the Kalinga's intermarriage with his neighbors. It becomes thus difficult to treat of the Kalinga as of a unit without making almost at every step allowance for intermixture. Modern ethnographers like Worcester, Beyer, and Cole, who, after personal investigations on the spot, have first recognized a distinct and prominent tribal unit among the jumble of so-called "tribes" reported in Spanish times from the territory above defined, and who have fixed on that unit the name Kalinga, have found it necessary to subdivide this people into a number of groups according to admixture of blood, culture, or dialect.[2] Beyer distinguishes the following groups:

1. The pagan Gaddang.
2. The Kaláua or Kalágua.
3. The true Kalinga of the lower Saltan, Nabayugan, Bukao, and Talifugu river valleys.
4. The Balbalasang-Ginaang group.
5. The Lubuagan-Sumadél group.
6. The Mangali-Lubo group.

Of these he says that in the present state of our knowledge this must be considered as a rough and tentative grouping only.[3]

The following items of information gathered by me from members of the Balbalásang-Ginaang group support the theory of a close relationship existing among the different Kalinga dialects. The Balbalásang people designate their speech as *kainalingka*, (Salegseg *Kenalingke*.) At those occasions when the chiefs of the various townships constituting the subprovince of Kalinga meet at the capital Lubuagan to confer with the

[2] Cf. Worcester, The non-Christian tribes of northern Luzon, Philip. Journ. Sci. 1 (1906) 791–805 and 818–826; also Fay-Cooper Cole, Distribution of the non-Christian tribes of northwestern Luzon, Am. Anthropologist 2 [3] (1909). An older conception of the Kalinga is found in the following translated quotation from Blumentritt, Versuch einer Ethnographie der Philippinen. Gotha (1882) 36: "According to Semper (Erdkunde, X, 256) the name Calinga seems to be a collective designation of unknown signification since thus are called also all the pagans who inhabit the provinces of Isabela, Cagayan, and Nueva Vizcaya. I designate here with this name that pagan Malayan tribe which lives in the same mountain stock as the Aripa, though only in its northern part, and goes especially by the name Calinga. But little is known of them."

[3] Beyer, H. Otley, Population of the Philippine Islands in 1916. Manila (1917) 50–51. On page 43, in treating of the Ibanák, the author says: "At least one quite different dialect exists. This is known as the Itávi or Malauég. The people speaking it are probably christianized Kalingas."

Lieutenant-Governor, they and their followers speak among themselves *kainalingka*, in which they are able, according to my informants, to make themselves mutually understood, with more or less difficulty, in spite of dialectic differences. Two

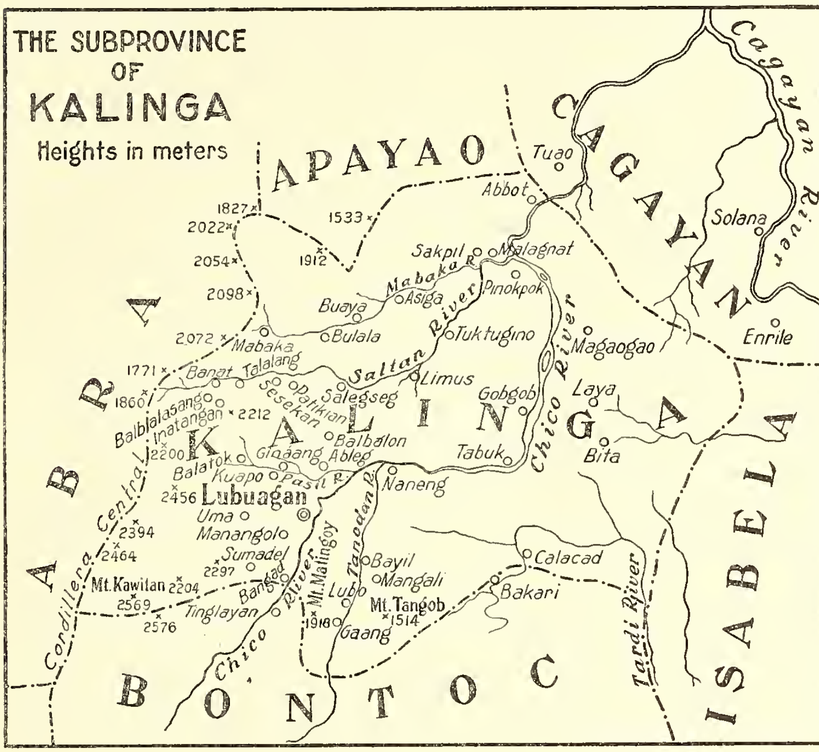


FIG. 1. The subprovince of Kalinga.

townships alone are pointed out as not coming within this range of general intelligibility; those are Bakali (?<*iba kali* other speech) and Kalakkad; to communicate with these the Iloko language is made use of.[4]

[4] The map of Northern Luzon of the Coast and Geodetic Survey (1912), on which my sketch is in part based, shows on the upper course of what is called farther down the Tardi River the two settlements of Bocale and Calacad, situated east of the Mangali-Lubo district. To Governor Carpenter, of the Department of Mindanao and Sulu and director of the Bureau of Non-Christian Tribes, I owe the information that by Executive Order No. 53 of May 29, 1914, "all that territory lying south of the Tardi River and the territory drained by the Siffu River now situate in the subprovince of Kalinga, Mountain Province," was transferred from the said subprovince to that of Bontoc.

In view of these facts the existence within the Kalinga territory of a goodly number of dialects may be expected. Whether these, once known in their totality and compared with one another and with the surrounding stocks, will show common charateristics leading to the establishment of a typical Kalinga speech as represented in its purest form by one or the other of these dialects, is one of the interesting questions the solution of which will reward the linguistic explorer of this region. The present state of our knowledge in this regard is characterized by Beyer in these words:

> The mixture of Kalinga dialects is as confusing as their type and culture, and in passing from one district to another most striking differences in phonetics are observed. Structurally those of the west seem to resemble the Iloko group, while the eastern dialects are closer to the Ibanag. We have too little information at the present time to attempt a classification of the Kalinga dialects, or even to state their number.[5]

The grouping of these dialects thus will have to follow for the present merely geographical lines.

BIBLIOGRAPHICAL NOTES

The only published records known to me of the speech of people coming under the designation of Kalinga as now in use are the following:

1. Schadenberg, Alexander, in Beiträge zur Kenntniss der Banao-Leute und der Guinanen, Gran Cordillera Central, etc., Verhandl. Berl. Anthr. Ges. (1887) 152–159. A vocabulary of some 660 words of the "Guinaan dialect as spoken in the rancheria of Copacopa." In this as in another vocabulary from central northern Luzon, this earliest scientific explorer of those regions shows himself to have fallen only too often a victim to the habit of those natives of substituting Iloko or other lowland terms for their own idioms when dealing with foreigners.
2. Meyer, Hans, Guinanisch-Tinguianisches Vocabular, in Eine Weltreise, Anhang: Die Igorroten. Leipzig (1884). Some 120 words.
3. Scheerer, O., in Linguistic travelling notes from Cagayan, Anthropos 4 (1909) 3 and 4. A list of 66 words from the rancheria of Gobgob on the Rio Chico.

INTERTRIBAL RELATIONS

The group of Kalinga whose speech is recorded in the following texts is at home on and around the upper course of the Saltan River where, according to Cole, they have married with the Igorot and Tinggian.

This author says:

[5] Beyer, op. cit. 51.

The towns of the upper Saltan river have drawn much from the three tribes which have contributed to their population, but the Tinguian material culture is the most pronounced. The typical costumes, method of hair-dressing and the arm-beads of the women, in vogue in Abra, are all found here. Agriculture is extensive, and the terraced fields compare favorably with those of Bontok. All kinds of domestic animals known to the natives of the coast are possessed by these people. The best iron-work of northern Luzon comes from this section, and their head-axes and spears have a wide distribution over the whole Tinguian and Kalinga territory.[6]

Beyer says of them:

In physical type they are more or less like the true Kalingas, but their culture and speech is a blended mixture of Apáyao, Kalinga, Tinggian, and Bontok. Out of this mixture there have been a number of curious and unique cultural developments.[7]

I may add to this that the different members of this group who were spoken to by me called themselves, as already stated, *Kalingká,* giving therewith evidence of their being conscious of belonging all to one and the same tribe. Since olden times they maintain trade relations with the Tinggian in the west, whom they call *Itnog* and whom they consider their friends; going as far as *Banged* (Span. Bangued), they take down to them rice (Bal. *pākoi* unhulled rice, *phínāyu* hulled rice) and tobacco (Bal. *taphiāko*) in change for salt (Bal. *asin*), pigs (Bal. *Pfūyok*[8]), woven stuffs (Bal. *lōpot*), beads (Bal. *ullayau*), metal pipes (Bal. *siwako* pipe), etc.; since the advent of the American régime they also trade with the people of Tuao and Piat in Cagayan to whom they bring likewise rice in return for salt, iron (Bal. *Phyāyang*), etc. Their main trade route lies along the Saltan River (Sal. *Saʎtan*) whose banks, hemmed in by steep rocks forming narrow and winding gorges, have given it, in local parlance, the name *Maʎokpfūb,* the cliff-bound. The significance of this river as a landmark is evidenced by the fact that the terms *chaya* and *lákūd,* denoting two cardinal points, have for the river-dwellers primarily the meaning of "up river" and "down river," respectively, and only according to the orientation of the river those of "west" and "east," respectively.

BALBALÁSANG

Balbalásang (locally *Phyaiphyayásang,* from *phyayásang* maiden) is officially stated to count at present approximately

[6] Op. cit. 342.
[7] Op. cit. 50.
[8] *O* quite open, as generally in these dialects.

1,048 souls. It is to be conceived as a district comprehending, besides Balbalásang proper, a number of "rancherias" or settlements (*phophóyoi*). The following were indicated to me as belonging socially, though not necessarily politically, to Balbalásang, and as speaking with little difference the same dialect:

Pasuál.	Kallagan.	Talagan.	Malibkóng.
Pattékyan.	Saʎtan.	Photlok.	Phulayāyau.[9]
Inilagan.	Sisík-an.	Phyánagan.	

The chief peculiarity of pronunciation that strikes the ear of the traveler who enters the Balbalásang district from the west is the sound which I represent by *ph* and which before *a* becomes *phy*. From a comparison of the word *phyayásang* above quoted with Ilk. *balásang* maiden it may be seen that *ph* replaces other Phil. *b*, and that the second *y* in that word stands for other Phil. *l*. Similar examples are: Ilk. *bató* stone, Bal. *phyató;* Tag. *gubat* forest, Bal. *kinophyat* same meaning; Ting. *banug* a certain eagle, Bal. *phyanúg*. The sound here in question is a pure bilabial, transitional from a stop to a fricative, and in so far difficult to judge correctly as not only its position in the word and the sounds preceding and following it are apt to make it fluctuate from *p* over *pf* to *f*, but also different speakers do not all produce it in exactly the same way.[10] On the question whether it is in all cases unvoiced—as I give to understand by the uniform writing *ph*—I must reserve a judgment which could be given only after a more extended investigation than was possible to me. I may say, however, that before *u* this sound approaches either *pf* or *f* so closely that I was tempted to write, for instance, *uppfu* (young of animal) for *upphu, naāfús* (finished) for *naāphús,* and others similarly.

This fluctuating sound is also found in the dialects of Gináang and Salegseg where it shows again some modifications.

Another notable feature of Bal. phonology, found likewise in Gin. and Sal., is a velar stop lying, in strength, between *g*

[9] Names here given are as locally pronounced; outsiders pronounce them somewhat differently.

[10] Though different in origin, this sound appears to be very similar to the one described by Conant in his F and V in Philippine languages, Bu. Sci. Div. Ethn. Publ. 5[2] (1908) 139; treating of the faulty pronunciation of *p* by individual Filipino children from various tribes, the author says that "the sound is produced by expelling the air through the lips when closed, but so relaxed that a very slight explosion is immediately followed by an almost imperceptible spirant, the result being a *pf* sound, the constituent elements of which are so blended as to be hardly distinguishable from each other."

and *k*. Also respecting this sound a definite statement as to the presence of voice must be reserved to further more leisurely observation. The general impression was that of a strongly articulated *g*, my unwillingness to set this sound down as a *k* being perhaps due to the fact that it is produced considerably farther back than *k* in English. Before *a*, especially before stressed *a*, it acquires the same strength as, for instance, *c* in English cat, even with some aspiration following it: *kaling-ká* almost *kaling-khá*. Disregarding fluctuations observed, I represent it for the present uniformly by *k*: *tákū* person, *iníngkāu* there was.

The consonantal diphthong *ch*, evolved, as in Inibaloi, from *d*, and which occurs in all three dialects here recorded, was pronounced much softer than in the first-named language. A study on the spot might lead to the adoption of a symbol corresponding to dʒ of the International Phonetic Association.

SALEGSEG

Salegseg (locally *Saʎogsog*) is reached from Balbalásang in four hours on horseback down the Saltan River. Official statistics give the population as about 940. Affiliated settlements speaking practically the same dialect are:

Pfūʎo (Bolo).	Chusō(k).	Kœwœan.	Possa.	Póttau.
Upoʎ.	Kā-wong.	Ōta.	Legleg.	Kilāyun.
Lopwóng.	Alengngag.	Náwoi.	Ta-wang.	Pfuayantoʎ.

My informant, a native of Salegseg proper, spontaneously stated that their dialect was about the most difficult to understand for the Kalinga of other districts, and this on account of its peculiar phonetics. Asked for the name of their speech, he unhesitatingly gave it as *kenalingkə* (<*kainalingka*). The chief phonetic peculiarities are:

1. A mixed vowel of the ö class replacing other Phil. *a* according to rules yet to be established. Being quite open, it is best represented by the *œ* of the International Phonetic Association. Isin. *gawa* middle, Bal. *kawa*, Sal. *kœwœ*. Occasionally this sound becomes rather indistinct (the *ə* of the Int. Phon. Ass.): Tag. *buaya* alligator, Bal. *phuāya*, Sal. *pfuœ̄yə*; Ilk. *dua* two, Bal. *chua*, Sal. *chuə*.
2. The peculiar Bal. bilabial *ph*, representative of other Phil. *b* is found in Sal. in about the same average form only before *i*: Tag. *gabí* night, Bal. *laphí*, Sal. *laphí*. Before an original *a* it becomes what might be called a hard *b* (I employ for it the symbol *ɗ*) and thus forms—seemingly according to the quantity of the syllable—either the syllable *ɗœ* (Inib. *mabayag* what lasts much time, Sal. *maɗœyəg;* Span. *bayoneta* bayonet, Sal. *ɗœyonēta;* Ilk. *bása* idea of reading, Sal. *ɗœssa;* Ilk. *ibagá* what is told, Bal. *iphyaká*, Sal. *iɗœgé*), or the group *ɗŭa* (Phil. *bató* stone, Sal. *ɗŭató;*

Phil. *basá* wet, Sal. *dŭassá*). An exception would seem to be Sal. *doʎoi* house (Bal. *phoyoi*, Ilk. *balái*). The essential distinction between the sounds represented by *b* and *p* is, of course, the presence or absence of voice, a question which, in reference to the sound here under review, must be left for future investigation. Before *u* (*o*) a fairly distinct, though very light, affricate is heard: *pfuǽyə* alligator, quoted above; Ilk. *bumangon* one rising, Sal. *pfumangon*; Ilk. *umisbó* who makes water, Sal. *umispfó;* Phil. *Bontók*, Sal. *Pfuntók*.

3. A sound produced by articulating an *l* with the tip of the tongue not touching the alveoli but passing more or less freely through the teeth, as my informants very clearly demonstrated to me. I use for it the symbol *ʎ*. The attempt to produce this sound, which is not found in English, is best made with an initial vowel; thus with *o*, for instance, a diphthong approaching *oi* will result; compare Ilk. *luppó* thigh, Inib. *ulpó* Sal. *oʎpó*. The name of the river Saltan, of the town Salegseg, and of the barrio (detached suburb) Bolo are locally pronounced *Saʎtan*, *Saʎogsog*, and *Pfūʎo*, respectively. The Spanish word for highroad, *calzada*, becomes in Sal. *kaʎsa*, the final syllable *da* being left out presumably under the mistaken belief that it is the possessive suffix of the third person plural *da*. Also in Bal. the change from other Phil. *l* to *ʎ* will be found through comparison (Ilk. *dakkêl* large, Bal. *chakkói*, Sal. *chakkóʎ*); the pronunciation of the sound is there, however, so glib and free of an admixture of *l* that I have not considered it necessary to use a special symbol for it. In Sal. the sound in question is often very deceptive and in the footnotes to the texts there will be found pointed out cases where it sounds almost like *l*.

Mention is to be made here also of the fact that tenues in final position are pronounced, especially in isolated words, with extreme softness making them sometimes scarcely audible: *Chusō* (*k*) a part of Salegseg, *áwa*(*k*) waist, *chœwa*(*k*) a semireligious ceremony (Ting. *dawak*), *awi*(*t*) load, *nasū-yo* (*p*) one sleeping, etc. Apparently this is due to the release of the stop being effected in a scarcely perceptible manner.

GINÁANG

Gináang, a town situated about half a day's ride southeast from Balbalásang, and about two hours northwest from Lubuagan, between the Rivers Pasíl and Tabía. The inhabitants, said to have been in former times the terror of their more peaceful neighbors and referred to by the Spaniards as "la tribu de los Guinaanes," number according to recent official statistics about 1,051 souls. Rancherias popularly affiliated with Gináang and speaking, with perhaps slight difference, the same dialect, are:

Púgung.	Mayoksád.	Yugyúg.
Poyāau.	Puāpu.	Gā-chang.
Bəktayan.	Matóngngak.	

The dialect of Gináang, as recorded in the following texts, is quite evidently part of the general Kainalingka speech-group; one of my informants, however, a son of the old fighting chief Atumpa of Gináang, had for it the special name *Gininúang* and disapproved of the generalizing term Kainalingka because of the existing dialectic differences. He had to admit, nevertheless, the similarity of their dialect to that of Balbalásang and, more especially, to that of Balatók, another considerable town some distance up the Pasíl River, with whose inhabitants they have no difficulty to converse.

Gináang phonetics, while in general very similar to those of Balbalásang, show in certain points a distinct weakening. The characteristic *ph* sound has less friction and approaches more a strong *b*. Similarly the dubious velar stop mentioned under Balbalásang inclines in Gináang more to *g*, so that words like *tákū, íngkāu,* and others I was tempted to write *tágū, inggāu,* etc. The consonantal diphthong represented in English by *ch*—and thus given also in the texts—often sounds rather like dʒ than tʃ, while some words seemingly ending in *d*, as *maíd, úkūd,* really wind up with a very slender hesitating sibilant: *maíd*-ʃ *úkūd*-ʃ. The almost inaudible final *k* mentioned under Salegseg is found also in Gináang where, moreover, initial and intervocalic Phil. *k* are elided: Inib. *kalbían* last night, Gin. *ayabían;* Bal. *káisan* gone away, Gin. *áisan;* Inib. *karagwían* custom, Gin. *achawían;* Sal. *kan seka* to thee, Gin. *an si-a;* Ilk. *balái ko* my house, Sal. *phoyói-o*. In place of the disappeared *k* no glottal check could be detected, nor were my informants conscious of any such; all that remained was a slight hiatus.[11]

There remains finally to be mentioned a quality which in all three dialects consonants occasionally revealed to possess for binding syllables together. Thus a word which was heard pronounced, in the ordinary flow of speech, *imusón* (object of asking), showed, when spelled by the speaker in syllables, the division *i-mus-són,* the *s* belonging as much to the second syllable as to the third, without becoming thereby audibly geminated.

[11] The regular elision in the cases above cited of *k* of other Philippine languages clearly indicates the distinction to be made between this original *k* and the dubious *k* before mentioned which has evidently been evolved from *g:* for example, *ug-úkud,* story, shows *g* closing the first syllable and in its stead *k* in intervocalic position; Ilk. *kigau* becomes in Bal. *kikau;* compare also words ending in *g* and followed by connective *a:* Bal. *kaag* plus connective *a* gives *kaag-ka,* monkeys—which (Ilk. *kaag* the young of the monkey). Note also that in Gin. *taphyako,* a loan-word from Span. *tabako, k* was not elided.

(Wherever a long consonant was sounded this was recorded in writing by doubling it: *ummói, pillak.*) There was no opportunity to make this point an object of special study; it may, however, be kept in mind when dealing with the coalescence which is shown in the texts often to take place between the connective particles *a, ot,* and the final consonant of the preceding word: *chakkói-ya phyanúg* large eagle, *akit-ta iphíl* little crying, *phyanúg-ka manánap* eagle-which searched, *phyató-wot* stone-and, *liang-ngot* cave-and. The language did not, however, seem to be very strict in this respect, for, while the borrowed consonant was at times pronounced even after quite a considerable intervening pause, leading me at first to the belief in the presence of such independent words as *ta, wot,* at others there was either a simple addition of the particle to the preceding word (*acháyaoma liang* deep cave), or the consonantal accretion before the connective was lost through a pause.

The coalescence just treated finds its reverse in a number of words the staccato pronunciation of which leads to such writing as: *man-ái-áyam, na-ám-ámod, inám-amāan, pít-ongōna, inum-ummói, ság-ón, man-iwá-aƘ* and others.

In words not marked with an accent the weight of the pronunciation falls as a rule on the penult.

ACQUISITION OF TEXTS

The following texts were collected by me during vacation time at the Teachers' Camp in Baguio and at the farm school at Trinidad, Mountain Province, from some Kalinga students of about twenty years of age. Thanks to the courtesy of the authorities concerned [12] a series of sessions could be arranged with these young men. It was at first tried to have the students write down their stories, an attempt which proved, however, an entire failure, as the boys either frankly stated their inability properly to represent in writing the uncommon sounds peculiar to these dialects, or rendered sounds and words in a way that made it difficult for them to decipher after a while what they had written. I had thus to undertake the not easy task of following the flow of the story-teller's relation while trying, at the same time, to put into writing his utterances which at the time being were, of course, absolutely unintelligible to me. Still, after repeated readings and corrections each story took ulti-

[12] The facilities for my work kindly granted by Professor Wright, director of the Trinidad Farm School, and by Mr. McCann, of Teachers' Camp, Baguio, are sincerely appreciated.

mately a form that was pronounced correct, whereupon the translation into English was taken up, and one or the other point of grammar discussed.

The stories thus recorded were:

IN THE DIALECT OF BALBALÁSANG

1. *Sacha phyanúg kan aphít;* The eagle and the child; from the town of Balbalásang (Phyaiphyayásang).
2. *Sacha Changatag kan cha kaag;* Changatag and the monkeys; from the rancheria of Phulayāyau.
3. *Sachat Iphuāyan nangáyau ud Pattékyan;* Those from Buaya go on a headhunt to Patikían; from the rancheria of Pattékyan.

IN THE DIALECT OF SALEGSEG

4. *Se Aʎukəna kennan chit pfuǣyə;* Si Alugan bitten by an alligator; from the rancheria of Pfuʎo.
5. *Ug-úkūd kan Lumawig;* The story of Lumawig; from the rancheria of Kā-wong.

IN THE DIALECT OF GINÁANG

6. *Ug-úkūd chat man-aman nagchayán;* The story of the father and child buried by a landslide; from the town of Gináang.

To these texts is added:

IN THE DIALECT OF THE TINGGIAN (ITNEG) OF ABRA AS SPOKEN IN THE TOWN OF PEÑARUBIA

7. *Mepənggep ta Itneg di Abra;* About the Itneg of Abra.

The last account, which was obtained from a young Tinggian student of the farm school already mentioned and is to my knowledge the first text ever published from that language, may afford students an opportunity to compare the Tinggian with the Balbalásang-Gináang dialects which latter are said to have been influenced by their western neighbors.

As regards the translation of the texts I should say that the liberties which I have occasionally taken with the English language are to be explained by the desire to reflect, as much as it can at all be done, the peculiarities of Kalingga diction.

A list of the personal and possessive pronouns in all dialects here recorded is added at the end.

PHYAIPHYAYÁSANG

SACHA PHYANÚG KAN APHÍT

1. Sachit nasulít sin phophóyoi ud Phyanakán iníngkāu chakkói-ya phyanúg. Inaikáuwa umói sit phophóyoi mang-

BALBALÁSANG

THE EAGLE AND THE CHILD

1. Long ago near the town of Banagán there lived a large eagle. Every day it came to the town to catch pigs and

āyas phoyók ya kikau. Maíd makapatói sit phyanúg tei umógyat chachit tákū.

2. Sat osán kidkícham iníngkāu osán aphít-ta man-ái-āyam sit páwai. Man-lín-lináwa sit man-ái-ayámana.

3. Masulít man inīlan chit phyanúg chit aphít. Manippókoi chit phyanúg ot chapyótonat aphít ot itáudna uschit philig.

4. Mangkolis mat aphít naāphús ngummato chit phyanúg. Na-ám-ámod chit ogyát chat táku sit oót-tapóncha man chit phyanúg-ka nang-āya sit aphít innókna uschit líang.

5. Unuchon chat tákū ot michatóngcha man sit philig; maíd máoi tai chopiyás on natáknang. Chuchóngyoncha chit iphil chit aphít ngato umya akit chit chóngyoncha. Masulít man chit mantá-tangáchancha, maíd chóngyonchas iphíl na. Mampaúlicha tai pasikónchan kínan chit phyanúg.

calves. There was nobody who could kill the eagle for the people were afraid.

2. On one afternoon there was a small child playing in the front-yard of a house. A delightful cool air was at the place where it played.

3. After a while the eagle saw the child in the yard. The eagle swooped down and snatched the child and flew away with it to the mountain.

4. When the child screamed, the eagle had already risen high. Excessive was the fright of the people when looking up at the eagle that had taken the child and carried it to the cave.

5. The people followed it and reached the mountain; it was impassable for it was very steep and high. They listened for the crying of the child above, but little was heard by them. After looking up for a while they did not hear its crying. They went back for they thought it had been eaten by the eagle.

1. *Phophóyoi* village, group of houses; from *phoyói* house.
   iníngkāu, past of *íngkāu*, finding one's self, staying, being.
   phyanúg probably the large, monkey-eating eagle, *Pithecophaga jefferyi* Grant, found on Luzón, Samar, and Mindanao. The Ibaloi of Benguet have a similar story of this bird called by them *saragmá* and found there only in the foothills.
   mang-āyas from *mang-āya* one getting+*s*.
2. *Aphít* small child, baby.
3. *man* (probably *ma*+*n*, compare later *mat* from *ma*+*t*) seems to mark the progress of events.
   chapyótonat from *chapyóton* object of snatching+*na* its+article *t*.
4. *naāphús* expresses finished action.
   ngummato, past of *ngumato* from *ngato* above+infix *um*.
   oót-tapón; imper. *otapóm* let (it) be the object of thy looking up; past *intap*.

6. Mawakás ot umói chit amāna mantangad manumphús; nagngoi nat akit-ta iphíl chit ánakna. Namingsāna chingngoina. Nampaúli chit amāna tai achína naka-āya sit ánakna. Chakkói-ya phyaphyáwinan chit kaisan tai adsāna na-īla chit ánakna.

7. Maphitil man chit aphít maíd mangai-ánas kanōna tai maíd apoi ya maíd phināyu. Maphítil mana-únai, nangan sichat inayan chit phyanúg-ka ugsa onno phoyók.

8. Makaduan phūyan ot chummakkói chit aphít ot chummachakkói pai chat upphūn chit phyanúg. Oyóg man chat upphūn tumaud chinomchom chit aphít on man-āyan.

9. Ot osán phigphikát man kaisan chit inan chat upphū. Postōna chit ikin chat upphū ot ilāyugna chicha. Ot inámammāam chit aphít-ta niphíanat sit pīta. Ichāyana chat chūan upphū sit phophóyoi.

6. The following day the father went to look up again; he believed to hear some little crying of his child. He heard it only once. The father went back for he could not take his child. Great was his sorrow on going away for he had not found his child.

7. The child was hungry, but there was no getting any food because there was no fire and no rice. Being very hungry it ate from the prey of the eagle which was deer or pig.

8. After two months had passed the child had grown bigger and also the young of the eagle had grown up. As the young eagles were able to fly the child thought of going away.

9. Then, one morning, the mother of the young eagles flew away. The child tied the legs of the young to use these for descending to the ground. And slowly the child sank down to the earth. It took along the two young eagles in going back to the village.

5. *unúchon* object of following.
michatóng, possibly from **maichatóng.*
maíd máoi not passable.
chuchóngyon, probably a progressive form of ** chongóyon* obj. of listening.
pasikón object of thinking; past *pinasíg.*
kínan, past of *kanón* object of eating.

6. *umói* one going; we would expect the past *ummói*, but this tense appears to be far from being regularly employed.
manumphús: our adverb "again" appears as a verbal form auxiliary to *mantangad.*
nagngoi a form said to denote one who believed to hear.

7. *inayan* what was taken (by the eagle).

8. *oyóg* seems to express the idea of enough, sufficient.

10. Sumáai man chit aphít naschá-au chat tákū tai pasikónchan natói. Natayók chat amāna ya susūnudna tai sumáai.

11. Mangwá man chat tákū nangwáchas sīlib. Iphyā-udcha chat chūan upphū sit pawai ot sukāoncha. Masulít manchi iníngkāu chingngóichan kas phyálin nampáipo sit kinófyat. Chumakko-chakkói chit anūnong an chingngói chat tákū ot lumókwas man si phyanúgka manánap sichat upphūna.

12. Maílana man chat upphūna manippókoi-yot chapiyótona chat upphūna sit sūka ot manokúyoscha chit tákū ot patáyoncha. Insangapatóicha chat chūan upphūna. Maāphús chiyot maíchon ogyātan chat tákū. Naaphús.

10. When the child arrived at home, the people were startled for they had thought it dead. Its parents and brothers and sisters rejoiced over its arrival.

11. The people decided to use a trick. They bound the two eaglets on the yard and planted sharpened sticks in the ground around them. They had been there a while when something like the rushing of wind was heard by them which came from the forest. Louder grew the sound which the people heard, and what appeared was the eagle looking for its young.

12. When it saw its young, it shot down to snatch them from among the sharpened sticks, and then the people rushed to the place and killed it. Together with it they killed the two eaglets. And thus was ended at last the fear of the people. Finished.

PHYAIPHYAYÁSANG
(Phulayāyau)
SACHA CHANGATAG KA CHA KÁAG

1. Sat osán ai-aikāu Si Changatag ud Saitan ummói ud

BALBALÁSANG
(Phulayāyau)
CHANGATAG AND THE MONKEYS

1. On a certain day Si Changatag of Saitan went to sell

9. *kaisan* was said to be the past of *manayan* one going away.
postón object of tying, past *pinsot.*
ilāyug with the help of which one descends; instrument of descending.
inam-ammaan, an auxiliary verbal form expressing the idea of "slowly" and being in the same (past) tense as the principal verb *niphíanat.*
ichāyan (probably from *chāyan* road, trail) what is taken along.

11. *mangwá* includes such meanings as: make, think, say, decide, etc.; past *nangwá* (contained in *nangwáchas*).
iphyá-ud, cf. Ilk. *ibalud.*

12. *maíchon,* from *maíd* there is not, and suffix, *on,* indicating direct object.

nanlako si kūsi. Kinimātana chit chuan phokói-ya kūsi on ina ingīna si lūwang úschin phophóyoi ud Photlok.

2. Ingkāu man sichit kawan chit kinúfyat iníngkāu chat kāag sit chāyan. Ot umíllong yān tai naphyanikói sit iningkawán chat kāag on inīlana.

3. Masulít manót ayāna chit phyató-wot pit-óngonat osán kāag. Masulít manót umachú cha chit kāag sit kāyu on maníschung kan sía.

4. Paiyán ayánat osán phyató-wot pit-óngona c h i c h a. Auní manót lumsá chat chūan kakuúphyanchan ummói kan sía. Sinóngpatna chicha.

5. Maphyayág manót naámin nilúmsa chat iníngkāu sit kāyu on manokuyus kan sía ot maliglikót.

6. Iníngkāu ud achāyoma līang uschit ikid chit chayan. Tinainána chit áwit nan kūsiyot phumtík sit liang-ngot

jars. He carried suspended from a pole on his shoulder a couple of jars which he went to sell for a water-buffalo in the town of Photlok.

2. When he was in the middle of the forest there were monkeys on the road. And he just sat down for rest as he was tired, at the place where there were the monkeys he had seen.

3. After a while he took a stone and threw it at a monkey killing it. Thereupon the monkeys became many on the trees and they peered down upon him wistfully.

4. Again he took a stone and stoned them. After that there came down two of their leaders who went at him. He cut them down.

5. After a while all of them that were in the trees came down and rushed upon him and he became excited.

6. There was a deep cave at the side of the road. He left the load of jars and ran to the cave and many were also the

1. *kinimāta;* a means of carrying loads is by a pair of baskets, *kimāta,* suspended from the extremities of a pole, *aséu,* carried over the shoulder; *mangimata* one thus carrying a load; *kimatáon* what is thus carried.
phokói a classifying auxiliary to numerals used to count globular things such as jars, demijohns, coconuts, etc.
ingīna si lūwang; also *ingīnat lūwang* might be said; *lūwang* is the *nuang* of other northern dialects.
2. *kawa middle,* Isin. *gawa.*
kinúfyat forest, cf. Tag. *gubat.*
umíllong one resting; *yān* meaning "just."
3. *pit-óngonat: pit-óngon* object of stoning (Past *pinít-ong*) +*na* his+ *t<si.*
man-íschung, cf. Bont. *umuschung* one looking down watching.

achūn únai chat kāag-ka metón-ud kan sía; umya iníngkāu phyáchangnan anchu.

monkeys who followed him; however, he had with him his long bolo.

7. Ipainókna chit potód na sit līang; pasawāyona chit áwakna on mampatói sichat kāag-ka mamatói kan sía. Awad pai nilumnok sit aphút tinogmānat óyuna.

7. He put the lower half of his body into the hole, stuck out his waist, and killed the monkeys who wanted to kill him. Whenever one entered the hole he cut off its head.

8. Achū man chit pinatóina on sachat kāag nangwachas sīlifcha. Ummói chat úchūm sit tongod chit līang-ngot kuyūphyanchat tongod chit phyató.

8. Many were those killed by him when the monkeys used a stratagem. Some of them went to the back of the cave and dug a hole at the back of the rock.

9. Na-amin pai chat kāag sit sauphían chit līang nisukat chat sumasāyum. Maphyayág manót sachat kāag-ka iníngkāu sit tongod chit phyató lummosphūcha sit chayom chit līang-ngot sa chiyon tinilíucha on Si Changatag-kot iphusnágcha ot mapoipoitóyancha ingkánas maicha únai ud maiwayang sit phukásna.

9. When the monkeys at the entrance of the cave were all exterminated many others came to replace them. After a while also those monkeys who were at the back of the rock passed through to the interior and thereupon caught hold of Si Changatag who was dragged out by them and torn to pieces until no more was left of his flesh.

10. Sa chiyon naichon Si Changatag ta kinan chi kāag sit cháyana inóina. Naāphús.

10. Thus perished Si Changatag bitten to death by the monkeys on the road which he had traveled. Finished.

4. *sinóngpat,* past of *songpáton,* object of cutting down.
6. *tinainan,* past of *tainan* what is left.
phumtik one running, past *phinumtik.*
7. *tinógma,* past of *togmáon: togmáok* my object of cutting off.
8. *sīlifcha* their trick; the last sound of *sīlif* is a very slender fricative.
9. *tinilíu,* past of *tiliwón* what is seized.
10. *kinan meaning* generally "eaten" but also "destroyed."
inói, past of *ayon* what is passed, as a road walked over.

PHYAIPHYAYÁSANG
(Pattékyan)

SACHAT IPHUĀYAN NANGÁYAU UD PATTÉKYAN

1. Sat osán ai-aikāu iníngkāu chad Iphuāyan nangáyau ud Pattékyan. Awád kad chatón tákūn nampáipod Phuāya tó·yumpūyu cha ot limá.

2. Umachanícha man ud Pattékyan umillóngcha yān ta mangancha ta payót naphīlogchan makapatoi si kancha.

3. Umya lamóng ot tai iníngkāu osán layākin Ipattékyana ummói mangāyu-wot awád kadton ina nangayúwan siat kapo·ngāton chit umillongan chat phūsoi.

4. Ot mampokpok man sit awitónan káyu iníngkāu chad tumotolíng-nga chingngóina ot maníschung man chopyá iníngkāu chad mankakāna tákū.

5. Nakítak si ogyátna ta sachit os-ossáan osyá. Mangwá si sīlip ot ok-óyona chit chakkóya phyató-wot itopákna man chopyá nipuntá sit káwachan chat phūsoi on mankakán.

BALBALÁSANG
(Patikían)

THOSE FROM BUAYA GO ON A HEAD-HUNT TO PATIKÍAN

1. On a certain day there were men from Buaya going on a head-hunt to Patikían. As for those men come from Buaya they were thirty-five.

2. When they came near to Patikían they sat down to rest a while and to eat in order to be strong to fight, as they said to themselves.

3. However, there was a man from Patikían who had gone to cut wood and as for the place to which he had gone to cut the wood it was just above the resting place of the enemies.

4. And while cutting his load of wood there were the sounds of talking people heard by him and when he looked down wistfully there were people who were eating.

5. Excessive was his fear for he was quite alone. He used a stratagem: he picked up a big stone and dropped it downhill hitting the place where the enemies were eating.

1. *nangayau,* past of *mangayau* who goes headhunting.
nampáipo, compare: *Nampaipuam?* Where do you come from?

2. *umachaní* one approaching, past *ummachaní.*
naphílog who or what is strong; a form with prefix *ma* does not exist.
kancha means primarily "they say" or "said" but probably also "they thought."

3. *tai, also pronounced tei* or *te.*
Ipattékyana, the final *a* is the connective particle.
nangayu from *káyu* wood.
kapongaton, for *kapangaton?*

6. Otchākona man chit phyató pinachisanānan nangkolís; impákoinan: "Mangói kayón uchúm lákūd ta salewángammin uchúm chaya!" Ot namphubtik chat phūsoi ta kancha nu achūn tákūn manchogchog kan chicha. Awāchoppai osossáan chit layākin nan-og-ogyát kan chicha.

7. Ot awád kadchatón phūsoi inamínchan tinainan chat kọchónga alikāmoncha ta sāchit nakiyatánchan nákig-tót osyá. Asúg-ka kanon cha naámin niwális.

8. Ot mapotīpot man chat phūsoi nisukat chit layāki ot aminōnan ubpōnon chat kochónga tináinancha, ot mampaúlid phophóyoi, on umói mangaya si phuyonan man-áwit sichat uyos, kamán, tōpyai kan cha kayāsag on tinóponna.

9. Sumāai phophóyoi chiyot iphyakānas chat susúnudna. Umōlicha ot ináminchan ināya chat kochónga alikāmon chat phūsoi ot kod-kodwáoncha chat ināyacha.

6. In dropping the stone he made at the same time a big noise shouting: "Some of you pass down river and we others get around them from up river!" Then the enemies started to run thinking that many men were pursuing them. And there was left alone the man who had scared them.

7. As for the enemies they left behind all their things for he had put them immediately into a fright. Their provision of boiled rice was all scattered.

8. When the enemies were hardly gone he entered the place they had left and piled up all the things abandoned by them and then he returned to the village to fetch his companions as carriers of those blankets, head-axes, spears, and shields which he had piled up.

9. Arrived at home he told his relatives of the affair. They went back and took all the belongings of the enemies and distributed their booty.

4. *tumotolíng*, compare *tumling* who talks noisily; past *tinumling*.
chingngói, past of *chongngōyon*.

5. *ok-óyon* what is lifted, past *inók-oi*.
nipuntá, past of *mipuntá* (possibly from **maipuntá*), compare Span. *apuntar* to aim at.
káwachan may have to be analyzed into *ka*+*awad*+*an* place of finding oneself.

6. *otchākon* what is dropped, past *inótchak*.
impákoi past of *ipakoi* what is shouted.
salewangammi from *saleu-ángan-mi* object of our surrounding, past *sinaleu-ángan*.

10. Ot sumāai man chat phū-soi sit phophóyoicha maichaú-nai insáaicha tai natainan chat kochónga alikāmoncha. Imph-yág-phyakáchas chat kailían-chan: "Nasúyagchan tákūd Pattékyan ta ichakami inafót" kancha.

10. And also the enemies arrived at their village bringing with them absolutely nothing for they had left behind their entire outfit. What they told to their villagers was: "The people of Patikían are brave for we were met by them," they said.

11. Sia chiyot kochóngchan umoi mangáya-wón ud Patté-kyan ta natīlogcha. Achícha inum-ummói ud Pattékyan ingkāna si sumāai chat Meli-kánon umói mampaāmod ka-lingká. Sansāton maid mam-phuphūsoi ta naámin ummāmon tákū.

11. This, then, was the end of their going head-hunting to Patikían for they were scared. No more did they go to Patikían until the Americans arrived who came to tame the Kalinga. At the present time there are none warring with each other for they are all tamed people.

7. *tinainan*, past of *tainan* what is left behind.
kochóng all without remainder, all to a finish; cf. Bont. *kœchœng chí* this is all, Inib. *nákcheng* finished.
alikāmon equipment, personal belongings.
nakiyatan has the sense of "having done immediately."
nakig-tót, past of *makig-tót* who frightens.
asúg boiled rice, with following connective *a*: *asúg-ka;* in rapid speaking *asúka.*

8. *mapotīpot* what has all but disappeared.
nisukat, past of *misukat* what takes the place of something else.
aminōnan probably *amin* all + *on* object of direct action + *na* his + *n* connective, the whole being adverbial to *ubpōnon;* past *inamin; ubpōnon* what is put on top of something else, past *inubpon.*
uyos cotton blanket, Inib. *ulœs.*

9. *inãya*, past of *áyon* what is taken; *Ayam nat lapis!* Take that pencil!
kod-kodwāon object of distributing, past *kinod-kodwá;* probably from radical *duá* two: *kad-kaduá-on*, the change from *a* to *o* not being seldom.

10. *maichaúnai* apparently from *maíd* nothing + *a* connective + *unai* expressing a high degree, as "at all" in nothing at all.
inafót, past of *aptón* what is met.

11. *mangáya-wón* from *mangayau* + *on.*

SAᴧOGSOG

(Pfūʌo)

SE AᴧUKəNA KÉNNAN CHIT PFUŒYə

1. Osán laphí inummói Se Aʌukəna Ipinokpok namungwít se ikan ot opatchœt kennāna. Ot anchímana kœwœen chi laphí manchukchuk-ʌōp kanó-wot nasū-yop set ikid chit chenúm.

2. Anchin kœwœen man chi laphí inī-nau chit pfuœ̄yə ot tumakchang chet pfuœ̄yə ot chinukmā-ana chet oʌpon Aʌukən ot illāyugnat chet kaacha-ʌœman chet chenúm ta piœōna no kanōna Se Aʌukən.

3. Nomyœ Se Aʌukən naphī-log ot anchímana il-lók chet pfuœ̄yə set liyang inawítna chet pfuœ̄yə ot intákchannat chit taʌantag.

4. Anchímana píllimaón chet pfuœ̄yən il-lók sichit chuʌom kummāpuyón Se Aʌukən ta achū chet phikœd set long-agna.

SALEGSEG

(Bolo)

SI ALUGAN WHO WAS BITTEN BY AN ALLIGATOR

1. On a certain night Si Alugan went to catch fish with a hook and four were caught by him. When it became midnight he became sleepy, it is said, and he slept at the edge of the water.

2. About midnight he was scented by the alligator and the alligator came out of the water going to the shore and caught hold of Alugan's leg and jumped with him into the deep of the water because it wanted to devour Si Alugan.

3. But Si Alugan was strong and when the alligator was already dragging him into a cave (under the water) he lifted it and went with it to the shore.

4. When the alligator had already sunk him five times into the deep Si Alugan became weak for many were the wounds on his body.

Title. Aʌukən, the form *Alugan* was said to be that given this name in Pinokpok, a town on the lower Saltan.

Se, *chit*, pronounced also *si*, *chet;* I show the fluctuation by writing the vowel just as I heard it; *ch* in *chit* and other words often sounds almost like *ds;* except before *œ* (as in *chœ*) where it approaches *dʒ*.

1. *namungwít*, compare Tag. *bingwit*, Bont. *fengwit* fishhook.
kennan was stated to be the past of *kon-on* object of catching, different from *kénnan*, past of *kanón* object of eating.

2. *inī-nau*, past of *inawón* object of smelling.
tumakchang one going from the water to the shore; past *tummakchang*.
chinukmā-an, past of *chukmā-on* object of seizing.
illāyug, past of *ilāyug* with what one jumps down.

5. Anchímana adyən-dyənín matói kenawótna chet attán chet pfuœ̄yə ot nilipsūtan chet pfuœ̄yə ta masikœbœn set attāna.

5. When he was almost dead he dug his fingers into the eyes of the alligator and the alligator let him free for its eyes caused it great pain.

6. Ot nilipsútana Se Aʎukən-not manāyan set duđóʎoina nomyə achína makākuə ta ma-sāʎom chet phikœdna.

6. When Si Alugan was set free he went to his village but he could not walk for he had many wounds.

7. Anchímana lumáos makat-lo ummói chit pfuœ̄yə inīnap chet innói Aʎukən ot inchasa-na chit nai-āngon chœ̄ʎan Aʎu-kən. Ot siyə inúnu-ūnod nan inīnau chet innóina. Ot chi-natóngna chet đoʎoi Aʎukən ot nansóyok set choya.

7. When three nights had passed, the alligator went to search for the road taken by Alugan and found it by the dried blood of Alugan. And it followed the smell of his track. And when it reached the house of Alugan it hid itself in the space under the floor.

8. Nomyə anchímana lumík-na Se Aʎukən nanchit nasū-yop chingngóʎna chet pfuœyə man-tattá-oʎ ta piœōnan payau-on Se Aʎukən.

8. But when Si Alugan awoke from his sleep he heard the alligator snorting for it wanted to cause him to come out.

3. *il-lók*, past *iníllok*, what is caused to enter.
inawīt, past of *awíton* what is carried as a load.
intákchan, past of *itákchan* what is taken from the water to the shore.

4. *píllimaón*, radical *limá* five; it appears herefrom that prefix *pi* (*pin?*) and suffix *on* are used to form with cardinal numbers derivatives indicating how often something is done.
long-ag whole body; *g* with nasal resonance.

5. *adyen-dyəní* almost, Ilk. *ngan-nganí*.
kenawót, past of *kautón* (from **kawoton?*) what is put into.
attá eye; note formation of genitive after noun ending in vowel: *attán chet pfuœ̄yə* eye of the alligator; compare genitive after noun ending in consonant: *ikid chet chənúm* edge of water.
nilipsútan, past of *lipsútan* object of letting go.
masikœbœn what is very painful.

6. *makākuə* one able to walk, say, do.
masaʎom what is numerous.

7. *makatlo*, the word "night" is evidently understood.
chœʎa blood, Inib. *chala*.

8. *payau-on* what is caused to come out, past said to be *pinayā-uə*.

9. Pfummāngon Se AΛukən-not ayāna osán chakkóΛa đūató-wot itup-úgna chet telid chet pfuœ̄yə ot phinumtek set ikōu-na.

9. Si Alugan got up and took a big stone and hit the back of the alligator which ran away to its lair.

10. Ot anchímana manchat-chatóng chet pfūyon AΛukən set man-u-úkūdchœ ta piœonchœ no patayónchœ chet pfuœ̄yə.

10. And then the neighbors of Alugan came together to talk for they wanted to kill the alligator.

11. Ot manchat-chatóngchœ man yϵ achūchœ ot kananchœn: "OΛóg takón patayón ta achū takó." Ot inummóichœ set ikōuna ot kummūΛubchœ se achœΛum-ma phito set ikid chet chənúm set sog-ón chet ikōuna.

11. And when they assembled they were many and they said: "We are sufficient to kill it for we are many." So they went to its lair and dug a deep hole at the edge of the water beside its home.

12. Maāpfus chet phiton kingwœ̄chœ ot pfunpfunanchœt set tūpfun chet kāyu. Maāpfus chīyot ichœyanchœ chit osán āso-wot ipápanchœt chit phitu.

12. When the hole was finished which they had made they covered it over with the leaves of trees. This done they went to get a dog and used it as bait in the hole.

13. Ot anchímana mantá-ūΛ chet āso chingngoΛ chet pfuœ̄yə ot manūchak chet pfuœ̄yə ta ina kanón nomyə naknát chit phītu. Ot pinatóichœon chet pfuœ̄yə. Nagangpōton.

13. And when the dog barked it was heard by the alligator and the alligator ran to go and eat it but was caught in the hole. And then they killed the alligator. Finished.

9. *ayan* object of taking, past *ináya*.
itup-ug object of throwing, past *intup-ug*.
ikōu (also *ikāu*) dwelling-place.

11. *sog-ón*, generally used as a preposition meaning "near:" *sog-ón chin đoΛoi* near the house (if house is in view; otherwise *sog-ón chit đoΛoi*).

12. *kingwœ* (from * *kinwœ?*), past of *kau-on* what is to be made; radical possibly *kuá*.
ipápan what is used as bait, past *nipápan; papánan* the place where a bait is used.

13. *nakná*, past of *makná*, what is caught (in a hole or on a hook).
pinatóichœon and *nagangpōton:* the final *on* in both expressions is probably equivalent to Iloko *en*, meaning "already," in such expressions as *nalpás aminen*, all finished already.

SAʌOGSOG
(Ka-wong)

UG-ÚKŪD KAN LUMĀWIG

1. Se Lumāwig na kawasāna kaphīlas maíd kanōna; hachœ̄chit amāna yə ināna natóichœn naāmin.

2. Hachœ̄chit kaāma-án Lumāwig kaīna-ána yə kakāpingsana issánchœ Se Lumāwig itchən se kanōna; ot chumakōʌ man Se Lumāwig ummói set úchūm-ma ɗuɗóʌoi ummōtang se pillák hichœ̄chit úchūm-ma tákū ta tuʌtuʌlian na chichœ. Hachit chœkup chit inōtangna nasuʌōk-ka chūen gasōt-ta pēsus.

3. Ummói man chœ̄chit tákū imusón chit pillákchœn inōtang Lumāwig; kanānan: "Aunī yan ta īyak man-īla se pillák se maʌakpús kotnat pillák-ka inōtangko ken chakayó." Ot maɗœyəg manón kawœsa maíd ochasāna si pillák se mamɗœ̄yədna chœ̄chit ōtangna.

4. Osán laphí man ummói Lumāwig inākau chit pfuyón chœ ɗœyug on napnō se apōngot. Ot hāchit pottóg chit apōngot ta inākau Lumāwig kan ud ɗœyug tuʌung gasōt-ta pēsus. Ot hāchit apōngot imɗœ̄yəd nan amin sed chœ̄chit ōtangnat chœ̄chit úchūm-ma tákū.

SALEGSEG
(Ka-wong)

THE STORY OF LUMAWIG

1. Si Lumawig was absolutely destitute and had nothing to eat. Those parents of his were all dead.

2. The uncle of Lumawig and his aunt and cousins would not give him any food and when he grew up he went to other villages to borrow money from some people to whom he told lies. The total of his debt exceeded two hundred pesos.

3. When the people went to ask for the money which Lumawig had borrowed he said: "Just wait, for I shall go and find the money to pay back that money which I borrowed from you." And for a long time after he absolutely could not find money to pay his debts.

4. On a certain night Lumawig went and stole the treasure-basket of the Bayug family which was full of beads. And the value of the beads stolen by Lumawig from Bayug was three hundred pesos. And the beads he used as a means to pay all his debts to the other people.

1. *hachœ̄chit*, the same as later *hichœ̄chit*, *hāchit*, is sometimes pronounced with *s* for *h* (*sachœchit*, etc.); the majority, however, is said to repudiate this as incorrect; for *œ* compare notes to Salegseg phonetics in the introduction.

2. *issán*, expressing unwillingness, adverbial to *itchən;* past *inissan.* *itchən*, one to whom is given, past *initchən*; *mangitód* one who gives.

5. Se ɗœyug ummói sichit ɗoʎoi Lumāwig ta ina chong-ʎon chit nang-aʎ-an ud Lumāwig set apōngot-ta namɗœ̄yədnat chet pillák-ka inōtangnat chœ̄chit úchūm-ma tákū.

5. Si Bayug went to the house of Lumawig in order to inquire about the place where Lumawig got the beads with which he paid the money he borrowed from the other people.

6. Ot imusón man ɗœyug kan Lumāwig: "Sinnot nang-aʎ-am chit apōngot-ta nam ɗœ̄yədnot chœ̄chit pillák-ka inōtangnot chœ̄chit úchūm-ma tákū?" kanán man ɗœyug.

6. Then Bayug asked of Lumawig: "From whom did you get the beads with which you paid the moneys you borrowed from the other people?" said Bayug.

7. Ken-āwat Lumāwig: "Ot uāk; no piœom umói ka ichəʎom kan kuphín-nachól." Ot ummói ɗœyug inchəʎom sichit kuphín-nachól chet apōngot-ta inākau Lumāwig ot Se Kuphín-nachól ina impa-āʎa chet nanākau chœ̄chit pōlis.

7. Lumawig replied: "They are mine; if you like go and report it to the governor." And Bayug reported to the governor the beads stolen by Lumawig and the governor ordered the police to arrest the thief.

8. Isaaʎ man chœ̄chit pōlis Se Lumāwig sinumāʎan chet kuphín-nachól ot nampudnu Se Lumāwig kan kuphín-nachól-la: "Sākón chit nangākau set apōngot chœ ɗœyug." Ot impa-ichœʎan kuphín-nachól Se Lumāwig se chœ̄chit pōlis ud Pfuntok ot innígkœ̄chœ chet kansél.

8. Si Lumawig was brought by the police to be examined by the governor and he confessed to the governor (saying:) "I am the thief of the beads of the Bayug people." And the governor caused Si Lumawig to be conducted by the police to Bontoc and they put him into jail.

3. *imusón* what is asked for, past *inimús*.
kotnat probably contracted from *ko* my and *sanat* that.

4. *inākau*, past of *akáwon* object of stealing.
chœ ɗœyúg (Ilk. *da Bayug*) the Bayug family, the Bayugs.
im ɗœ̄yəd, past of *iɗœ̄yəd*, means of paying.

5. *nang-aʎ-an*, past of *mang-aʎ-an* place where, or person from whom, something is obtained; *Si Pedro mang-aʎ-ak si taɗœko* Pedro is my purveyor for tobacco.
namɗœ̄yədnat, final *t* is an enclitic form of *si* (*hi*), likewise in following *inōtangnat*.

6. *sinnot* from *sinno si*.
namɗœ̄ʎədnot, the possessive suffix of the second person singular is *no*, not *mo*.

7. *uāk* from *uá* property + *ko* mine.

9. Ot maʎakpús man osán chəkūn sinumāʎan koēs Se Lumāwig ot nakuœ̄ chet lasón Lumāwig ot impaʎūpfus koēs. Ot imdœ̄kən Lumāwig kan koēs-sa achí man-ākau paī-yən ot ken-áwat koēs-sa: "No man-ākau-ka paí-yən ikansélme paī-yən seka ingkœnat matói-ka." Ot kaʎsán Se Lumāwig set ílina.

10. Ot in-kāu man set ílina nan-ākau paī-yən ot mangwœ̄ mat kapitán chœt Ilemus īna inchəʎom Se Lumāwig ot pinaɐʎa kuphín-nachól Se Lumāwig hichœ̄chit pōlis ot chumatóng man Se Lumāwig sinōmāʎən chet kuphín-nachól ot masulít manón nampudno Se Lumāwig ot kanānan: "Ŏn, nan-ākawák" ot painnigkən kuphín-nachól Se Lumāwig set đoʎoi chœ̄chit suʎchœcho ot imđœkœn chet kuphín-nachól no chuən pō-ʎon aʎaʎkau ichœʎanchœ ud Pfuntok.

9. When one year had passed he was examined by the judge and he gave explanations and was set free by the judge. And Lumawig told the judge that he would not steal again and the judge replied: "If you steal again we shall put you into prison until you die." And Si Lumawig went away to his town.

10. And when he found himself in his town he stole again and the capitan of the people of Lemus decided to go and report Lumawig and the governor caused the police to arrest him and when he arrived he was examined by the governor and by and by Si Lumawig confessed and said: "Yes, I have stolen," and the governor ordered him put into the house of the constabulary and the governor said that after twenty days he be conducted by them to Bontoc.

8. *sinumāʎa*, past of *sumāʎa*, very probably from Span. *sumária* first examination in court.
impa-ichœʎan, past of *pa-ichœʎan*, cf. *ichāyan* in notes to sect. 9 of The Eagle and the Child.
Pfuntok, for a number of years after the advent of the American régime, the Kalinga towns whose speech is here recorded formed part of the present subprovince of Bontoc.
innígkœ, past of *igkœ* what is put into something.
kansél, from Span. *cárcel* jail.

9. *chə́kūn* year, Iban. *dagun;* the above statement is evidently due to an error; the rights of an accused person are well established under American law all over the Islands.
koés, from Span. *juez*, judge.
nakuœ, past of *makuoé* one saying, doing.
lasón, from Span. *razón* reason.
imđœkœ, past of *iđœkœ̄* what is told; cf. *iphyaká* in Bal.

11. Ot osán laphí man kanán Lumāwig-kœ: "Iyak umispfō" ot in-kauchœ man set lasín inā-yan Lumāwig chet ɗœchœ̄ng-ngot songpātonat takʎai chet suʎchœcho. Ot mangwœ̄ mat suʎchœcho inchongpaʎnat ɗœ-yonēta set pfūáng Lumāwig ot natói.

11. And one night Lumawig said: "I go to make water," and when they were outside Lumawig took a bolo (cleaver) and cut into the arm of the soldier. And the soldier responded by sticking his bayonet into the stomach of Lumawig who died.

12. Ot mangwœ̄ man chœ̄chit pfuyón Lumāwig ichœ innāya lachoégna ot inchœʎanchœt chit ílichœ ot pa-īsan chœt Lumāwig se chuən pfuoʎ-ʎok. Lummáus mat chuən aʎ-aʎkau in-nilɗon chœt Lumāwig.

12. And the town-mates of Lumawig decided to go and get his body and to transport it to his town and they killed two pigs at his funeral. When two days had passed they buried Lumawig.

GINÁANG

UG-ÚKUDJ CHAT MAN-ÁMA NAGCHAYAN

1. Chat man-aáma tuyu na-pángugcha. Ináikau chi áikau incha man-iwá-ai sit payáu.

2. Sit osán ai-áikau ummoi-cha nan-iwá-ai sit payau-wot íngkāucha pon sit payau um-muchan-not man-iwá-aicha.

3. Sit amācha man-iwá-ai sit tuppíng, sit phuphyā-i man-iwá-ai sit sag-ón-na, sit layá-i man-iwá-ai sit phi-ik.

GINÁANG

THE STORY OF THE FATHER AND CHILD BURIED BY A LANDSLIDE

1. The father and his two children were diligent workers. Day after day they went to work in the rice-field.

2. On a certain day they had gone to work in the rice-field and finding themselves in the field the rain fell, yet they worked on.

3. The father was working near the stone-wall, the daughter (lit. woman) worked by his side, and the son (lit. man) on the other side (of the field).

10. *payən* again, Bal. would use here *umphós*, with same meaning.
mangwœ̄, cf. *mangwá*, in notes to sect. 11 of The Eagle and the Child.
Ilemus the people of the town of Lemus (Limus) on the Saltan east of Saleg-seg.
suʎchœcho from Span. *soldado*, here applied to members of the constabulary.

11. *songpāton* what is cut, past *sinúngpat*.
inchongpaʎ, past of *ichongpaʎ* instrument of sticking into.

12. *pa-īsan* who is made the recipient of the funeral honors consisting in the slaughtering of two pigs; the souls of the animals are supposed to accompany the deceased who is thus appeased and kept from making trouble for his bereaved friends.

4. Sat man-iwa-áyancha in-íngkāu ngas-ngās-sa nataknáng ot mangwá mat ūchan pina-chagson-nat pīta ot magchái chit ngas-ngās ot matab-ūnan-cha.

5. Ot sit layá-i chingngoi chit nagchaí-yot mantuwíli pon si-chát amāna an sunúdna naid-cha pon ot ummói pon umacha-ní nagchayáncha ot man-īphil ot chongyon man chat uchūm-ma tákū inī-moscha an siya.

6. Ot iphyakānan nagchayán chat amāna an sunúdna ot sit tákūn na-ngimús nampaói ot umāli chat tákū sit ili. Ot chummatóng man chat tákū an-nan maniíyung chit layá-i.

7. Ot phya-úngancha ot ayán-cha chichá. Ot ayancha man chichá natákucha. Ot phulí-kancha phuphyā-i ya amāna sit phuphōyoi.

4. At the place where (the former two) were working there was a steep slope which was very high, and as the rain had made the soil heavy, the slope collapsed and buried them.

5. When the son heard the slide he turned to look for his father and sister who were no more there and he went to approach those who were buried and he cried and he was heard by the other people who asked him.

6. And he told them that his father and sister were buried and the people who had asked shouted and the people from the town came. And when the people arrived there was the son crying.

7. And they dug for them and got them. And when they got them they were alive. And they carried the woman and her father to the town.

Title. *man-áma* a term used to designate a group consisting of a father and his child; if there are two or more children *man-aáma* is said; note added *tuyu*, three, indicating the number of persons comprehended in the group. (Sect. 1)

inagchayán, past of *magchayán* who is caught in a landslide.

1. *incha* went-they, past of *icha* go-they.
inaikau, the second *i* is the sound represented by *ʎ* in Sal.
2. *ummúchan*, past of *umúchan* it rains.
3. *tuppíng* the stone-wall supporting the next higher rice-terrace.
sag-ón, cf. *sog-ón* in note to sect. 11 of story of Si Alugan.
4. *pinachagsón*, past of *pachagsonón* what is becoming heavy.
pīta earth, soil.
magchái what collapses, past *nagchái*.
5. *naidcha pon: naidcha* not-there-they, *pon* seems to be added to make the statement more impressive after the manner of Ilk. *met.*
an siya to him, compare *kan sía* in sect. 3 of Changatag and the Monkeys.

8. Ot chat uchūm-ma iníng-kāu sit ili áncha gai-ya: "Patói!" Ot naámmin chat tákū ummói sit nagchayán.

8. And the others who had stayed in the town just said: "Killed!", and all the people went to (see) those who had been buried by the landslide.

9. Ot imūsóncha pon: "Phoómpon si patói?"—yot ipa-áu-áscha gai ilán chit nagchayán. Ot sit amácha na-alīwong-ngot man-u-úkudj chat apingsan-na ot patoyónchat opāt-ta phoyōk ta isichán chat tákūn nanchat-chatóng.

9. And they asked: "Not killed?" and passed on just to have a look at those buried by the landslide. And the father was sick and his cousins talked together and they killed four pigs for food of the people who had arrived.

10. Ot nagamputcha pon nángan aisáncha. Ot naánai liman phuyan pon naíd chit mansīkab sichat nagchayán.

10. And when they had finished eating they went away. And it took five months to cure the pains of those buried under the landslide.

11. Ot ilapōcha paiyan-nat ináikau chi áikau man-iwá-ay tai pia-ónchat chit magamput chit payáu ta asíyot matói chit mayong-ág.

11. And they again began to work day by day for they wanted to finish the rice-field before the old man died.

12. Ot chuan phuyan chit is-sāpon man-íllong chit amá. Na-alīwong si opāt-ta phuyan ot matói. Ot man-u-úkūdchat a-pingsan-na ot patoyónchat opāt-ta luang ta isichánchat tákū-wot chuan ai-áikau pon inilphoncha ot mangwácha si phoyoi sit lap-át chit lophón.

12. And for two months the father did not take a rest. He was in bad health for four months and then he died. And his cousins talked together and killed four water-buffaloes as food for the people and after two days they buried him and made a house over his grave.

6. *sunúd* brother or sister.
anna, probably a deictic expression similar in force to French *voilà*.

7. *phulíkan*, past *phinulíkan*, compare Ilk. *bulígan* what is carried between two.

8. *áncha gai* said-they just, cf. Ilk. *konada laeng;* Gin. *áncha* = Bal. *káncha*. *ya* after *gai* is connective particle *a* plus consonantal initial drawn over from *gai*.

9. *isichán* any boiled food taken with rice; preferentially meat.

10. *nagamput* or *nagangput* finished; pronounce *na-gamput*.
naánai was said to be the past of *umánai* what is sufficient.

11. *pia-ón* object of liking, past *pinía*.
mayong-ág old man; the *y* of this word is the sound represented in Sal. by *ʎ*.

13. Ot sit asāwan chit natói issāpon lumāwa si simphūyan. Ot sit payáu chit natói nampayáu chit anákna.

13. And the wife of the dead man did not go out for one month. And the rice-field of the deceased became the rice-field of his children.

TINGGIAN (ITNEG) OF ABRA (PEÑARUBIA)

MEPANGGEB TA ITNEG DI ABRA

1. Ítnœg ta kasigúdan na tā-o di Abra. Dad kōdil dangi kiū-ti kan dad búok dangi atáddo kan nangísit.

2. Daddi babāi-yē agikkuāda ta batek aglikmót kandi ulo, ima kan daddi tengnged dangi; ket daddi lalāki-ē agikkuāda ta ayābong aglikmót kandi ulo dangi, kan barikœs kan baál aglikmót kandi sikœt dangi kan agsaklitda ta immoko kandi barikœs dangi.

3. Daddi lugak dangi na-appía nga kāpas ket abuénda payēn daddi lugakda nén. Daddi ayābung dangi ma-appía nga ukes ta mālit-í kāyo.

ABOUT THE ITNEG OF ABRA

1. The Itneg are the original people of Abra. Their skin is brown and their hair is long and black.

2. The women put on beads around their heads, hands, and necks, and the men put a turban around their heads, and a girdle and gee-string around their loins, and they suspend the short bolo from their belts.

3. Their clothes are made of cotton and they weave also their clothes themselves. Their turbans are made of bark of the balete tree.

12. *issāpon man-íllong* did not rest; it appears that while Gin. uses *issá* as a negative particle in connection with verbal forms (*issáak pon man-íllong* I do not rest, *issacha pon lumāwa* they do not go out), Bal. uses instead *achi* (almost *adzi*): *umachik, umachika, umachina umillong* I do not, thou doest not, he does not rest; in Sal. texts we find: *achina makākuə* he could not walk, and *issánchœ itchən* would not feed.

phoyoi sit lap-át chit lophón, this probably ritualistic structure is known by the special term *bagong* and was said to be destined to protect the grave against rain.

1. *kasigúdan* origin, beginning, birth, thus *kasigúdan na tā-o* may also mean "native people."

2. *agikkuāda* put-they, compare Ilk. *ikuá* what is put in some place.

baál gee-string, Ilk. *baág*.

sikœt loins; the mixed vowel in this word, as in *Ítnœg, barikœs*, is short and similar to the one in French *neuf;* when long, it resembles *eu* in French *peur*.

4. Agyanda ta ābong nga na-appía nga kāyo, kawayan, kan gōlon. Unnég nid ābong dangi oad ta kál-ang nga na-appía nga lota. Ket sidiœ nga kál-ang uad ta ta-lo a úlona nga nagsa-sángo kœt dublēna ta agtuga-wāna nidi bangá-ngœ.

5. Ket no bolan ta ukop, kíang kan ladau aga-apoida kandí dud-duagan dangi kœt aga-anīdoda œdœng ta adí lum-tau di init-tē. Ket agtotogau-da kandí likmót nidi apoi-yē.

6. Kœt no madátngan ta bo-lan ta manabá mangrugída nga aguangœl kandi kab-kabasáan danín. Kœt daddi lalāki-yē daida ta agarado kan agpailid; kœt daddi babāi-yē daida ta agoto ta kánenda kœt mapánda ibaōnanda dad asawa dangi no mamatóon. Kœt no malpás ta panagróeœp ta págei daddi ba-bāi-yē agabōda ta lugak kœn ōwœs. Kœt daddi mœt lalāki-yē mapánda agayoan ta nūang, baka, kabāyo, kan īyas.

4. Their dwellings are houses built of wood, bamboo, and cogon grass. Inside of their houses there is a fire-pot made of clay. And that fire-pot has three heads which bend toward each other and this is the sitting-place of the cooking-pot.

5. And during the months of December, January, and February they will make fire in front of the houses and warm themselves while the sun does not rise. And they are sitting round the fire.

6. And when there has arrived the month of May they begin to work in their irrigated rice-fields. And the men they plow and harrow, and the women they cook their food and they go to provide their husbands with food at noon-time. And when the planting of the rice is finished, the women weave clothes and blankets. And also the men go to take care of the buffaloes, cows, horses, and pigs.

4. *unnég nid,* also *unnég nidi* is said.
kál-ang, Tag. *kalán* the typical Philippine utensil, consisting in a heavy, wide-open, flat fire-pot of clay on the flat floor of which the fire is kindled and on whose upper rim three projecting points are bent inward so as to serve as supports for the superimposed cooking-pot.

5. *dud-duagan,* cf. Ilk. *duag* roof over entrance to house.

7. Kœt no madátngan ta panaglaāni, nga dublēna ta bolan ta ukop, agkakalsōda, daddi babāi-yē nga mapánda aglaāni; kœt daddi mœt lalāki-yē daida ta agbetek kan agbónag-ga agyódong kadad pāgei-yē.

7. And when comes the time for harvesting the rice, which is the month of December, they go to the fields, the women in order to cut rice, and the men, on their part, they bundle and go to and fro carrying home that rice.

8. Kœt no malpás ta laāni ikuāda daddi pagei dangi kandi báang dangi ta sannon malāngo. Kœt no malāngo di pāgei nin, ipasakáida kandi ālang danín.

8. And when the cutting of rice is finished they put the rice in stacks in order to dry. And if the rice is dry they lift it up into their granaries.

9. Kœt kalpásan datoe nga maappía rugīandan ta agappía kadādi an-ánnongda nga annáwid. Kœt no oad ta masakít kadaida agbaláwada oenno agpal-lāanda ta sannon malaíngan di masakít-tē oenno pakawanēna nidi nangkaro dóbli nangi.

9. And after this work they begin to make their ceremonies which are customary. And if there is a sick person among them, they have the ceremony called "balawa" or the lesser ceremony called "pal-lāan," so that thus may get well the sick person, or that he may be freed from his malady (by the grace of him who caused it through his evil influence).

10. Ket dato Itnœg-ē naggagítda mœt nga aguangœl. Nalaéngda mœt nga agibaón kadaddi anak dangi nga agadal.

10. And the Itneg are also industrious as workers. They are likewise intelligent enough to send their children to study.

11. Adū pai lāmeng ta annáwid ta Itnœg. Nœm adiák mībaga nga lisán itá.

11. Many more yet are the habitual occupations of the Itneg. But I cannot relate them all now.

The personal and possessive pronouns in Tinggian, Balbalásang, Salegseg, and Ginâang.

PERSONAL PRONOUNS IN INDEPENDENT AND POSTPOSITIVE FORM.

	Tinggian.	Balbalá-sang.	Salegseg.	Ginâang.
Singular.				
First person	diaken, -ak	sakon, -ak	siak, -ak	sa-on, -ak
Second person	dika, -ka	seka, -ka	seka, -ka	si-a, -a
Third person	(dublina)	siya	siya	siya
Plural.				
First person inclusive	ditai, -tayo	chitako, -tako		chita-o, -ta-o
First person exclusive	dikame, -kame	chakame, -kame		chi-ame, -ame
First person dual	ditá, -ta	chitá, -ta		(si-a sa-on) -ta
Second person	dikayó, -kayó	chakayó, -kayó		chi-ayú, -ayú
Third person	daida, -da	chichá, -cha		chichá, -cha

POSSESSIVE SUFFIXES.

	Tinggian.	Balbalá-sang.	Salegseg.	Ginâang.
Singular.				
First person	ko, -k	ko, -k		o, -k
Second person	mo, -m	no, -m		no, -m
Third person	na	na		na
Plural.				
First person inclusive	tayó	tako		ta-o
First person exclusive	mi	me		me
First person dual	ta	ta		ta
Second person	yo	yo		yu
Third person	da	cha		cha

ILLUSTRATION

NOTES ON JAPANESE LEPIDOPTERA AND THEIR LARVÆ: PART VI *

By A. E. WILEMAN

Of Dorking, England

TWO COLORED PLATES

HETEROCERA

SATURNIADÆ

Genus SAMIA Hübner

Samia cynthia Drury.

Plate 1, fig. 1, larva, third ? stage; fig. 2, larva, fourth ? stage; figs. 3 and 4, larva, fifth ? stage, dorsal and lateral aspects; fig. 5, larva, sixth ? stage; fig. 5*a*, food plant. Larva of *Samia pryeri*.

Japanese names: *Shinju-san; aya-nishiki; mikazuki.*

Phalæna cynthia DRURY, Ill. Exot. Ent. 2 (1773) pl. 6, fig. 2; KIRBY, Cat. Lep. Het. (1892) 748; LEECH, Proc. Zool. Soc. London (1888) 634, No. 255; Trans. Ent. Soc. London (1898) 264, No. 4; HAMPSON, Moths Brit. India 1 (1892) 16; MOORE, Lep. East. Ind. Co. (1859) pl. 20, figs. 3, 3*a;* NAWA, Insect World (Konchū Sekai) 10 (1906) 366, pl. 9, larva, pupa, imago ♂; MATSUMURA, Cat. Insect. Japan (1905) 47, No. 383; Thousand Insects of Japan [Nihon Senchu Dzukai (Jap.)] (1909) suppl. 1, 40, No. 65, pl. 6, fig. 1, ♂; JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 212.

Attacus walkeri FELDER, Wien. Ent. Mon. 6 (1862) 34; Jordan, Seitz's Macrolep. Faun. Pal. 2 (1911) 212.

Attacus pryeri BUTLER, Proc. Zool. Soc. London (1878) 388; Ill. Typ. Lep. Het. 3 (1879) pl. 43, fig. 5; PRYER, Trans. Asiat. Soc. Japan 12 (1883) 53, No. 196; SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 3, 74, pl. 198, larva, cocoon, imago ♀; JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 213, pl. 33, fig. a, ♂.

Jordan [1] describes the larvæ and pupæ of the genus *Samia* as follows:

> Larvæ powdered with white; with six rows of fleshy thorns, which bear sparse bristles, the dorsal processes longer than the lateral ones in the earlier stages, later on the difference smaller. Cocoon long, pointed at both ends, usually wrapped up in a large or several small leaves. Pupa without bristles at the anal end.

* The editors have been unable to verify the quotations in this article.

[1] Seitz's Macrolep. Faun. Pal. 2 (1911) 212.

180732——6

Two species, one of which is confined to India while the other occurs from Japan to India and eastward to the Sula Islands, and is also acclimatised in several localities in Europe and North America.

Jordan describes the larva of *Samia cynthia* Drury as follows:

Larva at first yellowish, then white or greenish or bluish green, with black dots; the dorsal processes in the later stages about as long as the distance between two dorsal processes of the same segment; the processes of the different segments almost equal, bluish. Polyphagous, chief food-plants: Ailanthus, Ilex, etc.; prefers Syringa in Europe, but also takes Prunus, Pirus, Laburnum, and other plants. The cocoon consists of an outer layer of loose silk and an inner dense web. The silk, from which a very tough cloth is made, cannot be reeled, but is carded and then spun. It is coarse and not valuable for export. True cynthia Drury is confined to the Malayan districts. On Palearctic territory two forms are found: pryeri Butl. (33a) inhabits Japan. The proximal band of the forewing more or less convex posteriorly, without long teeth on the median veins, the discal band twice deeply incurved, only faintly reddish outside the white line, at least the red line is never sharply defined; on the hindwing the discal band is deeply incurved below the half moon. The cocoon is grey or yellowish white. The larvæ (tscho-san) are found especially on Ilex rotunda,[2] Ailanthus glandulosa and Phellodendron amurense.[3] The specimens from North and Central China, walkeri Fldr., are distinguished from pryeri by the discal band of both wings having a sharper outer edge and by the long median teeth of the proximal band of the forewing. This form goes northward to Manchuria and Corea, and is much kept domesticated for the sake of its silk, e. g. in the provinces of Shantung and Chekiang. This form was introduced into Europe in 1845 and has been domesticated in France with some success. In the Northern districts the species has only one brood, in the Southern countries several broods in a year. The second species of the genus, S. lunula Walk., is likewise easy to breed, and crosses between it and S. cynthia are also known.

Jordan gives the name *tscho-san* to the larva of *pryeri*. I have never heard this name. "Tscho" is certainly not Japanese but may be Chinese and probably refers to *walkeri* Felder, which occurs in China. The imago is known under the Japanese names of *shinju-san* (which name is probably given because the larva feeds on *shinju*), *aya-nishiki*, and *mikazuki*, "new moon," referring to the crescent on the wings.

The larva of *Samia pryeri* Butler is figured in what I believe to be the third, fourth, fifth, and sixth stages (Plate 1, figs. 1 to 5). A brood of young larvæ was taken about September 15, 1900, at Kobe, Settsu Province, Honshu, on *kusagi* (*Clerodendron tricotomum* Thunb.), one of which was selected to be

[2] *Ilex rotunda*, named in Japanese *fukura-shiba* and *kurogane-mochi*.

[3] *Phellodendron amurense*, named in Japanese *kiwada*.

figured in its various stages. This larva was figured in the third ? stage (Plate 1, fig.1), on September 19; in the fourth ? stage (Plate 1, fig. 2), on October 1; in the fifth ? stage (Plate 1, fig. 3, lateral aspect; fig. 4, dorsal aspect), on October 9; in the sixth ? stage, when it measured 66 millimeters in length, on October 26, 1900 (Plate 1, fig. 5). This larva and the rest of the brood were nearly all full-grown by October 26, but they all failed to develop imagoes after pupation as they were infested by the larvæ of an ichneumon fly. Several specimens of this fly emerged from the cocoons of *Samia pryeri* in April, 1901, and another emerged on June 27, 1901.[4]

A male imago was bred from a larva of *Samia pryeri* taken at Yoshino, Yamato Province, Honshu. This larva pupated in October, 1900, and the imago emerged on June 15, 1901. I also bred a specimen at Kobe, Settsu Province, Honshu, in August, 1901. Other food plants of the larva are maple, *momiji* (*Acer palmatum* Thunb.), and plantain, *bashō* (*Musa basjoo* Sieb.).

Nawa gives the following notes on *Attacus cynthia* Drury:

> The larva[5] feeds upon *shinju* [*Ailanthus glandulosa* Desf.]; *nurude* [*Rhus semialata* Murr. var. *osbeckii* DC.]; *konzui* [Latin name unknown, not given by Matsumura in his Shokubutsu Mei-i]. The body, head and ventrum are pale yellow; pale indigo, fleshy tubercles on each segment which are clothed with a white flourlike substance.
>
> The larva and the imago appear twice in the year. The first brood of the imago emerges about June or July, the second brood about September, or October. The larvæ which emerge from the second brood, when full grown, spin their cocoons and hibernate in the pupal stage, the imago emerging at the commencement of the following summer, when the ova are then deposited.

I find that in the final stage of the larva the white powder on the tubercles disappears. It seems to appear after the third ? stage when the larva turns from yellow to white.

Sasaki[6] gives descriptions and figures of the larva, cocoon, and imago of *Attacus pryeri* Butler (*Attacus cynthia* Drury) and a short record of its life history. He says:

> The larvæ emerge from the ova about middle or end of June, and are full-grown by the end of July. The imago emerges about the commencement of August and deposits ova which hatch in about three weeks at

[4] This ichneumon fly has been identified by Claude Morley, Entomologist 43 (1910) 11, as *Pimpla luctuosa* Smith, Trans. Ent. Soc. London (1874) 394.

[5] The larva figured by Nawa measures 72 millimeters.

[6] Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 3, 74, pl. 198.

the end of September when the second brood of larvæ appear. These larvæ are full grown by the end of October when they pupate and hibernate in the pupal stage, their imagoes emerging at the commencement of June of the following year. The ova deposited by these imagoes generally hatch in eight or nine days.

Pupa.—The pupa is contained in an elongated, brown cocoon, broad at the bottom and tapering above, which is made of extremely tough silk. It is suspended by a long, tough silken fiber to the bough of a tree, somewhat in the same manner as the cocoon of *Rhodinia fugax* Butler.

Local distribution.—Honshu, Musashi Province, Yokohama, July (*Pryer*): Musashi Province, Tokyo, July and August (*Wileman*). Kyushu (recorded by Leech, and my collector has gathered cocoons there). Matsumura records the species from Honshu, Shikoku, and Kyushu.

Time of appearance.—Larva, June to July, September to October; imago, June to October.

General distribution.—*Samia cynthia,* Malayan districts; *S. pryeri,* Japan; *S. walkeri,* northern and central China, Manchuria, Korea. (*Jordan.*)

Genus RHODINIA Staudinger

Rhodia MOORE, Proc. Zool. Soc. London (1872) 578 (nom. præocc.).
Rhodinia STAUDINGER, Rom. Mém. Lép. **6** (1892) 327.

Rhodinia fugax Butler.

Plate 1, fig. 6, larva, fifth ? stage; fig. 7, larva, sixth ? stage; fig. 8, paired dorsal tubercles on segment 4; fig. 9, tubercles on segments 11 and 12.

Japanese names: *Usutabi-ga, yama-bishaku, yama-kamasu, ajima-nishiki, yama-biku.*

Rhodia fugax BUTLER, Ann. & Mag. Nat. Hist. IV **20** (1877) 480; Ill. Typ. Lep. Het. **2** (1878) 17, pl. 26, fig. 1, ♂; PRYER, Trans. Asiat. Soc. Japan **12** (1883) 52, No. 193; LEECH, Proc. Zool. Soc. London (1888) 633, No. 251; STAUDINGER, Rom. Mém. Lép. **6** (1892) 327; LEECH, Trans. Ent. Soc. London (1898) 268, No. 13; STAUDINGER and REBEL, Cat. Lep. Pal. **1** (1901) 126, No. 1027; MATSUMURA, Cat. Insect. Jap. **1** (1905) 47, No. 386; NAWA, Insect World [Konchū Sekai (Jap.)] **10** (1906) 277, pl. 8, larva, pupa, imago ♀; MATSUMURA, Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909) suppl. 1, 41, No. 66, fig. 2, ♂; SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 2, 43, pl. 95, ova, larva, pupa, cocoon, imago ♂; JORDAN, Seitz's Macrolep. Faun. Pal. **2** (1911) 213, pl. 34, *c*, ♂, ♀; WILEMAN, Trans. Ent. Soc. London (1911) 344, No. 327.

Saturnia diana OBERTHÜR, Bull. Soc. Ent. France VI **6** (1886) 47; STAUDINGER and REBEL, Cat. Lep. Pal. **1** (1901) 126, No. 1027*a;* JORDAN, Seitz's Macrolep. Faun. Pal. **2** (1911) 213, pl. 34, *c*, ♂, ♀.

The larva figured (Plate 1, figs. 6 and 7) was taken in May, 1901, at Hiyeizan, near Kyoto, Yamashiro Province, Honshu, on dwarf oak (*Quercus serrata* Thunb.), Japanese name *kunugi*. It was figured on May 29 after its fourth ? molt (Plate 1, fig. 6) and again on June 23 after its fifth ? molt (Plate 1, fig. 7). It pupated on June 27, and a male imago emerged, which I identified at the South Kensington Museum as a dark form of *Rhodinia fugax* Butler.

Nawa [7] records the life history of *R. fugax* Butler and gives a figure of the larva after its sixth molt, of its pendant cocoon, and of the female imago.

Sasaki [8] also gives descriptions and figures of the ova, larva, pupa, cocoon, and male imago. He says that—

> * * * the larvæ emerge from their ova at the end of April and feed upon dwarf oak, nara [*Quercus glandulifera* Bl.] and dwarf oak *kunugi* [*Quercus serrata* Thunb.]. They are full-grown by the end of June and the imagoes emerge at the end of October or commencement of November when the female oviposits.

Jordan [9] describes the larva, cocoon, and pupa of the genus *Rhodinia* as follows:

> Larva almost naked, granulose, the six warts of the prothorax separated, but the two dorsal ones close together, the dorsal warts of the metathorax the largest, segment 11 with one dorsal wart instead of 2. Cocoon egg-shaped, but truncate at the upper end, and attached to a leaf or slender twig on one side so that the cocoon appears stalked at one corner (pitcher-like), dense, without outer loose silk. Pupa attached by the hooked bristles, which are placed close together, to a loosely woven transverse wall, which stands close to the apex of the cocoon. The full-grown larva as well as the pupa makes a loud chirping noise when disturbed. Distributed from the Himalayas to Amurland and Japan.

The following description given by Nawa of the larva of *Rhodinia fugax* in its various stages has been translated by me from the Japanese text:

On emergence from the ovum.—The head and segment 1 black; segment 2 and all the others light yellow; a black mediodorsal line; body clothed with black hairs.

Three or four hours after emergence from ovum.—The dorsum becomes almost entirely black; laterally yellow.

After first molt.—The larva becomes yellow below the subdorsal line; black-haired tubercles appear on the body.

[7] Insect World (Konchū Sekai) **10** (1906) 277, pl. 8.

[8] Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 2, 43, pl. 95.

[9] Seitz's Macrolep. 2 (1911) 213.

After second molt.—The black dorsal area becomes yellow, and the lateral yellow becomes black; the tubercles which have greatly increased in length are arranged as follows: Segments 1 and 12, four tubercles each; segments 2 and 11, six tubercles each; segment 3, two dorsal tubercles; segment 11, one dorsal tubercle; below the spiracles on segments 2 and 11 the tubercles are blue, each emitting four or five black spines.

After third molt.—The whole body becomes pale yellowish green and occasionally there is a black lateral stripe.

After fourth molt.—There is no change whatever.

After fifth molt.—The larva loses all the long spined tubercles, with the exception of the two dorsal tubercles on segment 3 and the one dorsal tubercle on segment 11. At this stage the larva, when alarmed at any thing, makes a noise something like the sound of "chū."

After sixth molt.—When full grown the larva is greenish yellow; ventrum bluish green; a subspiracular stripe above which there is on each segment one small blue tubercle; two longer dorsal tubercles on segment 3, the mediodorsal shorter tubercle on segment 11 still remains; the posterior margin of all segments paler in color; on the dorsum and body there are minute warts. When full grown it spins a green cocoon the upper end of which has a hole which seems as if it had been cut out in a circle; the cocoon is suspended by a thread attached to its upper angle and hangs down from the branch. The larva emerges from the ovum in April and feeds on *nara*, [dwarf oak (*Quercus glandulifera* Blume)]; *kunugi*, [dwarf oak (*Quercus serrata* Thunb.)]; *kuri*, [chestnut (*Castanea vulgaris* Lam. var. *japonica* DC.)]; *kashi* [*Quercus acuta* Thunb.].

It pupates at the end of June or beginning of July, and the imago emerges in October or November. The female deposits its eggs on the twigs of the tree or on the cocoon and they hatch in April as previously stated. The imago is single-brooded.

The larva as figured by Nawa measures about 87 millimeters. According to Matsumura it also feeds on *keyaki* (*Zelkowa acuminata* Lindl.) and *kashiwa* (*Quercus dentata* Thunb.). Pryer gives cherry and other trees. Jordan gives *Phellodendron* which, if it be the same as the Japanese species (*Phellodendron amurense* Rupr.), is called *kiwada*.

The following description of the larva is taken from my original figures:

After fourth ? molt.—Plate 1, fig. 6; figured, May 29. Length, 54 millimeters. Head light green; body apple green; ventrum, all legs, prolegs, and claspers darker green, speckled with minute yellowish spots; spiracles brownish; a yellowish white, subspiracular line; paired, spinous, dorsal tubercles on segments 2 to 13, those on segment 2 (next to the head) being blue; the tubercles on segments 4 and 12 are longer and more prominent than the rest; a spined, midlateral, blue tubercle on segment 2; a series of subspiracular, spined, blue tubercles on each segment from 2 to 12; two, spined, blue tubercles on the anal segment 13, above the subspiracular series; one spined, blue tubercle above each thoracic leg, below the subspiracular series; all the spined tubercles of segment 2, those of the anus, those of the subspiracular series, and those above the thoracic legs are blue; all the rest are green.

After fifth molt.—Plate 1, fig. 7, figured, June 13. Length, 64 millimeters. Segment 2 edged with yellow; body and head lighter in color, inclining to greenish yellow; ventrum as before; subspiracular line not so prominent; all the spined tubercles have disappeared with the following exceptions: There still remain long, spineless, paired tubercles on segment 4 and a single, shorter, spineless tubercle on segment 12; also the subspiracular series is represented by a spineless blue wart on each segment from 2 to 12 and by similar spineless, blue warts above each of the three thoracic legs. The dorsal and anal series of spined tubercles, which have disappeared, are represented by small yellow warts. My original figure of the larva agrees with those given by Nawa and Sasaki.

Cocoon.—The large, thick-ribbed, yellowish green cocoon, shaped, as Staudinger observes, something like a pitcher, is suspended from the twig of a tree by a stout silken thread, which Staudinger says measures from 10 to 30 millimeters in length. There is a hole at the bottom of the cocoon; and the top, which is slit longitudinally, opens to pressure. It mimics a pendant leaf, and when the leaves have fallen from the trees in winter it is quite a conspicuous object, easily perceived by any person walking through the woods. The larva and the pupa, as also stated by Jordan and Nawa, make a chirping noise, which somewhat resembles the creaking of a bough; and the sound made by the pupa, so I am informed, can be distinctly heard at some little distance even in the woods. It makes this sound on being touched, but it also appears to make it of its own accord, when suspended by its cocoon in the woods.

The Japanese names given to this moth are based upon the shape of the cocoon: *Yama-bishaku*, or mountain ladle; *yama-kamasu*, or mountain straw bag; *yama-biku*, or mountain basket.

Local distribution.—Honshu, Musashi Province, Yokohama, November and December (*Pryer*): Musashi Province, Tokyo, taken and bred in October and November (*Wileman*): Settsu Province, Kobe, bred in October (*Wileman*). Matsumura records the species from Hokkaido and Honshu.

Time of appearance.—Ovum, April; larva, April, May, and June; pupa, June and July; imago, October, November, and December. Single-brooded.

General distribution.—Japan; eastern Siberia (Amurland, Ussuri, Suifun, Vladivostok, Askold). (*Jordan.*)

The type of *Rhodinia fugax,* a male in the British Museum collection, is from Yokohama. (*Jonas.*)

Genus CALIGULA Moore

Caligula MOORE, Trans. Ent. Soc. London 1 (1862) 321.

Caligula boisduvali Eversmann.

Plate 1, fig. 10, full-grown larva, fifth ? stage; fig. 11, food plant.

Plate 2, fig. 1, young larva, third ? stage; fig. 2, food plant; fig. 3, thoracic segments, dorsal aspect; figs. 4 and 5, median and anal segments, dorsal aspect. Larva of *Caligula jonasi* Butler.

Japanese name, *hime-yama-nai.*

Saturnia boisduvali EVERSMANN, Bull. Mosc. 3 (1846) 83, pl. 1, fig. 1; 7 (1847) pl. 4, fig. 5; HERR-SCHÄFF., Schmett. Eur. 6 (1849) figs. 148–150; OBERTHÜR, Ann. Soc. France (1886) 46 (larva); STAUDINGER, Rom. Mém. Lép. 6 (1892) 325; STAUDINGER and REBEL, Cat. Lep. Pal. 1 (1901) 127, No. 1031; LEECH, Trans. Ent. Soc. London (1898) 265, No. 6; MATSUMURA, Cat. Insect. Jap. (1905) 47, No. 387; Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909) suppl. 1, 41, No. 67, pl. 6, fig. 3, ♀.

Caligula jonasi BUTLER, Ann. & Mag. Nat. Hist. IV 20 (1877) 479; Ill. Typ. Lep. Het. 2 (1878) 16, pl. 25, fig. 2, ♂; LEECH, Proc. Zool. Soc. London (1888) 633, No. 252; STAUDINGER, Rom. Mém. Lép. 6 (1892) 325; KIRBY, Cat. Lep. Het. (1892) 761; STAUDINGER and REBEL, Cat. Lep. Pal. 1 (1901) 127, No. 1031*a;* NAWA, Insect World [Konchū Sekai (Jap.)] 10 (1906) 191, pl. 5, imago ♀; SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 2, 34, pl. 92, larva, pupa, imago; JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 218, pl. 32, *b*, ♂.

Caligula fallax JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 217; pl. 32, *d*, ♀ (as *boisduvali*) (subspecies *jonasi* = Stgr. pt.; *boisduvali* auct. pt.).

Caligula boisduvali JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911 217.

Two larvæ are figured. The young larva (Plate 2, fig. 1) was probably in the third ? stage, but no note was made of this at the time. This larva was taken at Hakodate, Hokkaido (Yezo), in June, 1902 (figured, June 24), on wild pear, *yama-nashi* (*Pirus* sp.).

The full-grown larva (Plate 1, fig. 10) was probably in the fifth ? stage, but no note was made of this at the time. This larva was taken in June, 1901, at Yoshino, Yamato Province, Honshu (figured, June 17), on dwarf oak, *kunugi* (*Quercus serrata* Thunb.). The pupa of this larva died, but I bred other imagoes of *Caligula jonasi* from similar larvæ on September 21, 29, and 30, and October 1, at Hakodate. Pryer states that "the larva feeds on cherry and that it resembles a small Caligula japonica."

Staudinger comments on the larva of *Saturnia boisduvali* Eversm. (? var. *jonasi*), as follows:

> The yellow green (preserved) larvæ are covered with very short, bristly, yellow hairs, with a few, long, dark hairs, especially on the anterior segments. When young they have a broad, black, dorsal stripe with orange warts. They appear to differ a great deal, for Oberthür describes them in Ann. Soc. Fr. (1886), p. XLVI, as "black, with two red dorsal spots." They make a light lattice-like cocoon which resembles those made by the larvæ of *Saturnia caecigena*, with which they have some resemblance, and the moth appears, as in the case of *caecigena*, in autumn (September).

The six, paired, dorsal spots of my young larva of *Caligula jonasi* are red as described by Oberthür, not orange as described by Staudinger,[10] who, possibly, is speaking of the Amurland geographical form, subspecies *fallax* Jordan (not named by Jordan at the time the larva was described by Staudinger).

Nawa [11] states that—

> *Jonasi* hibernates in the ovum stage and the young larva emerges in May. The full-grown larva spins up and pupates, after the fourth ? or fifth ? molt is completed, about the middle of June and the imago emerges about the middle of October, when the female oviposits.
>
> The larva feeds on *nashi*, pear [*Pirus sinensis* Lindl.]; *ume*, plum [*Prunus mume* S. and Z.]; *keyaki* [*Zelkowa acuminata* Lindl.]; *midzuki* [*Cornus macrophylla* Wall]. At first it is black with tubercles on each segment which emit black and gray hairs; legs black; prolegs grayish yellow; when it grows in size the head becomes deep green and the body light green, dorsally tinged with white; the subspiracular line becomes light green; and the ventrum grayish green; spiracles chestnut color; the hairs of the subspiracular series of tubercles very long when full-grown.

Oberthür gives as food plants in Manchuria [? Amurland] *Betula; Prunus; Pirus baccata* Linn. [found and known in Japan as var. *manchurica* Maxim., under the Japanese names of *ko-ringo, beniringo, aka-ringo*]. Sasaki [12] gives descriptions and figures of the young and adult larva, cocoon, and male imago of *Caligula jonasi*. He says:

> The larva emerges about the month of June and feeds upon *ōnara*, oak [*Quercus crispula* Blume]; *gamazumi*, [*Viburnum dilatatum* Thunb.];

[10] Rom. Mém. Lép. 6 (1892) 326.

[11] Insect World (Konchū Sekai) 10 (1906) 191.

[12] Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910), pt. 2, 34, pl. 92.

kurumi, walnut [*Juglans* sp.]. It is full grown between September and October and the imago emerges by the end of October.

I describe the larva from my original figures as follows:

Young larva in third ? stage.—Plate 2, fig. 1. Length, 23 millimeters; light green; a broad diamond-pattern, longitudinal, black dorsal stripe with paired red tubercles emitting short, spinous black hairs on segments 3, 4, 7, 8, 9, and 10 (counting head as segment 1), paired black tubercles, with similar hairs on segments 2, 5, 6, 11, 12, and 13; subspiracular line lighter in color; head pale green, edged with black; spiracles dark; legs dark; prolegs and claspers green.

Larva in fifth ? stage.—Plate 1, fig. 10. Length, 65 millimeters. Body yellowish green, head of a darker shade; dorsum covered with short, bristly, yellow hairs with a few long, darker hairs interspersed amongst them; segmental sutures whitish; spiracles white, encircled with a ring of chestnut brown; subspiracular line yellowish; legs ochraceous; prolegs dark green; claspers yellowish green, with a long black dash at the base.

My original figure of the larva in the third ? stage agrees with that given by Sasaki. Jordan comments on *Caligula boisduvali* as follows:

Larva green, above and below with a black-brown, longitudinal stripe, the warts of both dorsal rows reddish yellow, full-grown without stripes (always ?). On various deciduous trees. Cocoon reticulate. The moth in the autumn. From Lake Baikal to Japan in three geographical forms.

Boisduvali Ersch. [=Eversm.], from Kiachta, Urga and the Kentei Mountains, southward of Lake Baikal * * *.

Fallax [Jordan], subsp. nov. (Jonasi Stgr. pt.; boisduvali auct. pt.) (32d as boisduvali). * * * Distributed from Vladivostok, Askold, Ussuri to the Amur.

Jonasi Butler (32b, d). * * * Japan, on the Main Island, [Honshu] in September. Two nearly full-grown larvae before me have no longitudinal stripe above or below.

Cocoon.—The pupa is enclosed in a cocoon similar to that of *Dictyoploca japonica* but it is smaller and spun with finer mesh. It also resembles, as Pryer observes of the cocoon of *japoncia,* "the wire net in a cartridge."

Local distribution.—Honshu, Musashi Province, Yokohama (*Pryer*): Musashi Province, Tokyo, October and November (*Wileman*): Shinano Province, Oiwake, September and October (*Leech*): Shimotsuke Province, Nikko, September and October (*Leech*). Hokkaido (Yezo), Oshima Province, Hakodate, September and October (*Wileman*). Matsumura records *Saturnia* (*Caligula*) *boisduvali* from Honshu and Hokkaido.

Time of appearance.—Larva, May and June; pupa, June to September; imago, September to November; ovum, November to May.

General distribution.—From Lake Baikal to Japan. (*Jordan*).

Genus DICTYOPLOCA Jordan

Dictyoploca JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 218.

Dictyoploca japonica Butler.

Plate 2, fig. 6, full-grown larva.

Japanese names: *Kuso-san, tegusu-ga, kuri-kemushi, tsuzuri-no-nishiki, shiragata-rō, kurimushi-ga.*

Caligula japonica MOORE, Trans. Ent. Soc. London (1862) 322 (pupa case) (*regina* Stgr.); BUTLER, Ann. & Mag. Nat. Hist. IV **20** (1877) 479; Ill. Typ. Lep. Het. 2 (1878) 16, pl. 26, fig. 2, ♂; PRYER, Trans. Asiat. Soc. Japan **12** (1883) 52, No. 191; OBERTHÜR, Ann. Soc. Ent. France (1886) 48, larva; LEECH, Proc. Zool. Soc. London (1888) 633, No. 253; STAUDINGER, Rom. Mém. Lép. **6** (1892) 328; LEECH, Trans. Ent. Soc. London (1898) 264, No. 5; MATSUMURA, Injurious Japanese Insects [Nihon Gaichūhen (Jap.)] (1899) 75, pl. 32, fig. 1, imago ♂; STAUDINGER and REBEL, Cat. Lep. Pal. **1** (1901) 126, No. 1026; PACKARD, Proc. Am. Acad. Arts and Sci. **39** (1904) 564 (larva); MATSUMURA, Cat. Insect. Jap. **1** (1905) 47, No. 385; NAWA, Insect World [Konchū Sekai (Jap.)] **10** (1906) 63, pl. 3, larva, pupa, imago ♂; MATSUMURA, Thousand Insects of Japan [Nihon Senchū Dzukei (Jap.)] (1909), suppl. 1, 50, No. 82, pl. 9, fig. 1, ♀; SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoko Gaichūhen (Jap.)] ed. 3 (1910) pt. 2, 89, pl. 119, larva, pupa, imago ♂; SASAKI, Insects Injurious to Fruit Trees [Kwajū Gaichūhen (Jap.)] ed. 5 (1911) 216, pl. 70, larva, imago.

Caligula castanea SWINHOE, Cat. Lep. Het. Oxford (1892) 249; JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 218, pl. 32 *c*, ♂.

Dictyoploca japonica JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 218, pl. 32, *c*, ♂, ♀.

Jordan erects a new genus, *Dictyoploca*, for this species, which was formerly placed in *Caligula* Moore.

Genus DICTYOPLOCA Jordan

Forewing with only two subcostal branches. The distal segments of the antennae below more produced at the apex than in *Caligula*, and with more distinct sensory cones, the pectinations of ♂ shorter, the apical ones on the middle segments of the ♀ short but distinct. Larva at first black, with rows of warts clothed with black bristles, in the following stages: greenish yellow below, black above, clothed with long white hairs, then more or less completely white with blue spots at the stigmata, small black dots, and short transverse streaks laterally. Cocoon with much larger meshes than in *Caligula*. Pupa very rugate, apex of abdomen almost truncate in a straight line, forming a sharp edge, on each side with a bundle of short bristles in a groove. The cocoons are used for the manufacture of silk, but both the quantity and quality are negligible. Himalayas to Japan.

Jordan [13] gives the following details concerning the imago and larva of *Dictyoploca japonica:*

D. japonica Butl. (regina Stgr.) (32*c*). Ground-colour varying, yellowish grey, brownish yellow, or almost olive; the markings on the contrary fairly constant. Forewing above in the basal fourth with a reddish or brownish transverse line which bounds a large basal spot, and with a second rather diffuse line beyond the middle which touches the ocellus at the outer side, or stands slightly distant from it; the area bounded by the two lines slightly lighter than rest of the wing; ocellus oblique. Hindwing usually redder than the forewing, with much larger and more sharply defined ocellus. Below more unicolorous than above; the ocellus on the forewing with black pupil, on the hindwing blind. Pale specimens are f. castanea Swinh. Larva on Juglans, Castanea, Camphora, in captivity takes Oak, Hawthorn, Willow, etc. The three first stages of the larva almost alike; in the fourth and fifth stages the black colour confined to the sides, the warts of the thorax with a few black bristles between the greenish white hairs. Meshes of cocoon large. Japan (Main Island and Kyūshū), Amurland, North China; the moth in the autumn (September and October), common. The silk glands of the caterpillar are sometimes employed for the manufacture of fishing lines.

The type of *D. japonica,* male, from Yokohama (*Jonas*) is in the British Museum collection. The larva figured (Plate 2, fig. 6) was taken in June, 1901, at Kobe, Settsu Province, Honshu, on *kunugi,* dwarf oak (*Quercus serrata* Thunb.). It pupated on June 27, and a female imago of the pale buff form emerged on a date unrecorded.

Packard [14] has described the larva at length, giving all the stages. Nawa [15] and Matsumura [16] record the life history and give figures of the ova, larva, pupa, cocoon, and male imago. Oberthür [17] also has described the larva.

Food plants.—The food plants are as follows, and probably several more should be included: *Ku-su-no-ki,* camphor tree (*Cinnamomum camphora* Nees); *kurumi,* walnut (*Juglans* sp.); *ringo,* apple, (*Pyrus malus* L.); *urushi,* lacquer tree (*Rhus vernicifera* DC.); *hakuyō,* poplar (*Populas alba* L.); *kusagi* (*Clerodendron tricotomum* Thunb.). The larva, however, is

[13] Seitz's Macrolep. Faun. Pal. 2 (1911) 218.

[14] Proc. Am. Acad. Arts Sci. 39 (1904) 564.

[15] Insect World (Konchū Sekai) 10 (1906) 63, pl. 3.

[16] Japanese Injurious Insects (Nihon Gaichūhen) (1899) 75, pl. 32.

[17] Soc. France (1886) 48.

found chiefly on *kuri*, Spanish chestnut (*Castanea vulgaris* Lam. var. *japonica* DC.), whence its popular name of *kuri-kemushi* or *kuri-mushi* is derived, equivalent to "chestnut caterpillar" or "chestnut grub" in English. Oberthür gives *Juglans mantschourica* as the food plant in Amurland.

Cocoon.—Pryer [18] remarks:

Commonly called the wire-cartridge moth, from the resemblance of the cocoon to the wire-net in a cartridge; last year, [1884], it was found feeding on poplars newly introduced into this country [Japan]. The natives make a strong coarse silk from the cocoon, and a fine gut from the intestines of the larva. Imago appears in October; larva hairy.

Nawa [19] gives the following description of the larva which, in his figure, measures about 60 millimeters, much smaller than mine, which measures 103 millimeters.

The larva at first is black and the head is covered with ashy white hairs; six small tubercles on each segment which emit long ashy white and black hairs; these become pale green when the larva grows bigger; head greenish yellow covered with pale yellow hairs; body pale green; the tubercles of each segment of the body emit long greenish white hairs, for this reason it is named *shiragata-rō;* spiracular stripe black; spiracles indigo-blue; subspiracular line yellow spotted with light red; ventrum dark yellowish green speckled with black spots; legs pale yellow; prolegs dark yellowish green and their extremities pale yellowish green. The cocoon is woven like a net and is commonly called *sukashi-dawara*, [or transparent rice-bag, because the pupa can be seen through the meshes.]

Sasaki [20] gives descriptions and figures of the larva, pupa, and male imago of *Dictyoploca japonica*. He says:

* * * the larva emerges between the end of April and commencement of May and feeds upon *hyakujikkō*, or *sarusuberi* [*Lagerstroemia indica* Linn.]; *kuri*, [Spanish chestnut (*Castanea vulgaris* Lam. var. *japonica* DC.]; *kusu-no-ki*, [Camphor tree (*Cinnamomum camphora* Nees)]; [*keyaki* (*Zelkowa acuminata* Pl.)]; *kurumi*, [walnut (*Juglans* sp.)]. It is full-grown between the middle of June and commencement of July and the imago emerges between the end of August and the commencement of October, when it oviposits.

Matsumura [21] records the life history of the species and gives figures of the male imago, ova, larva, and cocoon. He says that "in Hokkaido it is single brooded and hibernates in the ovum stage." The female deposits some three hundred forty or more

[18] Trans. Asiat. Soc. Japan 12 (1883) 52.

[19] Insect World 10 (1906) 63.

[20] Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 2, 89, pl. 199, larva, pupa, imago; Insects Injurious to Fruit Trees [Kwajū Gaichūhen (Jap.)] ed. 5 (1911) 216, pl. 70, larva, imago.

[21] Japanese Injurious Insects (Nihon Gaichūhen) (1899) 75.

ova in two or three different places on the bark of the tree on which it feeds. The ova hatch in May or June of the following year. At first the larva is black; after the second molt white hairs begin to appear, and it is full grown in about forty-five days, when it makes a netlike cocoon, which is commonly known as *sukashi-dawara*. The imago emerges at the end of September, when the ova are deposited by the female in the manner previously indicated. The larvæ sometimes appear in such numbers that they do much injury to the foliage of chestnut and walnut trees, but this is profitably counterbalanced to some extent by the fact that a kind of catgut named *tegusu*, used by fishermen, is made out of threads contained in the body of the full-grown larva and finds a ready sale.

Local distribution.—Honshu, Musashi Province, Yokohama (*Pryer*); Tokyo, taken and bred September and October (*Wileman*): Shimotsuke Province, Nikko, October (*Leech*): Settsu Province, Kobe, September (*Wileman*). Kyushu, Kyushu (*Leech*): Hyuga Province, Kuraoka, September (*Wileman*). Shikoku, my Japanese collector, informed me that he had taken the species in Sanuki Province. Matsumura records it from all the Japanese Islands, Hokkaido, Honshu, Kyushu, Shikoku, and from Formosa (Taiwan).

Time of appearance.—Ovum, September and October; larva, April to June; pupa, June to September; imago, September and October. The imago emerges in September and October and then the female deposits her eggs on the bark of the trees and on twigs, which pass the winter without hatching. The young larvæ emerge in May of the following year. Single-brooded.

As has been indicated by authors previously quoted, a gut, named in Japanese *tegusu-ito*, is manufactured from the silk glands or the intestines of the full-grown larva. Those interested in this subject and in the manufacture of the coarse silk, also made out of the strong netlike cocoon, can find further details in several Japanese scientific journals.[22]

The following account of the manufacture of tegusu-ito is given by Sasaki.[23] He quotes an extract from a pamphlet, or

[22] Toba, Insect World (Konchū Sekai) 1 (1897) pt. 3, 92–94: Sasaki, Nihon Jūmoku Gaichūhen (Insects Injurious to Japanese Trees) ed. 3 (1910) 92; Sasaki, Dai Nihon Nōkwaihō (Bull. Jap. Agr. Soc.) (1905) No. 294, 15–18; Honda, Dai Nihon Sanshi Kwaihō (Bull. Jap. Sericult. Soc.) (1905) No. 160, 1–7; Honda, Dai Nihon Nōkwaihō (Bull. Jap. Agr. Soc.) (1905) No. 292, 3–11.

[23] Nihon Jūmoku Gaichūhen.

article, named "Kusumushi Yō hō," "the method of rearing camphor grubs," which is as follows:

Many persons have tried to manufacture "tegusu-ito" from the full-grown larvæ of the "kuri-mushi" (chestnut grub). The process of manufacture is as follows:

Full-grown larvæ which are just on the point of spinning their cocoons are selected. They are slit open and the silken threads extracted. These threads are then soaked in a solution made of vinegar, (of 35 per cent strength), pure water and a little salt. After that they are removed from the solution, stretched out and dried, and are now called "tegusu-ito." These threads are now soaked again in white rice water [which is the water resulting after washing rice, preparatory to cooking], for about one hour, after which they are taken out and dried. When thoroughly dry they are placed between walnuts wrapped up in layers of cotton cloth and gently rubbed. This imparts to them gloss and elasticity and a fine-looking "tegusu-ito" is the result.

It is to be presumed that fresh green walnuts are used, as without the outer green skin they would probably be too hard and uneven for this purpose.

Genus AGLIA Ochsenheimer

Aglia OCHSENHEIMER, Schmett. Eur. 3 (1810) 11.

Aglia tau Linnæus.

Plate 2, fig. 7, larva; fig. 8, head; fig. 9, extended transverse section of larva; fig. 10, food plant. Larva of *Aglia japonica* Leech.

Japanese name, *yezo-yotsume.*

Bombyx tau LINNÆUS, Syst. Nat. 1 (1758) 497; HÜBNER, Bomb. (1800) pl. 13, figs. 51, 52; STAUDINGER and REBEL, Cat. Lep. Pal. 1 (1901) 127, No. 1039; JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 224, pl. 35, *a*, ♂, ♀; 35, *b*, ♀.

Aglia tau var. *japonica* LEECH, Proc. Zool. Soc. London (1898) 632, No. 250; Trans. Ent. Soc. London (1898) 269, No. 16; STAUDINGER and REBEL, Cat. Lep. Pal. 1 (1901) 127, No. 1039 *c;* MATSUMURA, Cat. Insect. Jap. 1 (1905) 47, No. 388; Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909) suppl. 1, 49, pl. 8, fig. 5, ♂; JORDAN, Seitz's Macrolep. Faun. Pal. 2 (1911) 224, pl. 35, *a*, ♂.

The larva figured (Plate 2, fig. 7) was taken in August, 1902 (figured, August 18), at Hakodate, Oshima Province, Hokkaido, on maple, Japanese name *momiji* (*Acer* sp.). A female imago of var. *japonica* Leech emerged from the resulting pupa on July 12, 1903.

Jordan[24] describes the larva, pupa, and cocoon of the genus *Aglia* as follows:

Young larvæ with two dorsal rows of warts, which are long and thorn-like on the pro- and mesothorax, on segment 11 only one such thorn, anal

[24] Seitz's Macrolep. Faun. Pal. 2 (1911) 224.

segment with a median thorn at the tip; laterally and dorsally numerous granules bearing small hairs; in the later stages the warts completely obsolescent, but the segments swollen transversely at the corresponding places. Cremaster of pupa sharp with curved bristles.

Cocoon loose, between leaves and moss or below the surface.

Jordan[25] describes the larva of *Aglia tau* as follows:

Larva green with light lateral stripes directed obliquely up- and backward, below the stigmata a light longitudinal line with a reddish edge, the line widened on segment 4 to form a black-centered spot. On deciduous trees especially Beech, Oak, Birch, etc. Pupa hibernates. Moth from March to June according to the locality, in the North later than in the South; the ♂♂ fly by day and are very restless, the ♀♀ remain on tree-trunks and on the ground. In the Central and Southern districts of Northern Europe, eastward to Japan; not in England and the Mediterranean countries.

Kirby[26] remarks:

The larva [of *Aglia tau*] is green, with five red spines when young, which it loses when full grown. It has yellowish-white oblique stripes on the side, running upwards and forwards, and a yellowish line on the sides, which is broadest on the 4th segment. It feeds on beech, lime and oak in June and July.

The original figure of my larva of var. *japonica* Leech agrees well with the description given by Jordan of *Aglia tau* Linn., but he does not give the number of the oblique lateral stripes which, in my larva, are seven in number and of a whitish color.

Poulton[27] remarks:

The larva of the European Tau Emperor (*Aglia tau*) has an eye-like mark which it can expose when attacked, but which is otherwise concealed. The appearance of the larva in its terrifying attitude is shown in fig. 58.

This larva is an example of the form of protective mimicry alluded to by Poulton under pseudaposematic colors.[28] In the figure of my larva (Plate 2, fig. 7) the eyelike spot on segment 5 does not seem to be fully expanded.

Local distribution of Aglia tau var. *japonica.*—Honshu, Shimotsuke Province, Nikko, May (*Wileman*). Hokkaido, Oshima Province, Hakodate and Jansai Numa, June and July (*Wileman*). Matsumura records var. *japonica* from Honshu and Hokkaido.

Time of appearance.—Larva, August; imago, May to July. In Hokkaido the larva pupates in September, and the imago emerges in July of the following year.

[25] Loc. cit.

[26] European Butterflies and Moths (1889) 125.

[27] The Colours of Animals (1890) 264, fig. 58.

[28] Vide Philip. Journ. Sci. § D 9 (1914) table 1, facing page 248.

General distribution.—*Aglia tau,* in the central and southern districts of northern Europe, eastward to Japan; not in England and the Mediterranean countries. *Aglia tau* var. *japonica,* Japan only. (*Jordan.*)

BRAHMÆIDÆ

Genus **BRAHMÆA** Walker

Brahmæa WALKER, Cat. Lep. Het. 6 (1855) 1315.

Brahmæa japonica Butler.

Plate 2, fig. 11, larva, fourth ? stage; fig. 12, food plant; fig. 13, head; fig. 14, head, enlarged.

Japanese names: *Ibota-ga* and *shokko-nishiki.*

Brahmæa japonica BUTLER, Ent. Month. Mag. **10** (1873) 56 (*mniszechii* Feld.); Ill. Typ. Lep. Het. 2 (1878) 17, pl. 26, fig. 3, ♂; PRYER, Trans. Asiat. Soc. Japan **12** (1883) 53, No. 194: LEECH, Proc. Zool. Soc. London (1898) 635, No. 257; Trans. Ent. Soc. London (1898) 270, No. 20; MATSUMURA, Cat. Insect. Jap. (1905) 48, No. 389; NAWA, Insect World [Konchū Sekai (Jap.)] **10** (1906) 415, pl. 11, larva, pupa, imago ♀; MATSUMURA, Thousand Insects of Japan [Nihon Senchū Dzukai (Jap.)] (1909) suppl. 1, 42, No. 68, pl. 6, fig. 4, ♀; SASAKI, Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910) pt. 3, 132, pl. 225, larva, pupa, imago; JORDAN, Seitz's Macrolep. Faun. Pal. **2** (1911) 228, pl. 35, fig. c, ♂.

Brahmæa mniszechii FELDER and ROGENHOFER, Reise Novara, Lep. **4** (1874) pl. 93, figs. 4, 5.

Brahmæa nigrans BUTLER, Ent. Month. Mag. **17** (1880) 110; WATERHOUSE, Aid **1** (1881) pl. 29.

Jordan [29] comments on the family Brahmæidæ as follows:

This group comprises about one and a half to two dozen of highly peculiar but very similar species. All are large and rather clumsy moths, with markings so characteristic that they at once catch the eye even in large and mixed collections. The wing is divided into an outer half traversed by ten parallel wavy lines, which on the forewing directly touches an often uniformly dark basal area, but on the forewing borders on a band which is sometimes modified at the inner margin to form an ocellus-like disc. The basal area of the forewing again contains a number of those peculiar parallel lines, which renders the scheme of markings so confusing, and the biological significance of which we do not yet understand. And as if even Nature could not carry out so complicated a pattern in all its details, we very often find among the Brahmaeidae unsymmetrical specimens in which one side bears sometimes one stripe more than the other, sometimes has the dots differently placed. Among a considerable

[29] Seitz's Macrolep. Faun. Pal. 2 (1911) 227.

number of otherwise very well developed B. japonica before me there is not one specimen the two sides of which agree in every detail.

The position of Brahmaea in classification has only changed in that it was sometimes placed among the Saturniids, sometimes among the Bombycids. The larvæ as far as they are known, when full-grown resemble huge larvæ of silk-moths but differ greatly from the latter in the early stages, which shows that there is no close relationship. It will be absolutely necessary to keep the genus Brahmaea separate as a distinct family, and it is very noteworthy that a similar phenomenon exists in America, a very homogeneous family in many respects resembling Brahmaea also standing alone nearly without transitions and playing the same part in the fauna of the New World as Brahmaea in the Old World. These are the Ceratocampids, the largest species of which is produced from that grotesque and strange caterpillar, with its curved horns on the thorax which we figure on the cover of each part of this work in a defensive attitude and which perhaps those who are not familiar with the American fauna may have considered a product of the imagination.

The Brahmaeids are confined to the Old World and are so distributed that three species occur in the Palearctic Region, but not in Europe, just as many forms are Indian, and the same number belong to the Ethiopian fauna. They do not go far north and inhabit mountainous countries, have only one brood in the temperate zone, and as larvæ are fairly polyphagous. The larvæ grow slowly and pupate in the ground without a cocoon; the moths fly at night, and rest by day on tree-trunks and branches, where, with their wings in steep roof-shape and folded close together, they resemble fruits or pieces of bark. The moths are rather rarely seen, but the larvæ are common wherever they occur, and lately large quantities of material for breeding have been imported.

The characters of the family are those of the single genus Brahmaea. * * * the larvae, when young, with long horns decreasing in length when the larva grows older, otherwise naked, soft, long and not strong; on deciduous trees.

The larva figured (Plate 2, fig. 11) was taken in August, 1902 (figured, August 2), at Hakodate, Oshima Province, Hokkaido (Yezo), on *ibotanoki* (*Ligustrum ibota* Siebold), but died without reaching the pupal stage. It is so well known amongst Japanese collectors that, although I have never succeeded in breeding the imago, I have no hesitation in referring the larva figured to *Brahmæa japonica*. Pryer [30] moreover comments on the larva as follows:

Feeds on the privet; larva is smooth, bright green, marked with black, and has four thin black filaments over $1\frac{1}{2}$ inches long on the foresegments and three on anterior [posterior]. Imago appears in March and April.

Pryer, however, speaks of the larva previous to the fifth molt when it loses all these filaments. My figure represents the larva in the fourth ? stage.

[30] Trans. Asiat. Soc. Japan 12 (1885) 53.

Nawa [31] records the life-history of the species and gives figures of the larva in its fourth ? and fifth ? stages with and without these curious filaments which are seven in number, also of the pupa and of the female imago. The following description is taken from my original figure:

Larva.—Fourth ? stage. Length, about 60 millimeters. Head black with a pattern of yellowish markings. Color pale whitish green, tinged with yellowish green patches subdorsally and laterally; a midlateral and spiracular series of black spots, streaks, and dashes; a suprapedal series of black elongated dashes situated on yellow patches; legs, prolegs, and claspers black, prolegs and claspers being dotted or streaked with white; ventrum blackish; segment 3 (counting head as segment 1) bears two black, wirelike filaments, much contorted, about 26 millimeters long; segment 4, two similar filaments of about equal length; segment 12 bears one similar, shorter, mediodorsal filament; the anal segment bears two filaments which are the shortest of the seven; all the filaments are more or less contorted and vary in length with the individual larva. The full-grown larva after the fifth molt measures from 90 to 110 millimeters and changes to yellowish brown. Nawa states that when it reaches maturity it loses these seven filaments and that it burrows in the earth where it pupates. He does not say, however, whether it forms a cocoon in the earth. My Japanese collector informed me that it makes a hard, subterranean cocoon, but I have never investigated the matter and am therefore unable to say whether it forms a cocoon or not. Nawa further says:

> * * * there is only one brood in the year. The imago emerges in April [at Gifu, Omi Province], the ova hatch in May, the larvæ appear in May and June and the pupa passes the winter under ground until the following April. The larva feeds on *nedzumu-mochi* [(*Ligustrum japonica* Thunb.)] and *ibotanoki* [(*Ligustrum ibota* Siebold)].

Ibotanoki is also called *yachi-tamo* in Hakodate, Hokkaido. Sasaki [32] gives descriptions and figures of the larva, pupa, and male imago of *Brahmæa japonica.* He says:

> * * * the larva emerges about the middle of May and feeds upon *nedzumi-mōchi* and *ibotanoki.* It is full grown by the middle of June and then pupates in the earth. It hibernates in the pupal stage and the imago emerges in April of the following year.

[31] Insect World (Konchū Sekai) 10 (1906) 415, pl. 11.

[32] Insects Injurious to Japanese Trees [Nihon Jūmoku Gaichūhen (Jap.)] ed. 3 (1910), pt. 3, 132, pl. 225.

I may mention that the larva of this species finds a place in the materia medica of the lower class Japanese as a specific for certain diseases, and Nawa corroborates me in this statement. He says:

Popular superstition attributes to this larva some efficacy in cases of consumption but I have never heard of any cures effected in such cases.

I have often in my wanderings through the Bukenji Woods, near Yokohama, met men carrying shallow baskets filled with these larvæ and, on inquiry, have learned that they were to be sold to native apothecaries. They are sold by collectors at about 3 sen (1.5 cents gold) per larva, and after being dried in the sun are grilled over a fire. The retail price at which they are sold by the apothecary ranges from 4 to 5 sen per larva (2 to 2.5 cents gold). It has been stated to me that these dried larvæ are supposed to be efficacious in cases of piles, convulsions, and worms in children. As a matter of fact the lower class Japanese employ the larvæ of several other species of Heterocera for similar purposes, such as those of *Sciapteron regale* Butler wich feeds inside the stems of the wild grape, *yama-budō* (*Vitis coignetiæ* Pull.), and also of *Phassus signifer* Walker and *Phassus excrescens* Butler, which are found in the stmes of the *kusagi* (*Clerodendron tricotomum* Thunb.) and other trees. This however is not surprising when one considers that the Romans are reported to have regarded the larva of *Cossus ligniperda* L., also an internal feeder, as a great table delicacy.

The following description of the larva of the allied species *Brahmæa certhia* Fabr. (=*undulata* Brem. and Grey; *petiveri* Butler), from Amurland, northern and central China, and Korea, is given by Seitz and is useful for comparison with that of *B. japonica,* which it seems to resemble in some respects:

Larva grey to blackish, when young with two horns rolled up at the ends on segment 2 and two similar ones on 3; the remaining segments only have small knobs, the anal segment bears an also very strongly curved horn resembling that of the Sphingidae. When full grown the larva is smooth, segments 2 and 3 swollen, on the anal segment a stumpy hump. Markings and colour very variable, frequently confined to a few small black streaks or bright-coloured spiracular dots. According to Staudinger the larvae of the East-Asiatic form are much more brightly marked and coloured than the almost uniformly dark larvæ of ledereri of Asia Minor [a form of *certhia* Fab.]. According to Korb the larvae often live in companies of from 20 to 30 specimens and prefer rather sunny, sterile localities; until June or August on Privet, Syringa, Ash, Phillyrea and other trees; when disturbed they emit a cracking or crackling noise. They pupate without a cocoon in or on the ground beneath stones; pupa blackish, very strongly glossy, clumsy, stumpy at both ends, deeply incised between the segments, rounded at the abdominal end, the cremaster a short point. The moth appears in June in Eastern Asia.

Imago.—Leech [33] remarks:

This is a variable species both as regards ground-colour and markings. Thus the former may be white or grey, and sometimes tinged with green; then the number of ocelli in central band and "rounded internal spot" is not the same in any two individuals comprised in my series of 15 specimens. The spot referred to sometimes has three ocelli across its centre on one wing, but its companion on the other wing has four. In all cases the number of ocelli, both in the spot and central band, is greater on one side than the other. Again the shape of the central band is subject to modification, and stages in the formation of the rounded internal spot from the lower portion of this band are exhibited in the specimens in my Japanese series; thus between an example in which the band is entire from costa to inner margin, and but slightly contracted below the middle, and a specimen with the rounded spot completely formed and quite independent, there are all the intermediate stages.

The Type of *Brahmæa japonica,* a male ?, is from Yokohama, Japan. The type of *B. nigrans* is from Japan.

Seitz [34] remarks as follows:

B. japonica Butl. (mniszechii Feld.) (35c). Smaller than the preceding [B. christophi Stgr.], more grey and often tinged with greenish. The median band of the forewing is strongly widened in the costal area; lighter and ornamented with small rings. These are nearly always asymmetrical; Leech did not find one symmetrical individual among 15 in Pryer's collection and the same applies to four specimens collected by me. The original of our figure also has on the right forewing (not reproduced) much fewer rings than on the wing figured. The median band also varies rather strongly in its inner marginal portion. Now it is more now less constricted on the lower median vein; but nearly always it forms an ocellus-like disc-patch. The species also varies considerably in the whole scheme of colouring and nigrans Butl., unknown to me in nature, is probably only a dark specimen; japonica is also closely allied to the Indian conchifera Butl. and is only a Northern form of wallichii Gray (spectabilis Hope), which we figure in Vol. 10, its ground-colour shading into greyish green and that of rufescens Butl. into reddish. These latter are Indian forms, which perhaps vary slightly according to locality, but belong to one species. But if Leech places wallichii with certhia, he is in error.—Japonica is not rare near Yokohama; occurs also in other localities on Hontō, [(Honshū)] and is also found in Hokkaidō.

Local distribution.—Honshu, Musashi Province, Yokohama, March and April (*Pryer*) ; Tokyo, March and April (*Wileman*) :

[33] Proc. Zool. Soc. London (1888) 635, No. 257.
[34] Macrolep. Faun. Pal. 2 (1911) 228.

Sagami Province, Hiratsuka, April (*Wileman*). Matsumura records it from Hokkaido and Honshu.

Time of appearance.—Larva, May, June, July ? and August; imago, March, April, and May. In Yokohama and Tokyo, Honshu, the larva is found in May. It pupates in June and lies until March of the following year, the earliest emergences taking place about the middle of March. In fact this species is one of the earliest of the Japanese moths to appear in the spring. It is often to be taken at rest on the trunks of pines or oaks. The larva taken at Hakodate in August, from which my original figure was drawn, was exceptionally late in the season owing to the more northern latitude of Hokkaido.

General distribution.—Japan. Is a northern form of *wallichii* Gray (*spectabilis* Hope). (*Seitz.*)

ILLUSTRATIONS

[Drawings by Hisashi Kaido.]

PLATE 1

FIGS. 1 to 5. *Samia pryeri* Butler.
1, larva, third ? stage; *2*, larva, fourth ? stage; *3* and *4*, larva, fifth ? stage, dorsal and lateral aspects; *5*, larva, sixth ? stage; *5a*, food plant.

6 to 9. *Rhodinia fugax* Butler.
6, larva fifth ? stage; *7*, larva, sixth ? stage; *8*, paired dorsal tubercles on segment 4; *9*, tubercles on segments 11 and 12.

10 and 11. *Caligula jonasi* Butler.
10, full-grown larva, fifth ? stage; *11*, food plant.

PLATE 2

FIGS. 1 to 5. *Caligula jonasi* Butler.
1, young larva, third ? stage; *2*, food plant; *3*, thoracic segments, dorsal aspect; *4* and *5*, median and anal segments, dorsal aspect.

FIG. 6. *Dictyoploca japonica* Butler, full-grown larva.

FIGS. 7 to 10. *Aglia japonica* Leech.
7, larva; *8*, head of larva; *9*, extended transverse section of larva; *10*, food plant.

11 to 14. *Brahmæa japonica* Butler.
11, larva, fourth ? stage; *12*, food plant; *13*, head; *14*, head, enlarged.

PLATE 1. LARVÆ OF JAPANESE LEPIDOPTERA.

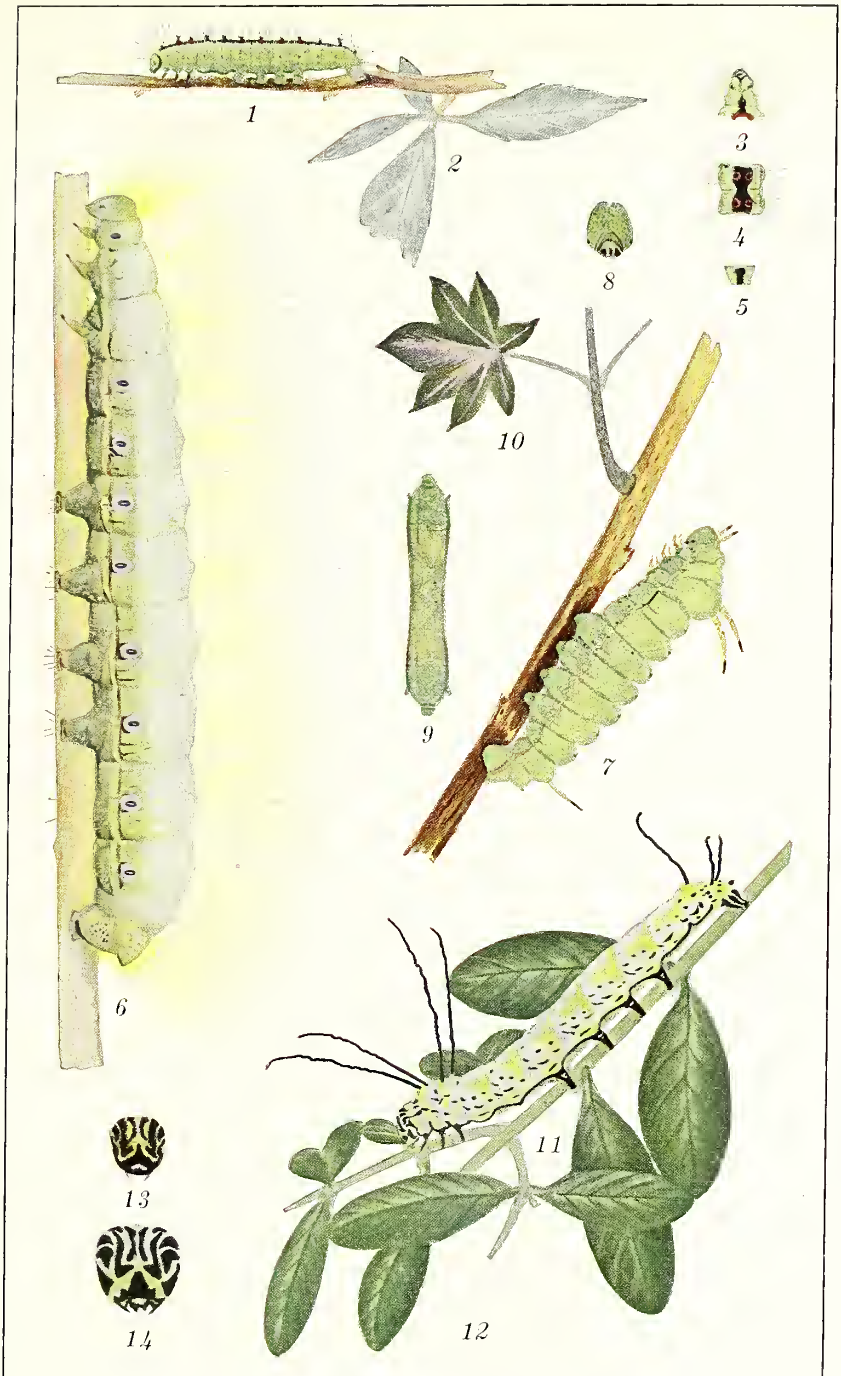


PLATE 2. LARVÆ OF JAPANESE LEPIDOPTERA.

ANCIENT CAVE DWELLERS OF BATWAAN, MASBATE, PHILIPPINE ISLANDS

By Warren D. Smith

Head, Department of Geology, University of Oregon; and Acting Chief, Division of Mines, Bureau of Science

FIVE PLATES AND TWO TEXT FIGURES

INTRODUCTION

On a recent trip to inspect the mines of the Aroroy district of Masbate, a large triangular and forked island just south of the southeast end of Luzon, the writer had the opportunity to visit some ancient cave-dwellings in the interior of that island which was on the whole a most interesting experience. He was told of the existence of these caves by Mr. Paul Schwab, an American prospector, who has lived in that district since 1905. The caves were shown to Mr. Schwab by a Filipino who harvests rice in Batwaan Valley each year. It is reported that a Mr. Wilson, a lawyer of Masbate, who has some agricultural interests in the interior, had visited these caves or similar ones and had brought away some relics, but the writer has been unable to learn anything about his finds and, as far as is known, nothing about them has heretofore been published.

In the preparation of this article the writer has consulted Prof. H. O. Beyer, professor of anthropology in the University of the Philippines, but the author alone is responsible for the statements herein. No one has as yet made an exhaustive study of the caves or the materials found there and the writer wishes merely to place on record the information he now has, as a preliminary contribution to further study of these and other Philippine caves. Similar burial caves have been noted in other parts of the Archipelago, but aside from some notes by the traveler Jagor,[1] with reference to some caves on the coast of Samar and Leyte, with Virchow's important appendix, little or nothing has been written about prehistoric peoples in the Philippines, and to the writer's knowledge this is the first description of cave dwellings in the Philippines. Many stories and reports

[1] Jagor, Fedor, Viajes por Filipinas. Madrid (1875). This is a translation from the German.

are current about such, but they have not yet got into the literature.

Mr. E. H. Taylor, formerly of the Bureau of Science, who has traveled extensively in the Archipelago making zoölogical studies, has kindly contributed the following memorandum relative to some modern cave-dwellers on Coron Island:

> There is a limestone cave on Coron Island, directly across from the town of Coron on Busuanga Island, inhabited at the present time by a very primitive people known as Tagbanuas. At the time of my visit there was no one at home, but there were remains of fire, pots, a hammock, etc., testifying to the recent occupation of the cavern. This cave is about 20 meters above the sea and close to shore. In addition to the articles named there was a large kitchen midden consisting mainly of shells of edible molluscs and fragments of pottery. Just opposite this site are three small limestone islands. In one of these is a very small burial cave containing three cadavers, and one very recent coffin made of bamboo and nipa. According to report in Coron there are many Tagbanua cave dwellers on islands north of Palawan and on Culion.

Geography.—The site of the Batwaan caves is close to the trail from Aroroy to Mandaon and about five hours by foot from Mandaon and about eight from Aroroy; that is to say, about 32 kilometers from Aroroy and almost due south of that place (fig. 1). Batwaan valley is about 8 kilometers long and 5 kilometers wide, and roughly oval in shape. It is surrounded by a rim of low hills with fairly steep escarpments toward the valley and more gentle slopes away from the valley. The caves are found in a large limestone mesa (Plate 1), which rises about 100 meters above the floor of a large, flat-bottomed valley, through which runs Batwaan Creek. The general situation is shown in the sketch, fig. 2. The limestone mesa is roughly 0.5 kilometers long and 200 meters wide. The formations in this region are generally sedimentary, but this valley lies very close to the contact between the igneous rock of the central cordillera of the island and the Tertiary sediments which dip away from the cordillera to the west. On the trail to Batwaan from Aroroy there is much conglomerate exposed, and in the hills forming the western rim of Batwaan Valley there is conglomerate and sandstone with here and there patches of residual limestone. The large limestone mesa in the center of the valley is a residual block left by erosion. Formerly limestone probably overlay much of this region. This limestone is correlated with the lower member of the Malumbang limestone, which is lower Pliocene or upper Miocene in age. On fresh fracture the rock is compact and creamy white; it weathers to a blue-gray. The caves in the limestone are the result of solution by water.

The caves.—The caves explored by Mr. Schwab and the writer are four in number, but there are several more in the hill. These four he has designated as follows: The great living cave, the burial cave, the ceremonial cave which is in reality a part of the living cave, and the great guano cave. In fig. 2 the general situation with reference to these caves is shown.

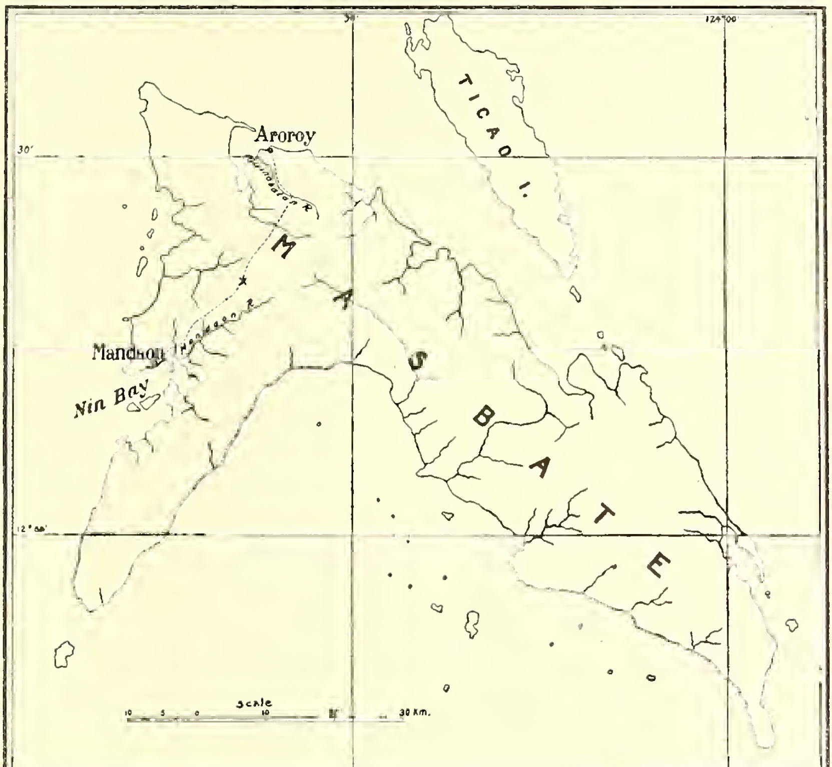


FIG. 1. Masbate Island; outline, showing cave site at X.

The great living cave is located at the southeast end of the hill and has a large opening which lets in plenty of light. The cave is somewhat semicircular in shape but is very irregular. It is perhaps 15 meters high and 20 meters long, and toward the back end of the cave the floor slopes upward to a chimney-like opening above. Special features of this and other caves of the hill are the large cylindrical holes in the roof. These are in some cases about a meter in diameter, but most of them are about 8 centimeters in diameter, and they do not go through

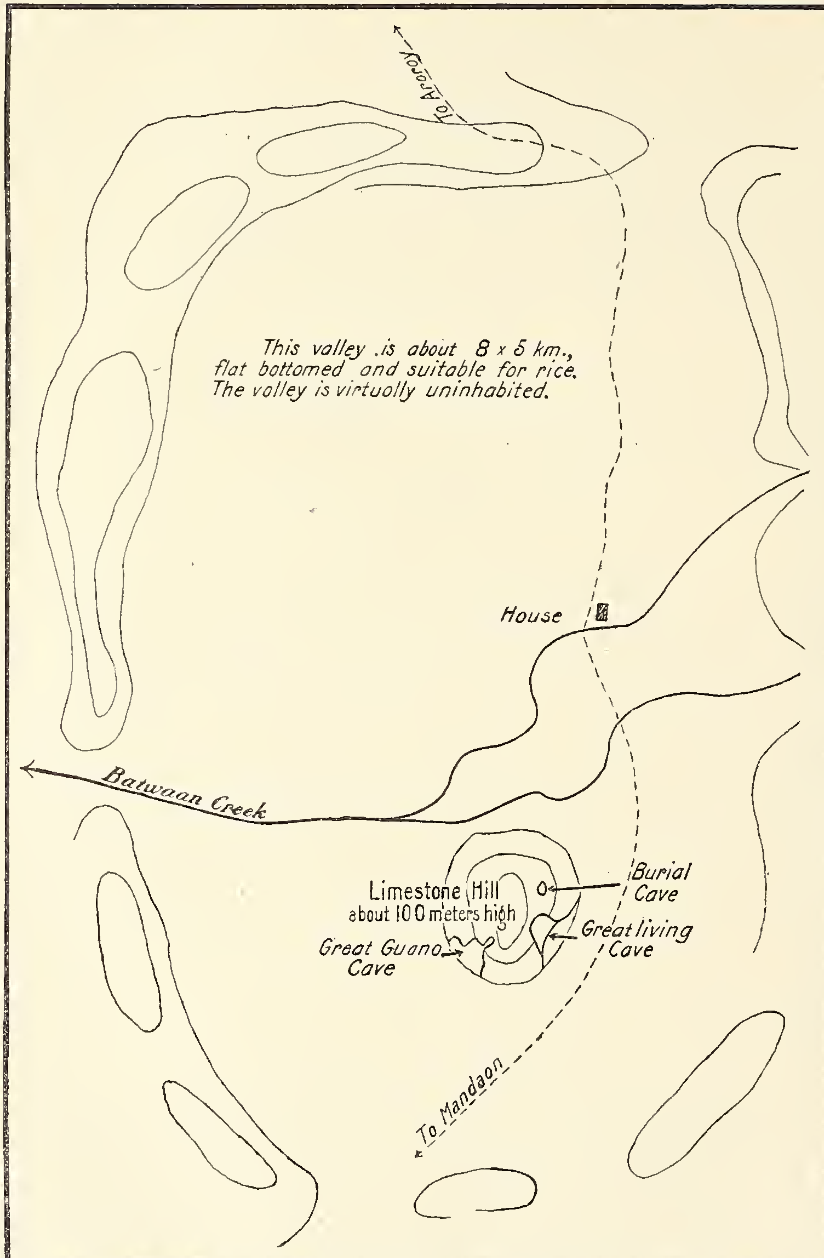


Fig. 2. Batwaan Valley and caves.

to the surface; usually swallows and various insects are found living in these cylindrical holes. The writer is at a loss to explain their origin as there is no indication of water having percolated through from the surface and dissolved the material. These holes are very symmetrical, very much resembling giant drill holes.

This cave is very dry, and anything found in it might have endured through many hundreds of years, as far as decomposition is concerned. The floor is somewhat sandy and is made up of loose blocks of limestone and fragments of pottery. It is quite evident from the amount of material on the surface that it would be easy to obtain many kilograms of broken pottery. On digging into the floor one comes across bits of charcoal from ancient fires, and many marine shells of species of *Arca* and *Turritella* which evidently formed one of the principal articles of diet of the people who inhabited the cave. These, being sea shells, of course, were brought from the ocean, probably from the nearest point, which is known as Nin Bay, about 15 kilometers to the southwest. There are also many deer teeth and broken jawbones of deer, indicating that these people were not only fishermen but hunters as well; in fact, this whole cave is one great kitchen midden.

Adjoining the great living cave, and virtually a part of it, is a second large chamber in which the floor slopes downward to a small outlet on the side of the hill. At the upper end of this slope there is a great flat block of limestone which forms a natural platform. There is a tradition among the Filipinos living in the neighborhood of this hill, one of whom accompanied the writer's party in their exploration, that this chamber was used in former times for a ceremony connected with marriage. There is also a tradition that the bride-to-be had to go into this chamber, where she would secure her trousseau from a shelf near the top of the cave. The people living in the valley at the present time have never taken part in these rites, but this story has been handed down to them with reference to this place.

The roof of this cave has a great hole open to the sky which lights up the whole place and has been instrumental in keeping the bats out of this and the living cave. Directly beneath this great natural skylight there are some trees growing in the center of the cave; the largest of these is not more than 6 centimeters in diameter and about 10 meters high. These indicate that probably the time necessary for them to grow, however much that might be, has elapsed since the cave was used.

The burial cave is a very small one, not over 8 meters from the entrace to the back wall, and not large enough to allow a person to stand upright in it. It is located on a shelf about 100 meters to the north of the living cave and perhaps 10 to 20 meters higher up. There is a very narrow ledge of rock leading up to it. Within this cave was found a heap of human bones among which there were forty-four human skulls. Here also was a head box about 1 meter long which would hold a row of five or six skulls. The head box was made of wood resembling molave, but was in a bad state of decay. This box had handles carved to represent the head of some animal, possibly a crocodile or a horse; it was impossible for the writer to tell which. There were fragments of a much smaller head box, about 0.5 meter in length, with nothing in it. At the far end of the cave there was a piece of basket work from which the bottom had rotted out. This type of basket work resembles the basket work, as far as shape is concerned, now found in the Islands. There was also a coconut shell with a hole in the bottom; and, curiously enough, in the same cave with these rather recent-looking artifacts were two stone implements.

On the west side of the hill and somewhat lower down than this cave is a great cavern with one fairly large entrance and in the rear a chimneylike opening to the surface. This cave is nearly semicircular in shape and resembles the interior of a cathedral. It is quite gloomy and is inhabited by innumerable bats. The floor is fairly level and is covered with bat guano. Apparently the deposit of guano in this cave is thick. In various parts leading off from the central chamber are some tunnels leading deep into the interior of the hill; these were not explored. The entrances to these various caves are well concealed by thick vegetation which has grown up around the lower slopes of the hill. The writer regrets exceedingly that the views taken of the interior of the caves did not turn out to be successful.

People inhabiting the cave.—The question as to the kind of people who lived here is of course open to some conjecture. It is certain that no people living on Masbate Island to-day inhabit caves; nor do the Filipinos living in Batwaan Valley (there are only two houses in the valley) know anything about the former dwellers in this interesting place, and with the exception of the two Filipino men who accompanied the party to the caves the people strictly avoid the locality. The writer has been in caves in northern Luzon where the Igorot people have buried their dead, but he has never heretofore found any people living in the caves nor found any remains of people formerly living in them other than the bones which were buried there. Therefore, these caves are particularly interesting because we find the artifacts and kitchen middens, indicating not only that people lived here but that many people lived in them for a long period of time; and, furthermore, we are able to judge pretty well as to how they lived.

The skulls.—Most of the skulls examined showed artificial deformation which, history records, was practiced by some of the peoples living in the Islands when the Spaniards first came here; but, so far as the writer knows, no people at present living in the Philippines indulge in this primitive practice. An examination of the skulls (see Plate 2) leads him to believe that an earlier race of people than now inhabits Masbate frequented these caves. From a preliminary study only, Professor Beyer has told the writer that in his opinion the smaller of the two skulls was that of a Negrito, the larger, perhaps, of a Chinaman. He called particular attention to the rather unusual deformation of these skulls. The smaller one, although that of an adult, has an open suture along the median line in the anterior part. This may have been caused by the use of two separate blocks, one on each side, being bound on the head. In the case of the larger skull, a totally different method seems to have been used. In this there is no flattening, but there is a most unusual depression which begins just in front of and above one ear, continuing across the top of the cranium down to the corresponding place on the other side. It looks as if a band of some metal had been bound tightly about the skull in the early years. The frontal suture in this case is completely closed.

The artifacts.—From a study of the artifacts it seems that three different cultures are represented, the oldest being represented by the stone implements; the second, by the unglazed and ornamented pottery; and the last, by the glazed pottery, the badly decayed and rusty fragment of a metal lock, and the basket work. The fragments of pottery, shown in Plate 3, are particularly interesting, since, so far as is known, nothing like this is being made in the Philippines to-day, save among the pagans of eastern Mindanao. As a rule, Filipinos do not etch designs on their pottery; but, whenever they do attempt decorations of any kind (which is the exception) the patterns are painted on very crudely. Possibly the patterns on these old fragments from Batwaan have Javanese affinities. It seems fairly certain that they represent a very early culture stage in the Philippines.

Plate 4, fig. 1, shows an earthenware vessel of a design with which the writer is quite unfamiliar in the Philippines.

Plate 4, fig. 2, may be either the bottom part of a native stove or a fragment of a lid of a giant *tinaja* (water jar).

In Plate 5, fig. 2, is shown a bracelet cut from the top of a large *Conus* shell, while the other two fragments (fig. 1) are pieces of pipe bowls.

We come now to the most interesting of all the artifacts found in these caves, namely, the stone implements. So far as the writer knows there are only five of these known from the Philippines; Mr. Dean C. Worcester has two, the writer has one that was given him years ago by a prospector but about which he has no data, and the two that are pictured in Plate 5, figs. 3 and 4. The one shown in Plate 5, fig. 4, is made from a greenish colored felsite, probably a fine-grained diorite, and may have been used as a hide scraper. Professor Beyer has suggested to the writer that the implement was made from this rock because of its general resemblance to jade, from which material many Chinese implements were, and perhaps still are, manufactured.

Plate 5, fig. 3, shows an implement of a cherty material, which was undoubtedly used as a sort of combination hatchet and chisel. These stone implements, some believe, may have some historical connection with the ancient Chinese mining exploits on this island. The writer is not in accord with that view, since tools of this design or of this material would be of little use or effectiveness in mining operations. He is of the opinion, on the other hand, that these stone implements represent a true indigenous stone-age culture in the Philippines belonging to the Neolithic Period.

The writer disclaims any pretense to a special training in ethnology; he has described these finds in the hope that qualified persons may become interested enough to make further investigations. However, the writer is sufficiently informed along those lines to realize the importance of a complete study of this subject, if any safe conclusion as to early movements of peoples in the Pacific area is to be arrived at. He agrees with a recent statement of Hrdlicka that the solution of Pacific anthropology and ethnology will have to be arrived at by way of a more complete study of the Continent of Asia and the festoons of islands off its east coast. The writer believes that the Philippines are in a strategic ethnologic position with respect to such a study.

ILLUSTRATIONS

PLATE 1. LIMESTONE MESA, SITE OF THE BATWAAN CAVES.

Fig. 1.

Fig. 2.

PLATE 2. SKULLS FROM THE BURIAL CAVE.

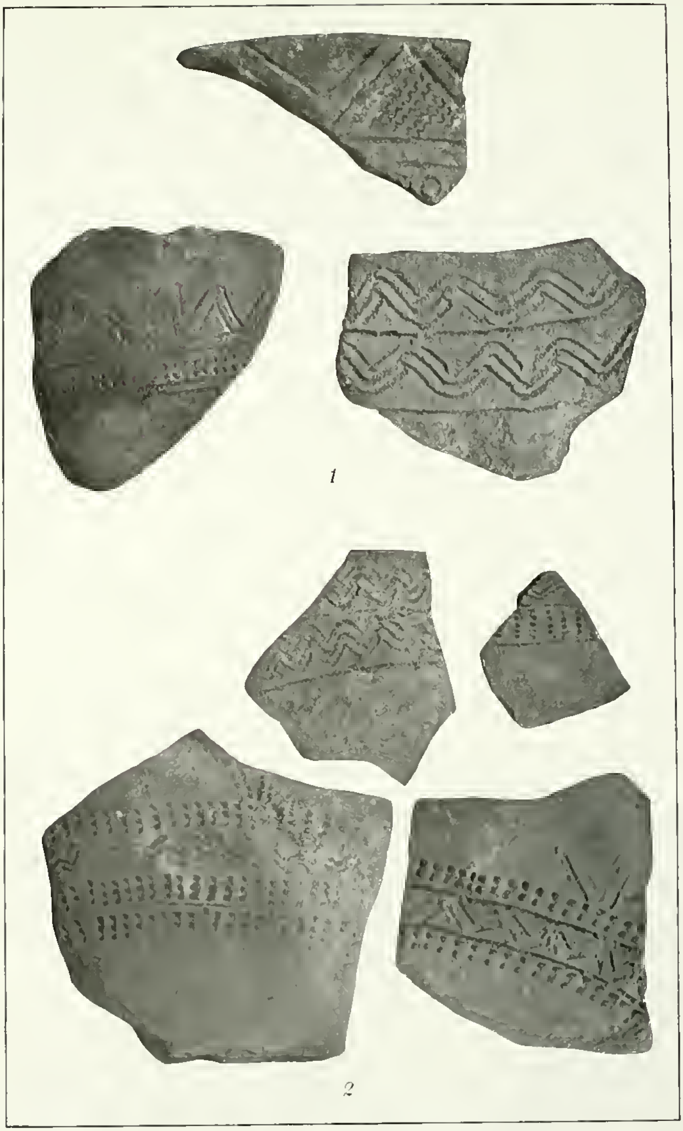


PLATE 3. FRAGMENTS OF DECORATED POTTERY FROM THE LIVING CAVE.

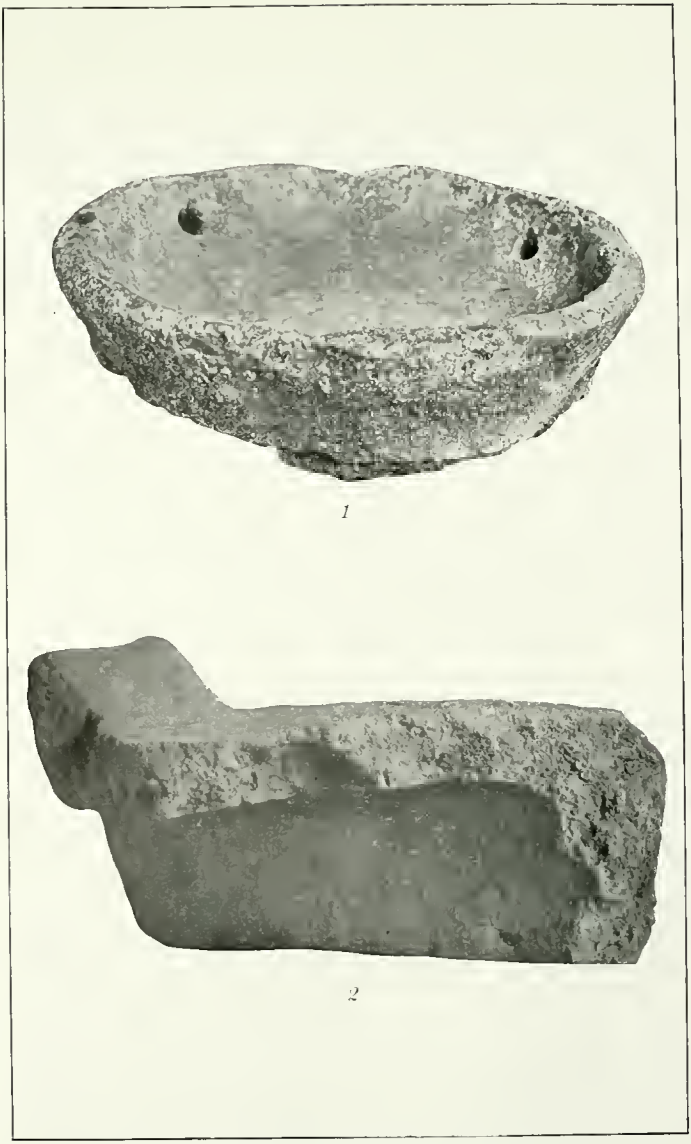


PLATE 4. EARTHENWARE UTENSILS FROM THE LIVING CAVE.

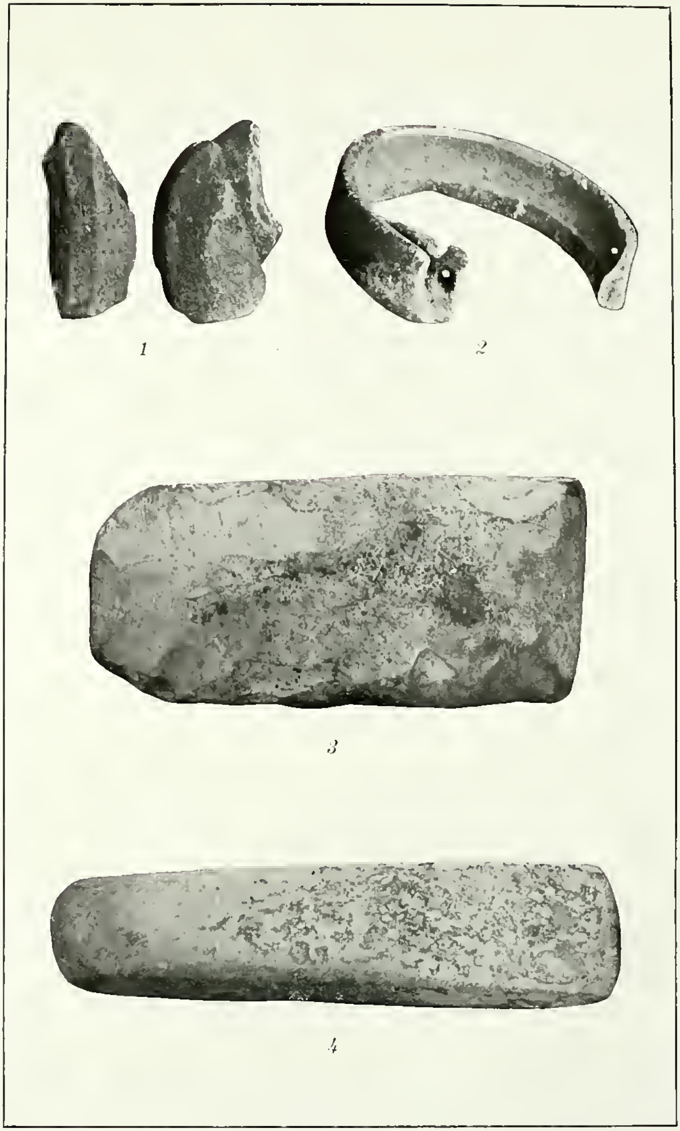


PLATE 5. ARTICLES FROM BATWAAN CAVES.

OPISTHORCHIS WARDI, A NEW SPECIES OF LIVER FLUKE FROM THE CAT IN THE PHILIPPINE ISLANDS

By LAWRENCE D. WHARTON

Dean and Professor of Zoölogy, Junior College of Liberal Arts, University of the Philippines, Cebu

ONE PLATE

In making postmortem examinations of cats for parasites at the College of Medicine and Surgery in Manila, the bile ducts of nearly 50 per cent of the specimens examined have been found to be infested with a species of *Opisthorchis*. The first specimens obtained were thought to be *Opisthorchis felineus* (Rivolta, 1884), and I sent a mounted specimen to Dr. H. B. Ward under that name. He very kindly sent me drawings of the type specimens of *O. felineus* and *O. pseudo-felineus* and pointed out several differences between my specimen and the other two forms mentioned. Since that time I have collected a large series of specimens from over twenty cats, all from Manila, and it was found that the characters which Doctor Ward had mentioned are constant and of sufficient importance to justify considering this form a distinct species. I therefore propose the name *Opisthorchis wardi* for this species.

Opisthorchis wardi sp. nov. Plate 1, fig. 2.

Specific diagnosis.—Body elongated, transparent, flat; length in preserved specimens, 6 to 9 millimeters; breadth, 1.6 to 2.2; living specimens, somewhat larger; anterior end conical, with a slight constriction at the level of the ventral sucker, posterior end rounded, occasionally with a small projection around the excretory pore; oral sucker 0.17 to 0.28 millimeter in diameter; ventral sucker about the same size and about one-fourth of the length of the body from the anterior end; pharynx 112 to 174 μ in diameter; œsophagus two to three times as long as the pharynx; intestinal cæcæ reach almost to the posterior end of the body; excretory pore at the posterior border; excretory bladder narrow, and extending to in front of the testes; testes in posterior fourth of the body, deeply lobed, anterior with four lobes, posterior with five lobes; ovary in the median line in front of the testes, with three distinct lobes, two to the right and one to the left; large saclike receptaculum seminis behind the ovary; Laurier's canal present; coils of the uterus extensive, filling nearly all of the middle half of the body; vitellaria lateral, extending from behind the ventral sucker to the level of the ovary, acini not in distinct groups, no distinct division into anterior and posterior portions; eggs, 28 to 30 μ by 11 μ.

Habitat and distribution.—Specimens found in the bile ducts of domestic cats from Luzon, Philippine Islands. Since coming to Cebu to live I have examined many cats with the hope of finding this parasite, but so far I have not found it on this island. I have had no opportunity to look for it anywhere else in the Islands.

The characters which distinguish this species from *O. felineus* (see Plate 1, fig. 1) are the relatively great length of the œsophagus, the distinct division of the testes and ovary into lobes, the simple arrangement of the vitellaria, and the greater extent of the uterine coils.

ILLUSTRATION

PLATE 1

FIG. 1. *Opisthorchis felineus* (Rivolta), from the type specimen of Doctor Ward.

2. *Opisthorchis wardi* sp. nov., from the type specimen in collection of Doctor Ward; cotypes in collection of L. D. Wharton.

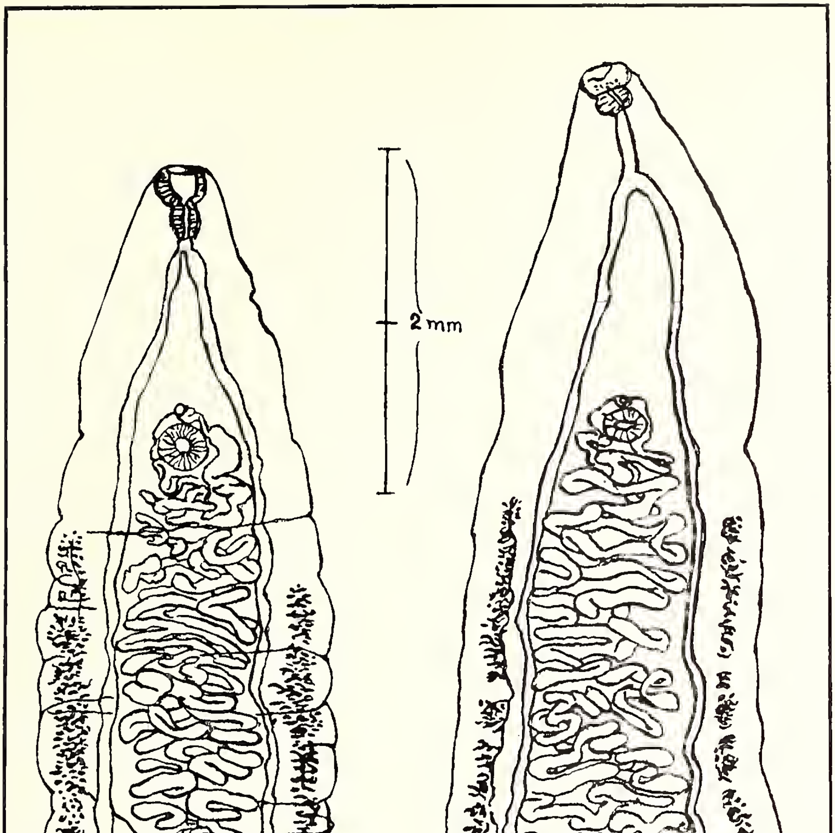


PLATE 1. OPISTHORCHIS FELINEUS (RIVOLTA) AND O. WARDI SP. NOV.

NOTES ON PHILIPPINE ALCYONARIA

PART VI: NEW PHILIPPINE PENNATULARIA (SEA PENS) OF THE GENUS LITUARIA

By S. F. Light

Professor of Zoölogy, College of Liberal Arts, University of the Philippines

The Philippine Pennatularia have been little studied, only eleven species being known from the Islands, all from the collections of Semper [1] and the *Challenger*.[2]

The present report deals with the specimens belonging to the genus *Lituaria* in the collection of the department of zoölogy, College of Liberal Arts, University of the Philippines, which represent four species, all new to science.

The only other representative of the suborder Sessilifloræ in the collection is the *Policella manillensis* of Kölliker,[1] here reported for the first time since Kölliker.

In this report I have adopted the systematic arrangement of the group suggested by Kükenthal in his revision,[3] and have followed him closely in the diagnosis of the genus *Lituaria* and the key to the species of the genus.

Suborder SESSILIFLORÆ

Polyps arising singly and directly from the rachis.

Section Pennatulina radiata

Polyps arising on all sides of the rachis.

Family VERETILLIDÆ

Polyps without a distinct calyx.

Genus **LITUARIA** Valenciennes MS., 1850

Colony club-shaped. Autozooids widely separated, scattered or in longitudinal rows. Siphonozooids very numerous, filling all the spaces between the autozooids. Axis of varying length and

[1] Kölliker, A., Abh. Senckenb. Naturf. Ges. 7 (1869–1870) 109–256; 8 (1872) 85–275.

[2] Kölliker, A., Report of the Voyage of H. M. S. Challenger during the years 1873–76 1[2] (1880).

[3] Kükenthal, W., Anthozoa, Pennatularia, Das Tierreich. Franz Eilhard Schulze, 43 Lieferung (1915).

always four-sided in the rachis region. Spicules are biscuit-shaped plates with warts and thorns, crosses, rods, and capstans with branched or warted ends.

This genus was instituted in 1850 by Valenciennes[4] in his manuscript for Pallas's long-known species *Pennatula phalloides*. Recently three other species have been added. Two of these, *L. habereri* Balss[5] and *L. hicksoni* Thomson and Simpson,[6] are new. One old species, the *Clavella* (*Sarcobelemnon, Veretillum*) *australasiæ* of J. E. Gray[7] has been referred to this genus by Kükenthal and Brock.[8]

Our collection contains specimens of four distinct types belonging to this genus, none of which can be identified with any of the four known species. These results might well be open to doubt were it not for the facts that these are the first species of *Lituaria* reported from the Islands, that the alcyonarian fauna of the Philippines is still to a great extent unknown, and that where it has been studied it has shown a surprisingly large percentage of new species.

Key to the species of Lituaria.

1. Axis with longitudinal furrows..2.
   Axis without longitudinal furrows.
   L. australasiæ (Gray) Kükenthal and Brock.
2. Axis with outgrowths on the upper end.
   L. phalloides (Pallas) Valenciennes.
   Axis without processes or outgrowths..3.
3. Axis not extending to the upper end of the rachis..L. kükenthali sp. nov.
   Axis extending to the upper end of the rachis..4.
4. Rachis of same length as stalk..5.
   Rachis longer than the stalk..6.
5. Polyp spicules up to 0.12 millimeter long..L. habereri Balss.
   Polyp spicules up to 0.20 millimeter long.
   L. hicksoni Thomson and Simpson.
6. Base of retracted autozooids directed upward, outer spiculated region triangular..L. philippinensis sp. nov.
   Base of retracted autozooids directed outward and upward, outer spiculated region not triangular..7.
7. Spicules of rachis averaging 0.13 millimeter in length, with long thorns..L. molle sp nov.
   Spicules of rachis averaging 0.085 millimeter in length, little branched at ends..L. breve sp. nov.

[4] Milne-Edwards, H., and Haime, Palaeontographical Society Monographs, Intr. p. 84.

[5] Balss, Abh. Bayer. Ak. suppl. 1, p. 81.

[6] Thomson and Simpson, Alcyonaria of the Investigator 2: 310.

[7] Gray, J. E., Catalogue Sea-Pens, British Museum, 33.

[8] Kükenthal and Brock, Ergb. Tiefsee Exp. 13: 117–170.

Lituaria kükenthali sp. nov.

Type.—No. C. 682 in the zoölogical collection, College of Liberal Arts, University of the Philippines; collected in Port Galera Bay on the north coast of Mindoro Island, by L. E. Griffin.

The rather slender, club-shaped colony, from 80 to 120 millimeters in length, ends in a slender stalk, from 5 to 12 millimeters in maximum diameter and from one-half to three-fourths as long as the rachis. The stalk shows no distinct swollen area. The rachis increases in size from the stalk to the blunt upper end. At or near its tip it reaches a maximum diameter of from 10 to 16 millimeters. The lower part of the rachis, while distinctly not a part of the stalk, bears no autozooids and in some colonies but few siphonozooids and might easily be mistaken for the upper portion of the stalk, in which case the stalk would appear to be of about the same length as the rachis.

The axis extends from the midregion of the stalk to a point about one-third the length of the rachis from the upper end of the colony. It tapers from a blunt end in the rachis region to a pointed but not recurved end in the stalk. It is four-sided and shows two deep longitudinal grooves in the rachis region which join over the blunt upper end. Those portions of the colony above and below the ends of the axis are often bent at an obtuse angle.

The large polyps are scattered at fairly regular intervals of from 1 to 3 millimeters, but are not in distinct rows. In expansion they are from 6 to 8 millimeters in length and from 2 to 3 millimeters in diameter at the base. They are transparent with the exception of a triangular brown area on the upper surface of the base of each polyp which gives the colony, particularly in contraction, a very characteristic spotted appearance. This spot fades in alcohol, leaving a transparent area. The extensile portion of the polyp contains no spicules and is completely retractile within low but quite distinct, outwardly and upwardly directed, spiculated basal portions which may or may not appear 8-rayed, depending upon the amount of contraction of the colony.

The siphonozooids, which are very numerous, filling all the spaces between the autozooids, appear near the base of the rachis to lie in crowded but distinct longitudinal rows.

The spicules, which are numerous only on the basal, nonretractile regions of the autozooids, are very irregular in shape and size, having the form of irregular clubs, crosses, capstans, etc., usually with divided ends and sculptured surfaces. They range in length from about 0.05 to 0.13 millimeter. The following are characteristic measurements in millimeters:

Capstans: 0.117 x 0.065 x 0.104; 0.104 x 0.039 x 0.052; 0.117 x 0.0455 x 0.08; 0.0845 x 0.026 x 0.065.

Clubs: 0.075 x 0.03.

Crosses: 0.0975 x 0.039; 0.0845 x 0.039; 0.117 x 0.039.

Irregular forms: 0.1235 x 0.091; 0.104 x 0.039.

There are no spicules in the inner or outer portions of the stalk.

The rachis is a grayish white, the spiculated regions a dead white, and the stalk grayish yellow in formalin or alcohol.

Measurements of specimens of Lituaria kükenthali sp. nov.

No.	Length of—			Maximum diameter of—	
	Colony.	Rachis.	Stalk.	Rachis.	Stalk.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
1	122	75	47	15	12
2	103	75	38	15	11
3	113	75	38	[a] 11	10
4	108	70	38	15	12
5	106	70	36	[b] 12	10
6	103	60	43	15	9
7	90	55	35	15	8
8	102	60	42	16	9
9	101	62	39	13	9
10	92	62	30	14	9
11	83	55	33	13	12.5
12	87	44	33	10	6
13	82	49	33	13	7
14	82	52	30	10	10
15	85	55	30	10	10
16	82	52	30	12	8
17	81	51	25	11	8
18	83	43	30	10	10
19	84	41	33	10	6
20	85	43	42	7	6

[a] Siphonozooids lacking on lower 15 millimeters of rachis.
[b] Siphonozooids very scarce on lower rachis.

This species differs from the four known species of the genus in the presence of the brown area on the upper basal portion of each autozooid which gives the contracted colony a characteristic spotted appearance. It differs from all but *L. australasiæ* in that the axis does not extend to the upper end of the colony, and from *L. australasiæ* in that the axis is deeply grooved on two sides in the region of the rachis and in the large size of its autozooids. From *L. hicksoni,* to which it is apparently most nearly related, it differs, aside from the difference in the length of the axis and the presence of the brown spot on the upper basal portion of the polyp, in the greater length of the rachis as compared with the stalk, in that the siphonozooids are arranged in distinct longitudinal rows, and in that the autozooids are considerably smaller.

I have named this species after Dr. Willy Kükenthal, whose revision of the Pennatularia has greatly facilitated systematic work in that group.

Lituaria philippinensis sp. nov.

Type.—No. C. 2459 in the Zoölogical collection, College of Liberal Arts, University of the Philippines; collected from Port Galera Bay, Mindoro, by R. P. Cowles.

The colony is slender and, with the exception of the lower portion of the stalk, rigid. The rachis is somewhat longer than the stalk and has a maximum diameter slightly less than that of the somewhat swollen lower portion of the stalk. The axis, which extends from the midportion of the stalk to the extreme tip of the rachis, is four-sided, slender, recurved at its lower end, and grooved on two sides throughout its whole length. It tapers from the middle of the rachis to the very slender lower tip, and less so toward the upper end, which is bluntly pointed. The grooves do not join over the upper end.

The polyps are scattered or in indistinct transverse rows or whorls, being from 2 to 3 millimeters apart in the long axis of the colony, and from 1 to 2 millimeters apart in the transverse axis. They are completely retractile within upwardly directed, flaplike, basal portions, which have a triangular, spiculated region on their outer surfaces. The polyps have transparent white walls with black or brown tentacles, or white tentacles and a brown stomodæum. The siphonozooids are numerous and distinct, irregularly arranged, each with a small nonretractile basal portion similar to that of the autozooids.

The spicules are unbranched or bluntly branched, sculptured capstans averaging 0.13 millimeter in length and 0.025 in central diameter.

Measurements of specimens of Lituaria philippinensis sp. nov.

No.	Length of—			Maximum diameter of—	
	Colony.	Rachis.	Stalk.	Rachis.	Stalk.
	mm.	*mm.*	*mm.*	*mm.*	*mm.*
1	103	60	53	6	7
2	87	55	32	7	9
3	92	50	42	6	7

This species differs from *L. phalloides* in the absence of any outgrowth from the upper end of the axis; from *L. hicksoni* in that the colony is much slenderer, that the nonretractile basal portions of the autozooids are of quite different shape and appearance, and that the spicules are smaller; from *L. australasiæ* in that the axis is deeply grooved; and from *L. kükenthali* in that the axis extends to the upper end of the rachis and in the absence of the characteristic brown area on the upper part of the polyp base.

From *L. habereri,* to which it is apparently most nearly related, it differs, so far as I have been able to determine from the rather meager description in Kükenthal's revision (I do not have access to Balss' description), in that the rachis is longer than the stalk; that the axis does not extend throughout the entire colony, ending below in the middle of the stalk; in that there are no spicules in the stalk rind; and in that the colors are different.

Lituaria molle sp. nov.

Type.—No. C. 2457 in the zoölogical collection, College of Liberal Arts, University of the Philippines; collected from Port Galera Bay, Mindoro, by L. E. Griffin.

The rachis, which is somewhat longer than the slender stalk, increases in size from the stalk to the blunt upper end where it reaches a maximum diameter of 10 millimeters. The entire colony is expanded and soft: hence the specific name.

The large, irregularly scattered autozooids reach a length of 10 millimeters and a basal diameter of 2 to 3 millimeters. The upper portion of the autozooids and the tentacles are brown. The numerous long, closely set pinnules are transparent white, as are the polyp walls. The lower portion of the stomodæum is brownish black and shows through the transparent polyp walls. The siphonozooids are few and scattered.

The four-sided axis extends from about the midregion of the stalk to the tip of the rachis. It is slender, pointed, and reflexed below and increases in size to a point near the upper end from which it tapers slightly to the bluntly pointed tip, showing two deep longitudinal furrows which do not meet over the upper end.

There are no polyp spicules. Those of the rind of the rachis are rather large capstans and stars with much-branched ends. They average 0.11 millimeter in length and are scattered, being thickest in the region around the base of the polyp, forming, in the upper region of the rachis, fairly distinct verruca-like structures.

The stalk rind contains scattered, unbranched, sculptured clubs, plates, and capstans. The colony, aside from the polyps, is yellow in formalin.

Measurements of a specimen of Lituaria molle sp. nov.

	mm.
Length of colony	130
Length of rachis	70
Length of stalk	60
Maximum diameter of rachis	10
Maximum diameter of stalk	9

This species, while based on a single specimen, seems distinct enough to stand without confusion. It differs from the other three Philippine species, among other things, in having spicules in the stalk rind; from *L. australasiæ* in having a grooved axis; from *L. phalloides* in having no outgrowths from the axis; from *L. habereri* and *L. hicksoni* in having a rachis longer than the stalk and in details of spiculation and in color.

Lituaria breve sp. nov.

Type.—No. 2458 [9] in the zoölogical collection, College of Liberal Arts, University of the Philippines; collected from Port Galera Bay, Mindoro, by S. F. Light.

The rachis is about twice as long as the slender stalk. The colony is slightly curved and tapers from about the middle of the rachis to the two ends. The autozooids are few, large, and irregularly scattered. In contraction they lie in outwardly and

[9] This species, like the others described in this paper, was described some time ago. Since then, unfortunately, the type specimens have been misplaced. In view of the very distinct characters of the species, however, I have considered it permissible to publish the description, in spite of the loss, temporary it is to be hoped, of the type specimens.

somewhat upwardly directed, heavily spiculated, verruca-like basal regions about 2 millimeters in diameter, whose large size in proportion to the diameter of the rachis gives the colony a characteristic, irregular appearance.

The siphonozooids are numerous and irregularly arranged and have spiculated nonretractile basal regions, similar to those of the autozooids, and are about 0.8 millimeter in diameter. In the lower one-third of the rachis the zooids are nonspiculated and 8-rayed, brown on the outer surface.

The axis is cylindrical in the stalk region ending in a slender recurved tip. It is four-sided in the rachis region, shows two shallow longitudinal furrows, and tapers toward the tip where, for a distance of about 10 millimeters, it is slightly roughened.

There are no spicules in the retractile portions of the polyps, in the stalk rind or in the rind of the lower part of the rachis. Those in the upper portion of the rachis are present only in the verruca-like basal portions of the autozooids and siphonozooids. They are small, averaging about 0.085 millimeter in length, sculptured, but little-branched, consisting mainly of plates constricted in the middle, crosses, and capstans.

The two colonies differ decidedly in detail due to the fact that one is immature and the larger colony has evidently been broken at some time and regenerated. The above description is an attempt to give a specific diagnosis. A study of new specimens will probably lead to some changes, but the species is so clearly distinct that it seemed justifiable to establish it here. Below are separate descriptions of the two specimens, in so far as they differ.

Specimen A.—Apparently a mature specimen. Length of colony, 69 millimeters; of rachis 49; of stalk 20. Maximum diameter of rachis 6 millimeters, stalk 4. Stalk constricted at point of union with the rachis. Rachis tapering to a point.

The axis, which extends from near the base of the stalk to the tip of the rachis, consists of two parts; the upper part, 25 millimeters long, has become attached throughout most of its length to the flat ungrooved side of the lower portion.

Specimen B; immature.—A very slender colony 40 millimeters in length. Rachis and stalk of about the same length, due apparently to the fact that the 8-rayed zooids found in the lower portion of the rachis of the mature colony have not developed. The autozooids and siphonozooids are somewhat smaller than in the larger colony, but they have the same form and arrangement. The spiculation is the same.

The similarity in the form of the colony, in the arrangement and form of the autozooids and siphonozooids, and in the spiculation mark these two specimens as belonging to the same, very characteristic new species.

CONTENTS

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.

VOL. 19, NO. 3 SEPTEMBER, 1921

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1921

181052

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science of the Government of the Philippine Islands

---

Manuscript intended for publication and books for review should be sent to the editor. One hundred separates of papers published in the Journal are furnished to authors without charge. Additional copies may be had at authors' expense.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

The Journal is issued twelve times a year. The subscription price is 5 dollars, United States currency, per year. Single numbers, 50 cents each.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 19 SEPTEMBER, 1921 NO. 3

FILARIASIS IN CHINA

By J. PRESTON MAXWELL[1]

Of the Peking Union Medical College, Peking, China

TWENTY-FIVE PLATES AND FOUR TEXT FIGURES

Among the causes of chronic invalidism and economic loss in China, filariasis may well be considered worthy of a place. It is true that the effects are not so striking in its influence on the death rate as those of plague among acute affections, or malarial fever and dysentery among endemic diseases; nevertheless in certain regions it plays a large part in diminishing the working capacity of a considerable number of the manual workers and in rendering many of them altogether incapable of work. The ætiology of the disease, considered in its broad aspect, is simple. With the one exception of an ocular filaria described first in China by Stuckey and Houghton(43) and now classified by Leiper(18) among *Thelazia*, there is only one filaria in China to be found in man; this is *Filaria bancrofti*. *Filaria perstans* has been seen once, but not in a Chinese, and there was no doubt that the infection had been acquired on the west coast of Africa, where the patient had previously resided.

Thus the subject of filariasis resolves itself into infection with *Filaria bancrofti*. This infection is carried out in China as elsewhere by the agency of the mosquito. *Culex fatigans* and *C. pipiens* are both common in China, although it is possible that there are other varieties of the Culicidæ that are potential carriers of the disease. According to Dutton(14) one variety of *Anopheles* is also a potential carrier. Post-mortem examina-

[1] Before coming to Peking, Dr. J. P. Maxwell was engaged in medical mission work in Fukien Province; this paper represents the results of twenty years' study of the subject and includes material that was compiled for a thesis, but which has never been published.

tions of its victims are still few in number, and there is much yet to be worked out concerning its morbid pathology.

We do not yet know, for example, how long it takes after infection before the embryos appear in the blood stream; nor do we know why hyperfilariasis does not take place in those who are continuously exposed to the bites of infected mosquitoes. We do not know how long the adult worms are capable of putting forth embryos, nor do we know the true cause of filarial periodicity. Occasionally it is possible for the parent worms to die as the result of a catastrophe, which may involve the human host and cause his severe illness or even death; and if this has taken place and the human host has survived, it is possible for the latter to become reinfected and again present the phenomena of the disease.

Yet again it is possible for the human host to harbor the parasite and present no symptoms of disease at all, the only evidence being the presence of the embryos in the circulating blood at the proper time.

The distribution of the disease throughout China is somewhat peculiar. Roughly speaking, the infection does not spread north of the Yangtse Valley, though individual cases of the disease may be met with farther north. These individuals, however, have been infected in the southern regions and not in the northern.

Following the line of the Yangtse River west, the disease is found sporadically along both banks and also in Kweichow and southern Szechwan, getting less and less frequent as one ascends the river.

Coming back to the coast from the mouth of the Yangtse down to the Tonquin border there is a belt some 15 to 25 miles (25 to 40 kilometers) broad, and the major portion of the disease is found in this coast belt. Most of the islands off the coast are also infected, but not heavily. When one passes inland beyond this belt, the infection is practically lost, although occasionally a small patch of infection may be found on the higher reaches of a river; for it tends to spread upward along the banks of all the rivers between the mouth of the Yangtse and the Tonquin border, but not to any considerable distance. Kiangsi is entirely free, and Fukien away from the coast belt is uninfected, and when imported inland, except in the larger river vicinities, the disease does not, according to my experience, tend to spread.

The case incidence, of course, varies with the region and, speaking broadly, increases toward the south and decreases toward the north. Taking a large hospital about the middle of the coast belt, I found a percentage of 2.4 of filarial cases, who came to the hospital for some disease connected with this infection (Changpu, Fukien) ; but this does not represent the incidence of filarial infection in this region. My figures give a percentage of 24.8 of the general population infected with the parasite, and the work of my successor at that hospital, Dr. J. H. Montgomery, shows a slightly higher figure.

Besides these figures, 3.39 per cent of the general population showed no embryos in the blood, but presented signs of old filarial disease, while 16.1 per cent of another series were found, on microscopical examination, to be infected but presented no signs and had no history that could be attributed to the presence of filaria.

With regard to the age incidence, taking a series of 67 cases affected with filarial disease, we have the following findings:

TABLE 1.—*Showing age at which disease commenced in sixty-eight cases.*

Ages in years.	Cases.
1 to 10	1
10 to 20	6
20 to 30	22
30 to 40	25
40 to 50	10
50 to 60	3
Above 60	1

TABLE 2.—*Showing duration of disease before patient's first visit to hospital.*

Years.	Cases.
1	7
1 to 5	28
6 to 10	17
11 to 15	9
15 to 20	6

According to the nature of their disease, a series of two hundred sixty hospital patients can be classified as follows:

TABLE 3.—*Two hundred sixty patients, classified according to disease.*

	Cases.
Elephantiasis of scrotum	48
Lymph scrotum	44
Elephantiasis of right leg	35
Elephantiasis of left leg	43
Elephantiasis of both legs	13
Filarial abscess	33
Filarial gangrene of scrotum	8
Lymphatic fistula	6
Chyluria	4
Other filarial diseases	26

All classes and varieties of individuals may become subjects of filariasis. The oldest patient in this series was 64 years of age; the youngest patient was 13, but patients may be infected at a still younger age.

There is no doubt that for some reason the female sex in this region is not so subject to filariasis as is the male sex. This may be partially due to dress, the women keeping their legs and ankles much more covered than do the men.

Of the two hundred sixty cases listed in Table 3, only five were women.

I am unable to give the statistics of infection among women in the general population, as they are so superstitious that there has been great difficulty in obtaining specimens of their blood; but granting that the mosquito-infection theory is correct, there is no absolute reason why anybody and everybody should not become infected.

There is no doubt that the field laborer is more subject to this disease, and to its severer forms, than the literary man and the shopkeeper. Probably the amount of leg that is normally bare contributes to this fact, and the rough, dirty work greatly assists such diseases as elephantiasis of the scrotum and leg.

It has been surmised that the fisherman is especially subject to the disease, but there is not sufficient evidence to support this assertion. Very often the immediate inhabitants of the seaboard are badly off and do not get sufficient to eat, and the exposure to salt-laden wind and blowing sand would assist the development of elephantoid changes.

Let us now turn to the parasite itself and the diseases of which it is the cause. The embryonic form of *Filaria bancrofti* was first discovered in 1863 by Demarquay(13) in a case of chylous dropsy of the tunica vaginalis. In 1866 Wücherer(46) found the same form in a case of chyluria. In 1870 Lewis(19) confirmed this in a case in India. In 1872 the same observer discovered that the blood of man was the normal habitat of the parasite. In 1874 Sonsino,(42) without knowledge of Lewis's discovery, made the same observation in Egypt.

The parental form was first discovered by Bancroft, sr.,(2) in Australia.

The discovery of the mosquito as the intermediate host was made by Manson in 1877;(24) and Bancroft, jr.,(3) in 1899, demonstrated that the complete metamorphosis takes about sixteen days.

Finally Low,(20) in 1900, showed that the filaria, after attaining its proper development, makes its way into the proboscis of the mosquito, apparently with a view of leaving the mosquito when it bites, and this migration generally takes place in pairs.

The parent filariæ [2] have been found many times. They are nematode worms, both sexes being found in the human body "often inextricably coiled about one another." They are some 3 to 4 inches (7.6 to 10.2 centimeters) in length, hairlike, and transparent. They have been found in many situations: in lymphatic trunks, in lymphatic varices, in varicose lymph glands, in the tissues removed in operating on lymph scrotum, in the tissues removed in operating on elephantiasis of the scrotum, and in filarial abscesses. The female worm is the larger of the two. In length, it is from 3 to 4 inches (7.6 to 10.2 centimeters); in breadth, about 1/90 of an inch (0.2 millimeter); the greater part of the body is occupied by the two uterine tubes, containing ova in all stages of development. The head is club-shaped and simple, and the tail is tapered and rounded off, with the anus opening just in front of its termination. The vagina opens near the mouth. The cuticle is smooth and devoid of markings.

The male worm is very slender and has a marked tendency to curl. The extreme end of the tail is sharply incurved. The cloaca gives exit to two unequal, slender spicules. Caudal papillæ are present. These parent filariæ have considerable mobility and can be kept alive in salt solution for some hours. Having described the parental forms of the worm, let us look at the characters of their progeny.

The ova are not normally found in the blood or lymphatic system; in fact, the appearance of these probably means that parturition has not gone on normally and has an important bearing on the question of lymphatic obstruction. I have met with them once in a case of lymph scrotum, in a microscopic preparation got by tapping the lymphatic system of that part, and in this case repeated examination failed to find the embryo in the blood. On the other hand, the embryo could be readily made out coiled up inside the ovum. The size of these ova is stated by Manson (25) to be about 1/500 by 1/750 of an inch (0.051 by 0.034 millimeter). The embryo coiled up in the ovum gradually stretches its chorional envelope, which probably forms the sheath of the mature filarial embryo.

In describing the embryos of *Filaria bancrofti*, as commonly met with in the blood, I largely follow Manson's description,

[2] For a full description of the parent filariæ and their embryos see Tropical Diseases. Cassell, London (1917) 681–702.

having verified the same in all points. When examined in a fresh specimen, the worm is easily made out as a transparent, colorless, snakelike organism, which wriggles about very actively among the blood corpuscles, but which does not rapidly pass out of the field of vision. It has a long, slender body, inclosed in a delicate, structureless sheath, in which it easily moves backward and forward. This body is blunt at the one end and pointed at the other. It is about 1/80 of an inch (0.317 millimeter) in length and 1/3000 of an inch (0.0085 millimeter) in breadth. It is most easily found with a 1-inch objective, but for the details a higher power must be employed.

Carefully examined under a higher power and with the assistance of a staining reagent, a musculocutaneous layer is made out, in which delicate transverse striation can be discerned. An indefinite viscus can also be made out in the center portion of the worm, rather toward its posterior end. A shining V-shaped spot is clearly to be seen about the junction of the head fifth with the remaining four-fifths of the body. This spot is well shown on staining with dilute hæmatoxylin, but is readily seen in unstained specimens. By staining, however, a second spot is also brought out a short distance from the tail, much like the first in form. The exact meaning of these spots is not quite clear, but it is suggested that they are connected with development. In the interior of the musculocutaneous cylinder is a mass of cells whose nuclei are brought out well by staining. There is a break in this central column of nuclei at a spot just posterior to the anterior V-spot, but the significance of this break is not yet understood.

The head is covered by a delicate 6-lipped prepuce, and a short fang is occasionally to be made out, protruding from the head, in specimens where the worm has almost ceased movement.

One of the most notable things about these filariæ is the feature that goes by the name of filarial periodicity. In the case of the embryos of *Filaria bancrofti* it is the rarest thing to find one of these in the peripheral blood during the day. About 5 or 6 o'clock in the afternoon a few begin to appear, and the number gradually increases until the maximum is reached, about midnight. The number then gradually diminishes until about 6 or 7 o'clock in the morning, when they disappear from the blood altogether till the following evening. If, however, the filarial subject be made to sleep during the day and rise at night, it is possible to reverse these conditions and cause the filariæ to appear during the day instead of at night. In the

Philippines it is known that this periodicity is usually lacking, and by the acetic acid concentration method, even where the regular periodicity prevails, it is possible to show that microfilariæ are never entirely absent from the peripheral blood.

What is the cause of this periodicity? To answer that it is a provision to enable them to be reached by their intermediate host is only to throw the question a step further back. What then is the cause that leads them to forsake the periphery during the day? Possibly it has to do with the accumulation in the body of some chemical substance which, while producing sleep, tends to attract the filariæ to the periphery. In this connection an article by Lynch [3] is of importance as confirming the views of Smith and Rivas that the mechanics of the capillary circulation play a large part in the production of filarial periodicity. He gives details of some experiments with drugs which alter the vessel tone. A vasodilator such as nitroglycerine was followed by a decrease of the embryos in the peripheral blood, while vasoconstrictors such as epinephrin or pituitrin were followed by an increase of these embryos, and a collapsed lung in a dog accumulated microfilariæ immitis in enormous numbers.

Their absence from the liver and spleen during the day, as proved by the results obtained from aspirating these organs, is remarkable. These results have been completely confirmed by the post-mortem examination reported in 1899, by Manson, (26) of the case of a man harboring this parasite who committed suicide during the day by swallowing prussic acid. In this case the liver and spleen were both practically free from embryos, and both of these organs are markedly concerned with metabolic processes.

Where do the embryos retire to during the day? In the case of suicide above quoted they were found to be distributed as follows:

TABLE 4.—*Distribution of embryos in body of man dying in the daytime.*

Lung	Many.
Large vessels near heart	Many.
Vessels of heart wall	Many.
Brachial venæ comites	Moderate number.
Liver	Almost absent.
Spleen	Almost absent.
Brain	A few.
Scrotum	None.

[3] Lynch, K. M., Filarial periodicity, Journ. Am. Med. Assoc. 73 (1919) 760.

How they, in their sheaths, manage to maintain their position in the larger vessels against the blood stream is as yet unexplained.

So far we have dealt with the parasite in its human host; now we must deal with its progress through its intermediate host.

By artificial means it is quite possible to make the filarial embryo cast its sheath. One of the best ways is to lay the preparation in an ice box overnight. When the slides warm up next day, wherever the blood has become laky, the filariæ endeavor to break through their sheaths, and in a short time they succeed in doing so and move very freely about the slide.

After the blood has passed into the mosquito's stomach, the same proceeding takes place. A few hours after feeding, this can be easily observed, and in another few hours the mosquito's stomach is found to contain only the empty sheaths. Where have the filariæ gone? As soon as they lose their sheaths, they become able not only to move about freely, but also to pierce the stomach wall.

They are found to have passed into the muscles of the mosquito's thorax. There they undergo a metamorphosis lasting some sixteen to twenty days, a proceeding which has for its result the formation of a mouth, an alimentary canal, a peculiar, trilobed tail, and finally a parasite much grown in size and activity. The metamorphosis being completed, they pass forward for the most part to the cephalic region, a few only passing backward into the tissues of the abdomen.

From the head they pass often in pairs into the proboscis, and are conveyed thence into the human host when the mosquito bites. They lie in the proboscis between the under surface of the hypopharynx and the upper surface of the labium, extended in the loose connective tissue of the latter.

As far as my researches go, in at least 95 per cent of the cases especially examined for eliciting the source of infection there was either a near relative, or a neighbor, or some one of the same village to be found as a possible source. But there were also cases like that shown in Table 5.

In this case the mother had lived with the father for at least twenty years after he started elephantoid fever, but she had never suffered from any form of filarial disease. Her blood was quite free from the parasite. The sons, who were infected and noninfected, had always lived together and slept two in one bed and three in another. The two infected ones had acquired the disease about thirteen and twelve years previously; at least their attacks of fever began about that time. Although they had continued to live cooped up in this way, no other member of the family had been infected.

TABLE 5.—*Showing irregular incidence of infection of one family by filariæ.*

	Age.	Condition.
Father		Dead; had slight elephantiasis of leg.
Mother	60	Uninfected.
Girl	18	Bought. No sign of disease.
Son	37	Uninfected.
Do	34	Do.
Do	31	Infected.
Do	29	Do.
Do	26	Uninfected.

Three years ago one of the infected individuals went to live in a separate house with his aunt and cousin. Although mosquitoes infected with filariæ have been found by me in this house, and there is nothing to prevent the members of the household being freely bitten, yet this aunt, aged 50, and cousin, aged 13, remain uninfected. The other infected individual married two years ago, and his blood literally swarms with filariæ, yet his wife at the present time shows no sign of disease.

How are these facts to be explained? It may be declared that in order to bring about a successful infection the mosquito bite must be in a region richly supplied with lymphatics and that probably this has not been the case in these persons. Both of the infected brothers are, otherwise, strong and healthy, and they were in good health when the attacks began. This tends to negative any theory that rests on the premise of lowered vitality as the cause that makes successful infection take place.

The probability that a single individual can be infected more than once, and that many mature worms may be found in the same subject, seems on the other hand to indicate that, in some instances at least, infection is not a work of great difficulty.

It is very probable that many people are bitten by the filaria-infected mosquito, with the result that the worm passes into their tissues, but it does not follow that embryos appear in the blood of such patients. For the appearance of these, it is necessary that the female worm should be present and should have been fertilized by the male.

Let us suppose that the male fails to find the female. Possibly they die and are absorbed without giving trouble.

At the same time, it is possible that a single worm might, by setting up an inflammatory process, lead to the blockage of a main lymphatic trunk, in which event embryos would be absent, and yet the case might present some of the characters of filarial disease. It is quite possible also that such a worm in its death might give rise to filarial abscess.

In this connection one may perhaps refer again to the tendency of the worms to pass in pairs into the proboscis of the mosquito; it may be intended by nature thus to provide, by the introduction of a male and a female, for reproduction.

The whole subject is one that needs careful working out, in view of its importance in devising prophylactic measures. For the present no doubt the mosquito net is the reasonable means of prophylaxis, each infected individual being a source of danger to the community.

MICROSCOPICAL DIAGNOSIS

For examination of fresh specimens, it is only necessary to take a large drop of the patient's blood, cover it gently with a cover glass, and examine it under a low power of the microscope, when the filaria is easily distinguished by its movement. If such preparations are ringed with vaseline, it is possible to preserve them for some time: at any rate, the filariæ may be kept alive for at least a week.

For systematic study it is better to keep to a fixed time. In these researches for statistical purposes all the specimens were taken between 9.30 and 10 o'clock in the evening. As my patients used to go to sleep at an early hour, and were up at daylight, this time was late enough.

For this class of work it is better to use specimens prepared in the following way: The blood is taken from the finger or ear, a lancet or triangular needle being the best instrument for the purpose. Several drops of blood should be received on a glass slip and spread out gently with the needle. The slide must then be laid aside on a flat surface and covered, to prevent dust spoiling the specimen. Two specimens at least should be taken from each patient. As soon as convenient, and the sooner the better, these slides, which must be already dry, are fixed by warming them over a spirit flame, and then are immersed in water. This dissolves out the hæmoglobin and leaves a colorless specimen, which is then placed in a watery solution of methylene blue for a few minutes, passed through water, and examined wet without a cover glass under a 1-inch objective. The filariæ are easily distinguished, being stained a distinct blue. The white corpuscles take the dye; the red corpuscles remain unstained.[4] In this work a mechanical stage with parallel movement is quite indispensable. If it is wished to prepare permanent specimens of filariæ, a patient should be selected in whose blood there are many embryos. A very thin preparation of blood should be taken and fixed with alcohol or heat. The hæmoglobin is washed out by water acidulated with a little acetic acid; the specimens are stained with any stain that may be wished and are mounted permanently in balsam. For single stains, hæmatoxylin or methylene blue are very good, while for double staining hæmatoxylin and eosin make a good combination.

I have already stated that the staining should be done as soon as possible. It is possible to leave the slides in a dry place for months and yet get a satisfactory result, but the removal of the hæmoglobin becomes more difficult, and the specimen does not stain well. It need hardly be said that, in taking the blood, due care must be taken. The needle or lancet must be carefully sterilized, and the skin of the part from which the blood is to be drawn should be cleaned first with soap and water and then with spirit. If this is done, there are never any unpleasant effects following.

The acetic acid concentration method of Smith and Rivas[5] is of great use in giving a quantitative estimation of microfilariæ in the blood.

The method is as follows:

> From 0.1 cc. to 1.0 cc. of blood is taken from the finger and collected in 5 cc. of a 2 per cent acetic acid solution for the purpose of laking the blood. The mixture is shaken gently for several minutes and then centrifuged and spreads are made from the sediment.

Lynch[6] used 1 cubic centimeter of blood in 10 cubic centimeters of 2 per cent acetic acid solution, centrifuged, washed and recentrifuged several times, spread the sediment on a slide and counted the whole number in the sediment.

During 1902 Gulland (15) suggested the possibility of the diagnosis of filariasis from a differential count of the leucocytes in the blood of the patient. He pointed out that filariasis is accompanied by a leucocytosis proportional to the number of

[4] For this method, which works very well, I am indebted to Sir Patrick Manson.

[5] Smith, A. J., and Rivas, D., Notes upon human filariasis, Am. Journ. Trop. Dis. and Preventive Med. 2 (1914) 368.

[6] Lynch, K. M., Filarial periodicity, Journ. Am. Med. Assoc. 73 (1919) 760.

filariæ found in the peripheral blood. Not only are the leucocytes increased in number, but there is a distinct condition of eosinophilia, which also varies in proportion to the number of filariæ present. Gulland's observations have been confirmed by Coles,(10) whose percentages are given in Table 6.

TABLE 6.—*Cole's differential count percentages.*

Leucocytes.	Case I.	Case II.	Normal.
	Per cent.	*Per cent.*	*Per cent.*
Multinuclear	34	43	60-75
Lymphocytes	44	33.5	24-30
Large uninucleated	7	6.5	3-6
Eosinophile	15	17	2, not above 3.

There is also a constant high proportion of lymphocytes, while there is a low percentage of polymorphonuclears.

At first sight it looks as though the data given in Table 6 might be a method helpful to diagnosis, but so far as I can judge the range of usefulness is very small; for, in the first place, it is just in the cases where the embryos are very difficult to find that the eosinophilia is least and therefore inconclusive; and, in the second place, *Ascaris, Oxyuris, Tænia*, and *Ancylostoma* are all prone to produce an eosinophilia.

In the region in which I worked the majority of the people were infected with *Ascaris*, while ancylostomiasis and other worm infections are by no means rare. With this knowledge, given a doubtful patient with a slight degree of eosinophilia, one would hesitate to say, on this ground alone, that he was the subject of filariasis; while, if the parasite be found in the blood, the method is unnecessary for diagnostic purposes.

A very valuable paper on this subject has been written by Whyte of Swatow, China.(44) Calvert(6) argued that eosinophilia is greatest when microfilariæ are absent from the peripheral blood; but Whyte hesitates to accept this view, and I agree with him.

FILARIAL DISEASES

In the first place, it must be again borne in mind that often the filarial worm gives rise to no inconvenience whatever and appears to be absolutely innocuous. It may be harbored for years without the host having any idea of its presence. The diseases dependent on its presence may be classified as follows:

I. Inflammatory mischief, either directly or indirectly connected with the parasite.
   1. Elephantoid fever.
   2. Lymphangitis.
   3. Erysipelătoid inflammation.
   4. Dermatitis and cellulitis.
   5. Abscess.
   6. Orchitis.
   7. Acute arthritis or synovitis.
   8. Gangrene of the scrotum.
   9. Filarial hæmoptysis.

II. Disease due to obstructive interference with the lymphatic system.
   1. Lymphatic varix.
   2. Lymphatic fistula.
   3. Varicose groin glands.
   4. Lymph scrotum.
   5. Chyluria.
   6. Chylous dropsy of the peritoneum.
   7. Chylous dropsy of the tunica vaginalis.
   8. Chylous diarrhœa.
   9. Elephantiasis scroti.
   10. Elephantiasis vulvæ.
   11. Elephantiasis of the legs.
   12. Elephantiasis of the arms.
   13. Elephantiasis of the mammæ.
   14. Elephantiasis of limited skin areas.

INFLAMMATORY MISCHIEF, EITHER DIRECTLY OR INDIRECTLY CONNECTED WITH THE PARASITE

ELEPHANTOID FEVER

Elephantoid fever is somewhat of a misnomer, as the fever is by no means always followed by elephantiasis; but its meaning is now so well known that there is no fear of confusion.

Fig. 1 shows very well the characteristics of a typical case. A filarial subject may be attacked in one of two ways. In the one form, after an hour or two of malaise, he is suddenly taken with a rigor, which may be exceedingly severe, but which is generally of moderate severity. The temperature rapidly rises, and the patient feels very ill, with a hot and burning skin and sometimes marked nausea. This condition persists for from forty-eight to seventy-two hours, and then the temperature falls with moderate rapidity, reaching the normal in from twelve to twenty-four hours. This fall is often accompanied by profuse sweating. In the other form there is no rigor, but there is malaise for some hours before the attack. There is also marked uneasiness or tenderness in some lymphatic region. The temperature rises rapidly, and the patient is as ill as in the preceding case, and the course and the termination of the affection are much the same.

It must be clearly understood that elephantoid fever may take place without any external signs of lymphangitis; on the other hand, very often there are definite signs of inflammation

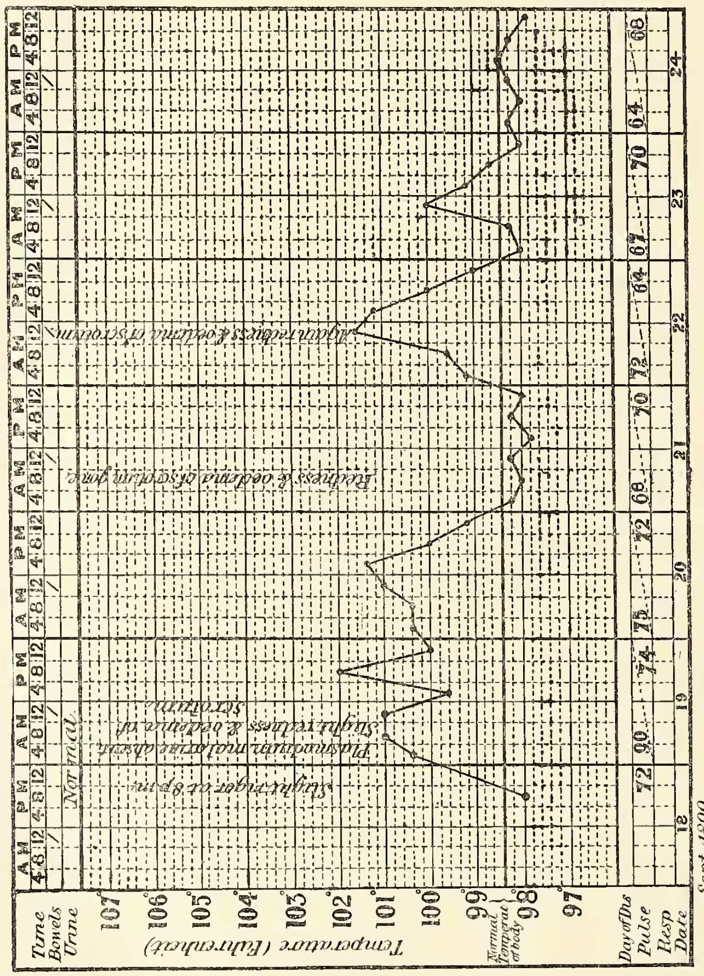


Fig. 1. Chart of elephantoid fever.

in a lymphatic region, although occasionally these are limited to the one physical condition of tenderness. Although elephantoid fever has been classified as an entity separate from lymphangitis, it is a question whether there is not in every case an affection of the deep or superficial lymphatics.

During these attacks there is often severe headache, delirium, and anorexia. Predisposing causes to an attack are a severe strain, as seen in the case of the burden bearers of this district; but overfeeding is a still more potent cause. During four years I frequently had, as one of my burden bearers, a man whose blood swarmed with filariæ. Sometimes he used to visit an island where the people were most hospitable and fish was plentiful; as often as he visited this place, this man got an attack, apparently through overfeeding. Cold and wet do not seem to be very potent causes in bringing on an attack.

As to treatment, there is no need to order the patient to bed, for he is feeling too ill to wish to be anywhere else. When an attack is well under way, there is no form of treatment that will stop it; but if the case be seen before the fever has started, it may be partially or wholly aborted by a sharp purgative and a stiff dose of quinine. Three or four "Livingstone rousers" and 15 grains of quinine in acid are a good prescription, and the fever has been cut short by this method in a remarkable way.

If there is a manifest accompanying lymphangitis, this should be suitably treated. Phenacetin sometimes gives relief to the headache and diminishes the fever, but its action in this respect is not at all certain. It may be said, generally, that once the fever is established, expectant treatment is the only course open to the medical man.

There is but little practical difficulty in the diagnosis of elephantoid fever. As a rule, there is some accompanying lymphangitis; and even if there is none, generally the native is quite able to distinguish between it and malarial fever. On one occasion a man walked into the consulting room and told me that he was suffering from both filarial fever and malarial fever. He was quite right, his malarial attack taking place at the time he foretold it, the quartan parasite being easily found, and two attacks of filarial fever occurring during his fortnight in the hospital. This case had no manifest accompanying lymphangitis.

LYMPHANGITIS

In the great majority of forms of filarial disease, lymphangitis is present at one time or another. If the affected lymphatics are on the surface, the characteristic red streak on the skin and the tender cordlike swelling of the lymphatics are very manifest almost at the commencement of the attack. Often, even before the commencement of the fever, the lymphatic glands of the implicated region are a little swollen and tender. If the attack is at all severe, the inflammation will spread to the surrounding parts, the skin of which will become tense and shiny.

Should the inflammation proceed farther, a severe cellulitis may ensue, or lymphorrhagia may take place.

As a rule the inflammation subsides under appropriate treatment, leaving behind, however, a legacy in the shape of some permanent thickening. This thickening is variable in amount, and it is almost impossible to predict in any given case what measure of thickening will be left.

The area of inflammation is sometimes very extensive. In one case the lymphatics of both cords, superficial lymphatics of the scrotum, and the lymphatics of the upper parts of both thighs were affected, and the condition of the patient was by no means enviable. But in other cases the inflammation of the lymphatics is confined to a very narrow area. In the upper arm this is often the case, and the inflammation in one patient was confined to an area less than 2 inches (5 centimeters) in length in the region of the brachial artery.

I have seen filarial fever without manifest lymphangitis; I have never seen filarial lymphangitis without fever of greater or lesser degree.

Diagnosis is easy, as a rule, as the absence of local cause and the presence of filariæ in the blood are readily determined. If there is a manifest possible local cause, it is sometimes difficult at first sight to be sure, but before long the course of the case gives clear indication.

As to treatment, rest, lead and opium lotion, and the treatment previously advised for elephantoid fever quickly clear up the trouble.

If the attack fails to resolve, a careful watch must be kept for the formation of abscess. It has been recommended that the swollen area should be scarified or pricked. Experience leads me to advise strongly against this procedure. It is extremely difficult to keep the parts about the scrotum, especially in natives, aseptic; and it is quite possible to start a most troublesome lymphorrhagia. In a few cases, after the inflammation has subsided, it may be advisable to dissect out the thickened lymphatics, and sometimes in this way it has been possible to secure the parent worm, which by its presence may have given rise to the lymphatic inflammation.

ERYSIPELATOID INFLAMMATION

It becomes necessary to use a name such as erysipelatoid to describe erysipelatoid inflammation, for the term "erysipelas" would convey a false idea. While it is no doubt true that the superficial resemblance between this affection and erysipelas is by no means slight, yet there are very important differences to be noted. Foremost among these is the practically non-contagious nature of this disease. In earlier practice it was feared that Chinese students might carry infection from such cases to operation cases, but it was soon found that this danger was a negligible quantity, as cases may lie alongside newly operated cases without any harm occurring. In spite of this, however, it is not an advisable thing, as it is quite possible for a filarial subject to get ordinary erysipelas, and the distinction is not always easy.

The rash, too, is far more diffused and, as a rule, it has no clearly marked, raised border. Argument from the constitutional symptoms cannot be used, as these vary within wide limits. It is not at all uncommon to see several of these affections of filarial origin present at the same time in one and the same patient, thus preventing any definite deductions from constitutional symptoms. Generally the diagnosis from erysipelas is easy because of these concomitant filarial affections; but occasionally a patient will come into the hospital with erysipelatoid inflammation and cellulitis of one leg, in whom this is practically the first serious symptom of the disease, and in such a case it is almost impossible to make an absolute diagnosis from erysipelas at first sight.

I have not found it possible to follow the Brazilian (5) physicians in dividing erysipelatoid inflammations into several classes. The only division that seems to me to be at all useful is to distinguish two forms:

a. Erysipelatoid inflammation of all degrees of severity from simple erythema to an acute type to be described later, and which generally terminates in the death of the part.

b. Ordinary erysipelas in a filarial subject.

The form in which the joints are simultaneously attacked is dealt with in a separate section.

What is the materies morbi in these cases?

In the case of *b* undoubtedly the poison is *Streptococcus erysipelatis,* and the pathology of these cases is perfectly well known.

In the case of *a,* however, the pathology is not so clear. There is, undoubtedly, lymph stasis in the infected area, and bacteriological examination of these cases is much needed. Such work as has been done is not conclusive. There is evidence to show that it is not merely a case of poison introduced from the outside. If a lymphatic fistula becomes established in an affected region (and very often a leg ulcer may serve the purpose), no attacks of filarial fever or erysipelatoid inflammation will occur as a rule, so long as drainage is kept up. Heal the ulcer or close the fistula, and the attacks recommence. This lends some weight to the view that these filarial inflammatory attacks are due to a poison that is generated in the body itself and not introduced from the outside into tissues that are merely weakened by the presence of the parasite or into an area of lymph stasis.

It is very easy to say that all these attacks are set up by small wounds, scratches, insect bites, and the like, but the evidence on this matter is far from satisfactory. Careful examination has often been made for a point of local infection; but, although sometimes points that might serve can be found, it is difficult to satisfy oneself that such was the actual point of infection.

Treatment consists of rest in bed and elevation of the affected part. In the case of the leg, wrapping it in a continuous cold-water dressing gives great relief in some cases. The bowels should be kept well open, and quinine and iron should be given internally. One of the marked features is the lingering character of some of these cases. An attack may last only a few days; on the other hand, it may drag on for a fortnight or three weeks. Not infrequently second and even third attacks may supervene while the patient is in bed recovering from the first.

DERMATITIS AND CELLULITIS

The section on dermatitis and cellulitis need only be dealt with shortly, as it concerns a more acute form of the inflammation seen in erysipelatoid inflammation or lymphangitis. Clinically it is just like an ordinary cellulitis, only much more amenable to treatment. For this reason it is not necessary to be in a hurry to incise, as many cases will yield to the treatment described in the last section. An additional reason for being cautious is that wounds made under these circumstances heal very slowly. A simple incision in a case of this kind may take seven months to heal. On the other hand, if it is clear that there is imminent danger of extensive sloughing, then free incision should be made at once, as the effects of extensive sloughing are most disastrous. As an illustration may be adduced the case of a man who came under care in the last stage of this trouble. He was greatly emaciated; he had had cellulitis in the lower part of both thighs, with the result that both legs were the subject of bad contracture. The cellulitis had also left him with lymphatic fistulæ on the outer surface of each thigh. Both legs were the subject of elephantiasis, and the condition of the man was miserable beyond description. He was extremely anæmic and died of exhaustion ten days after entering the hospital.

In rare cases the dermatitis becomes ulcerative. Of this only one good instance has been seen by me. It is always the result of infection of the bullæ which are apt to form on the surface of a limb that is already affected by erysipelatoid inflammation or the like. It must be treated like any ordinary ulceration, its pathology being precisely the same.

ABSCESS

Abscess of the scrotum is a disease by no means common in England even when we include tuberculous abscess connected with the epididymis and testicle, and it was a cause for some surprise and not a little incredulity to be confronted, soon after arrival in China, by a patient whose scrotum, swollen to the size of a fœtal head, appeared to be little more than a bag of pus.

The history of this patient was a curious but at the same time a typical one, although at the time it was not known to be such. Fifteen days previously, while at work, he had been seized with a violent rigor, which lasted about ten minutes and then passed into fever, which had been persistent since. He was cognizant of no previous illness, and denied any attacks of lymph fever, stating that he had been a strong man all his life. He was aged 42 years. He refused to come into the hospital, and I was unwilling to operate in his dirty hovel. Eventually part of the scrotum sloughed, and after a long illness, the man recovered. He was, however, subsequently troubled by attacks of elephantoid fever.

In seeking for the cause of this and subsequent cases of a like nature, gonorrhœa could easily be excluded, as not more than 30 per cent of the patients confessed to having had it. None of them had stricture of the urethra, and the orchitis, when present, was slight; in many cases it was absent. Besides the fact that the abscesses were mostly outside the testicle and seminal tract, the further knowledge that Morris [7] did not mention such an affection put it almost out of court.

[7] Diseases of the Urinary and Generative System. Cassell, London (1895).

Injury, with the suppuration of consequent hæmatoma, next suggested itself as a possible cause. But in every case in the list injury could be absolutely excluded.

Infection by the bite of some insect could also be excluded. Manson(27) mentions abscess as a manifestation of filarial disease, but it is well to realize that this may be the first and only manifestation. Systematic examination of the blood of the patients who suffered in this way showed every one to be suffering from *Filaria bancrofti;* and, in considering the subject of filarial abscess, every doubtful case (that is to say, every case in which lymph fever could not be found or a definite history obtained of this symptom) has been excluded. Only about one in ten abscesses judged to be filarial in origin has been excluded owing to this test, and none of these were abscesses of the scrotum.

To turn to the general question of filarial abscess, its incidence is naturally limited only by the incidence of infection with the filarial parasite, and it may occur either as an incident in the course of filarial disease or as the first symptom and sign of the same. It may occur in any situation where there is loose connective tissue, rich in lymphatics, and for this reason the majority of abscesses outside the scrotum are in the vicinity of the great vessels, and the abscess does not always form in the situation where the inflammatory focus starts. In two of the cases in which a filarial abscess was opened over the lower end of Hunter's canal, there was good evidence that the inflammatory focus was first situated in Scarpa's triangle. Both the patients themselves and students who saw the cases before me are perfectly clear on this point; this evidence is important as bearing on the question of pathology.

Previous observers, on opening such an abscess, have found the dead body of a parent filarial worm, and they have justly surmised that some at least of these abscesses were the result of the death of the parent worm.

In one of my cases portions of the body of a parent worm were found, but in none of the others could anything of the kind be found, although a most thorough search was carried out. In some, however, the abscess was of some standing, rendering the absence of a dead parent worm insufficient proof. On two occasions broth cultures were inoculated without any result, and in some there are undoubtedly ordinary pyogenic organisms, but these are cases which have been neglected and in which the skin is about to slough.

Dr. J. H. Montgomery has also found a parent worm in a case of this nature that came to him at Choanchiu, Fukien.

Some cases are probably due to causes other than the death of a parent worm. I was fortunate enough to be able to observe the whole process in a patient, who was in the hospital for a trivial affection. Within the space of a few days he had an attack of filarial lymphangitis of the cord on both sides of the scrotum; one side came to suppuration, the other did not. Both, at the outset, presented exactly the same appearance, the inflammatory process on the one side being apparently much the same as on the other.

On two other occasions, by promptly putting the part at rest and applying cold, the inflammatory process has been aborted. As a rule, a sharp local attack leads to the formation of pus.

There is another fact that has to be taken into account in considering the pathology; namely, that some of these abscesses in the scrotum are suppurating hydroceles. In such a case it is difficult to see where the death of a parent worm can come in, as parent worms have never been found inside hydroceles. One is inclined to think that the majority of these are due to a local cause and are probably connected with the blocking of lymphatic vessels; but there is no evidence to offer in support of this view save the fact that in some cases the abscess is the first manifestation of an affection that ends in elephantiasis of the scrotum or of the affected limb. In others it certainly does not end thus, but possibly this is due to the fact that a lesser area of the lymphatic system has been interfered with.

FILARIAL ABSCESS

Passing from the pathology of the disease to its clinical form and diagnostic point, these abscesses may be classified as follows:

Filarial abscess:
- A. Of the scrotum.
    1. Suppurating hydrocele.
    2. Abscess of the cord.
    3. Abscess below the testicle.
- B. Of the limbs.
- C. Intra-abdominal or intrathoracic.

Concerning the cases contained in *A*, the division may seem at first sight to be arbitrary and unnecessary. A further consideration will show that it is not really so. Commencing in the way that is common to all abscesses, they follow different courses and each must be treated in a different way.

Suppurating hydrocele.—A hydrocele of moderate or large size is usually already present. At the commencement of the attack this swells to nearly double its previous size and becomes intensely tender and painful. In a day or so the contents are purulent, and if left to itself the wall and skin over it will slough and the contents will discharge. A long convalescence may ensue, as the opening thus formed may be very large. Tapping is of use only in the early stage, and when the contents have become purulent, incision and drainage should be employed. Care should be taken to have the opening at the most dependent part, and the thick layer of lymph lining the hydrocele sac should be removed. Free bleeding will ensue, and the cavity may have to be packed for twenty-four hours with gauze. Healing is usually rapid, but care should be exercised not to allow the external opening to close too soon. Strict antiseptic precautions should be observed.

Abscess of the cord.—This is the most serious of the forms of abscess affecting the scrotum, by reason of the liability of the inflammatory process to spread up the cord. In several cases I could trace the cord as a thick, hard rope as far up as the internal ring; moreover, it was intensely tender. Whether or not in these cases there is any associated inflammation of the neighboring peritoneum, there is no positive proof; but the fixity and tenderness of that part of the abdominal wall is suggestive, and it is well known that an acute septic infection of the cord may spread inward and set up an acute septic peritonitis. Although the inflammation in these filarial cases may spread up the cord, the actual abscess in all the patients seen was outside the external abdominal ring. Abscess of the cord is also the most serious of the forms of abscess affecting the scrotum as regards treatment. The abscess is apt to have loculi and pockets, which interfere with free drainage and, consequently, with rapid healing.

Abscess below the testicle.—This is the simplest of the filarial abscesses occurring in the scrotum. Drainage is easy, and healing is rapid, a few days sufficing to end the affection, as the abscess does not extend far and is not of large size. From one of these the portions of a parent worm were obtained, and it is possible that all the abscesses in this situation are due to a similar cause.

Filarial abscess of the limbs.—As I have previously stated, abscesses of this kind occur in situations rich in lymphatic tissue, and generally in the immediate neighborhood of the large vessels. It is not an uncommon thing, on opening one of these abscesses, to be able to put a finger on or even around the main vessel of the limb. It is one proof of the mild form of inflammatory process that I have never seen one of these vessels give the slightest trouble from secondary hæmorrhage, due to softening of the vessel wall and subsequent rupture.

Of these abscesses, those in relation to the femoral artery give the most trouble. This is partly on account of their deep connections and the difficulty of thorough drainage. In some of them the lymphatic system seems to be so thoroughly disorganized that they pass directly into the commencement of an attack of elephantiasis of the limb. Consequently prognosis of the ultimate result of treatment must be guarded.

The treatment consists in free drainage; owing to the difficulty of draining the deeper portions, it is well to make free openings under chloroform and insert large rubber tubes. Troublesome contracture of the lower limb may occur during the healing of large abscesses, especially those involving the popliteal space. This can be avoided by splinting the limb and using massage as soon as possible. But among Chinese patients, who are absolutely intolerant of restraint, and over whom we have not the same command as in England, troublesome contracture is by no means unknown.

Intra-abdominal or intrathoracic abscess.—I have had no experience with intrathoracic abscess, but have met with four cases of the intra-abdominal form. In each case the illness coincided with the cessation of attacks of elephantoid fever, and each case was desperately ill when admitted to the hospital. All had commenced in the way hereafter described as typical.

In two cases deep fluctuation was present in the left lumbar region, and under chloroform a postperitoneal abscess was opened that apparently had no connection with any of the large abdominal organs. The urine contained the faintest traces of albumen in one of these cases, but neither formerly nor at the time of operation were there any symptoms pointing to disease of the kidney.

The first patient left the hospital at his own request; he was still desperately ill. The abscess was draining well, however, and he made an excellent recovery after having been ill for two and a half months.

The second was a similar case. He was operated upon in the same place, but made a speedier recovery.

The third came into the hospital looking like a typical appendicitis patient. He also was very ill, having been so for one and a half months. The abscess proved to be extraperitoneal; it extended both into the iliac fossa and downward into the pelvis. Probably it began in the loose tissue about the iliac vessels; the fact that the disease began with a rigor and immediate flexion of the right thigh on the abdomen to an extent that is rarely seen in an uncomplicated attack of appendicitis lends color to this supposition. This case slowly healed up, and the man regained health and strength. His bowels were regular and natural at the time of the attack.

The fourth was a case of perinephric abscess that had been neglected and had tracked into the gluteal region. Free incisions had to be made in both the lumbar and the gluteal regions. This patient was also very ill, but with free drainage and care he, too, did well.

Manson's(28) advice on the subject of these abscesses is sound:

> Deep seated pain in the thorax or abdomen, with inflammatory fever followed by hectic, and a diminution in the number of micro-filiariæ in, or their entire disappearance from the peripheral blood, should, in such circumstances, suggest a diagnosis of filarial abscess, and indicate exploration, and if feasible, active surgical interference.

Finally we must discuss the onset of this malady and its typical temperature. Fig. 2 is a typical temperature chart of the disease. Rising rapidly with a rigor, which may occur while the man is at work in the fields, cutting wood, or even lying in bed, it remains high for from one to three days and then descends by lysis, provided an unopened abscess is not left. On the other hand, if the patient be under favorable conditions and it is possible to abort the attack, the temperature may descend very rapidly (fig. 3).

In neglected cases and cases that do not run a proper course, owing to insufficient drainage or wide inflammatory focus, the temperature may assume a septic type (fig. 4).

In criticism it may be urged that this temperature is the result of *Plasmodium malariæ* complicating the filarial attack. In reply it may be stated first, that in many of the cases the blood was carefully examined for *Plasmodium malariæ* with negative results; and, second, that it is quite possible for the fever, due to the presence of *Filaria bancrofti,* and active malarial attacks to run concurrently, but in such cases both diseases are clinically and microscopically distinct; and moreover the patient, as I have proved in two instances, has been right in his statement that one night he had a filarial attack and the next an ordinary quartan paroxysm. In no case of filarial abscess of the limbs referred to in these lists was there any focus of infection to be discovered on the surface of the limb.

ORCHITIS

A great many diseases in times past were credited to malaria. Some of these seem to have been so considered on totally

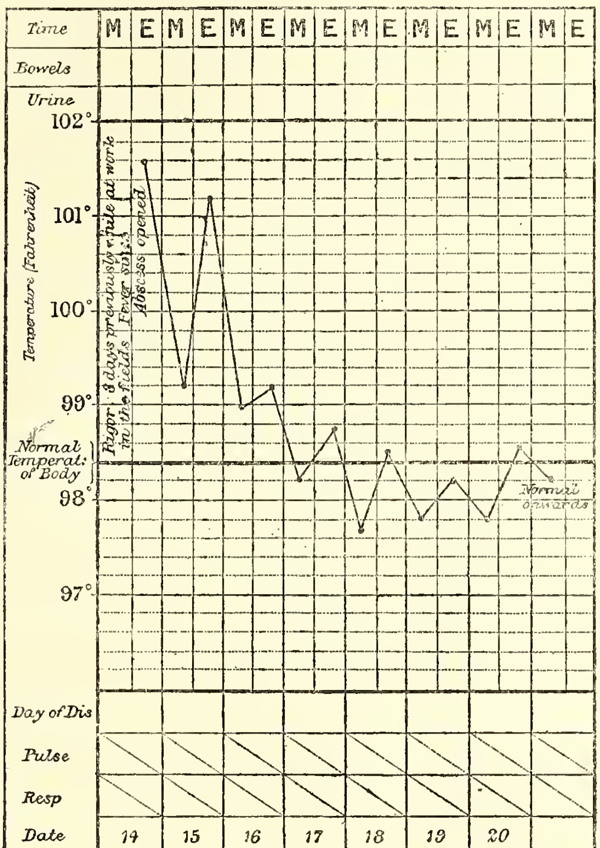


FIG. 2. Typical chart; filarial abscess.

inadequate grounds. In fact, the presence of malaria in a country has been held to account for almost any obscure disease in that country. While not denying that there may be a form of malarial orchitis, it is quite clear that in the region in which I have been working the majority of cases of orchitis are not malarial but filarial. In fact, I have never seen a case in which there was any suspicion of its being malarial; and this in spite of the fact that the whole region is scourged with malaria, large spleens being common, and malignant cases by no means rare.

Here is a typical example of a case of filarial orchitis: A

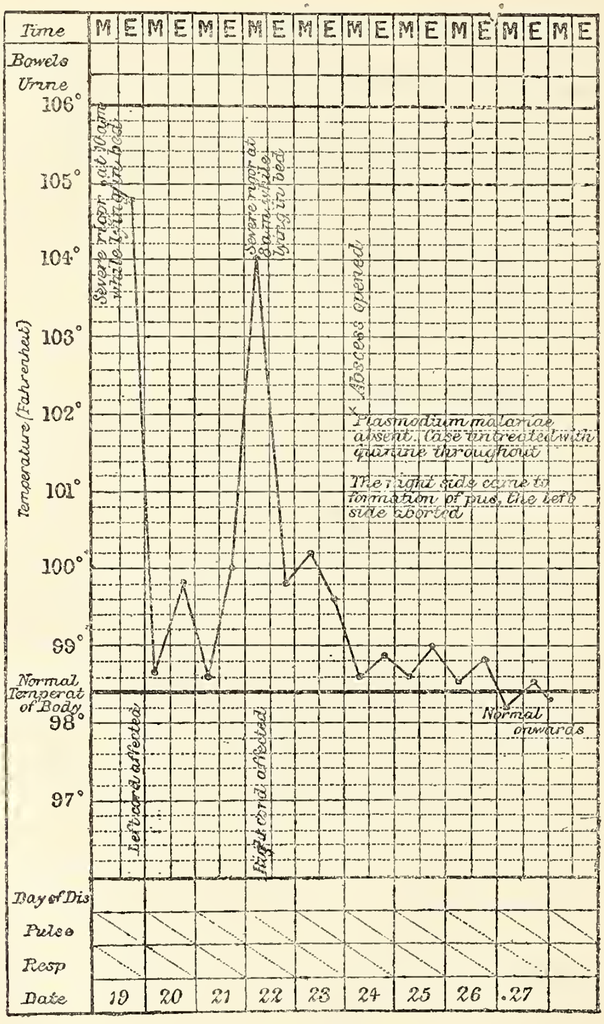


FIG. 3. Filarial abscess.

man of 45, who had previously suffered from filarial abscess and had lived a clean life, having had neither gonorrhœa nor syphilis, was suddenly seized with an attack of elephantoid fever. Filariæ were swarming in his blood at the time. On the next day his left testicle was swollen and intensely painful, the skin of the scrotum was red and swollen on the same side, and the constitutional symptoms were severe. So wretched did the man feel that he assured me he was going to die. The acute stage soon passed away under treatment, but the trouble was not quite cured for a month. In this case there was also lymphangitis of the spermatic cord. He has had one attack since,

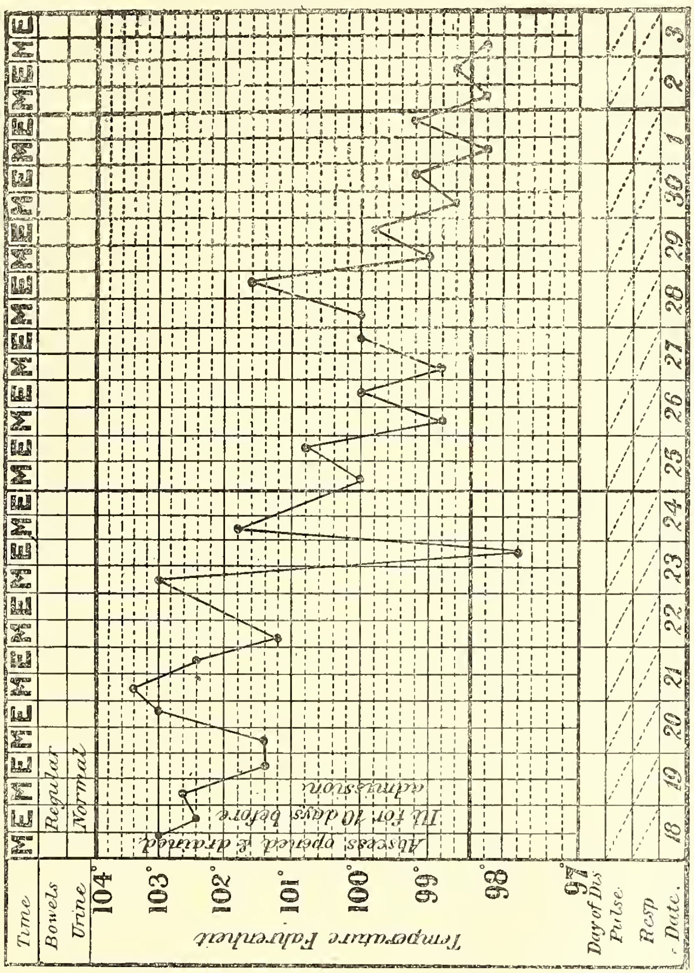


FIG. 4. Neglected case of filarial abscess.

and the symptoms were about the same. Six months separated the two attacks.

In four years' practice in the coast belt, three well-marked cases of this kind have been seen. Nearly always when there is filarial abscess of the scrotum there is some accompanying orchitis, but the orchitis is secondary; it is not very severe, is amenable to treatment, and shows no tendency to recurrence. Tendency to recur is marked in the true uncomplicated form. In some cases it leaves behind it a thickening of the spermatic cord.

Its pathology is probably the same as that of the other diseases in this section; that is, inflammation in an area of lymphatic congestion. In operating on a case of filarial lymphatic varix, Moty(38) discovered several soft cysts on the surface of the testicle which was enlarged. There was also great thickening of the spermatic cord in this case.

The treatment of the disease is the same as that of ordinary orchitis, and strapping should be employed if the case becomes chronic. If there is much pain, puncture of the testicle with a fine tenotome gives great relief.

ACUTE ARTHRITIS OR SYNOVITIS

In cases of erysipelatoid inflammation, affecting a limb, for example, it is by no means uncommon to hear a complaint by the patient of pain in one of the proximate joints and, on examining the same, to find evidence of some synovitis present. As a rule, this synovitis is a negligible quantity and gets better without treatment; but in a few rare cases the inflammatory process is much more severe. The connection between acute synovitis of the knee joint and filarial infection has been pointed out by Maitland.(21) My own cases consisted of two kinds.

a. Cases where the infection almost certainly came from the outside and simply fastened itself on a previously inflamed joint.

b. Cases where the infection was part and parcel of the inflammation depending on the presence of the parasite.

As an illustration of the first kind, the following is of interest: A man with an old lymph scrotum, who had previously had erysipelatoid inflammation of the leg, with accompanying pain in the knee, came into the hospital for some troublesome internal hæmorrhoids, of which I ligatured two masses. He was operated upon in the morning. The same evening he had a smart attack of erysipelatoid inflammation of the right leg. Next morning he was complaining of his knee joint, which was distended with fluid. On the following day he was worse, and the joint was aspirated and turbid fluid was drawn off. This did not clear up the trouble, and two days later the joint was opened and drained. He made a good recovery with a movable joint.

One more case of this kind has come under my care. The same joint was affected, and the history was identical. In this case the affection followed an operation for fistula in ano. Recovery followed drainage of the joint, but the movements of the joint were far from perfect.

These cases are the only two, in a hospital practice of twenty years' duration, where infection of a joint has followed an everyday operation, and it is curious that both should have occurred in the subjects of filarial infection, filariæ being easily found in the blood. The usual antiseptic precautions were taken in both cases.

In regard to the second kind—that is, cases where the infection was part and parcel of the inflammation depending on the presence of the parasite—strange to say, in both cases seen the joint affected was the wrist joint. The first case was that of a man 40 years of age. He had a lymph scrotum, and his blood swarmed with filariæ. On February 21, 1902, he was attacked with erysipelatoid inflammation of the right arm and forearm. Three days later his right wrist joint had become very painful. He was treated in the usual way, and the inflammation subsided except around the wrist joint, which remained swollen and very tender. On March 6 he was put under chloroform, and the joint was explored through a palmar incision. A little turbid fluid came out, and the ends of the bones entering into the joint were rough. The incision was then closed, and the part was put up in plaster of Paris. This was kept on for a month, and then massage was applied. The patient made a perfect recovery, the movements of the joint being normal when he was last seen.

Guided by the last case the treatment of the second patient was modified considerably. He was a man of 50, who had suffered from lymph scrotum for twenty-five years. He was attacked in the same way as the first patient—if anything, more severely. There was marked grating in the joint, which was intensely painful. After the acute symptoms had subsided, the part was put up in a fixed apparatus, and the joint was soon well.

Acute rheumatism is not present in this region, and both patients were otherwise free from disease.

GANGRENE OF THE SCROTUM

Gangrene of the scrotum is not a common disease, especially if all cases of nephritis are excluded. Its occurrence in a healthy young man is sufficiently remarkable to call for special notice. Table 7 gives particulars of 8 cases seen during four years.

TABLE 7.—*Cases of gangrene of the scrotum.*

Initials.	Age.	Evidence of filarial disease.	Hydrocele.
	Years.		
O. T	40	Filarial embryos and varicose groin glands	Yes.
O. H. [a]	43	Old elephantoid fever; no embryos found	Yes.
T. L	23	Varicose groin glands; fever; no embryos found	Yes.
T. T. [a]	35	Elephantoid fever and occasional swelling of scrotum; no embryos found.	No.
L	41	Varicose groin glands; elephantoid fever	Yes.
C. K	41	Elephantoid fever; no embryos found	No.
T	37	Varicose groin glands; no embryos found	Yes.
B	38	Elephantoid fever for many years; no embryos found	No.

[a] Slight erysipelatoid inflammation of the scrotum accompanying attacks.

The only common feature in these cases is that all had a history of filarial disease, past or present. They began in the same way; that is, with a sharp attack of fever, accompanied by redness and swelling of the lower half of the scrotum. This inflammation is from the first acute, and in a few days the lower half of the scrotum becomes black and comparatively dry. If left to itself, this gradually separates, and the exposed surface slowly heals. Healing may be hastened by skin grafting as soon as the surface is covered by healthy granulations.

Hydrocele, if present, may materially hinder the healing of the wound, and it must be tapped. If this is done with strict antiseptic precautions, there need be no fear of infecting the hydrocele. It should be tapped, of course, through healthy skin and not through the granulating surface.

It may be urged that these were malarial cases. While it is true that malarial gangrene is a well-known affection, in all these cases no evidence was obtained that would support this contention. Although none of them had been treated with quinine, the microscopical examination of the blood was entirely negative.

One point is worthy of note; namely, that of the eight cases only two had filariæ present in the blood. It is possible that in all such cases, however, the parent worm is present in the tissues that die, and that the death of the tissues is due to the inflammation set up by the death of the worm.

Another point worth noting is the little constitutional disturbance manifest in the patient after the initial sharp attack is over.

It may be urged that the evidence in favor of its being due to filarial infection is too slight. There is an important negative piece of evidence. I moved from Changpu, in the coast belt, to Yungchun, which is farther inland, and pari passu with the loss of practically all filariasis cases; gangrene of the scrotum became such a rarity that only one case was seen in twelve years, and the patient had resided for some time in the coast belt.

FILARIAL HÆMOPTYSIS

By filarial hæmoptysis is meant hæmorrhage from the lungs occurring in patients with filarial infection, correlated in time with an attack of filarial fever, with or without manifest evidence of lymphangitis.

In the case specially studied by me, there was a heavy filarial infection, and there was no manifest evidence of lymphangitis. It is known that during the day the filarial embryos have their habitat in the lungs; in the case that first directed my attention to the subject the hæmorrhages took place during the day, and live filarial embryos were present in the expectorated blood.

It may be said that the Chinese are very commonly subject to tuberculosis, and in the absence of post-mortems it is impossible to state that these hæmorrhages are not tubercular in origin. The only answer I can make is that the case here discussed has been under observation from time to time for the last twenty years; that the hæmorrhages only occurred when he was the subject of filarial infection (he became free from infection for several years during this time) ; that the sputum was carefully examined for tubercle bacilli many times with negative results; that examination of the chest was consistently negative; and that the patient never presented any symptom, save the hæmorrhage, that would suggest a tubercular infection.

I have never seen one of these cases die of the hæmorrhage. It may be of fair quantity, but it stops with the fall of the temperature and does not recur apart from a definite attack of filarial fever.

It is impossible to be dogmatic on the subject, but it is my conviction that the above diagnosis is correct, and this opinion is shared by both Dr. H. T. Whitney and Dr. J. H. Montgomery, of Fukien, who have had a large experience with filarial disease.

DISEASE DUE TO OBSTRUCTIVE INTERFERENCE WITH THE LYMPHATIC SYSTEM

In commencing this section on disease due to obstructive interference with the lymphatic system, it must be clearly understood that this division is an arbitrary one. While it is true in the main that the diseases of the one set are chiefly the result of inflammation, it must be borne in mind that there is at the same time, as a rule, lymphatic stasis in the affected part. On the other hand, although we speak of disease due to obstructive interference with the lymphatic system, it must be remembered that in the production of the lymphatic obstruction inflammation plays an important part. This point being clearly understood, we can turn to the consideration of details.

There are two main forms of filarial disease to be discussed under this section. Roughly speaking, the one is characterized by dilatation of the lymphatic, the other by the production of more or less solid œdema in addition to this dilatation. One of the main proofs that all of these diseases are due to the same cause is found in the fact that all grades of disease may be seen, from the small lymphatic varix to the most solid forms of elephantiasis.

How do these diseases originate? It cannot be said that it is always clear, and each case will be discussed in its proper section. The parent worm or worms may act as an embolus in one of the larger lymphatics, and may cause an attack of inflammation, or bleeding into the lumen, ending in the stenosis or occlusion of the vessel. The ova of the worm, if discharged prematurely, are probably able to block the smaller lymphatics, and are also able to block the circulation through the lymph glands. In either case a portion of the lymphatic system becomes wholly or in part cut off from the general lymphatic circulation. The pressure in this area rises, and varicosity of the lymphatics, or lymphatic œdema, or one of the many combinations of these two, results.

LYMPHATIC VARIX

The ramifications and anastomoses of the lymphatic system are fortunately very free, so that a compensatory circulation is not very difficult to establish. But in any case of lymphatic obstruction (especially if large trunks, such as the thoracic duct, are occluded) it takes a little time for this compensation to take place. Meanwhile the lymphatics of the occluded area are dilated, and lymphatic varix occurs. If the thoracic duct is occluded, then the chyle can only reach the general circulation by a retrograde route, and in consequence the abdominal and pelvic lymphatics become much dilated. Manson(29) speaks of these in the following terms:

> In dissections of such cases the thoracic duct has been found distended to the size of a finger, the abdominal and pelvic lymphatics forming an enormous varix, perhaps a foot in diameter and many inches in thickness, concealing kidneys, bladder, and spermatic cords. In such cases, when one of the vessels of the varix is pricked or ruptures, the contents are found to be white or pinkish. They are not limpid like ordinary lymph, they are chyle, therefore, chyle on its way to enter the circulation by a retrograde compensatory track.

Lymph scrotum, varicose groin glands, chyluria, and the like have as their basis a condition of lymphatic varix, but they are not pure lymphatic varices. They will be discussed under separate headings.

There are, however, cases of pure lymphatic varix that we must discuss as such. Occasionally one meets with cutaneous lymphatic varix. There are small swellings which, although sometimes permanent, are often evanescent. The kind described as "deeply-situated little swellings"(30) has been seen but once. On the other hand, I have sometimes met with groups of vesicles on the thigh, which might well fall under this category. They may occasionally form the starting point of a lymph fistula. The contents of these vesicles according to my experience are always clear fluid.

The deeper lymphatic varices are rarely seen, owing to the utter impossibility of obtaining post-mortems in inland China, but on one occasion a lymphatic varix of the spermatic cord was encountered when operating for the radical cure of hydrocele. In this case all of the lymphatics of the cord were dilated, and there were two or three small cystic dilatations on the lymphatic vessels. The contents were clear. No operation was performed on these dilated lymphatics, and the case convalesced like an ordinary radical cure. The patient had had elephantoid fever, and his blood contained many filarial embryos.

On another occasion I helped Dr. J. H. Montgomery to operate on a school boy, aged 16. In the right inguinal region there was a soft, compressible swelling, which enlarged when he stood up, and in which there was a marked impulse on coughing; on lying down it practically disappeared. The swelling turned out to be a lymphatic varix of considerable size situated in the inguinal canal. The lymph vessels were the size of a large quill and ran lymph on being wounded. The whole mass was removed, the vessels being tied as if they were a mass of varicose veins, and the patient made a good recovery.

On two occasions, when operating for elephantiasis of the scrotum, marked dilatation of the lymph vessels about the spermatic cord was seen over and above the general lymphatic dilatation seen in these cases.

As a rule, lymphatic varix is best let alone. If giving trouble, and if it is possible to remove the whole varix, this may be done; but it must be remembered that the varix is partly complementary, and any interference with it may involve the production of another varix elsewhere, or the formation of lymphatic fistula in some other part of the varicose area.

LYMPHATIC FISTULA

Under the heading of lymphatic fistula there are three varieties to be described—the spontaneous, the inflammatory, and the operative. The first forms spontaneously in an area already in a condition of lymphatic varix.

Spontaneous.—As an example may be adduced the case of a man, aged 23, the subject of filariasis. On the outer surface of the left thigh, rather toward the front of the limb and about its middle, was a small aperture from which lymph slowly drained away. A fine probe was passed in about a quarter of an inch (0.6 centimeter) inward and upward. There was no inflammation about the mouth of the fistula, the history of which was that it had formed spontaneously three days previously. Its appearance was preceded by a vesicle, and the lymph coming from it was transparent and free from blood.

This form is rarely seen, and the mouth of the fistula remains free from redness or swelling, unless secondary infection takes place. Unfortunately with native patients, who love to meddle with any aperture or wound, this almost always occurs, and then it becomes a septic sinus. Unless it is giving much trouble, it is best let alone, as its presence probably saves the patient from many attacks of elephantoid fever. In one case I cauterized and got the fistula to heal, but immediately the attacks of elephantoid fever, which had intermitted while the fistula was open, recurred.

Another patient presented a small, uninflamed aperture on the front of a small lymph scrotum. At times lymph would spout

out of the aperture to a distance of 6 inches (15 centimeters) and a test tube full of lymph could be collected in a short time. The strain on the patient was considerable, and I stopped the flow by surrounding the aperture with a purse-string suture of the finest horsehair. During the patient's stay in the hospital the flow did not recur.

The second variety follows the opening or bursting of a filarial abscess. It may for convenience be called inflammatory.

Inflammatory.—It is not at all uncommon, after the opening or bursting of a filarial abscess, for the patient to be troubled for some months by a lymph fistula in the site of the opening into the lymphatic abscess cavity. This sinus may be several centimeters deep, and it often runs down to the region of the lymphatics in connection with the large vessels of the limb. The usual site for a fistula of this kind is in the popliteal region. The abscess cavity closes up, leaving a fine sinus, through which lymph gradually trickles. Another favorite situation for this kind of fistula is in an elephantiasis scroti, an abscess forming in the elephantoid tissue, bursting, and leaving a lymphatic fistula.

As to treatment, in both regions it is better to do nothing in the first case because, given time, the fistula will almost certainly heal of itself; and in the second because the probability is that nothing short of removing the elephantiasis scroti will be of any avail. In some cases this also heals spontaneously, but this rarely occurs.

Under this class must also be included the ulcers of the leg occurring in elephantoid disease of this limb. These also act as fistulæ and are constantly moist with exuding lymph. They are very difficult to heal. A case is recalled of a man with both legs elephantoid and ulcers on one leg just above the ankle (Plate 21). As out-patient and in-patient I worked on him for three years, and finally gave up all treatment as hopeless. Although the ulcers diminished in size, they never showed any inclination to heal, and there was too much fibrous change about the ulcer to make it possible to do skin grafting with any reasonable hope of success. Besides, patients suffering from this affliction, although they wished to get their ulcers healed, yet confessed that the advent of the ulcer had almost entirely freed them from attacks of elephantoid fever.

The third class comprises those following operations.

Operative.—Temporary postoperative fistulæ are by no means uncommon. Twice in operating on varicose groin glands has the operation wound healed by first intention, except for a fine aperture at the lower end of the scar, which continued to run lymph for from a fortnight to three weeks. In the end, however, these fistulæ heal satisfactorily, and they may safely be let alone.

But it is sometimes otherwise with the fistulæ that may be left after operations for elephantiasis scroti. Occasionally the elephantoid change extends high up on the skin of the abdomen. In this case, particularly if the patient is well on in years, it is better to leave some of this diseased skin rather than make a huge operation wound. But this carries with it its own penalty, as it becomes necessary to operate through diseased tissues, which are notoriously difficult to heal. Then a fistulous opening is apt to occur in the region of the root of the penis. Twice this has occurred in my own patients: in the one case the fistula healed spontaneously, in the other case it was still open a year after the operation.

VARICOSE GROIN GLANDS

Where, in the course of the lymphatic varix, lymphatic glands occur, these participate in the general dilatation. In marked cases, on removal from the body, they may appear on section like a sponge. In other cases, especially where there have been many attacks of elephantoid fever with inflammation of the glands, they may be indurated, and there may be a great increase in the fibrous tissue forming the framework of the gland. Of these varicose glands by far the most important are those found in the groins of patients suffering from filarial disease.

These groin swellings may be found alone, or in association with other forms of filarial disease, notably with lymph scrotum, elephantiasis of leg or scrotum, chyluria, or chylous dropsy of the tunica vaginalis.

In a not inconsiderable number of cases the patient is quite unaware of their presence until they are discovered by the medical man. They are often quite painless and give no trouble whatever. In other cases the patient's attention is called to them by dragging or aching pains in the groin. The swellings vary much in size, from a slight enlargement to masses the size of a man's fist. In many cases the glands are discrete, but in the majority the lymphatics running into the gland are also dilated, and the whole forms a mass. All of the groin glands may form a large, ill-defined, matted swelling, inguinal and femoral glands being alike involved. One side only may be the seat of these swellings, but very frequently both sides are affected. In many cases the swelling is much smaller on one side than on the other.

The skin over these swellings is natural. In the case of the smaller swellings it is nonadherent, but if there has been inflammation about the glands, it may be difficult on operation to free it from the mass. The swellings themselves may be said to be adherent to the underlying fascia. A hypodermic syringe draws off lymph from these swellings, either clear or chylous, according to whether or not the varix is in connection with the chylous lymphatics. This fluid very often contains filarial embryos.

As to their diagnosis, it has been said that it is a common mistake to confuse these with herniæ. I have seen some two or three hundred cases, but have never seen one in which the slightest doubt on this head arose in my mind; and, with proper care in the examination of the swellings, this mistake should not occur. As there is often some other manifestation of filarial disease present, this may assist in diagnosis, if there is doubt. Masses of tubercular or lymphadenomatous glands might, if sufficient care be not taken, be mistaken for them, but there is one valuable positive sign that should greatly help: when the patient lies down with the buttocks raised, the tumors gradually get smaller, a condition that may be hastened by pressure with the hand; if the patient now stands up, the tumors gradually fill and become prominent. There is no impulse to speak of over these swellings. Manson(31) adds a hint that is a very wise one:

> Chronic swellings about the groin, cords, testes, and scrotum, in patients from the tropics should always be regarded as being possibly filarial.

Azema(1) has made the statement that these various glands may spontaneously disappear at or about the age of 40. It is difficult to see why this should be the case. I have never seen one spontaneously disappear, nor have I been able to get satisfactory evidence of this taking place. Certainly they generally do not, and many cases are seen after this period. Once I saw them appear for the first time in a woman of 64. She had come for dragging pains in the groins, accompanied by slight hæmaturia, for which no cause could be discovered. The hæmaturia ceased on the day of admission, leaving a urine in which nothing wrong could be discovered. Four months later she returned with markedly varicose groin glands, her blood full of the embryos, and it was clear that here was the explanation of her attack. Since that time she has had a distinct attack of chyluria, but not a severe one.

As to treatment, I agree with those who have had experience of the subject that it is advisable to let these glands alone unless they are causing a large amount of trouble; in troublesome cases, the glands may be safely removed.

Septic lymphangitis used to be greatly feared in these operations, and of course, unless care be taken, the operation is a dangerous one. No one who has not performed these operations can have any conception of the mass of dilated lymphatics, and these run when wounded and obscure the field of operation. As all the superficial veins and arteries are embedded in the mass, care must be taken, especially at the saphenous opening. The external saphenous vein is often a large one, and if cut just at the opening, it may be difficult to secure. As far as possible, the dilated lymphatics entering the mass should be ligatured, as this greatly diminishes the lymphorrhagia. The best material to employ for this purpose is fine catgut.

It must always be remembered that removal of these glands may precipitate an attack of chyluria or elephantiasis of the leg. An appearance of the beginning of elephantiasis of the leg, however, must not be taken as a certain sign that this trouble is going to supervene. In one patient I was much distressed to find that, a fortnight after the operation, the leg presented every appearance of commencing elephantiasis. It was swollen, and with a solid œdema affecting the skin in parts. Six months later the leg was perfectly normal, and it was clear that the condition was only temporary, due to the collateral circulation not having become fully established.

That the operation is very satisfactory in some cases is proved by the fact that the patient mentioned above came back in order to have a second operation on the opposite groin.

Rarely these varicose glands are met with in other exposed situations. One case of varicose axillary glands has been seen. In this case the mass was not very large.

In some cases the mass of glands forms the dwelling place of the parent worm.

If the glands are not removed, the daily painting of the skin over them with linimentum iodi seems to exert a beneficial effect. How it does this is not clear, but it certainly in many instances relieves the aching and dragging pain of which the patients frequently complain.

LYMPH SCROTUM

In a well-marked case of lymph scrotum the appearances are characteristic. The scrotum is swollen, and the natural rugosity of the skin is increased. This appearance is partly due to the fact that, during the attacks of elephantoid fever, the parts become very œdematous and partly to the condition of the skin itself. The latter is a little thickened, and the surface is covered with small vesicles. The whole is part of an extensive lymphatic varix involving the scrotum; and, as might be expected in these cases, the groin glands on both sides are often varicose, but this is not always so. In some cases it is only the scrotal skin that is affected.

The character of the fluid obtained from the vesicles varies with the site of the obstruction. If the obstruction is affecting the chyle vessels, the fluid will be chyle or sanguineous chyle; if not, it will be straw-colored only. When an acute attack supervenes, the vesicles on the skin, otherwise quite small, enlarge and become tense. If very carefully handled, the attack may pass off without any discharge of lymph; but, as a rule, the vesicles either spontaneously rupture or are broken by accident, and then lymph drains away. Sometimes it simply streams away, and I have collected an ounce (30 grams) in one and a half minutes from one opening.

The strain on the patient due to this constant flow is most trying, and I have seen a patient in a critical condition from sheer exhaustion due to this cause. Such acute cases are fortunately rare, and the main complaint that the patient makes is of discomfort due to his clothes being always in a wet condition.

Another point that should be borne in mind is that the discomfort of a lymph scrotum specially appears during or after an attack of lymph fever. Although the fever itself may have abated, there remains a recently inflamed lymphatic tract constituting a field of infection, ready to hand, in the area of scrotal lymphorrhagia. Occasionally most troublesome inflammation of the whole lymphatic region starts in this way, spreading into the superficial inguinal regions and then down the thighs fully halfway to the knees.

Erysipelatoid inflammation and elephantoid fever are common concomitants of lymph scrotum; and abscess, either preceding or accompanying the affection, is not rare. It must be remembered that all varieties of lymph scrotum are met with, from that in which the affection is just becoming manifest to that in which the scrotum is one mass of large vesicles.

Another very common type is that in which the scrotum is partly varicose and party elephantoid. This is particularly likely to be the case if the patient has suffered much from erysipelatoid inflammation in addition to the lymph scrotum. If, on the other hand, he has only suffered from elephantoid fever, and to a very limited extent from erysipelatoid inflammation, then the scrotum will remain a lymph scrotum to the end.

It is difficult to follow up these cases in the Far East but, as a rule, they take one of two roads: either they become elephantoid, in which case they may develop into large tumors like those scrota that are elephantoid from the beginning, or they remain varicose. In the latter event they tend, as the patient reaches to 50 years or more of age, to become atrophic. Some of the patients have had the disease for over thirty years.

Two cases were kept under observation for four years. In one, in spite of recurring attacks of elephantoid fever, the scrotum steadily shrunk. This patient was over 55 years of age. In the other case there were fewer attacks, but the erysipelatoid inflammation was more marked, and the scrotum double in size and was rapidly becoming an elephantiasis scroti.

Embryo filariæ are generally found in the blood in these cases, and very often they may be obtained from the lymph flowing from the scrotum. On one occasion, as mentioned on a previous page, filarial ova were found in the fluid from a scrotum of this kind, when repeated examination had failed to discover the embryo in the blood. In this case the fluid flowing from the varices was straw-colored, and the groin glands were not enlarged.

The past history of these cases varies greatly. Here is a patient who had suffered from elephantoid fever for at least fifteen years, and whose scrotum had only during the last year become a lymph scrotum. Here is another patient who, within six months of his first appearance of trouble due to the filaria, had developed a very marked condition of lymph scrotum; but as a rule a marked condition of lymph scrotum takes about a year to develop, and every degree of varicosity is produced. The largest varices are generally found near the root of the penis. Occasionally the testicles are a little thickened, especially if there has been an attack of filiarial orchitis. Also, single or double hydrocele may or may not be present.

Treatment may be divided into that of the acute attacks and that of the general condition. In acute attacks, the best place for the patient is in bed, with his scrotum supported at a higher level on a pillow. This simple proceeding often gives great relief. Strict cleanliness must be observed, and the scrotum must be treated by either a dry or a wet method. In the former it is dried and powdered with any antiseptic powder. A powder composed of zinc oxide, or a mixture of this with boracic acid, suits well. If a wet dressing is to be used and sometimes it suits a case much better than the dry one, lint kept continually wet with cold water or lotio plumbi subacetatis may be used. Occasionally a little opium added to the lotion is of advantage. Each case, however, must be treated on its merits.

Where the lymphorrhagia was very severe and mostly confined to a single spot, I have several times ligatured the lymphatic vessel, using a fine needle and horsehair, leaving the ligature in place for a day or two.

The treatment of the general condition raises large questions; for operation, though comparatively easy, involves the great risk of setting up trouble in some other part of the lymphatic area. Operation has been followed by the commencement of chyluria or elephantiasis of the leg. More than this, the wound is very large and takes a long time to heal, even if Thiersch grafting be employed. Six weeks to two months is not too long to estimate.

Supposing that operation has been decided upon, what operation should be performed? Manson(32) gives the following directions:

> The scrotum should be well dragged down by an assistant whilst the testes are pushed up out of the way of injury. A finger-knife is then passed through the scrotum and in sound tissues, just clear of the testes, and the mass excised by cutting backwards and forwards. No diseased tissue and hardly any flap should be left. Sufficient covering for the testes can be got by dragging on and if necessary dissecting up the skin on the thighs, which readily yields and affords ample covering. It is a very common but a very great mistake to remove too little. As a rule, the wound, if carefully stitched and dressed antiseptically, heals rapidly.

I am not in favor of this method, as in many cases it will fail to remove the whole disease, and the bleeding may be serious. I prefer an operation similar to the one undertaken in the following case:

A semicircular incision was made from side to side across and under the root of the penis and well up into each inguinal region. This incision was carried through the skin and underlying fascia, all vessels being clamped as cut. Two lateral incisions were then made from the extremities of this first incision on the lateral aspect of the scrotum from base to apex. The flap thus marked out was turned down, laying bare both testicles and their cords. These were freed and turned forward, the whole of the remainder of the scrotum being then cut away. The testicles were sewn in position to the wound in the perineum, and the skin from the lateral aspects of the thighs was drawn partially over them. Even though this was done, there still remained a wide, gaping wound which, in spite of Thiersch grafting, took six weeks to heal. The final result was very satisfactory, as the attacks of elephantoid fever ceased from that moment and had not recurred two and a half years later.

Many natives have asked for operation, but when they learned the time that they would have to stay in the hospital, they backed out, saying that the discomfort was not sufficient to make them give all that time to the cure. In the slight cases, it is not worth their while; and in the severe ones, there is no chance of obtaining flaps, a condition which greatly delays convalescence.

If it is decided not to operate, then the patient should be instructed to keep the parts scrupulously clean, suspended, and protected from undue friction between the thighs.

CHYLURIA

Fortunately for the subjects of filarial disease, chyluria is by no means common. It may begin in several ways. Sometimes it begins without warning and is the first indication to the patient that he is in any way out of health; but more often there are some premonitory symptoms, either in the form of dragging pain in the back or aching in the groins or hypogastric region. If the patient is at the same time the subject of one of the other forms of filarial disease, the onset may be heralded by the trouble pertaining to that form. For example, here is a man, the subject of lymph scrotum. In his case the first onset of the chyluria was associated with an attack of elephantoid fever and scrotal lymphorrhagia—and this is only natural; whatever raises the pressure in the already existing lymphatic varix is liable to precipitate the onset of chyluria.

The pathology of the affection is quite clear. Given a lymphatic varix in the wall of the bladder or in the region of the pelvis of the kidney, you have only to raise the pressure so that the dilated lymphatic ruptures in one or the other situation, and you have chyluria. This chyluria may be intermittent or permanent. In the intermittent cases the chyluria only occurs under provocation, such as is afforded by an attack of elephantoid fever, and in the intervals the urine is perfectly normal. It is important to bear this in mind, as the practitioner in a filarial region is sure, sooner or later, to meet with patients who complain of having passed bloody urine, in whom the urine is normal at time of consultation; in such cases the explanation is that they have had an attack of chyluria of sanguineous hue and, on questioning these patients carefully, the point may be elicited that they had an attack of fever at the time. In what have been called the intermittent cases the attack lasts a day or two at the longest.

The cases that have been called permanent are not truly so, for with rare exceptions the chyluria does not continue permanent through life; but it may last weeks or months at a time, then intermit, and at an uncertain and variable time reappear.

It must be remembered that the disappearance of the milky nature of the urine is not proof that the fistula is closed, as the urine may still contain proof of the lymphatic connection in the presence of albumen, lymph corpuscles, and a gelatinous clot.

Rarely, retention of urine from clot formation is the first sign of chyluria; and although it is true that in most cases this retention passes away spontaneously in the course of a few hours by the passage of the offending clots, yet their occurrence gives the patient much pain and inconvenience.

The general health of the subject of this disease is, on the whole, fairly good; but if the drain of chyle is severe, the patient may become anæmic, depressed, and melancholic.

The patient generally notices the color of the urine himself; but if its milky nature is not marked, the doctor may be the first to discover it in the course of a routine examination of his patient. The urine may be markedly milky, or pinkish, or red, and this color may vary widely in the course of a single day. It may pass from milkiness to limpidity in a couple of hours. The nature of the food taken also makes a great difference in the appearance of the urine, as will be noted in more detail when we come to speak of treatment.

What are the characters of chylous urine? As to odor, this may be best described as heavy and urinous. This urine decomposes very rapidly in hot climates. Whether decomposition would take place with the same rapidity in a cold climate is open to doubt, but I have no data on this point. It is said that the quantity of urine passed is in excess of the normal; but the quantity of urine passed, especially in a hot climate, depends so much on the amount of fluid taken, and the amount of the same lost by sweating, that it is impossible to make a definite statement on this point. The reaction and specific gravity also vary within wide limits.

If chylous urine is passed into a urine glass, in many cases the whole becomes coagulated within a very short time. This coagulum slowly contracts, becoming redder, denser, and more fibrous. The clot at first floats in a milky fluid, which in due time separates into three layers, consisting of a whitish pellicle on the surface, in the middle a thick stratum containing the coagulum in the meshes of which embryo filariæ can be usually found, and at the bottom a little reddish sediment which sometimes contains a few small clots of blood.

The main part of the fatty matter is contained in the middle layer in a granular condition. Microscopical examination shows the lowest stratum to contain lymphocytes, cells like red blood cells (and in some cases probably true red blood corpuscles), urinary epithelium, crystals, and a few filariæ. Of course, in some cases filarial embryos are absent, as in cases where, the parent worm having died, the lymphatic varix still persists. One good way of finding them is to centrifugalize the urine as soon as passed. This way has acted well in the few cases I have personally had to treat.

Ether shaken up with the urine removes the fat, and boiling the urine brings down the albumen that it contains.

Usually the urine is most chylous toward evening, and Manson(33) has clearly shown that the presence of the filaria in the urine is not regulated by the law of periodicity governing its presence in the blood.

Treatment is eminently unsatisfactory. It cannot be said that we have any drug that has been proved to have any effect whatever on the disease; nor is it clear what some of the drugs used are intended to do. If they are intended to kill the parent worm, their use may be very dangerous. Chyluria is not a disease that can be called dangerous to life, whereas a dead parent worm at the back of the abdomen is a very different matter. Personally I would rather keep the chyluria, if I were so unfornate as to acquire it. If it is intended to diminish the pressure in the lymphatic area, it is difficult to see how these drugs are going to accomplish the desired end. Those that have been specially recommended in the treatment of this disease are the following: Gallic and benzoic acids, thymol, beta-naphthol, methylene blue, glycerin, perchloride of iron, chromic acid, quinine, sodium salicylate, and ichthyol.

The best results in the treatment of the disease are to be obtained from general treatment. The patient should be placed in bed, and absolute rest should be prescribed; as the patient does not usually feel very ill, this absolute rest is by no means easy to obtain. The pelvis should be elevated, and the amount of food and drink should be restricted. The bowels should be well cleared out.

If a minimum of fatty and fluid food is administered, the milky character of the urine may quickly pass away. This does not necessarily mean that the fistula is closed, as I have previously stated; but very often, by the above treatment the fistula can be really got to close and remain closed, sometimes for many months.

The subjects of this affection should beware of excessive or very violent exercise, as it is probable that an attack may be precipitated in this way (see next section). Special care must be taken by women during pregnancy, as the extra strain of labor is not at all unlikely to bring on an attack in susceptible subjects.

Clots of large size form occasionally in the bladder and give much trouble in the way of retention. When this occurs they may be easily broken up with the aid of a metal catheter.

CHYLOUS DROPSY OF THE PERITONEUM

Chylous dropsy of the peritoneum is extremely rare. Winkel(45) records a case that was probably of this nature. The first serious symptom was the development of ascites. The fluid drawn off by tapping was of a milky character and contained what were probably filariæ. Afterward the patient developed swelling of the left leg, which gradually subsided. The ascites returning, she was again tapped, and fluid of the same character was drawn off. Two days later she died suddenly.

One case has come under my care. The patient was a man of middle age, who had suffered from elephantoid fever. After a wine party he went outside and "saw a demon." He was greatly frightened and ran all the way home, a distance of three-quarters of a mile (1.2 kilometers). He felt uneasy in the abdomen on reaching home, and by morning it was swollen. A week later he came to hospital. His abdomen was moderately swollen by free fluid. On tapping, milky fluid was drawn off, but no filaria was found in it. The patient refused treatment and left the hospital at once. He did not seem to be acutely ill. The fluid coagulated on standing, but not completely.

It is remarkable that this form of the disease is not more frequent. It is possible that small leakages take place more frequently than is known and that the peritoneum is able to dispose of such leakages without their actually causing ascites.

CHYLOUS DROPSY OF THE TUNICA VAGINALIS

Chylous dropsy of the tunica vaginalis is by no means as rare as chylous dropsy of the peritoneum. Presenting the characters of an ordinary hydrocele, with the one exception of translucency, it is very often undiscovered until tapped, when milky fluid flows through the cannula. This milky fluid generally contains many filariæ, quite out of proportion to what one might expect. Parent worms have never been found in one of these lymphoceles, which rarely attain great size. The fluid drawn off from one of these swellings does not always coagulate.

Lymphocele is usually associated with some other manifestation of filarial disease, such as lymph scrotum, varicose groin glands, or elephantoid fever.

It should be treated as an ordinary hydrocele. If not large, it may be let alone or treated by excision of the sac. This is a much safer way than injection. Certainly, if a case of this kind were to go wrong after injection, it would be much more serious than in the case of an ordinary hydrocele, owing to the varicosity of the lymphatics. This raises the whole subject of the relation of ordinary hydrocele to filarial disease. Manson, (34) years ago, suggested that the great frequency of hydrocele in tropical countries might be due to the presence of filarial disease, and James(16) advances the same view and gives a few points bearing on the subject. The matter is not yet cleared up, and from what I have observed I doubt that filarial infection is the cause of more than a small percentage of cases. Out of the last series of Charles's(7) elephantiasis operation cases, eighty in number, fifty-nine suffered from hydrocele. Of my own operation cases, every one suffered from hydrocele, small or large, so that I may justly say that in elephantiasis cases hydrocele is the rule and not the exception. Of course, it may be alleged that this is a secondary matter, and primarily not due to the filarial disease, but to the elephantoid change in the tissues.

Excluding these cases, certainly not above 10 per cent of the hydroceles in the coast belt with which I have had to deal by tapping or other operation have been the subjects of filarial infection. When compared with the figures given for general incidence, it must be admitted that the filarial disease, barring the elephantoid form, does not seem to be especially prone to give rise to hydrocele.

CHYLOUS DIARRHŒA

Chylous diarrhœa is extremely rare, and I have never seen a case. As the lymphatic varix must extend in some cases into the wall of the bowel, it is by no means an unexplainable trouble. As such cases are only a curiosity, they need not detain us further.

We have now to discuss the forms characterized by the production of more or less solid œdema in the parts affected, in addition to the lymphatic dilatation that characterizes all the affections that I have grouped under this section.

Not so very long ago it was necessary to enter into elaborate reasons which would justify the placing of the diseases characterized by solid œdema among the filarial diseases at all. Happily, with the advance of knowledge, this is no longer necessary; still, it is well to bear in mind the main reasons that justify this classification. It is true that not all cases of elephantiasis are connected with filarial disease and that, while the most common cause, it is not the only one. In the East and in Europe cases occur that have nothing to do with filarial disease and yet are as pronounced cases of elephantiasis as one could wish to meet; but, on the whole, it may be fairly stated that the elephantiasis of China is due to filarial disease, for the following reasons:

a. The distribution of filarial disease and elephantiasis are the same. Generally speaking, where there is no filaria, there is practically no elephantiasis, and vice versa. After a period of work in the coast belt of Fukien, I moved inland to a place well outside the belt. Here filariasis was absent, and the few cases of elephantiasis of the leg that came to me were either frankly due to other causes or were cases that had originated in the coast belt.

b. Every gradation between lymph scrotum—which is clearly a filarial disease—and elephantiasis scroti can be observed.

c. Both lymph scrotum and elephantiasis scroti are lymphatic varices.

d. The type of fever observed in undoubted filarial cases and elephantiasis cases is precisely the same.

e. The removal of a lymph scrotum or varicose groin glands—both manifestly filarial diseases—may be followed by the development of a form of elephantoid disease, either elephantiasis of scrotum or leg.

f. Acknowledged filarial disease and elephantiasis may and often do occur in the same subject.

Before taking up these diseases in detail, it will be well to discuss their pathology; and it must be freely conceded that in the majority of cases filariæ will not be found in the peripheral blood. Probably this is due to one of two causes: either to the death of the parasite or to the blocking of the lymphatics draining any affected area, so that the filariæ cannot make their way into the blood. The solid œdema characterizing the disease is brought about not by the mere obstruction of the lymphatics, but by a combination of this with inflammation set up in the blocked area. But what causes the blockage? First there is the action of the parent worm, which, from injury or some other cause, may abort. The ova then either block the lymphatics or obstruct the glands of the area in question, producing a lymph stasis. In this area, already in a condition of lymph stasis, inflammation takes place, and an abscess may form which destroys the lymphatics in its vicinity. Probably this plays a much greater part in the production of elephantiasis scroti than is supposed, and it is the common thing in Fukien to be able to elicit from elephantiasis patients a history of abscess in the scrotum, often the first sign of trouble in that part. To this are superadded frequent attacks of erysipelatoid inflammation, each attack aiding in the production of the permanently thickened condition of the tissues. In the case of the scrotum it will be observed that the tumor increases in size very slowly, up to a certain point, and then increases at a much more rapid rate. This phenomenon is due to the accident of position. As long as the scrotal tissues are able to support the weight, the tumor remains braced up, so to speak. As soon as the tumor reaches a certain size, the tissues yield and relax. The weight of the tumor then comes into play, and all the lymphatics passing over the upper edge of the pubis are further obstructed.

In the case of the leg, the dependent position of the part plays no small share in the production of the enlargement, and in an operation case of my own the forced rest involved by the operation for elephantiasis scroti sufficed to reduce the leg temporarily to a third of its former size. When one cuts into an elephantoid mass such as is found in elephantiasis scroti, after traversing the greatly hypertrophied skin, the subdermal tissues are found to be also much thickened, and the dilated lymphatics are easily made out; below this again is a mass of blubbery tissue containing much fluid, and this is easily traversed by the finger.

The rarity of elephantiasis of the upper parts of the body is explained by the rare lodgment of the parasite in these regions and by the free anastomosis of the lymphatics in these parts.

We come now to a discussion of erysipelatoid inflammation, which plays a large part in the formation of a fully developed case of elephantiasis of the leg. There are two views generally held. Many hold that the essential cause is a low form of streptococcic infection superadded on a limb that is already the subject of lymph stasis. Those who hold this view are unwilling to concede that the filaria plays any active rôle at all, and some deny even the passive rôle referred to above.(37)

Others, including myself, are convinced that elephantiasis of the leg is infinitely more common in filaria-infected regions than in those free from the infection, and are not convinced that the filaria plays a merely passive rôle in the production of lymph stasis and the subsequent elephantoid development, holding that the results of bacteriological examination of the tissues are not conclusive and that the inflammatory attacks may be due to a poison generated in the body itself. Why, for instance, should a case of lymphatic stasis due to sloughing of the glands in a case of plague be practically free from the constant inflammatory attacks common in a filarial case, and why should a lymphatic fistula ward off these inflammatory attacks in a filarial case without preventing the slow increase in the size of the parts below the fistula? More investigation is badly needed in these cases, both of the exact nature of the obstruction and of the nature of these erysipelatoid attacks, before the question can be deemed to be satisfactorily settled.

ELEPHANTIASIS SCROTI

Elephantiasis scroti generally begins with attacks of elephantoid fever combined with erysipelatous inflammation of the scrotum. The part becomes swollen and œdematous, and hydrocele not infrequently makes its appearance. The acute attack subsides, but leaves behind a legacy in the shape of some permanent thickening and enlargement. This process recurs and is varied perhaps by the occurrence of suppuration in the scrotum. In whatever way started, the thickening tends progressively to increase, and occasionally there are only a few attacks of fever throughout the whole disease.

The disease is not uncommon in the coast belt, but as a rule the tumors are not of large size; and so little trouble do the smaller tumors give that the patients are usually not willing to submit to operation, unless the condition is such as to prevent sexual relations.

As to the tumor itself, the scrotum is greatly increased in bulk, and the skin is thickened and rugose. Occasionally this rugosity is so marked as to make the surface appear to be covered as if by a crop of warts. The hair is scanty, dry, and coarse, and the mouths of the follicles stand out very distinctly. The skin is also firmly bound down to the subjacent tissue, and as a rule, when fully developed, the scrotum does not pit on pressure. The sweat and sebaceous glands, as a rule, are atrophied. It is generally very difficult to say precisely where the healthy skin ends and the unhealthy skin begins. The blood vessels of the scrotum are enlarged and slightly thickened, but this thickening is as nothing when compared with the thickening to be seen in the lymphatics. Some of these at operation stand out as large, open-mouthed vessels. A hydrocele is often found with walls thicker than usual. If a hernia of old standing be present, the cord on that side may be so spread out over the hernial sac as to make it a matter of difficulty to recognize the former.

The weight of these scrotal tumors varies very much. All sizes may be met, from the tumor weighing only a few ounces (grams) to the largest recorded of 224 pounds (102 kilograms).(35) The largest that I have operated on weighed, after removal, 71 pounds (32 kilograms). From 5 to 50 pounds (2.2 to 22.6 kilograms) is the commonest weight.

These scrotal tumors may be classified in two ways; namely, according to the clinical characters of the swelling or according to the clinical characters of its neck.

According to the first classification, we meet with four forms:

a. A hard and solid type with no hydroceles or only very small ones.
b. One with large hydroceles and a fair amount of elephantoid tissue, involving more than the skin.
c. Elephantoid disease of the skin only, around a large hernia or hydrocele.
d. Elephantiasis of the penile skin, the scrotum remaining practically unaffected.

According to the second method of classification, the tumors are divided thus:

a. Narrow-necked tumors.
b. Broad-necked tumors.

This may seem an arbitrary and unnecessary distinction, but its practical use is great; for the one kind of tumor, the narrow-necked, is an easy one on which to operate, whereas the broad-necked tumor requires considerable skill.

In considering the treatment to be advised for a patient suffering from elephantiasis scroti, it must be remembered that in many instances these scrotal tumors never reach a large size and, provided they are giving little trouble, are quite as well let alone. If they are growing or if they interfere with the performance of the sexual act, removal should be undertaken. In calculating statistics of mortality, the cases of small tumors should be placed by themselves, for the mortality from mere decortication of the scrotum, in which the portion removed weighs only a few ounces (grams) ought with reasonable care to be practically nil; whereas the removal of a large scrotal tumor, which in many instances cannot be properly disinfected, is by no means devoid of risk.

In the case of the larger tumors, including those with complications such as hernia, which sometimes are very serious, the mortality in competent hands should not be above 2 per cent.

We will now discuss the most suitable form of operation. Careful local preparation is essential. This is carried out as follows: The parts are shaved, and then soap and water are liberally applied with the aid of a nailbrush. As dirt is generally much in evidence, this should be done several days in succession. Any open sores and sinuses have to be dealt with. On large tumors these are of common occurrence, the sinuses being the remnants of old abscesses and sores, the result of the itching of eczema or ringworm which has led to scratching. If eczema or ringworm is at all severe, the operation should be delayed until this condition is improved.

On the night before operation a final scrubbing is given, followed by scrubbing with turpentine to remove fatty matter, and by careful washing with 1 to 500 biniodide of mercury lotion in weak spirit. This again is washed off with biniodide of mercury lotion, 1 to 4,000, and a dressing of gauze soaked in the same solution is applied, covered with protective, and kept in place with a bandage.

Another method is to allow the parts to get thoroughly dry after the preliminary preparation and then to employ either an iodine solution or one of the newer dyes, such as methyl violet and brilliant green, for the final disinfection before operation. At the operation the greatest care should be taken, by means of sterilized towels, to isolate the operation area and the instruments, and ligatures should be most carefully prepared.

As to the position of the patient, the lithotomy position maintained by a Clover's crutch or leg-rests should be used. This is by far the most convenient. When operating on a patient the subject of hernia, the hernia is best dealt with first by the usual incision, with the patient lying on his back. Thereafter the patient is put into the lithotomy position for the removal of the scrotum. During the general preparation of the patient, the bowels should be well cleared out with an effective purgative, best given on the second evening before operation, so as to ensure the patient's getting an undisturbed night before the event. Any cough should be treated, and the heart and urine examined in the routine way. It is difficult to give definite advice about operation on opium smokers, such a habit adding considerably to the risk of any large operation. Those who smoke heavily should be compelled to break it off before operation; otherwise the operator will have no end of trouble with them afterward. Patients who are the subjects of malarial cachexia should be guarded from unnecessary danger by previous suitable treatment.

I never kept the patient in bed before the operation, believing that the gain in the reduction in size of the tumor is little compared with the depression arising from the concentration of the patient's mind on his complaint and on the operation, which he naturally dreads. So he is allowed to do as he likes until the night before the operation.

Anatomy of the parts in question.—It must be borne in mind that all the vessels are greatly increased in size, and for this reason vessels that are otherwise quite unimportant may become serious sources of hæmorrhage.

The important vessels are the following:

Superficial vessels: Superior external pudic vessels.
Deep or inferior external pudic vessels.
Sciatic vessels, muscular branches.
Superficial perineal vessels.
Cremasteric vessels.
Dorsal vessels of the penis.
Artery of the frenum.
Inferior hæmorrhoidal vessels, if the skin has to be removed to near the region of the anus.
Deep vessels: Branches of the internal pudic vessel.

These should be looked for and found in their proper situations. The dorsal vein of the penis should not be cut.

The nerves and their positions may be entirely disregarded. Nerves, however, should be cut short, and not left hanging in the large wound.

The lymphatics, also, may be disregarded; but, if large and gaping, they should be tied.

So much for the anatomy of the part. Now we must discuss a most important question. Is a tourniquet to be used or not?

Use of a tourniquet.—Many urge the use of a tourniquet in order to save loss of blood, but the oozing in such cases after operation is frequently severe and troublesome. On the other hand, if a tourniquet is not used, the primary loss of blood may be severe. On the whole, I think the best advice is that if the surgeon is afraid of the primary hæmorrhage he should use a tourniquet, but if he is familiar with the anatomy of the area and is a fairly rapid operator, he will do better without. In the earlier cases I always used the tourniquet, but in later cases I did not; and since discontinuing its use I have had none of the unpleasant after-bleeding that was experienced in one or two of the earlier cases.

Another disadvantage in the tourniquet as applied by McLeod's(23) or Manson's method is that there is a constricting band around the abdomen, a thing that is objectionable, as it probably increases the danger of the anæsthetic. If a tourniquet is to be used, it is best applied in the following way:

Across the neck of the tumor is laid a long, sterile calico bandage from the right arm to the left foot. Behind, the same thing is done from the left arm to the right foot. The tumor and the two lower ends of bandage are held up and a piece of quarter inch drainage tube is carried around the neck and the bandages in a circular manner and tied securely. The lower end of the bandage in front is then turned upward toward the left arm, and the lower end of the bandage behind is turned up toward the right arm. The two ends toward the left arm and the two ends toward the right arm are held by an assistant on each side and so maintain the tourniquet in position. The tourniquet and bandages are, of course, carefully sterilized. This method obviates the necessity of having a tight band around the abdomen.

Incisions.—Hard and fast rules should not be laid down as applying to every case. For instance, in one case in which the skin of the penis was normal, the whole of it was left and after two years the skin was still perfectly sound.

Again it used to be urged that all diseased skin should be removed. If, as sometimes happens, the skin of the anterior abdominal wall is extensively involved, to remove the whole skin of this region is to make a huge wound without any real advantage to the patient.

Again a man of 60 years should not be treated like a man of from 25 to 30 years. In the latter case, to leave unhealthy skin is to court recurrence; in the former, it is most unlikely that there will be anything of the kind, and the attention of the surgeon should be rather drawn in the case of the older man to the provision of flaps, so as to insure a quick recovery.

The same discretion must be shown in dealing with the testicles. In a young man these must be certainly preserved, but in an old man, if atrophied, and their removal will facilitate healing, one or both may be removed. In a case complicated with hernia, it is good practice to remove the testicle on the side of the hernia. One can then be sure of closing the abdominal wall securely, and in this case there is the additional advantage that the operation is thereby shortened.

Speaking generally, I use two main forms of incision, one when using a tourniquet and another when operating without it. When not using a tourniquet, the incisions are made as follows:

The first is in the median line from the region over the pubis to the urinary orifice. Generally, as the tumor grows, the prepuce is inverted, and the glans may be several inches (centimeters) from the external orifice. A finger of the left hand is inserted into this orifice, and the incision is rapidly deepened. It is very easy to tell when one has exposed the penis. Using a pair of scissors, and with the aid of one's finger as a director, the prepuce is opened along the dorsum as far as the glans. All smegma is carefully cleaned away, and the lining membrane of the prepuce is dissected off and left attached to the glans penis.

The penis is now to be thoroughly separated from its surroundings from the suspensory ligament outward, taking care, below, not to cut the artery of the frænum. If it is wounded, it is better to ligature it at once. Above, care must be taken of the vessels on the dorsum of the penis, the vein being always very large. If due care is taken, it ought not to be wounded. The penis, having been separated, should be wrapped in gauze and turned upward.

The tumor is now pulled well over to the left, and beginning over the right external abdominal ring, a lateral flap is marked out, the incision ending in the middle line in front of the anus. The upper portion of this incision is now deepened, the vessels being picked up as cut. The external pudics will both be secured in this way. The skin left in this flap should be soft and pliable, and no œdematous, subcutaneous tissue should be left if it can possibly be helped. This incision and proceeding are repeated in the same manner on the other side of the tumor.

The upper ends of these incisions are now joined by a straight transverse incision, which crosses the upper end of that which has been used for separating out the penis.

A free incision is now made over one of the testicles, beginning from one of the lateral incisions near the external abdominal ring. This is rapidly deepened till soft, œdematous tissue is reached, when the knife is laid aside and the fingers are inserted. With their aid, the œdematous tissue, which runs with fluid, is torn open, and the testicle and cord are isolated. It is better to isolate the testicle first, as it is more easily found; the cord is not infrequently much expanded. The gubernaculum testis is in these cases very strong, and must be cut away with scissors or knife. The testicle is frequently compressed and deformed, and the cord is much lengthened, but this lengthened condition of cord soon corrects itself and needs no special treatment. If the testicle is hopelessly atrophied, then it is as well removed.

Charles(8) speaks of congestion of the head of the epididymis, or fibrous induration of the same, in cases attended with hydrocele. I have looked for this and have not been able to satisfy myself on the point.

The testicle having been freed, if there is a hydrocele, it should be cut open and the sac cut away, except a strip, which is left attached to the cord. The same procedure having been repeated on the other side, the testicles with their cords are then wrapped in gauze and turned up on the abdominal wall.

The incisions already made for the flaps are now to be rapidly deepened, and the whole mass is cut away from above, all vessels being clamped as cut.

Some operators advise arresting hæmorrhage by the clamp torsion method. I always ligature the vessels, using fine catgut. It is better not to employ silk for these large tumors as, owing to the impossibility of complete disinfection of the skin, infection of the wound is by no means unknown, and in such case the silk ligatures may give trouble. The number of vessels requiring ligatures is often very great, from forty to sixty ligatures being sometimes needed.

All bleeding having been arrested and clot sponged away, the testicles should be fixed in place by a stitch or two to the perineum. If the cord is very long, this too is secured in its proper situation by the same method. The flaps are now drawn over the testicles from each side and are fastened together by stitches of silkworm gut. If they do not come easily together, this may be facilitated by freeing the skin flaps at their attachment to the thigh, using knife and finger for the purpose.

A gauze drain should be inserted from the region of the base of the penis, bringing the end out at the lower extremity of the wound. This drain is removed in from twelve to twenty-four hours from the time of operation.

The penis is now drawn well forward, and the skin of the flaps is stitched to its base, the sutures going deeper than the cellular tissue and getting hold of the fibrous coat beneath. The lining membrane of the prepuce is also turned back and is used to cover a portion of the penis. The rest of the wound is sewn together with silkworm-gut sutures, and the operation is complete.

When using a tourniquet, it is well to commence with the median incision, then separate out the two testicles through two incisions down the front of the scrotum and, lastly, make the flaps and join the incisions.

Dressings.—Sterile gauze soaked in biniodide of mercury lotion, 1 to 4,000, is a good dressing. This is wrung out and is allowed to fall and arrange itself on either side of the penis, which is bandaged separately with gauze of the same kind. Oiled silk is extremely difficult to keep in good condition in the East. The dressing must be large, pass out on to both thighs, and fit well around the root of the penis.

The bandaging is an important and difficult matter. A bandaging block is an advantage. Calico is too stiff a material for the bandage; it should be made of a softer substance. What is called a water bandage does admirably. It must be put on in the form of a double spica, crossing and recrossing the perineum, and must be firmly fastened at the dangerous angles with safety pins. Especial care should be taken of the penis and the part just in front of the anus, which are the most liable spots for septic infection.

After treatment.—The patient must be placed in bed, and his knees should be tied together. There is no need to keep him absolutely at rest on his back; he may be allowed to lie in any way most comfortable. For the first twelve hours he should have nothing but a little very hot water to sip; rice water may be given for the next twenty-four hours, and after that whatever food he likes, within reason. The English method of after operative feeding does not suit the Chinese, and as a rule they flatly refuse such things as beef tea. Under the treatment given above they do very well. Usually they do not suffer severely from shock, but it is not true to say that this can be excluded, for occasionally severe shock may manifest itself; this shock is to be treated in exactly the same way as in England by strychnine, pituitrin, warmth, stimulants, posture, and saline infusion if necessary.

As has been previously said, the drain of gauze is to be removed from the lower part of the wound at the end of from twelve to twenty-four hours. If the flaps have been sufficient to cover everything, and all goes well, the wound need not be touched for seven days, when it will be found to be healed. The gauze about the penis should be removed by careful soaking, and the surface should be grafted, if need be, by Thiersch's method. Great care must be taken to avoid the binding down of the penis by cicatricial bands. The bowels should be opened by a laxative on the third day. Under favorable circumstances, healing should be complete within the month. Complications that may attend the convalescence are discussed in the following paragraphs.

Retention of urine.—This generally occurs at once, if it is going to occur at all. It is best treated by the passing of a soft rubber catheter, and after the first twelve hours the patient may be allowed to stand up to pass water. Occasionally, if the wound becomes septic, there may be a little difficulty, but it rarely needs instrumental relief.

Recurrent hæmorrhage.—This is a most troublesome complication when it does occur, and it is interesting to note that it hardly ever occurs except in patients in whose cases the tourniquet has been used. On one occasion I had to get up in the middle of the night, open the wound, and tie no fewer than twelve bleeding points. It is true, however, that this man had been unusually restless. In another case a hæmatoma that had formed over the upper part of the right cord and was becoming septic had to be evacuated. True secondary hæmorrhage I have never seen in these cases.

Œdema of the glans penis.—This is very liable to occur if care is not taken in bandaging the organ; but, when it does, the bandage must be taken off and reapplied.

Troublesome erections.—These sometimes occur, and they are a source of annoyance to the patient. If ice can be obtained—an impossibility in Fukien except in the coast ports—then an ice bag may be applied to the perineum. One useful plan is to insist on the patient emptying his bladder before sleeping, also whenever he wakes during the night, and to forbid him to sleep on his back. My experience of bromide and similar powders is distinctly disappointing.

Irritation of the skin.—This sometimes occurs as a result of the antiseptics used, helped also by the amount of scrubbing that the skin has had to undergo in order to make it anything like clean. It must be treated by powdering the surface with zinc oxide and changing the dressings for others that are less irritating.

Fever.—There are four causes of fever for which one must always be on the lookout. The first is malaria. In the southern region, where practically every one carries the plasmodium about with him, it is wise to give the patient a course of quinine before the operation. If this has not been done, then it is not at all unlikely that the shock of the operation will bring on an attack, in which case *Plasmodium malariæ* will be found in the blood. It is generally an atypical form of fever.

The second cause of fever is filarial. One of my cases had such an attack on the second day after operation. In this case the skin of the penis had been left untouched, and the erysipelatoid inflammation [8] of this part was well marked. Almost the whole wound healed by first intention, and the attack did not appear to have delayed convalescence. The patient's blood was swarming with filariæ at the time. Such an attack should be treated on general principles.

The third cause of fever is sepsis and need not be described, as it follows the usual course and presents the usual signs. If it occurs, a sharp lookout must be kept for an abscess or a suppurating hæmatoma, and free drainage must be provided.

[8] This typical erysipelatoid inflammation, if due to a streptococcal infection from the outside, should have produced much more serious results in this case.

The fourth cause of fever is pneumonia. The utmost care must be taken at the time of operation that the patient does not get chilled. If he should be so unfortunate as to get pneumonia, the case must be carefully watched and treated on ordinary principles.

So much for the complications of convalescence, but there are yet to be discussed the complications of operation.

Hernia.—In the principal writings on elephantiasis scroti, so little notice is taken of this complication that one is led to believe it does not greatly increase the risk of operation. It is nearer the truth to say that a large hernia is the most serious complication one can meet, for two reasons: first, that it is sometimes difficult to tell the size and contents of the hernia, owing to the thickness and hardness of the skin covering the parts; and, secondly, because the dragging of the tumor on the muscles of the abdominal wall, combined with the length of time the hernia has been down, has diminished the capacity of the abdomen, leaving little room for reduction.

It may be that I have been extremely unfortunate in the cases that I have had, but two of them gave me an anxious time. The first was a case in which there was a right inguinal hernia that had existed for years and was apparently reducible. Radical cure was performed on that side, the right testicle being removed and the scrotum amputated. Great difficulty was experienced in reducing the bowel, and the abdomen when the wound was sewn up was as tight as a drum. This case did well after looking unfavorable for the first few days.

The second case was more unfortunate. The patient was a man of 44 years, with elephantiasis scroti which weighed, after removal, 18 pounds (8.2 kilograms). He had a large right inguinal hernia, the size of which was hard to estimate accurately, owing to the very thick skin that extended well up on the abdominal wall. I was strongly of the opinion that it was not all reducible, and, owing to the risk, was rather unwilling to operate. However, the man was unable to work, and he was urgent in his request that the operation should be done at all risks; so it was finally undertaken. I found myself confronted with a huge hernia, in which some of the bowel had evidently been long out of the abdomen. After removing 0.5 pound (0.226 kilogram) of omentum, and puncturing the bowel in three places to let out gas, it was reduced, but the abdomen was so tight that there was danger of the stitches giving way. For three days the patient did well, then rapidly collapsed and died. It was not typical peritonitis, and the puncture holes into the bowel had been carefully closed with Lembert sutures; but as no postmortem was possible, it was impossible to learn the precise cause of death. Probably it would have been better to have excised the bowel; but after the experience of these two cases it is clear that the complication of hernia may be a serious one, and one which should call for great care in prognosis.

Hydrocele.—As has been previously stated, the common thing is to find hydrocele, and sometimes it is very large. It does not complicate the case in any serious way and is treated by excision of the sac in the usual method. The thickness of its wall varies greatly, from the almost normal condition to one in which the whole sac is much thickened. Occasionally this thickening is irregular.

Besides the ordinary form of hydrocele, there are found what are called hydroceles of the cord. When present these are to be treated by opening them and cutting away part of the wall. They are of little importance.

Varicocele.—This is not common, but is occasionally met with; in such a case the veins should be tied, and a portion should be excised in the usual way.

Cysts.—These are occasionally met with in the body of the tumor. They are generally smooth-walled, irregular spaces, and may commence in the rupture of some dilated lymphatics or may be the remnants of some old lymph abscess cavity. In a case in which I found one, it was directly beneath the scar of an old abscess. They are merely curiosities and do not affect treatment.

Complicated cases.—Under this heading may be included a case like the following: The patient came to the hospital in a miserable condition, with an elephantiasis scroti of some 10 pounds (4.5 kilograms) in weight, a bad stricture of the urethra, a right scrotal hernia, and several urinary fistulæ. The procedure adopted by me was to operate on the hernia by an incision placed well up on the abdominal wall, accomplishing a radical cure, and tying and severing the cord and pushing down the lower end into the scrotum. A week later the patient was put into the lithotomy position, and the scrotum was amputated, the right testicle being removed with the mass, and the left one shelled out. The stricture was now divided by an external urethrotomy, and a metal, full-sized catheter was tied in. All the fistulæ were followed up to their origin, and the left testicle was sewed in position and covered by a flap from the thigh. The penis, which was little affected, was let alone. The patient made an excellent recovery and left the hospital with one tiny fistula in the scrotum and was able to pass his water by the proper channel. He had been taught before discharge to use a full-sized, metal sound. A year later he had completely recovered.

What is the result of operations for elephantiasis scroti? It can be definitely stated that the results are very satisfactory. As a rule, the disease, if effectively treated, shows no tendency to recur. The first patient I treated has had two children since the operation. One of these was premature and only survived its birth a few hours, but the second was a healthy, full-term child.

In another case the patient unfortunately was left with a lymphatic fistula at the root of the penis. In this case the patient was old (63 years), and the elephantoid disease had affected the skin of the abdomen as far as the umbilicus, so that part of the operation had to be carried out through diseased tissues. Under these conditions it is hardly surprising that a fistula should be left.

These favorable results are corroborated by the experience of others.

ELEPHANTIASIS VULVÆ

Elephantiasis vulvæ is a rare disease. It may attack the whole of the external genitals or some one of their various parts. In the latter case the labia majora or the labia minora or the prepuce may be affected. There are two main types to be distinguished. In the one case the disease is sessile, corresponding to the broad-necked form of elephantiasis scroti. In the case illustrated (Plate 22, fig. 2), the disease had lasted for some ten years. The patient had acquired it in the coast belt and when seen was also suffering from malignant disease of the base of the bladder. Sometimes it involves the two labiæ, and as a rule the sessile form, if it needs operation at all, can be removed by an incision going clear of the growth on both the outer and inner side. It must be borne in mind that a form of elephantiasis vulvæ, having nothing to do with filarial disease, is by no means so rare. This is due to venereal infection and is generally small in size; its ætiology is not obscure.

The other type is a rarer one, where, a portion of the vulva being affected, this local trouble is accentuated by posture, and the whole forms a pendulous mass from the region of one or the other labium, varying in size, and comparable with the narrow-necked form of elephantiasis scroti. Plates 23 and 24 show cases of this kind well. The patients lived in the coast belt and had masses of filarial groin glands, which can be seen in the photograph of one case (Plate 24).

In this form of the disease, operation is simple and consists of amputating the tumor through the neck. The only point especially important is to note that the vessels are stretched and should be picked up and tied before they retract.

Charles (9) recommends that a catheter be introduced into the bladder before the operation and be retained there, in order to prevent the wound being douched with urine during or after the operation. Of course, the operation must be conducted under strictly antiseptic precautions. Recovery is generally rapid and satisfactory.

ELEPHANTIASIS OF THE LEGS

Elephantiasis of the legs may effect one or both legs and is, as a rule, much more marked below the knee, although the lower part of the thigh is often affected at the same time. Very rarely the thigh is affected before the leg, and I have seen at least one good example of this condition. The pathology and history of the growth of the legs are much the same as those of the scrotum. Very frequently the glands of both groins are varicose, even though the elephantiasis is confined to one leg.

The muscles of the part are frequently atrophied from pressure, constriction, and disuse. They are also said to undergo fatty degeneration from a like cause. The vessels are enlarged, and their coats are thickened. The bones may be thickened and have osteophytic growths; more rarely they are atrophied. The skin is very coarse, does not sweat at all readily, and is often ulcerated, especially about the ankle, where in a normal case of elephantiasis there is a constriction permitting of movement of the joint. The leg may attain an enormous size, having been found as much as 24 inches (61 centimeters) around the ankle. Still it is surprising how active some of these patients remain; for example, a patient, a horse keeper whom I used frequently to employ, whose leg was not less than 16 inches (40.5 centimeters) in circumference, and who had been in hospital for abscess in the leg and for filarial fever. Yet he has walked 12 miles (19.3 kilometers) after his ponies without any difficulty, and that over rough mountain paths. This for a man of 54 years of age cannot be considered a poor performance.

It must be remembered that an abscess in the leg may be the first sign of filarial disease, and it is not infrequent for abscesses to form in the already elephantoid leg; these may give much trouble, owing to their tendency to form lymph fistulæ. In like manner they are prone to become the seat of intractable ulcers, which, however, act as lymph fistulæ and so save their owners a number of attacks of elephantoid fever.

Before treatment, one should determine how much inconvenience the patient really suffers. In many cases it is not much, and it is as well in such cases to do nothing. If a leg is badly ulcerated in addition, it may be amputated, but this should rarely be done. I have had to advise it in only one instance, where the limb was deformed and ulcerated. Ligature of the femoral artery has been practiced; but, besides being useless, it may be followed by gangrene, and is therefore unjustifiable. Electrolysis has also been used, but it is of no use whatever. Aseptic puncture during the acute attacks of erysipelatoid inflammation has been performed with good results, but the benefit is only temporary; unless done with great care and antiseptic precautions, it may be followed by ulceration or a lymph fistula.

The main treatment is prophylactic, and the part should be carefully kept from injuries, such as wounds, insect bites, and scratches by thorns. If possible, the patient should give up work that involves wading in water, with bare legs exposed to the sun. If ulceration is already present, it should be prevented from spreading over a large area by antiseptic dressing.

In some cases a spell in bed with the limb slightly raised and the use of an elastic bandage will greatly lessen the size of the limb. In other cases the constant use of an elastic bandage helps the patient.

In serious surgical treatment, there are several operations that have been tried and abandoned.

Decortication of the limb with subsequent Thiersch grafting has been performed. Although in some instances the huge wound so formed has been induced to heal, the surface broke down again, and intractable ulceration and contracture followed, necessitating the removal of the limb.

Longitudinal strips of skin have been dissected off the fascia, but here again the procedure proved of doubtful value, and often it was a matter of great difficulty to get the wound to heal.

There are two operations, however, that have been attended with a great measure of success in nonfilarial cases, and they probably will be of value in selected filarial cases. One is the

Sampson-Handley (39) operation for the establishing of a new lymphatic circulation; the second is the Kondoléon (17) operation.

The first, so far as I am aware, has proved disappointing in cases of this kind. It consists in the insertion of silk threads leading from the area of lymph stasis into an area above the seat of obstruction. Dr. A. F. Cole, late of Ningpo, performed several of these operations on cases of this class. In the ones that succeeded there was considerable improvement in the size of the limb for the time being, but, so far as I am aware, all relapsed later.

The Kondoléon (17) operation gives more promise of success, but so far few operations of this kind have been performed in China. One has been reported by Bell, (4) who speaks favorably of the result, and several have been performed by Dr. E. J. Strick of Amoy, with good results; but hardly sufficient time has elapsed for one to be able to judge of the final ending of the cases. The principle of the operation is the placing of the deep and the superficial lymphatics in connection by the removal of a large strip of the deep fascia. The fullest and best description of the operation will be found in two papers by Sistrunk, (41) of the Mayo Clinic, Rochester. Some of his results are very good, but they are in nonfilarial cases, and the amount of obstruction at the back of the abdomen must have its influence in determining the final result. At one time it was hoped that the injection of fibrolysin would aid greatly in the treatment of cases of this class; but, so far as I know, it has proved unavailing in producing permanent improvement. The same must also be said of the proposed anastomosis of veins and lymphatics about the saphenous opening.

ELEPHANTIASIS OF THE ARMS

Elephantiasis of the arms is very rare, and I have never seen a case in which I could be quite sure of the diagnosis. I have seen cellulitis of the arm, of filarial origin, but the limb was not a typical case of elephantiasis, and I have not been able to obtain information of a well-marked case in China.

Treatment is unsatisfactory and resolves itself into bandaging, massage, and suitable support. It is possible that the Kondoléon operation might greatly benefit such a case.

ELEPHANTIASIS OF THE MAMMÆ

Elephantiasis of the mammæ also is very rare, and I have never met a case. Probably the smaller incidence of filarial disease among women is the cause. If the growth becomes large, the breast should be amputated. These tumors are occasionally very large and have been known to descend as far as the knees. One on record weighed 21 pounds (9.5 kilograms).(36)

Cases of hypertrophy of the breast may reach a huge size and are found in China, but so far I have seen none to which filarial infection could be assigned as a cause.

ELEPHANTIASIS OF LIMITED SKIN AREAS

Elephantiasis of limited skin areas are also rare, but not so rare as the kind just discussed. I have several times seen flat elephantoid areas on the thighs, but have never seen any sufficiently serious to justify operation.

Localized pedunculated tumors have been reported from other localities. Corney, (11) of Fiji, Daniels, (12) and Silcock (40) have described cases of this kind. Daniels met with his cases in Fiji and Demerara, and Silcock's patient was an East Indian. The tumors are easily removed by operation.

THE EFFECT OF FILARIAL INFECTION ON THE COURSE OF OTHER DISEASES

A few observations have been made on the effect of filarial infection on the course of other diseases. Surgical wounds in the subjects of filarial disease heal very well, unless they happen to be in an elephantoid area and have been allowed to become septic, in which case they heal very badly. One case, a man who had been clawed by a tiger, who came into my hands very badly torn and whose blood was swarming with filaria, healed well. Ordinary operation wounds heal by first intention quite as well as in other subjects. Broken bones also unite without any trouble. Operations for cataract follow a normal course.

Of the medical diseases, malaria and filariasis are not antagonistic, and they have been frequently seen combined in the same subject. Enlarged malarial spleen and elephantiasis not infrequently coexist in a patient.

Typhoid fever is not influenced in its course by filariasis. Three times I have seen them coexist, without the fever being in the least modified.

Lung diseases are unfavorably modified by the presence of filariasis, especially pneumonia. Twice I have seen patients, the subjects of filarial disease, removed in a dying condition by their friends; one case died in the hospital, and two or three have had narrow escapes. One cannot dogmatize on the matter, but probably it will be found that a large number of these filariasis cases die of lung trouble in the end. A fair number suffer from phthisis, but whether the number is greater among them than among the general population, it is impossible to say.

A certain number of such patients suffer from nephritis, but what has just been stated about the proportion of phthisis cases holds for these also.

How is the disease to be dealt with as a whole?

McNaughton (22) has reported a few cases treated by salvarsan, in which it was claimed that the parent worm had been killed by the treatment. I am not aware of any special work that has been done in this direction in China; but, as has been stated previously, the killing of the parent worm, even if it can be certainly done, is not altogether devoid of risk to the host.

The extirpation of the mosquito carrier in southern China is a matter of impossibility, but much might be done by a proper use of the mosquito net or a screening of the bedroom in which the infected person sleeps. But what of the number of patients who are infected and do not know it? The whole problem is one beset with difficulties, and it must be confessed that the mosquito net, with all its drawbacks, is the most practical preventive measure at our command at the present time.

ACKNOWLEDGMENT

I wish to thank many of my fellow workers in southern China for kindly answering queries put to them from time to time as well as those who have kindly placed photographs at my disposal.

REFERENCES

(1) Azema, M. Tropical Diseases. Cassell, London (1917) 715.

(2) Bancroft, Sr. Discovery of the adult representative of microscopic filarias. Lancet, London 2 (1877) 70, communicated by T. S. Cobbold.

(3) Bancroft, T. L. Journ. Trop. Med. London 2 (1899) 91.

(4) Bell, L. N. Am. Journ. Gyn. & Obstet. 29 (1919) 199.

(5) Brazilian Physicians. Diseases of Warm Climates. Pentland, London (1893) 781.

(6) Calvert, W. J. Johns Hopkins Bull. 13 (1902) 133.

(7) Charles, R. H. Ind. Med. Gaz. 36 (1901) 133.

(8) Idem. Ind. Med. Gaz. 36 (1901) 133.

(9) Idem. Ind. Med. Gaz. 36 (1901) 133.

(10) Coles, A. C. The blood in cases affected with filariaris and bilharzia haematobia. Brit. Med. Journ. 1 (1902) 1137.

(11) Corney, B. "Sibi and Ceke." Lancet, London 1 (1889) 679.

(12) Daniels, C. W. Brit. Guiana Med. Ann. (1896).

(13) Demarquay. Gaz. Med. de Paris **18** (1863) 665.
(14) Dutton, J. E. Brit. Med. Journ. **2** (1901) 612.
(15) Gulland, G. L. The condition of the blood in filariasis. Brit. Med. Journ. **1** (1902) 831.
(16) James, S. P. Ind. Med. Gaz. **36** (1901) 114 (letter).
(17) Kondoléon, E. Centralbl. f. Chir. **39** (1912) 1022.
(18) Leiper, R. T. Thelaziasis in man; a summary of recent reports of "Circumlocular Filariasis" in Chinese literature with a note on the zoölogical position of the parasite. Brit. Journ. Ophthalmology **1** (1917) 546.
(19) Lewis, T. R. 8th, 10th, and 14th Annual Reports of the Sanitary Commissioner with the Government of India.
(20) Low, G. C. A recent observation on Filaria in Culex. Brit. Med. Journ. **1** (1900) 1456.
(21) Maitland. Ind. Med. Gaz. (1898) October.
(22) McNaughton, J. G. Journ. Trop. Med. **19** (1916) 249.
(23) McLeod. Tropical Diseases. Cassell, London (1917) 728.
(24) Manson, P. Trans. Linn. Soc. London 2d ser. Zoölogy **11**, part 10, 367.
(25) Idem. Hygiene and Diseases of Warm Climates. Pentland, London (1893) 765.
(26) Idem. Tropical Diseases. Cassell, London (1917) 688.
(27) Idem. Tropical Diseases. Cassell, London (1917) 710.
(28) Idem. Tropical Diseases. Cassell, London (1917) 711.
(29) Idem. Tropical Diseases. Cassell, London (1917) 704.
(30) Idem. Tropical Diseases. Cassell, London (1917) 715.
(31) Idem. Tropical Diseases. Cassell, London (1917) 713.
(32) Idem. Tropical Diseases. Cassell, London (1917) 717.
(33) Idem. Hygiene and Diseases of Warm Climates. Pentland, London (1893) 787.
(34) Idem. Hygiene and Diseases of Warm Climates. Pentland, London (1893) 791.
(35) Idem. Tropical Diseases. Cassell, London (1917) 725.
(36) Idem. Tropical Diseases. Cassell, London (1917) 733.
(37) Matas, R. Am. Journ. Trop. Dis. & Preventive Med. **1** (1913) 60–85.
(38) Moty. Revue de Chirurgie (1892) January.
(39) Sampson-Handley, W. Lymphangioplasty. Lancet, London **1** (1908) 783–785.
(40) Silcock. Ind. Med. Gaz. (1895) July.
(41) Sistrunk, W. E. Surg. Gyn. & Obstetrics **26** (1918) 388–393; Mayo Clinic Papers **10** (1918) 983–996.
(42) Sonsino. Med. Times & Gazette, London (1882).
(43) Stuckey, E. J., and Houghton, H. S. Circumlocular filariasis. China Med. Journ. **31** (1917) 24 and Brit. Journ. Ophthalmology **1** (1917) 542.
(44) Whyte, G. D. Journ. Trop. Med. **12** (1909) 172.
(45) Winkel. Hygiene and Diseases of Warm Climates. Pentland, London (1893) 789.
(46) Wücherer. Gaz. Medica de Bahia (1868) December 5; (1869) September 30.

ILLUSTRATIONS

[Plates 1, 2, and 3 are reprinted from Tropical Diseases by the kind permission of Messrs. Cassell & Company, Limited; Plate 11 is from a photograph by Dr. J. M. Howie; Plate 15, from a photograph by Dr. P. B. Cousland; Plate 16, from a photograph by Dr. J. H. Montgomery; Plate 25, from a photograph by Canton Hospital staff; and Plate 26, from a photograph by Dr. E. J. Strick.]

Plate 1

Anatomy of *Filaria bancrofti* embryo. *a*, sheath; *b*, central viscus; *c*, V spot; *d*, tail spot.

Plate 2

Fig. 1. Section of thoracic muscles of mosquito about twelve days after it had fed on a filariated patient.

2. Filariæ in head or proboscis of mosquito. *a*, filariæ; *b*, labium; *c*, labium; *d*, base of hypopharynx; *e*, duct of veneno-salivary gland; *f*, cephalic ganglia; *g*, eye; *h*, œsophagus; *j*, pharyngeal muscles.

Plate 3

Metamorphosis of filaria in mosquito. *a*, *b*, *c*, *d*, *e*, *f*, progressive forms of the parasite.

Plate 4

Section of a varicose groin gland, showing great dilatation of vessels, both lymphatic and blood vessels, with hyperplasia of the gland tissue; × 60.

Plate 5

Fig. 1. Section of skin just becoming affected with elephantoid changes, showing a tendency to round-cell infiltration, with dilatation of lymph spaces. × 60. The large space is a defect in the section.

2. Section of skin from fully developed elephantiasis scroti, showing dense fibrous felting with thickening of the epithelial layers and corium. × 60.

Plate 6

Early elephantiasis scroti, showing the scar of a filarial abscess of the scrotum on the right side.

Plate 7

Lymph scrotum. In this case the swelling of the groin glands is not marked. There is some œdema of the preputial skin, and the vesicles on the scrotum are well shown.

Plate 8

Lymph scrotum; penis unaffected. Shows well the lax, œdematous look that some of these cases present. The dark patch is due to iodine, which had been painted over large and aching groin glands.

PLATE 9

FIG. 1. Elephantiasis of penis; scrotum unaffected.
2. Cauliflower condition of preputial tissues.

PLATE 10

Elephantiasis of the penis; scrotum slightly affected.

PLATE 11

Elephantiasis scroti (narrow-necked), weighing, after removal, 32 kilograms. Patient an opium smoker. The slit in the center represents the urinary orifice, the glans being just beyond the reach of my finger when inserted at the opening.

PLATE 12

Condition of parts three weeks after operation. The testicles being atrophied, and the patient in a weak condition at the time of operation, these were removed, thus facilitating healing.

PLATE 13

Elephantiasis scroti. The warty condition of the penis is well shown. The skin of the abdomen was slightly affected as far up as the umbilicus. Weighed, after removal, 16.3 kilograms. It will be evident how impossible it is properly to disinfect the skin in a case of this kind.

PLATE 14

Elephantiasis scroti, showing a twisted condition, not infrequently seen, affecting the penile tissues. Weight after removal, 3.2 kilograms.

PLATE 15

FIG. 1. Elephantiasis scroti, broad-necked.
2. Elephantiasis of the cheeks.

PLATE 16

Condition of parts thirteen days after operation. Shows well the preputial lining turned back to form part of the coating of the penis. This patient has had two children since operation.

PLATE 17

Œdema of the penis, which came on shortly after the operation. This was due almost certainly to the contraction of the healing wound. It passed away of itself within a year, and the patient recovered completely. In the right groin the scar of the hernia incision is visible.

PLATE 18

Elephantiasis scroti. Leg also affected.

PLATE 19

Elephantiasis of both legs, the left also showing the troublesome chronic ulceration met with in some of these affected legs. The fold at the ankle and the shapeless condition of the foot are well shown.

PLATE 20

Elephantiasis of leg, due to plague.

PLATE 21

Elephantiasis of leg, due to tertiary syphilis.

PLATE 22

FIG. 1. Elephantiasis of one leg.
2. Elephantiasis vulvæ, sessile form.

PLATE 23

Elephantiasis vulvæ, pedunculated.

PLATE 24

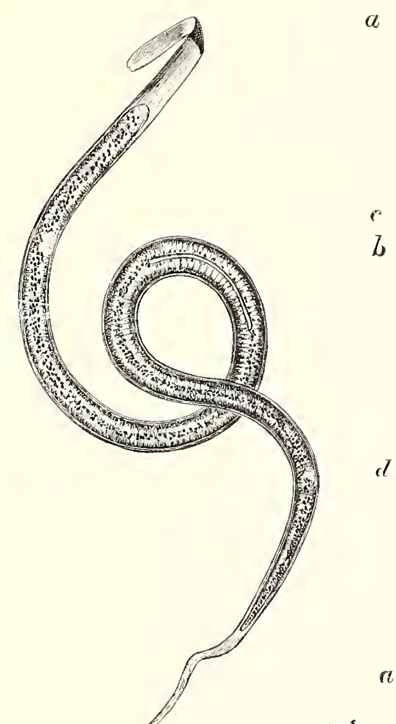
Elephantiasis vulvæ, pedunculated.

PLATE 25

Map of China, showing the distribution of filarial disease.

TEXT FIGURES

FIG. 1. Chart of elephantoid fever.
2. Typical chart; filarial abscess.
3. Chart of filarial abscess.
4. Chart of neglected case of filarial abscess.



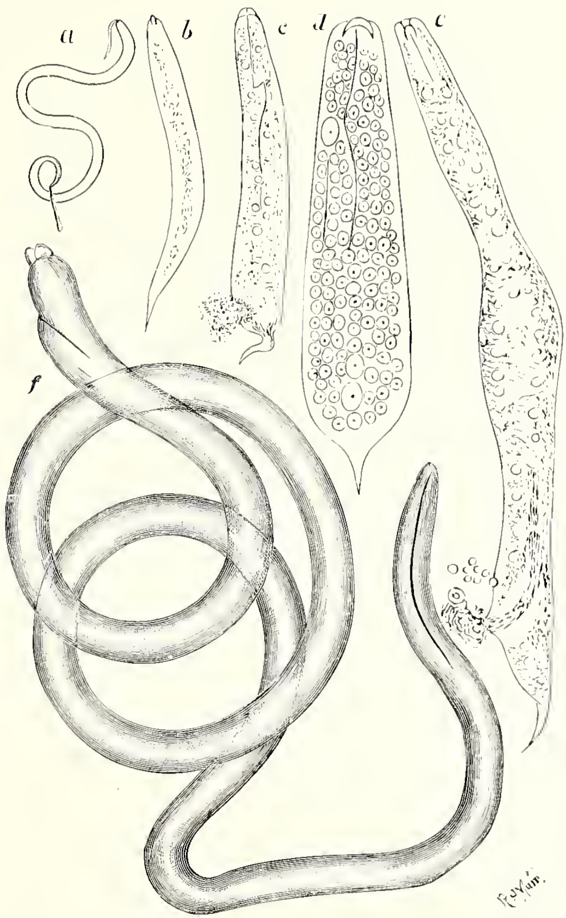
a, sheath; b, central viscus; c, V spot; d, tail spot.

PLATE 1. ANATOMY OF FILARIA BANCROFTI EMBRYO.

Fig. 1. Filariæ in thoracic muscles of mosquito.

Fig. 2. Filariæ in head or proboscis of mosquito.

PLATE 2.



a, b, c, d, e, f, progressive forms of the parasite.

PLATE 3. METAMORPHOSIS OF FILARIA IN MOSQUITO.

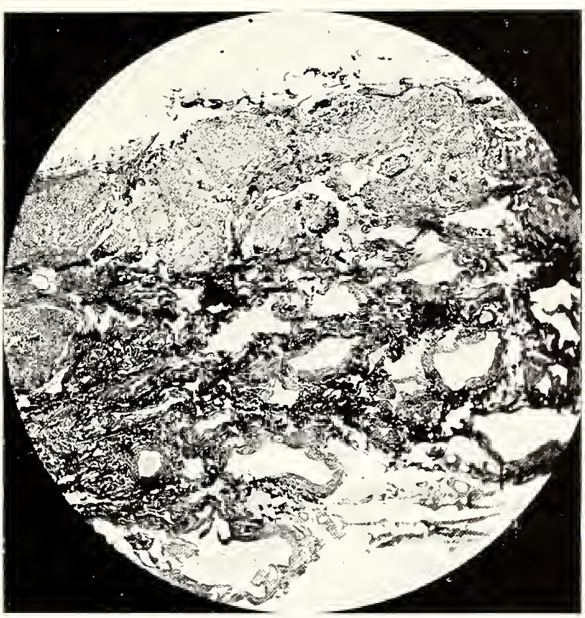


PLATE 4. SECTION OF A VARICOSE GROIN GLAND, SHOWING GREAT DILATATION OF VESSELS, BOTH LYMPHATIC AND BLOOD VESSELS, WITH HYPERPLASIA OF THE GLAND TISSUE; $\times$ 60.

Fig. 1. Section showing early elephantoid changes in skin.

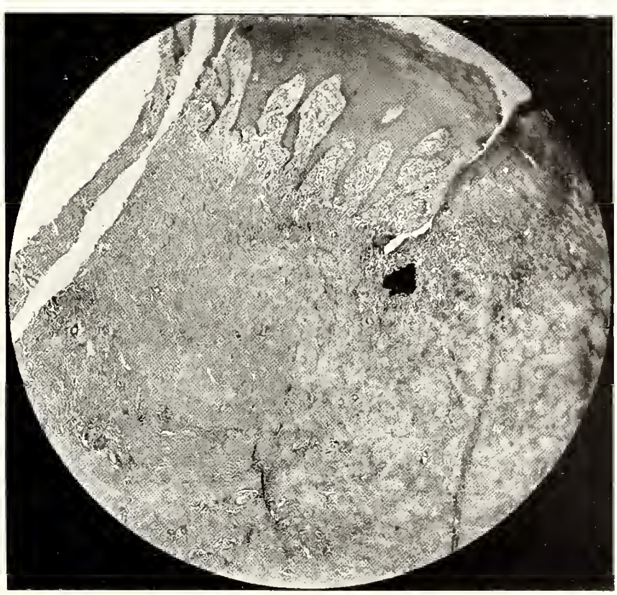


Fig. 2. Section of skin from case of fully developed elephantiasis.

PLATE 5.

PLATE 6. EARLY ELEPHANTIASIS SCROTI, SHOWING THE SCAR OF A FILARIAL ABSCESS OF THE SCROTUM ON THE RIGHT SIDE.

PLATE 7. LYMPH SCROTUM. IN THIS CASE THE SWELLING OF THE GROIN GLANDS IS NOT MARKED. THERE IS SOME ŒDEMA OF THE PREPUTIAL SKIN, AND THE VESICLES ON THE SCROTUM ARE WELL SHOWN.

PLATE 8. LYMPH SCROTUM; PENIS UNAFFECTED. SHOWS WELL THE LAX, ŒDEMATOUS LOOK THAT SOME OF THESE CASES PRESENT. THE DARK PATCH IS DUE TO IODINE, WHICH HAD BEEN PAINTED OVER LARGE AND ACHING GROIN GLANDS.

Fig. 1. Elephantiasis of the penis; scrotum unaffected.

Fig. 2. Cauliflower condition of preputial tissues.

PLATE 9.

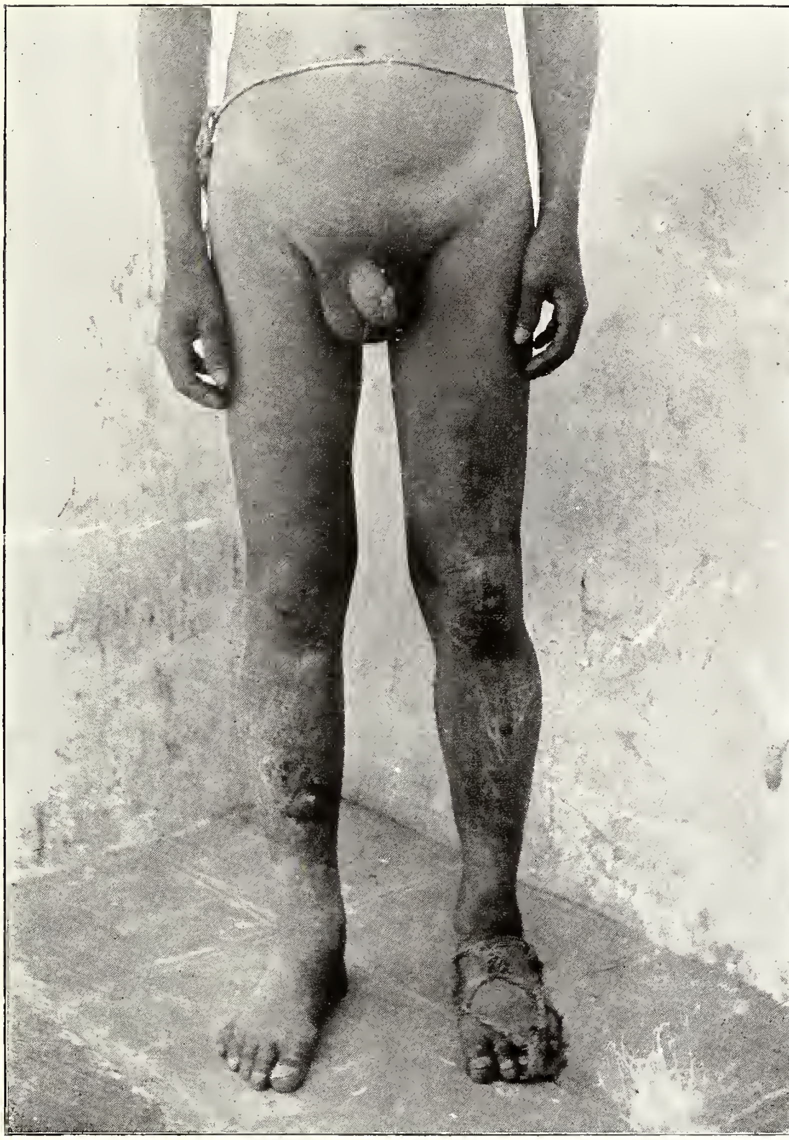


PLATE 10. ELEPHANTIASIS OF THE PENIS; SCROTUM SLIGHTLY AFFECTED.

PLATE 11. ELEPHANTIASIS SCROTI (NARROW NECKED), WEIGHING, AFTER REMOVAL, 32 KILOGRAMS. PATIENT AN OPIUM SMOKER. THE SLIT IN THE CENTER REPRESENTS THE URINARY ORIFICE, THE GLANS BEING JUST BEYOND THE REACH OF MY FINGER WHEN INSERTED AT THE OPENING.

PLATE 12. CONDITION OF PARTS THREE WEEKS AFTER OPERATION. THE TESTICLES BEING ATROPHIED, AND THE PATIENT IN A WEAK CONDITION AT THE TIME OF OPERATION, THESE WERE REMOVED, THUS FACILITATING HEALING.

PLATE 13. ELEPHANTIASIS SCROTI. THE WARTY CONDITION OF THE PENIS IS WELL SHOWN. THE SKIN OF THE ABDOMEN WAS SLIGHTLY AFFECTED AS FAR AS THE UMBILICUS. WEIGHT, AFTER REMOVAL, 16.3 KILOGRAMS.

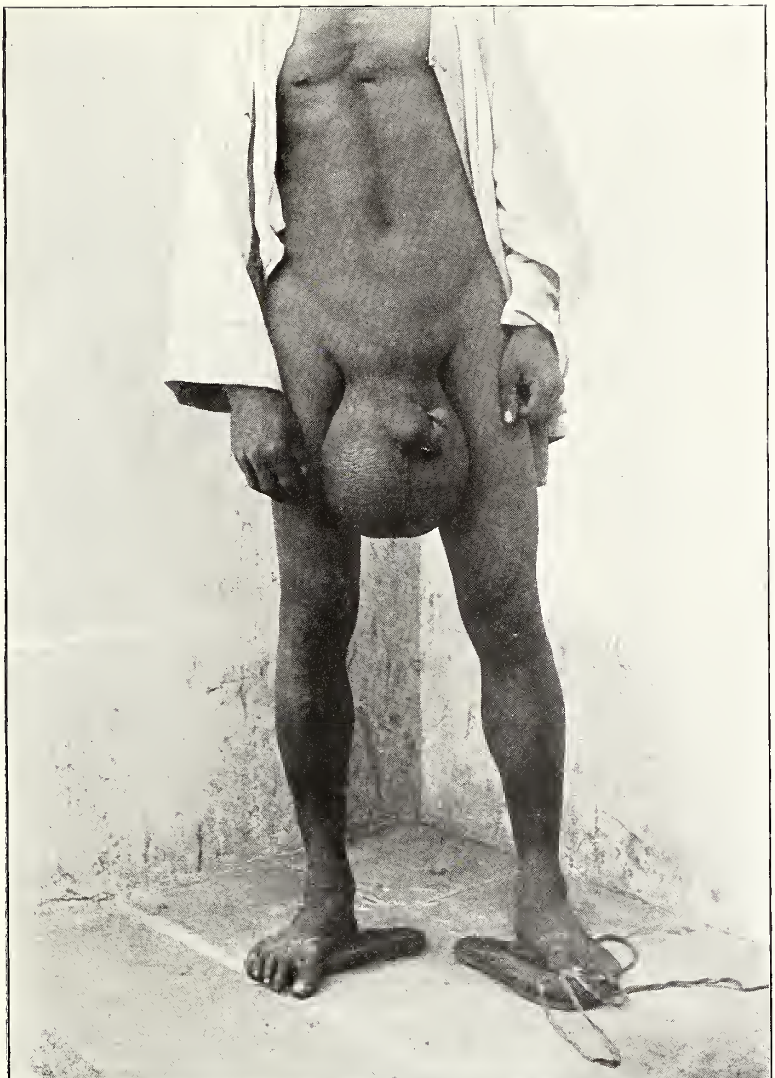


PLATE 14. ELEPHANTIASIS SCROTI, SHOWING A TWISTED CONDITION, NOT INFREQUENTLY SEEN, AFFECTING THE PENILE TISSUES. WEIGHT AFTER REMOVAL, 3.2 KILOGRAMS.

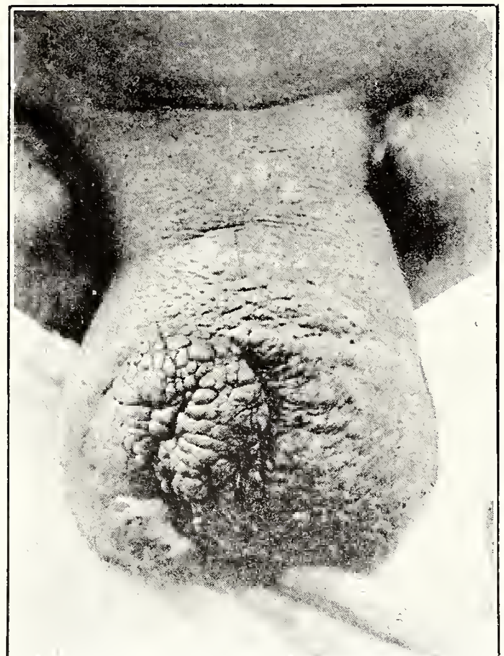


Fig. 1. Elephantiasis scroti, broad-necked.

Fig. 2. Elephantiasis of the cheeks.

PLATE 15

PLATE 16. CONDITION OF PARTS THIRTEEN DAYS AFTER OPERATION. SHOWS WELL THE PREPUTIAL LINING TURNED BACK TO FORM PART OF THE COATING OF THE PENIS.

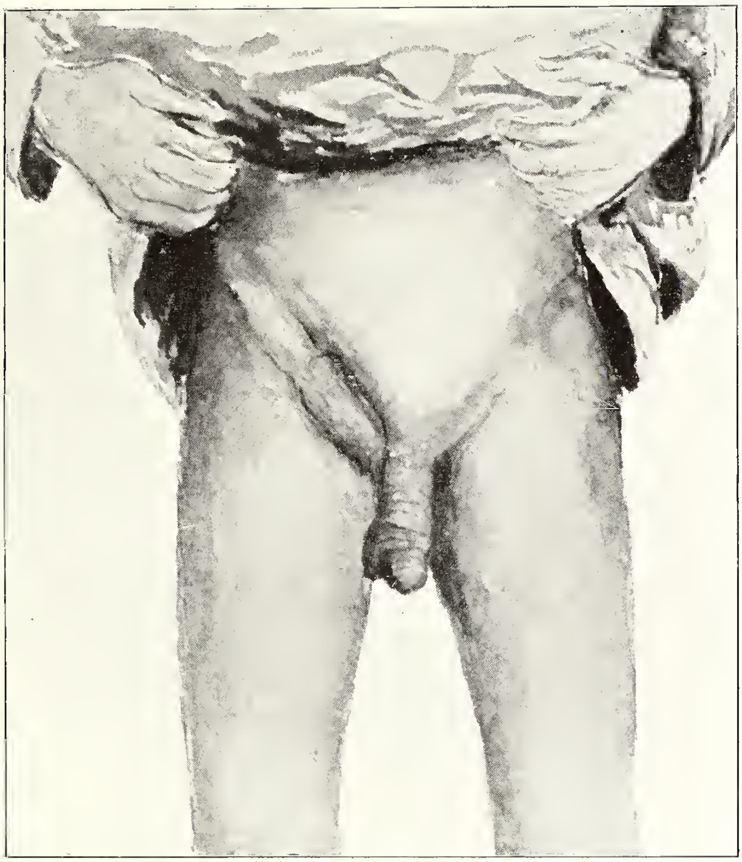


PLATE 17. ŒDEMA OF THE PENIS, WHICH CAME ON SHORTLY AFTER THE OPERATION. THIS WAS DUE ALMOST CERTAINLY TO THE CONTRACTION OF THE HEALING WOUND. IT PASSED AWAY OF ITSELF WITHIN A YEAR, AND THE PATIENT RECOVERED COMPLETELY. IN THE RIGHT GROIN THE SCAR OF THE HERNIA INCISION IS VISIBLE.

PLATE 18. ELEPHANTIASIS SCROTI. LEG ALSO AFFECTED.

PLATE 19. ELEPHANTIASIS OF BOTH LEGS, THE LEFT ALSO SHOWING THE TROUBLESOME CHRONIC ULCERATION MET WITH IN SOME OF THESE AFFECTED LEGS. THE FOLD AT THE ANKLE AND THE SHAPELESS CONDITION OF THE FOOT ARE WELL SHOWN.

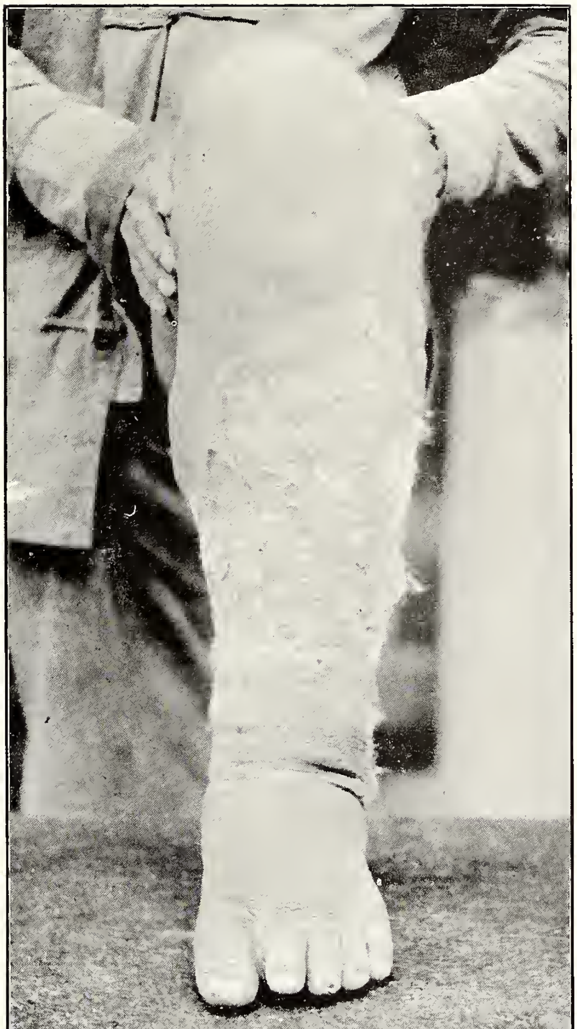


PLATE 20. ELEPHANTIASIS OF LEG, DUE TO PLAGUE.

PLATE 21. ELEPHANTIASIS OF LEG, DUE TO TERTIARY SYPHILIS.

Fig. 1. Elephantiasis of one leg

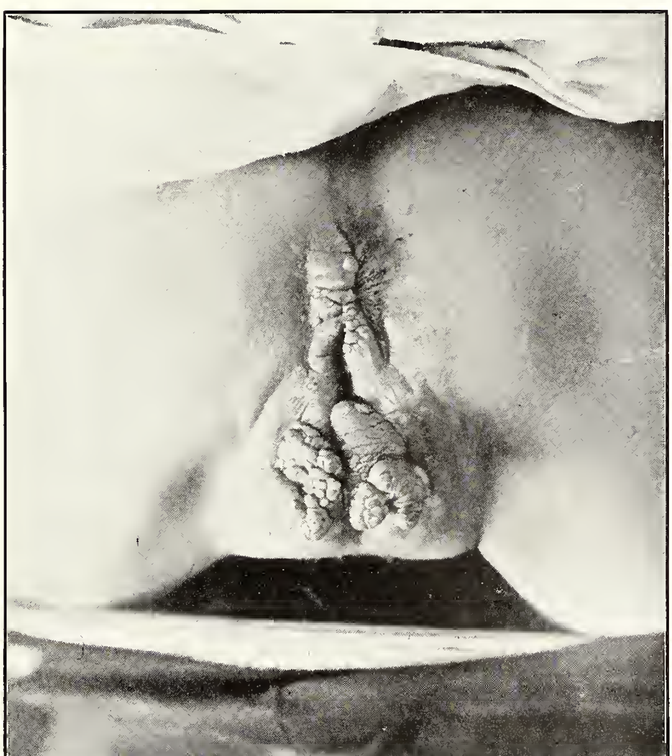


Fig. 2. Elephantiasis vulvæ, sessile form.

PLATE 22.

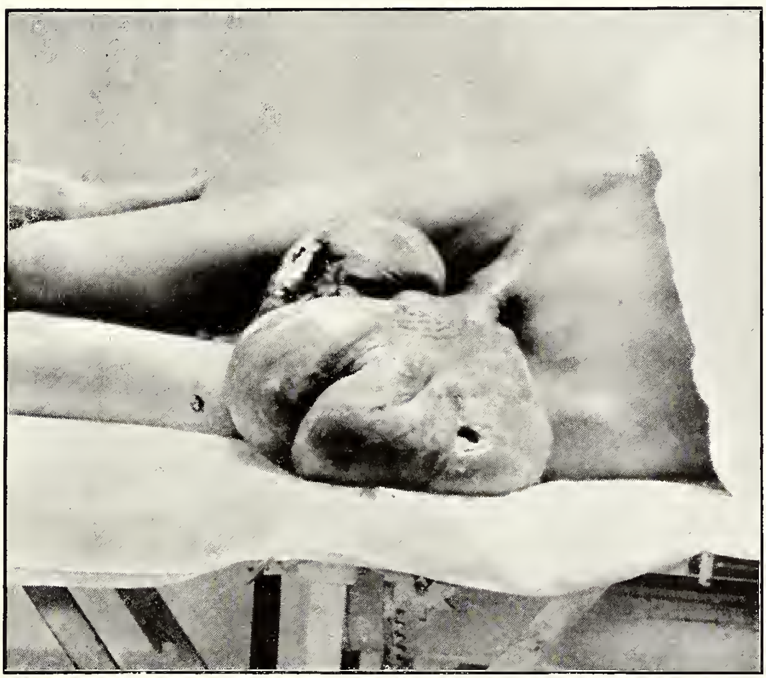


PLATE 23. ELEPHANTIASIS VULVÆ, PEDUNCULATED.

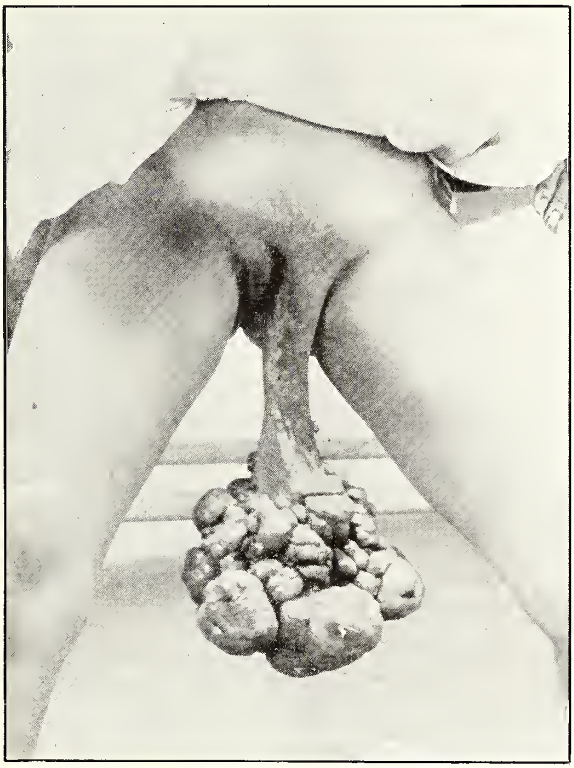


PLATE 24. ELEPHANTIASIS VULVÆ. PEDUNCULATED

PLATE 25. CHINA, SHOWING THE DISTRIBUTION OF FILARIAL DISEASE.

A REVIEW OF THE NEW SPECIES OF PLANTS PROPOSED BY N. L. BURMAN IN HIS FLORA INDICA

By Elmer D. Merrill

Director and Botanist, Bureau of Science, Manila

Burman's Flora Indica was published in 1768.[1] The appended "Series zoophytorum Indiae Orientalis" occupies 2, and the "Flora Capensis Prodromus" 28 additional pages. The work is illustrated by 67 plates with 179 figures, the illustrations for the most part being excellent. The present review deals only with those species proposed as new in the Flora Indica.

Burman's Flora Indica is of distinct importance from a historical standpoint owing to its early date of publication, as it is one of the first works other than those of Linnaeus himself, published under the Linnean system of classification and nomenclature.

It is apparent that most of the species proposed by Burman were based on actual specimens, although some of the binomials are manifestly based on descriptions and figures in various pre-Linnean works. In most cases where new binomials are proposed by Burman, the figures, the descriptive data from actual specimens, or the actual citations of specimens clearly indicate that Burman had specimens even when, as is frequently the case, he adds in his synonymy references to pre-Linnean works. It is hardly necessary to note that, as with Linnaeus, the pre-Linnean references are not always correctly placed.

Burman was in close correspondence with Linnaeus, having visited Upsala in 1760, as noted by Jackson,[2] bringing with him his father's large collection of Cape plants, and was afterwards a frequent correspondent.[3] Burman himself notes in the introduction to his Flora Indica that Linnaeus communicated to him his observations regarding various species. Duplicate specimens

[1] Burman, N. L. Flora Indica. | cui accedit | series zoophytorum indicorum, | nec non | Prodromus | Florae Capensis. | IV + 1–242, t. 1–67, + indices 1–15, 1768.

[2] Jackson, B. D., Index to the Linnean Herbarium, Proc. Linn. Soc. (1912) Suppl. 22.

[3] Jackson, B. D., op. cit. 11.

transmitted to Linnaeus by Burman were often described by Linnaeus, either under the same binomial Burman used or under another name, some in Mantissa Plantarum 1 (1767), one year earlier than Burman's publication, others in Mantissa Plantarum 2 (1771), three years after Burman's work was published. Of the 241 binomials proposed by Burman in his Flora Indica, about 20 were also published by Linnaeus, as indicated above, while in the case of about 25 others Linnaeus published the same species under binomials other than those used by Burman, but manifestly based on material received from him.

The Flora Indica consists of brief descriptions of about 1,305 species of which about 241 are proposed as new. Burman's work was apparently intended as a descriptive one, covering the species from "the Indies" represented in the material secured by his father, being for the most part based on collections of Piso, Hermann, Garcin, Breyn, Oldenland, Harthog, Kleinhof, Outgaerden, and Pryon. The term India is used in a very broad sense, covering the Tropics of both hemispheres, although the bulk of the material on which the work was based was from the Old World. Of the species included more than 500 are definitely indicated as from India; that is, mostly from what is now known as India proper, although Burman frequently included Javan material under the designation "India." In some cases more definite localities are given, about 20 being indicated as from Coromandel, 25 from Malabar, and a few from other localities in India such as Surat and Bengal. Very many of the species are indicated as occurring in the Tropics of both hemispheres. This distribution in many cases is based perhaps not so much on actual specimens examined from the Tropics of both hemispheres as on material from the Old World, the pantropic distribution being based on pre-Linnean synonyms cited as representing the species; in many cases these pre-Linnean references manifestly are erroneously placed. From Java about 115 species are enumerated; from Ceylon about 90; from China about 50; from Japan about 15; from Persia about 20. There are a few references to Brazilian plants, and fairly numerous ones to those of Amboina and the Moluccas, the latter being largely under those binomials primarily based on references to Rumphius's Herbarium Amboinense. Other species are enumerated from Jamaica, from Virginia, from Egypt, from Arabia, from Peru, from Canada, from Malacca, from Mexico, and a few even from the Cape of Good Hope.

While in most cases the geographic origin of the various specimens cited is correct, some errors have been detected. Thus *Polypodium spinulosum* Burm. f., indicated as originating in Java, is the Australian proteaceous *Synaphea polymorpha* R. Br. = *S. spinulosa* (Burm. f.) Merr.; *Adianthum truncatum* Burm. f., indicated as originating in Java, is the Australian *Acacia decipiens* R. Br.; and the type of *Lotus persicus* Burm. f. was apparently from South Africa rather than from Persia.

Burman proposed but five new generic names, of which three are universally recognized as valid, and two have been reduced as synonyms. These names are as follows: *Clausena*,[4] *Embelia*, *Porania*, *Usubis* (=*Allophylus*), and *Zaleya* (=*Trianthema*).

With the exception of those binomials proposed as new, totaling about 241, all the others in the work are accredited to Linnaeus. In a considerable number of cases it is perfectly evident that Burman erred in his interpretation of Linnean species, and some of his misinterpreted binomials have by later authors been made the basis of new names. Thus *Panicum repens* (non Linn.) Burm. f. Fl. Ind. (1768) 26, *t. 11, f. 1*, although a *Panicum*, scarcely represents the Linnean species; *Poa malabarica* (non Linn.) Burm. f. op. cit. 27, *t. 11, f. 2*, is *Centotheca latifolia* (Osb.) Trin., the Linnean species being *Panicum malabaricum* (Linn.) Merr. (*P. arnottianum* Nees); *Pavetta indica* (non Linn.) Burm. f. op. cit. 35, *t. 13, f. 3*, seems to be an *Ixora;* and *Vitex pinnata* (non Linn.) Burm. f. op. cit. 138, *t. 43* [f. 2] is *Aglaia odorata* Lour., the Linnean species being apparently identical with *Vitex altissima* Linn. f.[5] These are but a few cases that have been noted by me in which Burman's binomial represents other than the species Linnaeus intended; there are unquestionably numerous other similar ones.

The younger Burman's collections, on which the Flora Indica was based, are preserved in the Delessert herbarium, now at the Botanic Garden, Geneva, Switzerland,[6] some specimens from him being also preserved in the Munich herbarium. The actual types, in many cases, have been examined by subsequent authors who were engaged in monographic work; and wherever more amplified descriptions have been published, or reductions made

[4] In the text this appears as *Claucena*, a manifest typographical error for *Clausena* as printed in the index to Burman's work. According to Wittstein the name is derived from P. Clausön, a Danish author of a work on algae published in 1632.

[5] See Trimen Fl. Ceyl. 3 (1895) 358.

[6] De Candolle, A., La Phytographie (1880) 401.

from an examination of Burman's actual types, this has been indicated in the present paper. No botanist with a wide knowledge of the Indo-Malayan flora seems to have made a critical examination of Burman's Flora Indica or of his herbarium with a view of correlating his work with that of other authors. It would admittedly have been best could the extant specimens have been examined; but it being impracticable for me to do this at the present time, I have attempted a preliminary interpretation of Burman's species from the published data alone. Considering the usually short and imperfect descriptions a surprisingly high percentage of Burman's species can definitely be correlated with those of other authors without the necessity of examining his types; but in some cases, indicated by an asterisk in the following enumeration, more definite interpretations than those here indicated cannot be made without an examination of the actual type in each case.

In completing this short work I am impressed with the fact that many European botanists do not seem fully to realize the value and utility of types when interpreting insufficiently described species of the early authors. In many cases a few hours' journey, or in others merely a little correspondence would make available the data which would definitely fix the status of a species. Instead of this course, however, the unsatisfactory but easy method seems to have been pursued of leaving the unknown ones under "species incognitae," "species valde dubiae," "species excludendae," or other equally unsatisfactory categories.

In order to make the present publication more generally useful to modern botanists I have not treated Burman's species in the sequence in which they were published under the Linnean system of classes and orders, but have rearranged them under the modern system of families and genera, following the Engler and Prantl system.

THALLOPHYTA

ALGAE

CHARALES

CHARA Linnaeus

* CHARA sp.[7]

? *Ulva javanica* Burm. f. Fl. Ind. (1768) 239.

This was based on a Javan specimen with a citation of the

[7] Species marked with an asterisk in this enumeration are of more or less doubtful status.

Javanese names *rompot scriboe ajer* and *sajor codock.* The reference to *Tremella marina* Dill. Musc. 46, *t. 10, f. 8,* cannot be interpreted as the type as Burman states that his specimens differed from this figure in rather numerous and apparently essential characters. Burman's species is probably a *Chara.*

LICHENES

USNEA Linnaeus

* **USNEA** sp.

> *Lichen capillaris* Burm. f. Fl. Ind. (1768) 239. "Habitat in Amboina & Java."

The type is Kleinhof's Javan specimen, which perhaps represents the same form as that figured by Rumphius as *Muscus capillaris* Rumph. Herb. Amb. 6: 86, *t. 40, f. 2.* It is clearly a species of *Usnea.*

PTERIDOPHYTA

POLYPODIACEAE

NEPHROLEPIS Schott

NEPHROLEPIS RADICANS (Burm. f.) Kuhn in Ann. Mus. Bot. Lugd.-Bat. 4 (1869) 285.

> *Polypodium radicans* Burm. f. Fl. Ind. (1768) 233, *t. 66, f. 3.*

A well-known species of wide distribution in the Indo-Malayan region.

DAVALLIA Smith

DAVALLIA DENTICULATA (Burm. f.) Mett. ex Kuhn Fil. Deck. (1867) 27.

> *Adiantum (Adianthum) denticulatum* Burm. f. Fl. Ind. (1768) 236.

The actual type is a Javan specimen collected by Pryon. Burman notes that this specimen differed somewhat from Plukenet Phyt. 151, *t. 180, f. 4,* which he cites as representing the same species.

ODONTOSORIA Fée

ODONTOSORIA CHINENSIS (Linn.) J. Sm. Bot. Voy. Herald (1857) 430.

> *Trichomanes chinensis* Linn. Sp. Pl. (1753) 1096.
> *Adiantum (Adianthum) chinense* Burm. f. Fl. Ind. (1768) 236.

The actual type was a Chinese specimen, and the description, while short, seems to apply to the very common *Odontosoria chinensis* (Linn.) J. Sm. Burman adds a reference to Plukenet Phyt. 10, *t. 4, f. 1,* and to Ray Hist. 1854.

BLECHNUM Linnaeus

BLECHNUM INDICUM Burm. f. Fl. Ind. (1768) 231. "Habitat in Java."

This is almost certainly identical with *Blechnum serrulatum* Rich. Act. Soc. Hist. Nat. Paris 1 (1792) 114, and if this proves to be the case Burman's name should be adopted for this pantropic species. It is the only Malayan species of the genus to which Burman's description applies.

BLECHNUM ORIENTALE Linn. Sp. Pl. (1753) 1077.

Polypodium simplex Burm. f. Fl. Ind. (1768) 235. "Habitat in Amboina."

Burman apparently had a Javan specimen collected by Kleinhof. *Lonchitis amboinica rubra* Rumph. Herb. Amb. **6**: 70, *t. 30, f. 1,* cited as a synonym, is clearly identical with the common and widely distributed *Blechnum orientale* Linn.

STENOCHLAENA J. Smith

STENOCHLAENA PALUSTRIS (Burm. f.) Bedd. Ferns Brit. Ind. Suppl. (1876) 234.

Polypodium palustre Burm. f. Fl. Ind. (1768) 234. "Habitat in indiis."

Burman apparently had a Javan specimen, as he cites the local Javanese name as *daun peekou,* although his description is a compiled one from pre-Linnean authors. The species is perhaps typified by the reference to Linn. Fl. Zeyl. 200 and to Burm. Thes. Zeyl. 100, *t. 46.* The species is a well-known one of wide distribution in the Indo-Malayan region.

HEMIONITIS Linnaeus

HEMIONITIS ARIFOLIA (Burm. f.) Moore Index (1859) 114.

Asplenium arifolium Burm. f. Fl. Ind. (1768) 231. "Habitat in India."

A well-known characteristic species of wide distribution in the Indo-Malayan region.

ADIANTUM Linnaeus

ADIANTUM PHILIPPENSE Linn. Sp. Pl. (1753) 1094.

Adiantum (Adianthum) lunulatum Burm. f. Fl. Ind. (1768) 235. "Habitat in Malabara & Java."

The actual type was apparently a Javan specimen, the Malabar reference being apparently added either from *Avenka* Rheede Hort. Malabar. **12**: 72, *t. 40,* or from Petiver Gaz. *t. 54, f. 10,* both cited as representing the species. The Linnean binomial is the oldest one for this well-known species, which is very common and widely distributed in the Philippines.

CHEILANTHES Swartz

CHEILANTHES TENUIFOLIA (Burm. f.) Sw. Syn. (1806) 129, 332.
Trichomanes tenuifolia Burm. f. Fl. Ind. (1768) 237.

The type is an actual specimen from Pryon, probably of Javan origin. *Dryopteris campestris* Rumph. Herb. Amb. **6**: 77, *t. 34, f. 2*, is cited by Burman as representing his var. β. The Rumphian figure is an excellent illustration of the common and widely distributed *Cheilanthes tenuifolia* Sw.

PTERIS Linnaeus

PTERIS ENSIFORMIS Burm. f. Fl. Ind. (1768) 230. "Habitat in Zeylona & Java."

This is a common and well-known species of wide distribution in the Indo-Malayan region, extending to China, Polynesia, and Australia.

PTERIS VITTATA Linn. Sp. Pl. (1753) 1074.
Polypodium trapezoides Burm. f. Fl. Ind. (1768) 233, *t. 66, f. 2.* "Habitat in Java."

Burman's figure clearly represents a juvenile form of the very common Indo-Malayan species currently known as *Pteris longifolia* Linn. Hieronymus considers that the Old World *Pteris vittata* Linn. is specifically distinct from the tropical American *Pteris longifolia* Linn.

POLYPODIUM Linnaeus

POLYPODIUM SCOLOPENDRIUM Burm. f. Fl. Ind. (1768) 232 (*scolopendria*). "Habitat in India."
Polypodium phymatodes Linn. Mant. 2 (1771) 306.

The actual type of the species is doubtless Pryon's Javan specimen for which the local name *daun sembang* is cited. Pre-Linnean references are given to Burman Thes. Zeyl. 196, *t. 86,* Breynius Cent. 190, *t. 98, f. 1–3,* Morison Hist. 3, *f. 14, t. 1, f. 17,* Plukenet Mant. 82, Almath. 94, and Phyt. 404, *f. 1, 5.* Burman's specific name will replace the Linnean one for this very common and widely distributed species. Linnaeus in his description of *Polypodium phymatodes* gives the same references as does Burman f. to Burman and to Plukenet. It is probable that his actual type was material transmitted to him by Burman.

CYCLOPHORUS Desvaux

* **CYCLOPHORUS LONGIFOLIUS** (Burm. f.) Desv. in Berl. Mag. 5 (1811) 301.

Acrosticum longifolium Burm. f. Fl. Ind. (1768) 228. "Habitat in Java."

Burman's description is the basis of *Cyclophorus longifolius* Desv., a species of uncertain status within the genus, but in all probability a synonym of *C. adnascens* (Sw.) Desv., or *C. varius* (Kaulf.) Gaudich. The description was based on a Javan specimen collected by Pryon, and a reference to *Asplenium longifolium* Petiver Gaz. 310, *t. 61, f. 2, 4.* His specific name is older than either of these or than *Cyclophorus acrostichoides* (Forst.) Presl, another suggested reduction of the species, but the exact status of *Acrosticum longifolium* Burm. f. cannot be determined from the imperfect description alone.

GLEICHENIACEAE

GLEICHENIA Smith

GLEICHENIA LINEARIS (Burm. f.) C. B. Clarke in Trans. Linn. Soc. Bot. 1 (1880) 428.

Polypodium lineare Burm. f. Fl. Ind. (1768) 235, *t. 66, f. 4.* "Habitat in Java."

Burman's actual type is a Javan specimen. He adds a reference to Linn. Fl. Zeyl. 201. The species is a well-known and characteristic one of wide distribution, and Burman's excellent figure leaves no doubt as to the exact form intended by his description.

SCHIZAEACEAE

LYGODIUM Swartz

LYGODIUM PEDATUM (Burm. f.) Sw. in Shrad. Journn. 1800[2] (1801) 106.

Ophioglossum pedatum Burm. f. Fl. Ind. (1768) 227, *t. 66, f. 1.*
Ophioglossum circinnatum Burm. f. op. cit. 228.
Lygodium circinnatum Sw. Syn. (1806) 153.

Ophioglossum pedatum Burm. f. was based on a Javan specimen, and *O. circinnatum* Burm. f. on a Javan specimen with a reference to *Adianthum volubili polypodioides* Rumph. Herb. Amb. 6: 76, *t. 33,* and Petiver Gaz. *t. 64, f. 10.* Page priority will involve the acceptance of Burman's specific name *pedatum,* for both of his descriptions apply to a single well-known and widely distributed species.

PTERIDOPHYTA OF DOUBTFUL STATUS

* POLYPODIUM ADIANTHOIDES Burm. f. Fl. Ind. (1768) 234. "Habitat in Indiis."

Burman's description was based on an actual specimen collected by Pryon, probably of Javan origin. The reference to Petiver Fil. 69 *t. 2. f. 9,* cannot be interpreted as the type of the species. The species is unrecognizable from the short description alone, but it is probably no *Polypodium.*

* POLYPODIUM GLABRUM Burm. f. Fl. Ind. (1768) 235. "Habitat in Java, Zeylona."

The type is apparently a Javan specimen collected by Pryon; Burman added a reference to *Filix non ramosa, foliis integris non serratis, zeylanica minor* Burm. Thes. Zeyl. (1737) 100, which is unrecognizable from the description and which may or may not represent the same species as the Javan fern. Burman's species is unrecognizable from the description alone.

* POLYPODIUM OVATUM Burm. f. Fl. Ind. (1768) 233. "Habitat in Java."

The very brief description "fronde petiolata alterna, laciniis oblongis integerrimis" was based on a Javan specimen, but the identity of the species cannot be determined from the description alone. The species cannot be interpreted from the reference to Petiver Fil. 38, *t. 14, f. 2,* as this characterizes the variety β of Burman's species.

* POLYPODIUM ROSTRATUM Burm. f. Fl. Ind. (1768) 235. "Habitat in India."

This species was based on an actual specimen collected by Pryon with a reference to Plukenet Mant. 80, *t. 399, f. 4.* Burman compares it to *Polypodium decussatum* Linn., which is a *Dryopteris.* The species is unrecognizable from the description alone, but is evidently no *Polypodium.*

* TRICHOMANES NIVEA Burm. f. Fl. Ind. (1768) 237. "Habitat in utraque India."

There is little evidence that Burman had a specimen except in his statement "in utraque India." It is probable that he had a specimen from India or Java. I have not seen Sloane's figure which Burman cites as representing the species. The species is one of unknown status.

SPERMATOPHYTA

GYMNOSPERMAE

TAXACEAE

PODOCARPUS Persoon

PODOCARPUS JAVANICUS (Burm. f.) comb. nov.

Thuja ? javanica Burm. f. Fl. Ind. (1768) 202 (err. typ. 302), *t. 64, f. 3.* "Habitat in Java."
Podocarpus imbricatus Blume Enum. Pl. Jav. (1827) 89; Pilger in Engl. Pflanzenreich 18 (1903) 56.
Podocarpus cupressina R. Br. ex Mirb. in Mém. Mus. Paris 13 (1825) 75.

This is clearly a form of the species commonly known as *Podocarpus imbricatus* Blume, as indicated by the description of the upper leaves on the branchlets as lanceolate and again as plane and ovate-lanceolate. The figure presents a branch with branchlets covered with the small, imbricate, greatly reduced leaves, the tips of the branchlets presenting the transition stage to the much larger, differently shaped, distichous ones. Burman's name, being much the older, should be adopted for this well-known and widely distributed Malayan species.

ANGIOSPERMAE

MONOCOTYLEDONS

GRAMINEAE

PANICUM Linnaeus

PANICUM PUNCTATUM Burm. f. Fl. Ind. (1768) 26. "Habitat in India."

This was apparently based on *Gramen paniceum, multiplici spica, maderaspatanum* Pluken. Phyt. 174, *t. 191, f. 1.* The specimen in the Sloane herbarium, British Museum, on which Plukenet's description was based, is extant and is the form described as Burman's species by Hooker f. Fl. Brit. Ind. 7 (1897) 29.

PENNISETUM L. C. Richard

PENNISETUM GLAUCUM (Linn.) R. Br. Prodr. (1810) 195.

Panicum glaucum Linn. Sp. Pl. (1753) 56.
Panicum americanum Linn. l. c.
Pennisetum typhoideum A. Rich. in Pers. Syn. 1 (1805) 72.
Alopecurus typhoides Burm. f. Fl. Ind. (1768) 27.

No locality is cited, the species apparently being typified by *Gramen alopecuroides, spica maxima Indiae orientalis* Pluken.

Almag. 174, *t. 32, f. 4.* It is clearly identical with the species currently known as *Pennisetum typhoideum* A. Rich. in Pers. Syn. 1 (1805) 72, the generally accepted name of the species. However, this name is antedated by *Holcus spicatus* Linn. Syst. ed. 10 (1759) 1305, typified by the same reference to Plukenet, and further by *Panicum americanum* Linn. Sp. Pl. (1753) 56, and by *Panicum glaucum* Linn l. c., the latter having page priority. Additional synonyms are: *Pennisetum spicatum* R. & S., and *Pennisetum americanum* K. Schum. in Engl. Pflanzenw. Ostafr. B (1895) 51. Munro, Journ. Linn. Soc. Bot. 24 (1887) 136, has shown that the type of *Panicum glaucum* Linn. is a *Pennisetum*, not a *Setaria*. See Hitchcock in Am. Journ. Bot. 2 (1915) 300, and Chase op. cit. 8 (1921) 41–49.

SPINIFEX Linnaeus

SPINIFEX LITTOREUS (Burm. f.) Merr. in Philip. Journ. Sci. 7 (1912) Bot. 229, Interpret. Herb. Amb. (1917) 92.

Stipa littorea Burm. f. Fl. Ind. (1768) 29.
Stipa spinifex Linn. Mant. 1 (1767) 84.
Spinifex squarrosus Linn. Mant 2 (1771) 300.

No locality is cited, but Burman gives pre-Linnean references to India, Ceylon, and Amboina, and cites the Javanese name *rompot laut;* all of these refer to the species commonly known as *Spinifex squarrosus* Linn. The earliest valid specific name is that supplied by Burman's publication.

ELEUSINE Gaertner

ELEUSINE LAGOPOIDES (Burm. f.) comb. nov.

Cynosurus lagopoides Burm. f. Fl. Ind. (1768) 29. "Habitat Coromandeli."
Eleusine brevifolia R. Br. in Wall. Cat. (1831) No. 3815, *nomen nudum;* Hook. f. Fl. Brit. Ind. 7 (1897) 294.
Dactylis brevifolia Willd. Sp. Pl. 1 (1797) 410.

This is reduced in Index Kewensis to *Aeluropus pubescens* Trin., which is a synonym of *Aeluropus villosus* Trin. = *Aeluropus lagopoides* (Linn.) Trin., which Burman otherwise described and figured as *Dactylis lagopoides;* see page 340. Burman's *Cynosurus lagopoides* is apparently identical with the species currently known as *Eleusine brevifolia* R. Br., so that it would seem that the new combination is necessary for this species. *Eleusine lagopoides* (Burm. f.) Merr. and *Aeluropus lagopoides* (Linn.) Trin. are very badly confused in the early botanical literature.

DACTYLOCTENIUM Willdenow

DACTYLOCTENIUM AEGYPTIUM (Linn.) Richt. Pl. Europ. 1 (1889) 68.
Cynosurus aegyptius Linn. Sp. Pl. (1753) 72.
Dactylis geniculatus Burm. f. Fl. Ind. (1768) 28, *t. 12, f. 3.* "Habitat in Java."
Spartina geniculata Beauv. Agrost. (1812) 25.

Although the rather poor drawing does not show the characteristic mucronate tip of the rachis, and further presents but three spikes, this is clearly referable to the very common species currently known as *Dactyloctenium aegyptiacum* Willd. The only other possibility is *Eleusine corocana* (Linn.) Gaertn., which Burman otherwise described in the same work as *Cynosurus corocanus* Linn.

AELUROPUS Trinius

AELUROPUS LAGOPOIDES (Linn.) Trin. ex Thwaites Enum. Pl. Zeyl. (1864) 374 (*lagopodioides*).
Dactylis lagopoides Linn. Mant. 1 (1767) 33.
Dactylis lagopoides Burm. f. Fl. Ind. (1768) 28, *t. 12, f. 2.*
Aeluropus villosus Trin. Fund. Agrost. (1820) 143; Hook. f. Fl. Brit. Ind. 7 (1897) 334.

No locality is cited, but three references are given to pre-Linnean literature. The species was described by Linnaeus one year earlier as *Dactylis lagopoides* Linn. Burman's species may have included two distinct forms, but his figure is clearly the species currently known as *Aeluropus villosus* Trin.; he gives a reference to *Gramen dactyloides javanicum* Garzin herb., but no representative of the genus *Aeluropus* is known from Java.

CYPERACEAE

CYPERUS Micheli

CYPERUS ROTUNDUS Linn. Sp. Pl. (1753) 45.
Schoenus tuberosus Burm. f. Fl. Ind. (1768) 19. "Habitat in Java & Malabara."

This reduction has been made from Burman's description; I have not seen the illustrations in Rheede and in Sloane which Burman cites as illustrating his species.

* **CYPERUS UMBELLATUS** Burm. f. Fl. Ind. (1768) 21. *t. 9, f. 1.*

No locality is given by Burman. Regarding this species C. B. Clarke in Hook. f. Fl. Brit. Ind. 6 (1893) 619 states "perhaps grass." The description and figure appear to be based on a mixture of two entirely distinct forms. The stem and leaves unmistakably represent a cyperaceous plant; the inflorescences are distinctly grasslike, and the statement that the peduncles are sheathed to the middle would indicate that the inflorescences, drawn as attached to the vegetative parts of a cyperaceous plant, are indeed the upper parts of grass culms.

FUIRENA Rottboell

FUIRENA UNCINATA (Willd.) Kunth Enum. Pl. 2 (1837) 184.

Scirpus uncinatus Willd. Sp. Pl. 1 (1797) 300.
Scirpus capitatus Burm. f. Fl. Ind. (1768) 21. "Habitat in India."

This reduction follows C. B. Clarke in Hook. f. Fl. Brit. Ind. 6 (1893) 666. Burman's specific name is much older than Kunth's but is invalidated in *Fuirena* by *F. capitata* Willd.

ELEOCHARIS R. Brown

ELEOCHARIS DULCIS (Burm. f.) Trin. ex Henschel Vita Rumph. (1833) 186; Merr. Interpret. Herb. Amb. (1917) 104.

Andropogon dulcis Burm. f. Fl. Ind. (1768) 219. "Habitat in India."
Hippuris indica Lour. Fl. Cochinch. (1790) 35.
Carex tuberosa Blanco Fl. Filip. (1837) 35.

This was based on *Cyperus dulcis* Rumph. Herb. Amb. 6: 7, *t. 3, f. 1.* The reference to Plukenet added by Burman typifies the var. β and cannot be interpreted as the type of the species. There is no evidence that Burman had an actual specimen.

* **ELEOCHARIS** sp.

Carex ovata Burm. f. Fl. Ind. (1768) 194 (err. typ. 294). "Java."

This has been placed as a wholly doubtful species of the section *Primocarex*, but I suspect that it does not belong in the genus, but perhaps in *Eleocharis* or possibly *Fimbristylis*, for no species of the section *Primocarex* is known from Java. The references to figures in Plukenet and Sloane cannot be interpreted as the type of the species in view of Burman's statement that he had a Javan specimen. I have seen neither of the figures cited.

SCLERIA Bergius

* **SCLERIA** sp.

Schoenus paniculatus Burm. f. Fl. Ind. (1768) 19. "Ilad. Javanis ex India missa."

Burman's description conforms better with the characters of *Scleria bancana* Miq. than with any other species known to me, but Rheede's illustration cited by Burman as representing his species certainly does not represent Miquel's species. *Schoenus paniculatus* Burm. f. has been referred to *Scleria sumatrensis*

Retz. (which has strongly tessellated fruits) and to *S. elata* Thwaites (which also has tessellated fruits), while Burman described the fruits as "laevibus" and as "splendentia saepe nigricantibus." Burman's specific name is valid in *Scleria* and eventually should probably be taken up for some well-known Malayan species of the genus now appearing in literature under some other specific name. The word "ilad" is a Javanese name for various species of *Scleria*.

ARACEAE

RHAPHIDOPHORA Hasskarl

RHAPHIDOPHORA LACINIATA (Burm. f.) comb. nov.

Polypodium laciniatum Burm. f. Fl. Ind. (1768) 231. "Habitat in Java & Malabara."

Pothos pertusus Roxb. Fl. Ind. 1 (1820) 455.

Rhaphidophora pertusa Schott in Bonpl. 5 (1857) 45; Engl. & Krause in Engl. Pflanzenreich 37 (1908) 47.

Burman states regarding his Javan specimen, for which he cites the local names *kakajar* and *tally kassa*, that the leaves lacked the perforations, but these are by no means constant in this species. From Burman's reference to *Elettadi maravara* Rheede Hort. Malabar. 12: 41, *t. 20, 21*, it is clear that his species is a *Rhaphidophora*, identical with the species commonly known as *R. pertusa* (Roxb.) Schott, which extends from India to Java. Burman's specific name, being much the older, should be adopted.

COMMELINACEAE

COMMELINA Plumier

COMMELINA PAPILIONACEA Burm. f. Fl. Ind. (1768) 17 *t. 7, f. 1.* "Habitat Coromandeli."

Commelina salicifolia Roxb. Fl. Ind. 1 (1820) 176.

Burman's species is clearly identical with the one later described by Roxburgh as *Commelina salicifolia* and, although it is not mentioned by C. B. Clarke in his monograph of the Commelinaceae [8] his specific name should be retained for the species.

COMMELINA NUDIFLORA Linn. Sp. Pl. (1753) 41.

Commelina diffusa Burm. f. Fl. Ind. (1768) 18, *t. 7, f. 2.* "Habitat Coromandeli."

Burman's species is clearly a form of the ubiquitous *Commelina nudiflora* Linn., where it was placed as a synonym by C. B. Clarke.

[8] DC. Monog. Phan. 3 (1881) 113–324.

COMMELINA BENGHALENSIS Linn. Sp. Pl. (1753) 41.

Commelina nervosa Burm. f. Fl. Ind. (1768) 18, *t. 7, f. 3.* "Habitat Coromandeli."

C. B. Clarke was certainly correct in placing Burman's species as a synonym of *Commelina benghalensis* Linn., a very common plant in the Indo-Malayan region.

ANEILEMA R. Brown

ANEILEMA MALABARICUM (Linn.) Merr. in Philip. Journ. Sci. 7 (1912) Bot. 232.

Tradescantia malabarica Linn. Sp. Pl. ed. 2 (1762) 412.
Commelina nudiflora Linn. Mant. 2 (1771) 177, non Linn. 1753.
Commelina nudicaulis Burm. f. Fl. Ind. (1768) 17, *t. 18, f. 1.* "Java."
Aneilema nudiflorum R. Br. Prodr. (1810) 271.

The figure and description clearly indicate that Burman's species is identical with the very common Indo-Malayan form currently known as *Aneilema nudiflorum* R. Br.

PONTEDERIACEAE

MONOCHORIA Presl

MONOCHORIA VAGINALIS (Burm. f.) Presl Rel. Haenk. 1 (1827) 128.

Pontederia vaginalis Burm. f. Fl. Ind. (1768) 80.

Burman's species was based on pre-Linnean references to Rheede and to Plukenet. The same species was described under the same binomial three years later by Linnaeus Mant. 2 (1771) 222. A common plant in the Indo-Malayan region.

ZINGIBERACEAE

LANGUAS Koenig

(*Alpinia* auct., non Linnaeus)

LANGUAS MALACCENSIS (Burm. f.) comb. nov.

Maranta malaccensis Burm. f. Fl. Ind. (1768) 2. "Habitat in Malacca."
Alpinia malaccensis Rosc. in Trans. Linn. Soc. 8 (1807) 330, non Roxb., nec K. Schum.
Alpinia nobilis Ridl. in Journ. Str. Branch Roy. As. Soc. 32 (1899) 169.

Burman's binomial typifies *Alpinia malaccensis* Rosc., a species that has apparently been misinterpreted by modern authors; see Valeton in Merr. Interpret. Herb. Amb. (1917) 155. The type of the genus *Alpinia,* as described by Linnaeus, is *Alpinia racemosa,* of tropical America, which currently appears in botanical literature as *Renealmia racemosa* (L.) A. Rich. This is the only species of *Alpinia* that was known to Linnaeus; hence it must be the generic type. The proper application of the generic name *Alpinia* is to the numerous American species now known as *Renealmia,* the latter generic name falling as a synonym. Among the numerous synonyms of *Alpinia* auct., non Linn., *Languas* is the earliest available one for the numerous Old World species currently but erroneously referred to *Alpinia.*

ORCHIDACEAE

GALEOLA Loureiro

* GALEOLA sp.

Cassytha corniculata Burm. f. Fl. Ind. (1768) 93, *t. 33, f. 1.* "Habitat in Java."

The type was a Javan specimen collected by Kleinhof. The reference to *Cassutha cornea* Rumph. Herb. Amb. 7: 52 must be excluded as it refers to the mycelium of *Marasmius.* Dr. J. J. Smith, in answer to my suggestion that Burman's species might be a *Galeola,* states in lit., July 12, 1918, that he is convinced that it is either *Galeola altissima* Blume or *G. pterosperma* Schltr., the drawing representing the upper part of a plant. The "thorns" represent the roots; the "floruli imperfecti" probably are the young branches or young floral branches which often appear in the axils of the scales.

DENDROBIUM Swartz

DENDROBIUM CANINUM (Burm. f.) comb. nov.

Epidendrum caninum Burm. f. Fl. Ind. (1768) 189. "Habitat in India."

Dendrobium crumenatum Sw. in Schrad. Journ. 2 (1799) 237.

This was apparently based on a Javan specimen, judging from the Javanese name cited, *angrec utan,* and is unquestionably the very common and widely distributed species currently known as *Dendrobium crumenatum* Sw. The Rumphian reference *Angraecum caninum* Rumph. Herb. Amb. 6: 105, *t. 47, f. 2,* represents the very closely allied *D. papilioniferum* J. J. Sm., of the Moluccas. I propose to adopt Burman's name in place of Swartz's for this very common and well-known species.

* DENDROBIUM sp. § *Aporum.*

Epidendrum articulatum Burm. f. Fl. Ind. (1768) 189. "In India ex arboribus dependet."

This was apparently based on an actual specimen collected by Pryon, in Java (?). The only other reference given is to *Herba supplex quinta* Rumph. Herb. Amb. 6: 111, *t. 51, f. 2,* which is *Dendrobium calceolum* Roxb. Whatever Burman's species may ultimately prove to be, it is clearly a *Dendrobium* of the section *Aporum.*

DICOTYLEDONS

SALICACEAE

SALIX Tournefort

SALIX CHINENSIS Burm. f. Fl. Ind. (1768) 211 (err. typ. 311). "Habitat in China and Java."

This would appear to be identical with the later *Salix japonica* Thunb. Fl. Jap. (1784) 24, *t. 31,* which is common in Japan and in China, and which has long been cultivated in Java. It is to be noted that Koorders, Exkursionsfl. Java 2 (1912) 44, cites among other Javan specimens in the herbaria at Leiden and Utrecht a specimen "Kultiviert, ohne Fundort (Herbar Javan. Burman fide Blume = *S. Japonica*)." Burman's name, being the older, should be retained.

MORACEAE

FICUS Tournefort

FICUS AMPELOS Burm. f. Fl. Ind. (1768) 226. "Habitat in India."

Burman gives, in addition to his short descriptive sentence, first, a reference to *Folium politorium* Rumph. Herb. Amb. 4: 128, *t. 63,* and second, one to *Teregam* Rheede Hort. Malabar. 3: 79, *t. 60;* these two forms certainly are not conspecific. The species should be interpreted from the first reference and is, I believe, the form amply described by Koorders and Valeton, Bijdr. Boom. Java 11 (1906) 162, under Burman's binomial.

* FICUS GROSSULARIOIDES Burm. f. Fl. Ind. (1768) 227. "Habitat in Suratta."

This has been reduced to *Ficus heterophylla* Linn. f. Suppl. (1781) 442, which, if the correct disposition of it, would involve the acceptance of Burman's specific name for the species. It is probable that this reduction was based on the identity of *Valli-teregam* Rheede Hort. Malabar. 3: 83, *t. 62,* which Burman cites as representing his variety *β,* and which manifestly represents *Ficus heterophylla* Linn. f. Burman's very short description was based on an actual specimen collected by Garcin.

* **FICUS MONTANA** Burm. f. Fl. Ind. (1768) 226. "Habitat in India."

The short description was based on a Javan specimen collected by Kleinhof. The description is entirely too short and imperfect to permit the correct interpretation of the species.

FICUS PADANA Burm. f. Fl. Ind. (1768) 226.

Ficus toxicaria Linn. Mant. 2 (1771) 305.

The description was based on a Sumatran specimen and is the form described three years later as *Ficus toxicaria* Linn. Linnaeus cites Burman's species as a synonym. The two descriptions were doubtless based on material originating from the same collection. Burman's name, being the older, should be retained.

FICUS PYRIFOLIA Burm. f. Fl. Ind. (1768) 226. "Habitat in Japonia."

From the very short description it is believed that this will prove to be identical with *Ficus erecta* Thunb. Ficus (1786) 9, in which case Burman's name should replace Thunberg's.

FICUS SEPTICA Burm. f. Fl. Ind. (1768) 226. "Habitat in India."

Burman apparently had a Javan specimen, as he cites the Javanese name *siri bipar* for the species, but he also adds references to Rumphius and to Rheede. The Rumphian reference, which is the first one given, represents the widely distributed species commonly known as *Ficus leucantatoma* Poir.; but I believe that Burman's *Ficus septica* should be adopted in its stead, as it is the oldest valid name for this particular species.

FICUS TSJAKELA Burm. f. Fl. Ind. (1768) 227. "Habitat in Malabara."

This was based on a specimen collected by Garcin *"Ficus surattensis & malabarica, mori folio,"* and *Tsjakela* Rheede Hort. Malabar. 3: 87, *t. 64*. It has been badly confused with *Ficus infectoria* Roxb., and is really *Ficus infectoria* Willd., non Roxb. It is the valid name for a species of India and Ceylon, fully described and figured by King, in Ann. Bot. Gard. Calcutta 1 (1887) 57, *t. 70,* who has there adjusted the synonymy, on page 61. It is entirely different from *Ficus tsiela* Roxb.

URTICACEAE

BOEHMERIA Jacquin

BOEHMERIA PLATYPHYLLA D. Don Prodr. Fl. Nepal. (1825) 60.

Urtica caudata Burm. f. Fl. Ind. (1768) 198 (err. typ. 298). "Habitat in Java."

Boehmeria caudata J. J. Sm. in Koord. & Val. Bijdr. Boom. Java 12 (1910) 706, non Sw.

Weddell reduced Burman's species to *Boehmeria platyphylla* D. Don. var. *scabrella* Wedd. in DC. Prodr. 16[1] (1859) 311, and it is clearly a form of Don's species.

BOEHMERIA NIVEA (Linn.) Gaudich. Bot. Freyc. Voy. (1826) 499.

Urtica nivea Linn. Sp. Pl. (1753) 985.

Urtica candicans Burm. f. Fl. Ind. (1768) 197 (err. typ. 297). "Habitat in Java."

This is clearly a synonym of *Boehmeria nivea* (Linn.) Gaudich., placed by Weddel as the variety *candicans* Wedd. of the above species.

POUZOLZIA Gaudichaud

POUZOLZIA ZEYLANICA (Linn.) Benn. Pl. Jav. Rar. (1838) 67.

Parietaria zeylanica Linn. Sp. Pl. (1753) 1052.

Parietaria indica Linn. Mant. 1 (1767) 128.

Parietaria indica Burm. f. Fl. Ind. (1768) 211. "Habitat in Java."

Pouzolzia indica Gaudich. Bot. Freyc. Voy. (1826) 503.

It is suspected that both the Linnean and the Burman *Parietaria indica* were based on material of similar origin. The species is synonymous with the earlier *Parietaria zeylanica* Linn.=*Pouzolzia zeylanica* (Linn.) Benn.

DEBREGEASIA Gaudichaud

DEBREGEASIA LONGIFOLIA (Burm. f.) Wedd. in DC. Prodr. 16[1] (1869) 235[24].

Urtica longifolia Burm. f. Fl. Ind. (1768) 197 (err. typ. 297). "Habitat in Java."

This is the basis of *Debregeasia longifolia* (Burm. f.) Wedd., a well-known species of wide distribution on the mountains of the Indo-Malayan region. The Philippine *Debregeasia angustifolia* C. B. Rob. does not appear to be distinct from the Javan form, although differing slightly from Indian material.

PROTEACEAE

SYNAPHEA R. Brown

SYNAPHEA SPINULOSA (Burm. f.) Merr. in Proc. Linn. Soc. N. S. W. 44[2] (1919) 354.

Polypodium spinulosum Burm. f. Fl. Ind. (1768) 233, *t. 67, f. 1.*

Synaphea polymorpha R. Br. in Trans. Linn. Soc. 10 (1810) 156.

From the excellent figure this is manifestly the proteaceous *Synaphea polymorpha* R. Br., of western Australia, this involving the acceptance of Burman's specific name. The figure is excellently matched by Australian specimens before me. It would seem that the locality cited by Burman as "Java" is an error.

LORANTHACEAE

VISCUM Tournefort

VISCUM ARTICULATUM Burm. f. Fl. Ind. (1768) 211 (err. typ. 311). "Habitat in Java."

This species, at least in a broad sense, is of very wide distribution in the Indo-Malayan region. *Aspidixia articulata* Van Tiegh. is a synonym.

AMARANTHACEAE

CELOSIA Linnaeus

CELOSIA ARGENTEA Linn. Sp. Pl. (1753) 205.

Celosia pyramidalis Burm. f. Fl. Ind. (1768) 65, *t. 25, f. 1.* "Ex Java per semina allata * * *."

The description and figure refer to but a single species, which appears to be *Celosia argentea* Linn. rather than *C. cristata* Linn.; in Index Kewensis the species is reduced to *C. cristata* Linn. and *Allmania albida* R. Br.

AERUA Forskål

AERUA PERSICA (Burm. f.) comb. nov.

Iresine persica Burm. f. Fl. Ind. (1768) 212 (err. typ. 312), *t. 60, f. 1.*
Iresine javanica Burm. f. l. c. *t. 60, f. 2.*
Celosia lanata Linn. Sp. Pl. (1753) 205, non *Aerua lanata* Juss.
Aerua javanica Juss. in Ann. Mus. Paris 11 (1808) 131.

Iresine persica Burm. f. was based on a Persian specimen and *I. javanica* Burm. f. on one from Java. Both figures and descriptions apparently are referable to a single species, the former species being a more robust form than the latter.

AIZOACEAE

MOLLUGO Linnaeus

MOLLUGO LOTOIDES (Linn.) C. B. Clarke in Hook. f. Fl. Brit. Ind. 2 (1879) 662, 776.

Glinus lotoides Linn. Sp. Pl. (1753) 463; Burm. f. Fl. Ind. (1768) 112, *t. 36, f. 1.*
Mollugo hirta Thunb. Fl. Cap. (1794) 24.
Glinus ononides Burm. f. Fl. Ind. (1768) 113, *t. 36, f. 2.*
Glinus dictamnoides Burm. f. l. c.

The type of *Glinus ononides* Burm. f. was probably a Javan specimen, as Burman cites Pryon as the collector and gives the Malay name as *aud-gam pait*. It is apparently a form of *Mollugo lotoides* (Linn.) C. B. Clarke, which Burman describes on the preceding page as *Glinus lotoides* Linn. The type of *Glinus dictamnoides* Burm. f. was from India and can scarcely be other than a form of *Mollugo lotoides* (Linn.) C. B. Clarke.

MOLLUGO PENTAPHYLLA Linn. Sp. Pl. (1753) 89.

Mollugo paniculata Burm. f. Fl. Ind. (1768) 32. "Habitat in Zeylona."

Burman's species is typified by *Alsine lutea ramosissima pentaphylla polyanthos* Burm. Thes. Zeyl. (1737) 12, *t. 6, f. 2.* It is nearly the typical obovate-leaved form of *Mollugo pentaphylla* Linn. Sp. Pl. (1753) 89, to which the lanceolate to narrowly lanceolate-leaved form, *Mollugo stricta* Linn., is usually reduced as a synonym.

MOLLUGO OPPOSITIFOLIA Linn. Sp. Pl. (1753) 89.

Mollugo erecta Burm. f. Fl. Ind. (1768) 32.
Mollugo triphylla Burm. f. l. c.

The reference to Burman, Thesaurus Zeylanicus (1737) 13, *t. 7,* places *Mollugo erecta* Burm. f. definitely as a synonym of *Mollugo oppositifolia* Linn., although it would seem that Trimen, Fl. Ceyl. 2 (1894) 271, considered it rather a synonym of the very different *Mollugo pentaphylla* Linn. I can see no reason for distinguishing *Mollugo triphylla* Burm. f. from *M. erecta* Burm. f. = *M. oppositifolia* Linn. Burman's material of *Mollugo erecta* was from Ceylon and that of *M. triphylla* was from India.

TRIANTHEMA Linnaeus

TRIANTHEMA DECANDRA Linn. Mant. 1 (1767) 70.

Zaleya decandra Burm. f. Fl. Ind. (1768) 110, *t. 36, f. 1.* "Coromandeli."

Both binomials were doubtless based on material of similar origin. A well-known and widely distributed plant.

BASELLACEAE

BASELLA Linnaeus

BASELLA RUBRA Linn. Sp. Pl. (1753) 272.

Basella japonica Burm. f. Fl. Ind. (1768) 76, *t. 39, f. 4.* "Habitat in Japonia."

This is clearly referable to the Linnean species.

CARYOPHYLLACEAE

COMETES Linnaeus

COMETES SURATTENSIS Linn. Mant. 1 (1767) 39.

Cometes surattensis Burm. f. Fl. Ind. (1768) 39, *t. 15, f. 5.*

This was based on Indian material. The species was described one year earlier by Linnaeus under the same binomial, the material described by both authors doubtless being parts of the same collection.

NYMPHAEACEAE

NYMPHAEA Tournefort

NYMPHAEA NOUCHALI Burm. f. Fl. Ind. (1768) 120. "Habitat Coromandeli."

Nymphaea pubescens Willd. Sp. Pl. 2 (1799) 1154.

This is tentatively reduced in Index Kewensis to *Nymphaea stellata* Willd., but it would seem that, in spite of the description of the flowers as "caeruleo," it is the same as *Nymphaea pubescens* Willd. (1797), in which case Burman's name should be adopted for the species. Conard, The Waterlilies, Carnegie Inst. Washington Publ. 4 (1905) 198, *t. 17*, cites Burman's species as a synonym of Willdenow's on the basis of an actual specimen examined by him: "coll. [that is, ex herb.] Burman in India, in hb. Delessert."

MENISPERMACEAE

TINOSPORA Miers

* **TINOSPORA** sp.

Menispermum glabrum Burm. f. Fl. Ind. (1768) 216 (err. typ. 316). "Habitat in Java."

The reference to *Cit-amerdu* Rheede Hort. Malabar. 7: 39, *t. 21*, should be excluded, as it represents *Tinospora cordifolia* (DC.) Miers, a species of wide distribution in India, but which does not extend to Java; Burman's species was based on an actual Javan specimen. I cannot determine, from the short description or from the Javanese name cited, *daun tayonam*, the proper status of Burman's species, except that it apparently belongs in the Menispermaceae; it may prove to be the same as *Tinospora rumphii* Boerl. It is not accounted for by Diels in his recent monograph of the Menispermaceae, Engl. Pflanzenreich 46 (1910) 1 345.

MAGNOLIACEAE

MICHELIA Linnaeus

MICHELIA CHAMPACA Linn. Sp. Pl. (1753) 536.

Michelia euonymoides Burm. f. Fl. Ind. (1768) 124. "Habitat in Indiis."

Burman's species is certainly only a form of the earlier *Michelia champaca* Linn.; the Javanese name cited by Burman is one of those still in use in Java for the Linnean species. The Rumphian synonym cited represents *Michelia tsiampacca* Linn., whatever that may ultimately prove to be. I have not seen Sloane's figure which Burman also cites as a synonym, but it probably does not represent Burman's species.

LAURACEAE

CINNAMOMUM Blume

* CINNAMOMUM sp.

Laurus malabatrum Burm. f. Fl. Ind. (1768) 92. "Habitat in Malabaria & Amboina."

There is no description, the species being based on references to Rumphius, Rheede, and "*Malabathrum malabaricum* Garcin. herb." The reference to Rumphius represents *Cinnamomum javanicum* Blume. Burman's species is manifestly typified by the Malabar specimen and the reference to Rheede, and is hence identical with the form described by Solander as *Laurus malabathrica* Soland. in Roxb. Fl. Ind. ed. 2, **2** (1832) 297. Hooker f., Fl. Brit. Ind. **5** (1886) 136, was unable to place it to his satisfaction.

CRUCIFERAE

FORTUYNIA Shuttleworth

FORTUYNIA GARCINI (Burm. f.) Shuttl. ex Boiss. in Ann. Sci. Nat. Bot. II **17** (1842) 178.

Peltaria garcini Burm. f. Fl. Ind. (1768) 139, *t. 46, f. 1* (*garzini*). "Habitat in Persia."

The species is known only from Persia.

NASTURTIUM Linnaeus

NASTURTIUM INDICUM (Linn.) DC. Syst. **2** (1821) 199.

Sisymbrium indicum Linn. Mant. **1** (1767) 93.
Sisymbrium indicum Burm. f. Fl. Ind. (1768) 140.
Sisymbrium sinapis Burm. f. l. c.

This species is widely distributed in the Indo-Malayan region. *Sisymbrium sinapis* Burm. f. was based on Javan material, while that on which *S. indicum* Burm. f. was based was from India. Doubtless the material Linnaeus had in describing the species one year earlier was a part of the same collection.

NASTURTIUM HETEROPHYLLUM Blume Bijdr. (1825) 50.

* ? *Cardamine indica* Burm. f. Fl. Ind. (1768) 140. "Habitat in Java."

De Candolle, who saw Burman's specimen in the Delessert herbarium, retained this in *Cardamine,* with the comment "An potius inter Nasturtia ad sectionem Clandestinariae referenda?" while Schulz, Monogr. Gattung Cardamine in Engl. Bot. Jahrb. 32 (1903) 594, states that it is a *Nasturtium.* I suspect that it is the same as *Nasturtium heterophyllum* Blume. Burman's specific name, however, is invalidated in *Nasturtium* by *N. indicum* (Linn.) DC.

FARSETIA Turra

FARSETIA CANESCENS (Willd.) comb. nov.

Heliophila canescens Willd. Sp. Pl. 3 (1800) 528.
Arabis heliophila DC. Syst. 2 (1821) 237, Prodr. 1 (1824) 147.
Heliophila incana Burm. f. Fl. Ind. (1768) 140, *t. 46, f. 2,* non *Farsetia incana* R. Br. "Habitat in India."
Farsetia jacquemontii Hook. f. & Th. Fl. Ind. 1 (1855) 140.

De Candolle's and Willdenow's binomials are based on Burman's description; the latter's specific name being invalidated in *Farsetia,* I propose to adopt Willdenow's specific name. *Farsetia jacquemontii* Hook. f. & Th. is clearly a synonym.

LEGUMINOSAE

PROSOPIS Linnaeus

PROSOPIS SPICIGERA Linn. Mant. 1 (1767) 68.

Prosopis spicata Burm. f. Fl. Ind. (1768) 102. "Habitat Coromandeli."

This was described one year earlier by Linnaeus and is a well-known Indian species. Both descriptions were doubtless based on material from the same collection.

ACACIA Willdenow

ACACIA TRUNCATA (Burm. f.) Hort. ex Hoffmsg. Pfl. Verz. (1824) 34.

Adianthum truncatum Burm. f. Fl. Ind. (1768) 235, *t. 66, f. 4.* "Habitat in India."
Acacia decipiens R. Br. in Ait. Hort. Kew. ed. 2, 5 (1813) 463.

Kleinhof's specimen cited by Burman is credited to Java, the locality being certainly an error. Captain van Alderwereldt van Rosenburgh informs me that the species does not grow in Java, although the reduction of *Adianthum truncatum* Burm. f. to *Acacia decipiens* R. Br., indicated in Index Kewensis and in Christensen's Index Filicum, is certainly correct. The type was undoubtedly from western Australia, erroneously localized as Javan. *Polypodium spinulosum* Burm. f. = *Synaphea polymorpha* R. Br. presents a parallel case.

SARACA Linnaeus

SARACA INDICA Linn. Mant. 1 (1767) 98.

Saraca arborescens Burm. f. Fl. Ind. (1768) 85, *t. 25, f. 2.* "Habitat in Java."

Burman's species is clearly identical with the Linnean one published one year earlier, both descriptions doubtless being based on material from the same collection.

DIALIUM Linnaeus

DIALIUM INDUM Linn. Mant. 1 (1767) 24.

Dialium javanicum Burm. f. Fl. Ind. (1768) 12. "Habitat in Java."

Burman's species is clearly identical with the one described one year earlier by Linnaeus; both descriptions were doubtless based on material of the same collection. *Cortex papetarius* Rumph. Herb. Amb. 3: 212, *t. 137*, which is cited by Burman as a synonym, must be excluded, as it represents *Weinmannia fraxinea* Sm.

CASSIA Tournefort

CASSIA SURATTENSIS Burm. f. Fl. Ind. (1768) 97.

Cassia glauca Lam. Encycl. 1 (1783) 647.

The description was based on "*Senna surattensis* Garzin. herb." It is apparently correctly placed as a synonym of *Cassia glauca* Lam. in spite of Burman's description of it as "herbaceus." Burman's name is much older than that proposed by Lamarck and should be retained.

SOPHORA Linnaeus

SOPHORA JAPONICA Linn. Mant. 1 (1767) 68.

Sophora japonica Burm. f. Fl. Ind. (1768) 93. "Habitat in Japonia."

This is a well-known species of wide distribution in China and Japan. Both descriptions were probably based on specimens from the same collection.

181052——7

CROTALARIA Dillenius

CROTALARIA NANA Burm. f. Fl. Ind. (1768) 156, *t. 48, f. 2.* "Habitat in India."

This species is a well-known one of India and Ceylon.

CROTALARIA PERSICA (Burm. f.) comb. nov.

Cytisus persicus Burm. f. Fl. Ind. (1768) 163, *t. 51, f. 1.* "Habitat in Persia."

Spartium persicum Willd. Sp. Pl. 3 (1800) 931.

Crotalaria furfuracea Boiss. Diagn. 1^2 (1843) 6.

De Candolle, Prodr. 2 (1825) 157, retains this as a doubtful species of *Cytisus,* giving an amplified description from Burman's specimen in the Delessert herbarium. It is apparently identical with *Crotalaria furfuracea* Boiss.

CROTALARIA QUINQUEFOLIA Linn. Sp. Pl. (1753) 716.

Lupinus javanicus Burm. f. Fl. Ind. (1768) 157. "Habitat in Java."

The genus *Lupinus* is represented in Java by but three species, all casual and apparently recent introductions. From Burman's description it is quite evident that he had flowering specimens of *Crotalaria quinquefolia* Linn., in spite of the fact that the corolla is described as "purpurascens." In this species of *Crotalaria* the flowers are yellow, although the petals are often tinged with purple on the outside.

CROTALARIA SERICEA Burm. f. Fl. Ind. (1768) 156. "Habitat in India."

Crotalaria burmanni DC. Prodr. 2 (1825) 126.

This is the basis of *Crotalaria burmanni* DC., the new name having been proposed because of *Crotalaria sericea* Retz. (1783), which, however, manifestly does not invalidate Burman's specific name. Baker, in Hook. f. Fl. Brit. Ind. 2 (1876) 75, places *Crotalaria sericea* Burm. f. and *C. burmanni* DC. as doubtful synonyms of *Crotalaria assamica* Benth.

ASPALATHUS Linnaeus

ASPALATHUS ANTHYLLOIDES Linn. Sp. Pl. ed. 2 (1763) 1002.

Lotus persicus Burm. f. Fl. Ind. (1768) 173, *t. 49, f. 3.* "Habitat in Persia."

Anthyliis asphaltoides Linn. Cent. Pl. 2 (1756) 183, Amoen. Acad. 4 (1759) 326.

Ononis ? asphaltoides DC. Prodr. 2 (1825) 167.

De Candolle, who examined Burman's type in the Delessert herbarium, referred it with doubt to the genus *Ononis,* with the comment "sed descr. et patriae dubiae remanent." The Linnean species is South African; it would seem, therefore, that Burman was in error in accrediting his species to Persia.

ONONIS Linnaeus

ONONIS PERSICA Burm. f. Fl. Ind. (1768) 157, *t. 49, f. 1.* "Habitat in Persia."

This is supposed to be a synonym of *Ononis sicula* Guss.; this being so, Burman's specific name is much the older and should be retained.

LOTUS Tournefort

LOTUS GARCINI DC. Prodr. 2 (1825) 212.

Aspalathus persica Burm. f. Fl. Ind. (1768) 155. "Habitat in Persia & Malabaria."

The Persian specimen, the type of the species, is a *Lotus*, and Burman's name is the basis of *Lotus garcini* DC. The reference to Rheede Hort. Malabar. 9: 71, *t. 38*, must be excluded, as it does not represent the species Burman actually described. The type is in the Delessert herbarium. The specific name *persica* is invalidated in *Lotus* by *Lotus persicus* Burm. f.

INDIGOFERA Linnaeus

INDIGOFERA COLUTEA (Burm. f.) comb. nov.

Galega colutea Burm. f. Fl. Ind. (1768) 172. "Habitat in India."
Tephrosia colutea Pers. Syn. 2 (1807) 326.
Indigofera viscosa Lam. Encycl. 3 (1789) 247.

This species is currently known as *Indigofera viscosa* Lam., but Burman's specific name is older and should be retained.

INDIGOFERA ARGENTEA Burm. f. Fl. Ind. (1768) 171. "Habitat in Persia."

Burman's name antedates *Indigofera argentea* Linn. Mant. 2 (1771) 273 and should be maintained, with *Indigofera semitrijuga* Forsk. as a synonym. The proper name for the species described by Linnaeus as *Indigofera argentea* is *I. articulata* Gouan., for his species does not seem to have been based on specimens of the same collection as Burman's.

INDIGOFERA ENNEAPHYLLA Linn. Mant. 2 (1771) 272.

Hedysarum prostratum Linn. Mant. 1 (1767) 102, non *Indigofera prostrata* Perr.
Hedysarum prostratum Burm. f. Fl. Ind. (1768) 168, *t. 55, f. 1.* "Coromandeli."

Hedysarum prostratum of Linnaeus and of Burman were doubtless based on material of similar origin. It is a synonym of *Indigofera enneaphylla* Linn.

TEPHROSIA Persoon

TEPHROSIA VILLOSA (Linn.) Pers. Syn. 2 (1807) 329.

Galega villosa Linn. Syst. ed. 10 (1759) 1172.
Galega barba-jovis Burm. f. Fl. Ind. (1768) 172. "Habitat in India."

Burman's name is a synonym of the earlier Linnean one.

TAVERNIERA de Candolle

TAVERNIERA SPARTEA (Burm. f.) DC. Prodr. 2 (1825) 339.

Hedysarum sparteum Burm. f. Fl. Ind. (1768) 166, *t. 51, f. 3* (err. *f. 2*). "Habitat in India."

De Candolle examined Garcin's specimen in the Delessert herbarium on which Burman's species was based; he indicates that this was from Persia rather than from India. *Taverniera nummularia* DC. is probably not specifically distinct.

DESMODIUM Desvaux

DESMODIUM HETEROCARPUM (Linn.) DC. Prodr. 2 (1825) 337.

Hedysarum heterocarpon Linn. Sp. Pl. (1753) 747.
Hedysarum siliquosum Burm. f. Fl. Ind. (1768) 169, *t. 55, f. 2.* "Java."
Desmodium siliquosum DC. Prodr. 2 (1825) 336.
Desmodium polycarpum DC. op. cit. 334.

Burman's species is clearly identical with the very common Indo-Malayan *Desmodium heterocarpum* (Linn.) DC., more commonly known as *D. polycarpum* DC.

DESMODIUM CAPITATUM (Burm. f.) DC. Prodr. 2 (1825) 336.

Hedysarum capitatum Burm. f. Fl. Ind. (1768) 167, *t. 54, f. 1.*

No definite locality is given, but Burman's specimen was from either Java or India. This is the basis of the well-known and widely distributed *Desmodium capitatum* (Burm. f.) DC.

DESMODIUM TRIFLORUM (Linn.) DC. Prodr. 2 (1825) 334.

Hedysarum triflorum Linn. Sp. Pl. (1753) 749.
Hedysarum stipulaceum Burm. f. Fl. Ind. (1768) 168, *t. 54, f. 2.* "Crescit in Persia."

Burman's species has been reduced to *Desmodium triflorum* (Linn.) DC., a very common species in most tropical countries; this doubtless is the correct disposition of it, as the figure agrees with *Desmodium triflorum* DC.

ALYSICARPUS Necker

ALYSICARPUS MONILIFER (Linn.) DC. Prodr. 2 (1825) 353.

Hedysarum moniliferum Linn. Mant. 1 (1767) 102.
Hedysarum moniliforme Burm. f. Fl. Ind. (1768) 168, *t. 52, f. 3.* "Coromandeli."

Burman's species is clearly identical with the one described a year earlier by Linnaeus; both descriptions were doubtless based on material from the same collection. It is widely distributed in India.

URARIA Desvaux

URARIA CRINITA (Linn.) Desv. Journ. Bot. 1 (1813) 123.

Hedysarum crinitum Linn. Mant. 1 (1767) 102.

Hedysarum crinitum Burm. f. Fl. Ind. (1768) 169, *t. 56*. "Habitat in Java."

A characteristic Indo-Malayan species, both Burman's and Linnaeus's binomials doubtless being based on material of similar origin.

PONGAMIA Ventenat

PONGAMIA PINNATA (Linn.) Merr. Interpret. Herb. Amb. (1917) 271.

Cytisus pinnatus Linn. Sp. Pl. (1753) 741.

Robinia mitis Linn. op. cit. ed. 2 (1763) 1044.

Robinia javanica Burm. f. Fl. Ind. (1768) 163. "Habitat in Java."

Burman's species was based on a flowering specimen, and in view of this fact it is scarcely possible that it is a synonym of *Cassia sulfurea* DC. = *Cassia glauca* Lam., to which it has been reduced and which Burman otherwise described as *Cassia surattensis* Burm. f. The description is entirely inadequate, consisting only of the statement: "caule inermi foliis pinnatis sex jugis, pedunculis simplicibus multifloris." Burman's species is apparently identical with the common and widely distributed *Pongamia pinnata* (Linn.) Merr., currently known as *Pongamia glabra* Vent.

ELEIOTIS de Candolle

ELEIOTIS MONOPHYLLA (Burm. f.) DC. Mém. Legum. 7 (1825) 350, Prodr. 2 (1825) 348.

Glycine monophyllos Burm. f. Fl. Ind. (1768) 161, *t. 50, f. 2*. "Habitat Coromandeli."

Hedysarum sororium Linn. Mant. 2 (1771) 270.

Eleiotis sororia DC. l. c.

Burman's specific name has priority and should be retained for this species. The description of Burman and that of Linnaeus were doubtless based on material from the same collection.

TERAMNUS P. Browne

TERAMNUS UNCINATUS (Linn.) Sw. Prodr. (1783–87) 105.

Dolichos uncinatus Linn. Sp. Pl. ed. 2 (1763) 1019.

Dolichos uncinatus Burm. f. Fl. Ind. (1768) 161. "Habitat in India utraque."

There is no evidence that Burman's binomial was intended to represent *Dolichos uncinatus* Linn., although it probably represents the Linnean species which is the basis of *Teramnus uncinatus* (Linn.) Sw. Burman's actual type is clearly Kleinhof's specimen, as he notes that the specimen differed somewhat from Plukenet's figure, Phyt. 290, *t. 214, f. 2,* which he cites as representing the species. The Linnean species is typified by Plumier Spec. 8. *ic. 221;* there is no specimen in the Linnean herbarium.

PHASEOLUS Tournefort

PHASEOLUS TRILOBATUS (Linn.) Baill. in Bull. Soc. Linn. Paris 1 (1883) 379.

Dolichos trilobatus Linn. Mant. 1 (1767) 101.
Glycine triloba Burm. f. Fl. Ind. (1768) 162. "Habitat in Java."
Glycine triloba Linn. Mant. 2 (1771) 442.
Dolichos trilobus Ait. Hort. Kew. 3 (1789) 30.

In describing *Glycine triloba*, Linnaeus cites Burman's publication and gives as synonyms *Dolichos trilobatus* Linn. Mant. 1 (1767) 101, and *Phaseolus aconitifolius* Jacq. Obs. 3 (1764–71) 2, *t. 52*. Jacquin's species is generally considered a distinct one, while the proper name for the form Linnaeus described is *Phaseolus trilobatus* (Linn.) Baill. *Dolichos trilobatus* (Linn.) Baill. occurs in Java, but Jacquin's species is not reported from that island.

VIGNA Savi

VIGNA SINENSIS (Linn.) Savi ex Hassk. Cat. Hort. Bogor. (1844) 279.

Dolichos sinensis Linn. Cent. Pl. 2 (1756) 28.
Dolichos catjang Burm. f. Fl. Ind. (1768) 161. "Habitat in India."
Dolichos catjang Linn. Mant. 2 (1771) 259.
Vigna catjang Walp. in Linnaea 13 (1839) 533.

If Burman's species be typified by the first reference to an illustration, and the reference from which he took his specific name, namely, Malay *Katjang poeti, Phaseolus minor* Rumphius Herb. Amb. 5: 383, *t. 139, f. 1,* it is identical with *Vigna cylindrica* (Linn.) Skeels in U. S. Dept. Agr. Bur. Pl. Industry Bull. **282** (1913) 32; Merr. Interpret. Herb. Amb. (1917) 284 [*Phaseolus cylindricus* Linn. Amoen. Acad. 4 (1759) 132]. There is no direct evidence that Burman had an actual specimen. The catjang, however, does not appear to be specifically distinct from the cowpea, *Vigna sinensis* (Linn.) Savi.

ZYGOPHYLLACEAE

FAGONIA Tournefort

FAGONIA CRETICA Linn. Sp. Pl. (1753) 386.

Fagonia indica Burm. f. Fl. Ind. (1768) 102, *t. 34, f. 1.* "Habitat in Persia."

This is apparently a synonym of the Linnean species, where it has long been placed as a synonym.

RUTACEAE

MURRAYA Koenig

MURRAYA PANICULATA (Linn.) Jack in Malay Miscel. 1^5 (1820) 31.

Chalcas paniculata Linn. Mant. 1 (1767) 68.
Chalcas camuneng Burm. f. Fl. Ind. (1768) 104. "Habitat in Java."
Murraya exotica Linn. Mant. 2 (1771) 563.

A variable species of wide distribution in Asia and Malaysia, now pantropic in cultivation.

CLAUSENA Burman f.

CLAUSENA EXCAVATA Burm. f. Fl. Ind. (1768) 87 (*Claucena*), 243. "Habitat in Java."

This is the original publication of the genus. Burman's original spelling was *Claucena,* apparently a typographical error for *Clausena,* as he gives it in the index to his work as *Clausena.* The name, according to Wittstein, was derived from P. Clausön, a Danish botanist. The species is a well-known one of wide distribution in the Indo-Malayan region.

TRIPHASIA Loureiro

TRIPHASIA TRIFOLIA (Burm. f.) P. Wils. in Torrea 9 (1909) 33.

Limonia trifolia Burm. f. Fl. Ind. (1768) 103, *t. 35* (err. typ. 34), *f. 1.* "Habitat in Java."
Limonia trifoliata Linn. Mant. 2 (1771) 237.
Triphasia trifoliata DC. Prodr. 1 (1824) 536.
Triphasia aurantiola Lour. Fl. Cochinch. (1790) 153.

A very common and widely distributed Indo-Malayan species for which Burman's binomial supplies the earliest specific name. The Linnean description was doubtless based on material of the same collection as that on which Burman's was based.

FERONIA Correa

FERONIA LIMONIA (Linn.) Swingle in Journ. Wash. Acad. Sci. 4 (1914) 328; Merr. Interpret. Herb. Amb. (1917) 293.

Schinus limonia Linn. Sp. Pl. (1753) 389.
Feronia elephantum Correa in Trans. Linn. Soc. 5 (1800) 225.
Limonia acidissima Burm. f. Fl. Ind. (1768) 102. "Habitat in India."

Burman's binomial was probably not intended as a new one, but was doubtless intended as the Linnean species of the same name, Sp. Pl. ed. 2 (1762) 554.

RUTACEAE OF UNCERTAIN STATUS

* **SOLANUM TRIFOLIATUM** Burm. f. Fl. Ind. (1768) 57, *t. 22, f. 3.*

The reduction given in Index Kewensis to *Triphasia aurantiola* Lour. is an impossible one, the latter being described and figured by Burman as *Limonia trifolia,* Fl. Ind. (1768) 103, *t. 35, f. 1.* The two figures present nothing in common, but depict two entirely different plants. *Solanum trifoliatum* Burm. f. apparently represents some rutaceous plant.

BURSERACEAE

PROTIUM Burman f.

PROTIUM JAVANICUM Burm. f. Fl. Ind. (1768) 88. "Habitat in Java."

Amyris protium Linn. Mant. 1 (1767) 65.

The description is based on an actual specimen, with a reference to *Tingulong* Rumph. Auct. 54, *t. 23, f. 1,* which represents the same species. It typifies the genus. The Linnean *Amyris protium* was doubtless based on material originating from the same source as Burman's type.

MELIACEAE

SANDORICUM Cavanilles

SANDORICUM KOETJAPE (Burm. f.) Merr. in Philip. Journ. Sci. 7 (1912) Bot. 237, Interpret. Herb. Amb. (1917) 308.

Melia koetjape Burm. f. Fl. Ind. (1768) 101. "Habitat in Java."
Sandoricum indicum Cav. Diss. 4 (1787) 359, *t. 202, 203.*

Burman's species is clearly identical with the common and widely distributed Indo-Malayan species currently known as *Sandoricum indicum* Cav. *Koetjape* is the common Javanese name for the species.

EUPHORBIACEAE

ANTIDESMA Burman

ANTIDESMA BUNIUS (Linn.) Spreng. Syst. 1 (1825) 826.

Stilago bunius Linn. Mant. 1 (1767) 122.

Stilago bunius Burm. f. Fl. Ind. (1768) 16. "Habitat in India."

A very common Indo-Malayan species, described by Linnaeus one year earlier than by Burman and under the same binomial. Both descriptions were doubtless based on material of similar origin.

CROTON Linnaeus

CROTON GLABRESCENS Miq. Fl. Ind. Bat. 1 [2] (1858–59) 382.

Croton castaneifolium Burm. f. Fl. Ind. (1768) 205 (err. typ. 305), *t. 64, f. 1,* non Linn. "Habitat in Java."

Burman's figure represents a true *Croton* and is apparently the same as *Croton glabrescens* Miq.

CROTON OBLONGUM Burm. f. Fl. Ind. (1768) 205 (err. typ. 305), *t, 64, f. 2.*

Croton laevifolius Blume Bijdr. (1825) 603.

No locality is cited, and the entire description consists of the words "foliis oblongo-ovatis integerrimis." Burman's material was probably from Java, and from the figure it is clearly identical with the form later described as *Croton laevifolius* Blume. Burman's name should be retained for the species.

CROTON TIGLIUM Linn. Sp. Pl. (1753) 1004.

? Croton racemosum Burm. f. Fl. Ind. (1768) 206 (err. typ. 306), *t. 62, f. 2.*

The type of this was apparently a Javan specimen, and from the description and figure I can suggest no other reduction than *Croton tiglium* Linn., although the description of the leaves as tomentose scarcely applies to the Linnean species. The form indicated as var. *β*, based on *Beénel* Rheede Hort. Malabar. 5: 7, *t. 4,* is certainly not congeneric with *Croton racemosum* Burm. f.

CLAOXYLON A. Jussieu

CLAOXYLON POLOT (Burm. f.) Merr. Interpret. Herb. Amb. (1917) 200.

Croton polot Burm. f. Fl. Ind. (1768) 205 (err. typ. 305). "Habitat in Amboina & Java."

Claoxylon indicum Hassk. Cat. Hort. Bogor. (1844) 235.

Burman based his description on an actual Javan specimen, which must typify his species in spite of the fact that he took his specific name from *Folium urens s. polot* Rumph. Herb. Amb. 3: 217, *t. 141*. The specimen described is clearly the species commonly known as *Claoxylon indicum* Hassk. The Rumphian reference must be excluded, as it represents *Laportea amplissima* (Blume) Miq.

CLEIDION Blume

CLEIDION SPICIFLORUM (Burm. f.) Merr. Interpret. Herb. Amb. (1917) 322.

Acalypha spiciflora Burm. f. Fl. Ind. (1768) 203 (err. typ. 303), *t. 61, f. 2.* "Habitat in India utraque."
Cleidion javanicum Blume Bijdr. (1825) 613.

The form figured and hence the type of Burman's species is clearly the one commonly known as *Cleidion javanicum* Blume, with staminate inflorescences. The references to Plukenet, P. Browne, Rheede, Burman, and Rumphius must be excluded, as none of these pre-Linnean citations represents the form that Burman f. figured and described.

ACALYPHA Linnaeus

ACALYPHA HISPIDA Burm. f. Fl. Ind. (1768) 203 (err. typ. 303), *t. 61, f. 1.* "Habitat in India."

Caturus spiciflorus Linn. Mant. 1 (1767) 127, non *Acalypha spiciflora* Burm. f.
Acalypha densiflora Blume Bijdr. (1826) 628.
Acalypha sanderi N. E. Br. in Gard. Chron. (1896) 2: 392.

This is a species of wide distribution in the Indo-Malayan region in cultivation, and is also cultivated for ornamental purposes in Europe and America. It was later described as *Acalypha densiflora* Blume, and as recently as 1896 as *A. sanderi* N. E. Br. The earlier *Caturus spiciflorus* Linn. Mant 1 (1767) 127 is invalidated by *Acalypha spiciflora* Burm. f.

RICINUS Linnaeus

RICINUS COMMUNIS Linn. Sp. Pl. (1753) 1007.

Ricinus speciosus Burm. f. Fl. Ind. (1768) 207 (err. typ. 307), *t. 63, f. 2.* "Habitat in Java."

This is certainly a form of *Ricinus communis* Linn., with very narrow leaf-segments and unusually deep sinuses.

ANACARDIACEAE

RHUS Tournefort

RHUS JAVANICA Linn. Sp. Pl. (1753) 265.

Schinus indica Burm. f. Fl. Ind. (1768) 215 (err. typ. 315). "Habitat in India."
Rhus semialata Murr. in Comm. Gotting. 6 (1784) 27, *t. 3.*

There is nothing in the description by which the identity of this species can be determined with absolute certainty, it consisting only of the statement: "Foliis pinnatis, foliolis ovatis serratis impari aequali, petiolis alatis subcanaliculatis." The type probably came from Java, which being so the species is clearly no *Schinus,* all species of which are American. It can scarcely be other than a synonym of *Rhus javanica* Linn., more commonly known as *R. semialata* Murr.

SAPINDACEAE

ALLOPHYLUS Linnaeus

ALLOPHYLUS TRIPHYLLUS (Burm. f.) comb. nov.

Usubis triphylla Burm. f. Fl. Ind. (1768) 89, *t. 32, f. 1.* "Habitat in Java."

Allophylus javensis Blume Rumphia 3 (1847) 183.

Burman's species has been reduced to *Allophylus cobbe* (Linn.) Blume, *sensu lat.,* but the latter is limited to India and Ceylon. *Usubis triphylla* is clearly identical with *Allophylus javensis* Blume.

RHAMNACEAE

ZIZYPHUS Tournefort

ZIZYPHUS JUJUBA (Linn.) Lam. Encycl. 3 (1789) 318.

Rhamnus jujuba Linn. Sp. Pl. (1753) 194.

Rhamnus nummularia Burm. f. Fl. Ind. (1768) 61, saltem pro parte. "Habitat in Zeylona & Java."

It is suspected that two or more species are included in the references given by Burman. The Javan reference to Pryon is probably *Zizyphus jujuba* (Linn.) Lam., there being no other Javan species known to which the descriptive sentence applies. "Rhamnus persica herb. Garzin." probably appertains to *Zizyphus rotundifolia* Lam. The Ceylon references probably appertain to *Zizyphus jujuba* Lam. and *Z. oenoplia* Mill.

ZIZYPHUS SPINI-CHRISTI (Linn.) Willd. Sp. Pl. 1 (1797) 1105.

Rhamnus spini-christi Linn. Sp. Pl. (1753) 195.

Rhamnus heterogenea Burm. f. Fl. Ind. (1768) 61. "Habitat in India orientali & Persia."

Burman's species is apparently referable to *Zizyphus spini-christi* (Linn.) Willd.

SCUTIA Commerson

SCUTIA MYRTINA (Burm. f.) comb. nov.

Rhamnus myrtinus Burm. f. Fl. Ind. (1768) 60. "Habitat Coromandeli."

Scutia indica Brongn. in Ann. Sci. Nat. I 10 (1827) 363.

Scutia commersonii Brongn. l. c.

It would seem that Burman's specific name should be adopted for this Asiatic and Madagascar species.

VITACEAE

LEEA Royen

LEEA INDICA (Burm. f.) Merr. in Philip. Journ. Sci. 14 (1919) 245.

Staphylea ? indica Burm. f. Fl. Ind. (1768) 75, *t. 24, f. 2.* "Habitat in Indiis."

Aquilicia sambucina Linn. Mant. 2 (1771) 211.

Leea sambucina Willd. Sp. Pl. 1 (1797) 1177.

From the description and figure Burman's species is clearly identical with the widely distributed form currently known as *Leea sambucina* Willd., the latter being based on the Linnean binomial, and the Linnean binomial in turn typified by Burman's description.

MALVACEAE

ABUTILON Tournefort

ABUTILON PERSICUM (Burm. f.) comb. nov.

Sida persica Burm. f. Fl. Ind. (1768) 148, *t. 47, f. 1.* "Habitat in Persia."

Sida polyandra Roxb. Hort. Beng. (1814) 50, Fl. Ind. ed. 2, 3 (1832) 173.

Abutilon polyandrum Schlecht. in Link Enum. Hort. Berol. 2 (1822) 264.

Burman's species is clearly identical with *Abutilon polyandrum* (Roxb.) Schlecht. to which it is reduced by Masters in Hook. f. Fl. Brit. Ind. 1 (1874) 325. Burman's specific name should be adopted for the species.

SIDA Linnaeus

SIDA ACUTA Burm. f. Fl. Ind. (1768) 147. "Habitat in India."

This is the earliest valid name for this very common and widely distributed species; it was later described by the younger Linnaeus as *Sida carpinifolia* Linn. f. Suppl. (1781) 307.

SIDA RACEMOSA Burm. f. Fl. Ind. (1768) 148.

Sida mysorensis W. & A. Prodr. (1834) 59.

No habitat is cited. This species has been reduced to *Sida glutinosa* Cav., probably from confusion of Cavanilles's species with *Sida mysorensis* W. & A. The description applies very closely to *Sida mysorensis* W. & A., and it is believed that Burman's specific name should be retained for the Indo-Malayan form generally referred to the latter.

HIBISCUS Linnaeus

HIBISCUS PANDURAEFORMIS Burm. f. Fl. Ind. (1768) 151, *t. 47, f. 2.*

No species of *Althaea* (*Alcaea*) Burman, cultivated or other-
No locality is cited, but the type was either Indian or Javan. The species is a well-known one, extending from India to tropical Africa, Java, and tropical Australia.

MALVACEAE OF UNCERTAIN STATUS

* ALCAEA INDICA Burm. f. Fl. Ind. (1768) 149. "Habitat in Java."

No species of *Althaea* (*Alcaea*) Burman, cultivated or otherwise, is reported from Java, and Burman's species has not been considered by any modern author. It is suspected that his specimen represents some species of *Hibiscus,* but the description alone is scarcely sufficient to determine this matter.

TILIACEAE

CORCHORUS Dillenius

CORCHORUS TRIDENS Linn. Mant. 2 (1771) 566.

Corchorus trilocularis Burm. f. Fl. Ind. (1768) 123, *t. 37, f. 2,* non Linn. "Habitat in India."

Burman's description and figure apparently belong with *Corchorus tridens* Linn., rather than with *C. trilocularis* Linn. Mant. 1 (1767) 77, at least as the two species are interpreted by Masters in Hook. f. Fl. Brit. Ind. 1 (1874) 397, 398.

STERCULIACEAE

MELOCHIA Dillenius

MELOCHIA CONCATENATA Linn. Sp. Pl. (1753) 675.

Melochia corchorifolia Linn. l. c.
Corchorus javanicus Burm. f. Fl. Ind. (1768) 123, *t. 36, f. 3.*
Melochia erecta Burm. f. op. cit. 143.

Burman's types of both species were from Java. From the distinctly good figure the first is manifestly synonymous with the species currently known as *Melochia corchorifolia* Linn., which is a synonym of *M. concatenata* Linn. The drawing is erroneous in that all the leaves are represented as alternate. *Melochia erecta* Burm. f. is clearly synonymous with *Corchorus javanicus* Burm. f.

* MELOCHIA CORDATA Burm. f. Fl. Ind. (1768) 143. "Coromandeli."

If this be a *Melochia* it can scarcely be other than a form of *Melochia concatenata* Linn., but the description of the flowers as yellow, solitary, and opposite the leaves, and the capsules as compressed scarcely conforms to the characters of the Linnean species.

DILLENIACEAE

TETRACERA Linnaeus

TETRACERA AKARA (Burm. f.) comb. nov.

Calophyllum akara Burm. f. Fl. Ind. (1768) 121. "Habitat in India."
Tetracera laevis Vahl Symb. 3 (1794) 71.

Burman's species is typified by *Akara patsjoti* Rheede Hort. Malabar. 5: 15 *t. 8*, this being an excellent illustration of the species commonly known as *Tetracera laevis* Vahl.

GUTTIFERAE

CALOPHYLLUM Linnaeus

CALOPHYLLUM SOULATTRI Burm. f. Fl. Ind. (1768) 121. "Habitat in Java."

Calophyllum spectabile Willd. in Ges. Naturf. Fr. Berl. Mag. 5 (1811) 80.

Burman's binomial is the oldest valid one for the well-known species described in 1811 as *Calophyllum spectabile* Willd.; Burman's name should be retained.

MESUA Linnaeus

MESUA FERREA Linn. Sp. Pl. (1753) 515.

Calophyllum nagassarium Burm. f. Fl. Ind. (1768) 121. "Habitat in Amboina & Java."

Burman's species is a synonym of the well-known *Mesua ferrea* Linn. *Nagassarium* Rumph. Herb. Amb. 7: 3, *t. 2*, cited by Burman as a synonym of his species, is correctly placed.

GARCINIA Linnaeus

GARCINIA sp.

Rheedia javanica Burm. f. Fl. Ind. (1768) 118. "Habitat in Java."

The description clearly applies to *Garcinia*, but the further identity of the species is scarcely determinable from the description alone.

COCHLOSPERMACEAE

COCHLOSPERMUM Kunth

COCHLOSPERMUM GOSSYPIUM (Linn.) DC. 1 (1824) 527.

Bombax gossypium Linn. Syst. ed. 12 (1767) 517.
Bombax conga Burm. f. Fl. Ind. (1768) 145. "Habitat in India."

Burman's species is identical with *Bombax gossypium* Linn., which was published one year earlier.

VIOLACEAE

IONIDIUM Ventenat

IONIDIUM SUFFRUTICOSUM (Linn.) Ging. in DC. Prodr. 1 (1824) 311.
Viola suffruticosa Linn. Sp. Pl. (1753) 937.
Polygala thea Burm. f. Fl. Ind. (1768) 154, excl. var. β.
Polygala theezans Linn. Mant. 2 (1771) 260.

No definite locality is given, but the species is based on two Ceylon references, one Javan, and perhaps one Japanese, and is unquestionably a mixture. If typified by the first and only illustrations cited, *Polygala frutescens, lavandulae folio, flore caeruleo. Burm. zeyl. 195, t. 85,* it is a synonym *of Ionidium suffruticosum* (Linn.) Ging., which is perhaps the best disposition of it. The native name *kimelala,* representing the variety β, *Kimelala Javanis, quae foliis ovalibus triplo majoribus,* is unquestionably *Polygala glomerata* Lour., now known in Java as *malela;* it is not the type of Burman's species. *Polygala theezans* Linn. Mant. 2 (1771) 260 is a new name for *Polygala thea* Burm. f. and should go with *Ionidium suffruticosum* (Linn.) Ging. as a synonym.

FLACOURTIACEAE

FLACOURTIA L'Héritier

FLACOURTIA INDICA (Burm. f.) Merr. Interpret. Herb. Amb. (1917) 377.
Gmelina indica Burm. f. Fl. Ind. (1768) 132, *t. 39, f. 5.* "Habitat in Java."
Flacourtia sepiaria Roxb. Pl. Coromandel 1 (1795) 48, *t. 68.*
Flacourtia ramontchi L'Hérit. Stirp. Nov. (1784–85) 59, *t. 30, 31.*

A common species in the Indo-Malayan region, for which Burman's binomial supplies the oldest valid specific name.

THYMELAEACEAE

PHALERIA Jack

PHALERIA OCTANDRA (Linn.) Baill. in Adansonia 11 (1876) 321.
Dais octandra Linn. Mant. 1 (1767) 69.
Dais octandra Burm. f. Fl. Ind. (1768) 104, *t. 32, f. 2.* "Habitat in Java."
Drimyspermum burmanni Decne. in Ann. Sci. Nat. II 19 (1843) 40.

A well-known Javan species, both Burman's and Linnaeus's descriptions doubtless being based on material of similar origin.

RHIZOPHORACEAE

BRUGUIERA Lamarck

BRUGUIERA CYLINDRICA (Linn.) Blume Enum. Pl. Jav. (1828) 93; Merr. Interpret. Herb. Amb. (1917) 388.

Rhizophora cylindrica Linn. Sp. Pl. (1753) 443.

Rhizophora caryophylloides Burm. f. Fl. Ind. (1768) 109. "Habitat in India."

Bruguiera caryophylloides Blume Enum. Pl. Jav. (1828) 93.

A widely distributed Indo-Malayan species currently known as *Bruguiera caryophylloides* Blume.

COMBRETACEAE

QUISQUALIS Linnaeus

QUISQUALIS INDICA Linn. Sp. Pl. ed. 2 (1762) 556.

Quisqualis pubescens Burm. f. Fl. Ind. (1768) 104, *t. 35, f. 2, t. 28, f. 2* (var. β *glabra*). "Habitat in Amboina."

Both drawings represent the well-known *Quisqualis indica* Linn.; Burman's species can be safely placed as a synonym of the Linnean one.

MYRTACEAE

PSIDIUM Linnaeus

PSIDIUM CUJAVILLUS Burm. f. Fl. Ind. (1768) 114. "Habitat in India."

Psidium pumilum Vahl Symb. 2 (1791) 56.

Psidium angustifolium Lam. Encycl. 3 (1789) 17.

Burman's binomial is the proper name for the species more commonly known as *Psidium pumilum* Vahl. His type was probably from Java. *Cujavillus* Rumph. Herb. Amb. 1: 145, *t. 49,* is correctly placed as a synonym.

EUGENIA Micheli

EUGENIA AQUEA Burm. f. Fl. Ind. (1768) 114. "Habitat in Amboina."

This is typified by *Jambosa aquea* Rumph. Herb. Amb. 1: 126, *t. 38, f. 2,* there being no evidence that Burman had a specimen. The species is widely distributed, in cultivation, in the Malayan region.

MELALEUCA Linnaeus

MELALEUCA LEUCADENDRON Linn. Mant. 1 (1767) 105 (*leucadendra*).

Myrtus leucadendra Linn. in Stickm. Herb. Amb. (1754) 9, Amoen. Acad. 4 (1759) 120, Syst. ed. 10 (1759) 1056, Sp. Pl. ed. 2 (1762) 676.

Myrtus saligna Burm. f. Fl. Ind. (1768) 116. "Habitat in Java & Amboina."

This is the well-known cajuput tree, widely distributed in Malaysia, in cultivation.

MELASTOMATACEAE

MEMECYLON Linnaeus

MEMECYLON UMBELLATUM Burm. f. Fl. Ind. (1768) 87. "Habitat in Zeylona."

This is the form amply described by Trimen, Fl. Ceyl. 2 (1894) 217, who states that *Memecylon umbellatum* Burm. f. was published without description. It is, however, a valid publication, as it is typified by the excellent figure cited, Burm. Thesaurus Zeylanicus (1737) *t. 31*.

OENOTHERACEAE

JUSSIEUA Linnaeus

JUSSIEUA SUFFRUTICOSA Linn. Sp. Pl. (1753) 388.

Jussiaea tenella Burm. f. Fl. Ind. (1768) 103, *t. 34* (err. typ. *35*), *f. 2*. "Habitat in Java."

This can scarcely be other than a form of the Linnean species, in spite of Burman's description of the leaves as opposite; in the drawing, which is good, some are drawn as alternate, others as opposite.

ARALIACEAE

NOTHOPANAX Miquel

NOTHOPANAX SCUTELLARIUM (Burm. f.) Merr. Interpret. Herb. Amb. (1917) 409.

Crassula ? scutellaria Burm. f. Fl. Ind. (1768) 78. "Java."
Aralia cochleata Lam. Encycl. 1 (1783) 224.
Panax cochleata DC. Prodr. 4 (1830) 253.

A species in common cultivation; its native habitat is uncertain.

ERICACEAE

RHODODENDRON Linnaeus

RHODODENDRON LEDIFOLIUM G. Don Gen. Syst. 3 (1834) 846.

Rhododendron burmanni G. Don l. c.
Rhododendron rosmarinifolium Dippel Handb. Laubholzk. 1 (1889) 421, non Vidal 1886.
Azalea rosmarinifolia Burm. f. Fl. Ind. (1768) 43, *t. 3*, *f. 3*. "Habitat in Japonia, colitur in Java."

Burman's species represents the well-known *Rhododendron ledifolium* G. Don, its identity having been kindly verified for me by Dr. B. Hayata. *Rhododendron rosmarinifolium* (Burm.

f.) Dippel (1889) is invalidated by *Rhododendron rosmarinifolium* Vidal (1886), the latter being an unrelated Philippine species.

MYRSINACEAE

EMBELIA Burman f.

EMBELIA RIBES Burm. f. Fl. Ind. (1768) 62, *t. 23*. "Habitat in Zeylonia."

The species is a well-known one and has been correctly interpreted by subsequent authors. It is the type of the genus.

SALVADORACEAE

SALVADORA Garcin

SALVADORA PERSICA Linn. Sp. Pl. (1753) 122.

Galenia asiatica Burm. f. Fl. Ind. (1768) 88, *t. 31, f. 1* (err. typ. *f. 5*). "Persia & Arabia."

Burman's species is a synonym of the earlier Linnean one.

OLEACEAE

JASMINUM Tournefort

JASMINUM ANGUSTIFOLIUM (Linn.) Willd. Sp. Pl. 1 (1797) 36.

Nyctanthes angustifolia Linn. Sp. Pl. (1753) 6.

Nyctanthes triflora Burm. f. Fl. Ind. (1768) 4, *t. 2*. "Habitat in Java."

Burman's species, from his excellent figure, seems to be identical with *Jasminum angustifolium* (Linn.) Willd., a species of India and Ceylon. The indicated place of origin, Java, is probably erroneous.

JASMINUM PUBESCENS (Retz.) Willd. Sp. Pl. 1 (1797) 37.

Nyctanthes pubescens Retz. Obs. 5 (1789) 9.

Nyctanthes multiflora Burm. f. Fl. Ind. (1768) 5, *t. 3, f. 1*. "Habitat in China & Malabaria."

Burman's species is apparently referable to *Jasminum pubescens* Willd., a species of wide distribution in tropical Asia, and one frequently cultivated for ornamental purposes. Burman's specific name is apparently invalidated by *Jasminum multiflorum* Roth.

OLEACEAE OF DOUBTFUL STATUS

* **OLEA INDICA** Burm. f. Fl. Ind. (1768) 6. "Java."

This was based on Javan material, but the description is entirely inadequate, consisting only of the statement: "foliis lanceolatis subtus tomentosus * * * vix differt ab Europaea." The binomial does not appear in Index Kewensis.

GENTIANACEAE

ENICOSTEMA Blume

ENICOSTEMA VERTICILLATUM (Linn.) Engl. Pflanzenw. Ost-Afr. C (1895) 313; Engl. & Prantl Nat. Pflanzenfam. 4 ^{2} (1895) 67, *f. 31.*

Gentiana verticillata Linn. Syst. ed. 10 (1759) 952; Burm. f. Fl. Ind. (1768) 73. "Coromandeli."

Enicostema littorale Blume Bijdr. (1826) 848.

Burman's species is clearly the same as the Linnean one of the same name, and perhaps he did not intend to describe it as a new one. It is commonly known as *E. littorale* Blume.

APOCYNACEAE

CARISSA Linnaeus

CARISSA CARANDAS Linn. Mant. 1 (1767) 52.

Capparis carandas Burm. f. Fl. Ind. (1768) 118, 119.

Echites spinosa Burm. f. op. cit. 69.

Burman's *Capparis carandas* is clearly based on *Carandas* Rumph. Herb. Amb. 7: 57, *t. 25,* and is a synonym of *Carissa carandas* Linn. The same binomial appears twice in Burman's work, in both cases based on the same Rumphian synonym. *Echites spinosa* Burm. f. seems also to be clearly referable to *Carissa carandas* Linn.

TABERNAEMONTANA Linnaeus

TABERNAEMONTANA DIVARICATA (Linn.) R. Br. ex Roem. & Schultes Syst. 4 (1819) 427.

Nerium divaricatum Linn. Sp. Pl. (1753) 209.

Nerium coronarium Jacq. Coll. 1 (1786) 138.

Nyctanthes acuminata Burm. f. Fl. Ind. (1768) 5. "In Java, Malabara, Zeylona indigena, translata a Portugallis ex Manilhis in Amboinam."

Tabernaemontana coronaria Willd. Enum. Hort. Berol. (1809) 275.

This is clearly *Tabernaemontana divaricata* (Linn.) R. Br., a species now pantropic in cultivation and more commonly known as *T. coronaria* Willd. It occurs in Manila only as an introduced and rarely cultivated plant and is not a native of the Philippines.

STROPHANTHUS de Candolle

STROPHANTHUS CAUDATUS (Burm. f.) Kurz in Journ. As. Soc. Beng. 46 ^{2} (1877) 257.

Echites caudata Burm. f. Fl. Ind. (1768) 68, *t. 26.* "Habitat in Javae locis altioribus."

Strophanthus dichotomus DC. in Bull. Soc. Philom. 3 (1802) 123.

Burman's binomial typifies the species. It is more commonly known as *Strophanthus dichotomus* DC., and extends from Burma and Indo-China to Malaysia. *Nerium scandens* Lour. Fl. Cochinch. (1790) 116 = *Strophanthus scandens* R. & S. Syst. 4 (1819) 412 does not appear to be specifically distinct.

VALLARIS Burman f.

VALLARIS GLABRA (Linn.) O. Kuntze Rev. Gen. Pl. (1891) 417.

Pergularia glabra Linn. Mant. 1 (1767) 53.
Vallaris pergulanus Burm. f. Fl. Ind. (1768) 51. "Habitat in Java."
Emericia pergularia Roem. & Schultes Syst. 4 (1819) 401.

Burman's specific name should be retained for this well-known species. *Flos pergulanus* Rumph. Herb. Amb. **5**: 51, *t. 29, f. 2,* is a synonym. It is probable that both Burman's and Linnaeus's descriptions were based on material of similar origin.

APOCYNACEAE OF DOUBTFUL STATUS

* **APOCYNUM VINCAEFOLIUM** Burm. f. Fl. Ind. (1768) 71.

The references are to "*Asclepias javanica angustifolia* Garzin. herb." and to an illustration of an American plant in Plukenet Alm. 35, *t. 260, f. 14.* It is clear that the two are neither conspecific nor congeneric. The short description is based on the Javan plant, but there are no data by which its identity can be safely determined; it is clearly no *Apocynum.*

* **ECHITES NUMMULARIA** Burm. f. Fl. Ind. (1768) 69, *t. 28, f. 1.* "Habitat in India."

I do not recognize the species figured; it is, however, distinctly characteristic. The citations to pre-Linnean literature added by Burman probably all represent species different from the one figured and described by him. It probably represents some apocynaceous plant.

* **JASMINUM OBLONGUM** Burm. f. Fl. Ind. (1768) 6, *t. 3, f. 2.* "Habitat in Java."

This was described and figured from Javan material; it is manifestly no *Jasminum,* but probably represents some apocynaceous plant.

ASCLEPIADACEAE

TELOSMA Coville

TELOSMA CORDATA (Burm. f.) comb. nov.

Asclepias cordata Burm. f. Fl. Ind. (1768) 72, *t. 27, f. 2.* "Habitat in Java."
Cynanchum odoratissimum Lour. Fl. Cochinch. (1790) 166.
Pergularia odoratissima Sm. Ic. (1790–93) *t. 16.*
Telosma odoratissima Coville in Contr. U. S. Nat. Herb. 9 (1905) 384.

The data given by Burman and the distinctly good figure clearly indicate that his species is the same as *Pergularia odoratissima* Sm. It is to be noted that the Javanese name *malatti tonquin,* cited by Burman from Kleinhof, is still used in Java for this species, being given by Koorders as *malati tungking.* The species is a native of southeastern Asia and, as the native name indicates, is an introduced one in Java; it is in general cultivation in the Indo-Malayan region for its very fragrant flowers. I do not consider *Pergularia minor* Andr. to be other than a synonym of *P. cordata* (Burm. f.) Merr. The generic name *Pergularia* of Linnaeus is the proper one for the African species long placed in *Daemia. Prageluria* N. E. Br. (1907) is a synonym of *Telosma.*

TYLOPHORA R. Brown

TYLOPHORA INDICA (Burm. f.) comb. nov.

Cynanchum indicum Burm. f. Fl. Ind. (1768) 70. "Narin-talie. Javanis. D. Outgaerden e Coromandel."
Asclepias asthmatica Linn. f. Suppl. (1781) 171.
Tylophora asthmatica Wight & Arn. in Wight Contrib. (1834) 51.

This is clearly the species commonly known as *Tylophora asthmatica* (Linn. f.) W. & A., as Hooker f. Fl. Brit. Ind. 4 (1883) 45 cites "*Cynanchum indicum* Herb. Burm." as a synonym of *T. asthmatica* W. & A. Burman's specific name is the oldest valid one for the species and should be adopted.

ASCLEPIADACEAE OF UNCERTAIN STATUS

* PERIPLOCA DUBIA Burm. f. Fl. Ind. (1768) 70. "Habitat in Java & Malabara."

This has been reduced to *Cryptolepis buchanani* R. & S., but it is evident that two species are involved. The reference to *Katu pal-valli* Rheede Hort. Malabar. 9: 15, *t. 11,* belongs with the Indian *Cryptolepis buchanani* R. & S. The Javan reference "Paepe-sajor. Javanis. *D. Kleinhof*" apparently typifies Burman's species, but the description is altogether too short to warrant a reduction of it from the description alone.

CONVOLVULACEAE

PORANIA Burman f.

PORANIA VOLUBILIS Burm. f. Fl. Ind. (1768) 51, *t. 21, f. 1.* "Habitat in Java."

A well-known species of wide distribution in southeastern Asia and Malaysia; the type of the genus.

JACQUEMONTIA Choisy

JACQUEMONTIA PANICULATA (Burm. f.) Hallier f. in Engl. Bot. Jahrb. 18 (1894) 95.

Ipomoea paniculata Burm. f. Fl. Ind. (1768) 50, *t. 21, f. 3.* "Habitat in Java."
Convolvulus parviflorus Vahl Symb. 3 (1794) 29.

A well-known and widely distributed species, for which Burman's specific name should be retained.

MERREMIA Dennstaedt

MERREMIA EMARGINATA (Burm. f.) Hallier f. in Engl. Bot. Jahrb. 16 (1892) 552.

Evolvulus emarginatus Burm. f. Fl. Ind. (1768) 77, *t. 30, f. 1.* "Habitat in India."
Convolvulus reniformis Roxb. Fl. Ind. 2 (1824) 67.
Ipomoea reniformis Choisy Conv. Or. (1834) 64.

A well-known and widely distributed Indo-Malayan species, more commonly known as *Ipomoea reniformis* Choisy.

MERREMIA GEMELLA (Burm. f.) Hallier f. in Engl. Bot. Jahrb. 16 (1892) 552.

Convolvulus gemellus Burm. f. Fl. Ind. (1768) 46, *t. 21, f. 1.* "Habitat in Java."
Ipomoea gemella Roth Nov. Pl. Sp. (1821) 110.
Ipomoea chrysedeis Ker in Bot. Reg. *t. 270.*

Burman's binomial is the basis of the well-known and widely distributed *Merremia gemella* Hallier f.

MERREMIA HEDERACEA (Burm. f.) Hallier f. in Engl. Bot. Jahrb. 18 (1894) 168.

Evolvulus hederaceus Burm. f. Fl. Ind. (1768) 77, *t. 30, f. 2.* "Habitat in Java."
Ipomoea polyantha Miq. Fl. Ind. Bat. 2 (1857) 613.

A well-known and widely distributed Malayan species.

MERREMIA VITIFOLIA (Burm. f.) Hallier f. in Engl. Bot. Jahrb. 16 (1892) 552.

Convolvulus vitifolius Burm. f. Fl. Ind. (1768) 45, *t. 18, f. 1.*
Convolvulus angularis Burm. f. op. cit. 46, *t. 19, f. 2.*

Burman's material was from Java, *Merremia vitifolia* (Burm. f.) Hallier f. being a characteristic, well-known species. I can see no reason for distinguishing *Convolvulus angularis* Burm. f., for Burman describes its flowers as yellow, although including a reference to Pryon "flore purpureo." The reference to Pryon should probably be excluded.

IPOMOEA Linnaeus

IPOMOEA BATATAS (Linn.) Poir. in Lam. Encycl. 6 (1804) 14.
Convolvulus batatas Linn. Sp. Pl. (1753) 154.
Dioscorea cylindrica Burm. f. Fl. Ind. (1768) 215 (err. typ. 315).

Burman's species is typified by *Kappa-kelengu* Rheede Hort. Malabar. 7: *t. 50,* which clearly represents the common sweet potato. Hooker f., Fl. Brit. Ind. 6 (1892) 296, is in error in considering that Rheede's figure represents some cucurbitaceous plant. There is no evidence that Burman had any botanical material for examination in proposing the binomial *Dioscorea cylindrica.*

QUAMOCLIT Moench

QUAMOCLIT SAGITTAEFOLIA (Burm. f.) Choisy in DC. Prodr. 9 (1845) 335.
Ipomoea sagittaefolia Burm. f. Fl. Ind. (1768) 50, *t. 18, f. 2.* "Habitat in Java."
Ipomoea hastata Linn. Mant. 2 (1771) 204.
Ipomoea phaenicea Roxb. Fl. Ind. 2 (1824) 92.
Quamoclit phaenicea Choisy Conv. Or. (1834) 51.

This is clearly a yellow-flowered form of *Quamoclit phaenicea* (Spreng.) Choisy, which is, however, not clearly distinguishable from *Quamoclit coccinea* (Linn.) Moench.

ARGYREIA Loureiro

ARGYREIA MOLLIS (Burm. f.) Choisy Conv. Or. (1834) 38.
Convolvulus mollis Burm. f. Fl. Ind. (1768) 44, *t. 17.* "Habitat in Java."
Convolvulus sericeus Linn. Mant. 1 (1767) 43, non *Argyreia sericea* Dalz. & Gibs.

Burman's specific name is the proper one for this well-known Malayan species. It is suspected that both Burman's and Linnaeus's descriptions were based on material of similar origin.

ARGYREIA NERVOSA (Burm. f.) Bojer Hort. Maurit. (1837) 224.
Convolvulus nervosus Burm. f. Fl. Ind. (1768) 48, *t. 20, f. 1.* "Habitat Coromandeli."
Convolvulus speciosus Linn. f. Suppl. (1781) 137.
Argyreia speciosa Sweet Hort. Brit. (1827) 289.

Burman's specific name should be retained for this well-known species, which commonly appears in botanical literature as *Argyreia speciosa* Sweet.

HYDROPHYLLACEAE

HYDROLEA Vahl

HYDROLEA ZEYLANICA (Linn.) Vahl Symb. 2 (1791) 46.

Nama zeylanica Linn. Sp. Pl. (1753) 226.

Steris aquatica Burm. f. Fl. Ind. (1768) 73, *t. 39 f. 3.* "Habitat Coromandeli in locis aquosis."

This is clearly identical with *Hydrolea zeylanica* (Linn.) Vahl, a common and widely distributed species in the Indo-Malayan region. The figure is poor, but the description is ample.

BORAGINACEAE

TRICHODESMA R. Brown

TRICHODESMA ZEYLANICUM (Burm. f.) R. Br. Prodr. (1810) 496.

Borago zeylanica Burm. f. Fl. Ind. (1768) 41, *t. 14, f. 2.* "Habitat in Zeylona."

A common and well-known Indo-Malayan species. It was described by Linnaeus three years later under the same binomial, Mant. 2 (1771) 202.

VERBENACEAE

LIPPIA Houstoun

* LIPPIA JAVANICA (Burm. f.) Spreng. Syst. 2 (1825) 752.

Verbena javanica Burm. f. Fl. Ind. (1768) 12, *t. 6, f. 2.* "Habitat in Java."

Zapania javanica Lam. Ill. 1 (1791) 59.

This species is one of doubtful status. The figure is distinctly different from the common *Lippia nodiflora* (Linn.) Rich., which is figured on the same plate by Burman as *Verbena nodiflora* Linn. The only other species of the genus reported from Java is *Lippia asperifolia* Rich. to which Burman's description scarcely applies, although H. J. Lam in his recent treatment of the Verbenaceae of the Malay Archipelago states: "Probably this is the same as *L. asperifolia*." Should this prove to be the case, Burman's specific name will replace Richard's.

PREMNA Linnaeus

PREMNA INTEGRIFOLIA Linn. Mant. 2 (1771) 252.

Premna serratifolia Linn. op. cit. 253.

Cornutia corymbosa Burm. f. Fl. Ind. (1768) 132, *t. 41, f. 1,* non *Premma corymbosa* Rottl. & Willd. "Habitat in Zeylona."

The two forms characterized by Linnaeus do not appear to be distinct. *Premna integrifolia* Linn. is primarily based on

Cornutia corymbosa Burm. f. *Premna corymbosa* Rottl. & Willd. was based on Indian material with no reference to Burman's *Cornutia corymbosa*. H. J. Lam, in his recent treatment of the Verbenaceae of the Malay Archipelago, interprets the Linnean species as a polymorphous one, reducing to it, among many others, *Premna foetida* Reinw., as well as the common coastal form with entirely glabrous leaves. The range is given as from Madagascar to tropical Asia, Malaysia, and Polynesia.

GMELINA Linnaeus

GMELINA ASIATICA Linn. Sp. Pl. (1753) 626.

Gmelina coromandelica Burm. f. Fl. Ind. (1768) 132. "Habitat in India utraque."

The Coromandel form is doubtless identical with the Linnean species, but the reference to Sloane probably represents an entirely different plant; I have not seen Sloane's figure.

CLERODENDRON Linnaeus

CLERODENDRON CALAMATOSUM Linn. Mant. 1 (1767) 90.

Volkameria alternifolia Burm. f. Fl. Ind. (1768) 137, *t. 44*.

Both species were described from Javan material, Burman's clearly being synonymous with the one described by Linnaeus one year earlier. *Volkameria alternifolia* Burm. f. was reduced to *Clerodendron calamatosum* by Linnaeus, Mant. 2 (1771). Both descriptions were probably based on material of similar origin.

CLERODENDRON PHLOMOIDES Linn. f. Suppl. (1781) 292.

Volkameria multiflora Burm. f. Fl. Ind. (1768) 137, *t. 45, f. 1*, non *Clerodendron multiflorum* G. Don. "Habitat in Java."

Burman's species seems to be identical with that later described by the younger Linnaeus, but his specific name is invalid in *Clerodendron*.

SOLANACEAE

SOLANUM Linnaeus

SOLANUM SURATTENSE Burm. f. Fl. Ind. (1768) 57.

Solanum xanthocarpum Schrad. & Wendl. Sert. Hanov. 1: 8, *t. 2;* C. B. Clarke in Hook. f. Fl. Brit. Ind. 4 (1883) 236, cum syn.

The specimens on which Burman's description was based were from Surat, India, collected by Garcin. The species is unaccounted for in Clarke's treatment of the Solanaceae of British India, but the description clearly applies to *Solanum xanthocarpum* Schrad. & Wendl., which Burman's binomial displaces.

The pre-Linnean references to Dillenius, Plukenet, and Ray probably do not belong here; and from one of those Dunal, who placed Burman's species as a synonym of *Solanum virginianum* Linn., doubtless interpreted Burman's species.

LABIATAE

BALLOTA Linnaeus

BALLOTA PERSICA (Burm. f.) Benth. Lab. Gen. Sp. (1836) 598, DC. Prodr. 12 (1848) 520.

Molucella persica Burm. f. Fl. Ind. (1768) 128, *t. 38, f. 2.*

Bentham's amplified description is based on Burman's specimen in the Delessert herbarium.

ANISOMELES R. Brown

ANISOMELES INDICA (Linn.) O. Kuntze Rev. Gen. Pl. (1891) 512.

Nepeta indica Linn. Sp. Pl. (1753) 571.
Anisomeles ovata R. Br. in Ait. Hort. Kew. ed. 2, 2 (1811) 364.
Ballota disticha Linn. Mant. 1 (1767) 83.
Ballota disticha Burm. f. Fl. Ind. (1768) 126.
Marrubium indicum Burm. f. op. cit. 127.

Ballota disticha Burm. f. was from Java and Coromandel and was described one year earlier by Linnaeus under the same binomial; both descriptions were doubtless based on material of similar origin. *Marrubium indicum* Burm. f. was from Ceylon and Java; and from the excellent figure cited, Burm. Thes Zeyl. (1737) 153, *t. 71, f. 1,* it is, like *Ballota disticha,* clearly identical with the very common and widely distributed *Anisomelis indica* (Linn.) O. Kuntze.

POGOSTEMON Desfontaines

POGOSTEMON BENGHALENSE (Burm. f.) O. Kuntze Rev. Gen. Pl. (1891) 529.

Origanum benghalense Burm. f. Fl. Ind. (1768) 128, *t. 38, f. 3.* "Habitat in Benghalia."
Pogostemon plectranthoides Desf. in Ann. Mus. Paris 2 (1803) 155.

Bentham, in DC. Prodr. 12 (1848) 151, cites Burman's species with certainty as a synonym of Desfontaines's *Pogostemon plectranthoides,* adding that the figure is very poor. Burman's specific name should be retained.

DYSOPHYLLA Blume

DYSOPHYLLA AURICULARIA (Linn.) Blume Bijdr. (1826) 826.

Mentha auricularia Linn. Mant. 1 (1767) 81.
Mentha foetida Burm. f. Fl. Ind. (1768) 126. "Habitat in Java."

The form Burman described was characterized one year earlier by Linnaeus as *Mentha auricularia. Majana foetida* Rumph. Herb. Amb. 6: 41, *t. 16, f. 2,* is correctly placed as a synonym by both Linnaeus and Burman. Burman's species was reduced to *Mentha foetida* by Linnaeus Mant. 2 (1771).

ACROCEPHALUS Bentham

ACROCEPHALUS INDICUS (Burm. f.) O. Kuntze Rev. Gen. Pl. (1891) 511.

Prunella indica Burm. f. Fl. Ind. (1768) 130.
Ocimum capitatum Linn. f. Suppl. (1781) 276.
Acrocephalus capitatus Benth. in Wall. Pl. As. Rar. 2 (1831) 18.

Burman's species was based on a Javan specimen, "*Brunella javanica* D. Kleinhof." It is commonly known as *Acrocephalus capitatus* Benth., but Burman's specific name should be retained.

GENIOSPORUM Wallich

GENIOSPORUM TENUIFLORUM (Linn.) comb. nov.

Ocimum tenuiflorum Linn. Sp. Pl. (1753) 597.
Geniosporum prostratum Benth. in Bot. Reg. sub. *t. 1300,* et in Wall. Pl. As. Rar. 2 (1831) 18.
Thymus indicus Burm. f. Fl. Ind. (1768) 129. "Habitat Coromandeli."

This species is currently known as *Geniosporum prostratum* Benth., but it would seem that the Linnean specific name should be adopted for it.

OCIMUM Linnaeus

OCIMUM SANCTUM Linn. Mant. 1 (1767) 85.

Ocymum inodorum Burm. f. Fl. Ind. (1768) 130. "Habitat in India."

Burman's species is apparently a synonym of *Ocimum sanctum* Linn., where it is definitely placed by Bentham. The figure in Burman Thesaurus Zeylanicus (1737) 175, *t. 80, f. 2,* is good for the Linnean species, and from this citation the younger Burman took his specific name; the Javan *Sulassi puti-utan,* judging from this native name, might be *Ocimum basilicum* Linn.

LABIATAE OF DOUBTFUL STATUS

* SCUTELLARIA ? JAPONICA Burm. f. Fl. Ind. (1768) 130. "Habitat in Japonia, Java."

Two species are involved, but the form actually described by Burman was the Javan plant. It has been reduced by Bentham in part to *Plectranthus coetsa* D. Don, which is not known from either Java or Japan; and in part to *Melissa parviflora* Benth., likewise definitely known from neither Japan nor Java, although Bentham actually examined the species in Burman's herbarium. A critical examination of the type material is desirable.

SCROPHULARIACEAE

SCHWEINFURTHIA A. Braun

SCHWEINFURTHIA PAPILIONACEA (Linn.) Boiss. Fl. Orient. 4: 387.

Antirrhinum papilionaceum Linn. Mant. 1 (1767) 86.
Antirrhinum papilionaceum Burm. f. Fl. Ind. (1768) 131, *t. 39, f. 2.* "Habitat in Persia."
Schweinfurthia sphaerocarpa A. Braun in Sitzb. Ges. Naturf. Fr. 20 (1866) 24.

Both Burman's and Linnaeus's binomials were probably based on material from the same collection, the latter's publication having priority by one year.

ARTANEMA D. Don

ARTANEMA LONGIFOLIA (Linn.) comb. nov.

Columnea longifolia Linn. Mant. 1 (1767) 90.
Sesamum javanicum Burm. f. Fl. Ind. (1768) 133. "Habitat in India."
Archimenes sesamoides Vahl Symb. 2 (1791) 71.
Artanema sesamoides Benth. Scroph. Ind. (1835) 39.
Artanema longiflora Wettst. in Engl. & Prantl Nat. Pflanzenfam. 4^{3b} (1891) 79.

The Linnean name is one year earlier than Burman's, and both are much earlier than that proposed by Vahl on which Bentham's binomial is based. It is suspected that both *Columnea longifolia* and *Sesamum javanicum* were based on material of similar origin.

LINDERNIA Allioni

(*Vandellia* Linnaeus)

LINDERNIA CRUSTACEA (Linn.) F. Muell. Census (1882) 97.

Capraria crustacea Linn. Mant. 1 (1767) 87.
Capraria crustacea Burm. f. Fl. Ind. (1768) 133.
Capraria uniflora Burm. f. l. c. *t. 14* (err. typ. *19*), *f. 3.*
Vandellia crustacea Benth. Scroph. Ind. (1835) 35.

Capraria crustacea Burm. f. is identical with the species described one year earlier by Linnaeus under the same binomial; both descriptions were doubtless based on material of similar origin. For *Capraria uniflora* Burman cites no locality; but, judging from the figure, it is synonymous with *Capraria crustacea* Linn. = *Lindernia crustacea* (Linn.) F. Muell.

ILYSANTHES Rafinesque

(*Bonnaya* Reichenbach)

ILYSANTHES ANTIPODA (Linn.) Merr. Interpret. Herb. Amb. (1917) 467.
Ruellia antipoda Linn. Sp. Pl. (1753) 635.
Ruellia anagallis Burm. f. Fl. Ind. (1768) 135. "Habitat in Java and Amboina."
Gratiola veronicaefolia Retz. Obs. 4 (1786) 8.
Bonnaya veronicaefolia Spreng. Syst. 1 (1825) 41.

Burman's species is clearly identical with the very common and widely distributed form currently known as *Bonnaya veronicaefolia* Spreng. *Crusta ollae major* Rumph. Herb. Amb. 5: 460, *t. 170, f. 2,* cited by Burman as representing his species, is correctly placed as a synonym.

BIGNONIACEAE

CRESCENTIA Linnaeus

* **CRESCENTIA OVATA** Burm. f. Fl. Ind. (1768) 132. "Habitat in Java."
Crescentia cucurbitina Linn. Mant. 2 (1771) 250.

If the current reduction of Burman's species be correct it will involve the acceptance of his specific name. However, the only species of the genus reported from Java is *Crescentia cujete* Linn., and Burman's description is so short and imperfect that it is impossible to determine from it alone to which of the Linnean species it applies. All the species of the genus are natives of tropical America.

ACANTHACEAE

DYSCHORISTE Nees

DYSCHORISTE MADURENSIS (Burm. f.) O. Kuntze Rev. Gen. Pl. (1891) 486.
Justicia madurensis Burm. f. Fl. Ind. (1768) 9, *t. 4, f. 3.* "Habitat in Madura."
Ruellia littoralis Linn. f. Suppl. (1781) 289.
Calophanes littoralis T. Anders. in Thw. Enum. Pl. Zeyl. (1859–64) 225.

This is the basis of *Dyschoriste madurensis* (Burm. f.) O. Kuntze, of which *Calophanes littoralis* T. Anders. (*Ruellia littoralis* Linn. f.) is a synonym.

DYSCHORISTE ERECTA (Burm. f.) O. Kuntze Rev. Gen. Pl. (1891) 485.
Ruellia erecta Burm. f. Fl. Ind. (1768) 135, *t. 41, f. 3.* "Habitat in India."
Calophanes nagchana Nees in DC. Prodr. 11 (1847) 109.

This is the basis of *Dyschoriste erecta* (Burm. f.) O. Kuntze, of which *Calophanes nagchana* Nees is apparently a synonym.

HEMIGRAPHIS Nees

HEMIGRAPHIS ALTERNATA (Burm. f.) T. Anders. in Journ. Linn. Soc. Bot. 7 (1864) 114.

Ruellia alternata Burm. f. Fl. Ind. (1768) 135. "Habitat in Java."
Ruellia blumeana Nees in DC. Prodr. 11 (1847) 149.
Ruellia repanda Blume Bijdr. (1825) 794, non Linn.
Hemigraphis blumeana Boerl. Handl. Fl. Nederl. Ind. 2 [2] (1899) 658.

The reference to *Prunella silvestris alba* Rumph. Herb. Amb. 6: 31, *t. 13, f. 2,* should be excluded, as it represents *Hemigraphis reptans* K. Schum. var. *glaucescens* Hallier f. The reference to Rheede Hort. Malabar. 9: 115, *t. 59,* should also be excluded.

RUELLIA Plumier

RUELLIA REPENS Linn. Mant. 1 (1767) 89.

Ruellia repens Burm. f. Fl. Ind. (1768) 135, *t. 41, f. 2* (err. typ. *f. 1*). "Habitat in Java."

I consider that Burman's figure represents *Ruellia repens* as described one year earlier by Linnaeus, although C. B. Clarke, Journ. As. Soc. Beng. 74 [2] (1907) 649, considered that it represents a plant not of the genus *Ruellia*. The probability is very great that both descriptions were based on material of similar origin.

BLEPHARIS Jussieu

BLEPHARIS PERSICA (Burm. f.) O. Kuntze Rev. Gen. Pl. (1891) 483.

Ruellia persica Burm. f. Fl. Ind. (1768) 135. "Habitat in Persia."
Acanthus edulis Forsk. Fl. Aeg.-Arab. (1775) 115.
Blepharis edulis Pers. Syn. 2 (1807) 180.

Burman's specific name, being much older than Forskål's, should be retained for this species.

BLEPHARIS MADERASPATENSIS (Linn.) Heyne ex Roth Nov. Pl. Sp. (1821) 320.

Acanthus maderaspatensis Linn. Sp. Pl. (1753) 639.
Acanthus ciliaris Burm. f. Fl. Ind. (1768) 139, *t. 42, f. 3.* "Habitat in Zeylona."
Blepharis boerhaaviaefolia Pers. Syn. 2 (1807) 180.

Burman's species is clearly identical with the Linnean one.

ANDROGRAPHIS Wallich

ANDROGRAPHIS PANICULATA (Burm. f.) Nees in Wall. Pl. As. Rar. 3 (1832) 116.

Justicia paniculata Burm. f. Fl. Ind. (1768) 9. "Habitat in Malabaria & Zeylonia."

This is the basis of the well-known *Andrographis paniculata* (Burm. f.) Nees.

PERISTROPHE Nees

PERISTROPHE HYSSOPIFOLIA (Burm. f.) comb. nov.

Dianthera hyssopifolia Burm. f. Fl. Ind. (1768) 11, *t. 5, f. 2.* "Habitat in Java."
Justicia salicifolia Blume ex Steud. Nomencl. ed. 2 1 (1841) 839.
Peristrophe salicifolia Hassk. Cat. Hort. Bogor. (1844) 152.

The description and excellent figure clearly indicate that Burman's species is the same as the one later described by Blume. *Peristrophe acuminata* Nees, *P. blumeana* Nees, and *Justicia roxburghiana* Blume are probably synonyms of the same species.

CLINACANTHUS Nees

CLINACANTHUS NUTANS (Burm. f.) Lindau in Engl. Bot. Jahrb. 18 (1894) 63.

Justicia nutans Burm. f. Fl. Ind. (1768) 10, *t. 5, f. 1.* "Habitat in Java."
Clinacanthus burmanni Nees in DC. Prodr. 11 (1847) 511.
Justicia fulgida Blume Bijdr. (1825) 784.

A well-known species extending from Siam to Hainan, the Malay Peninsula, Borneo, and Java.

JUSTICIA Houstoun

JUSTICIA GENDARUSSA Burm. f. Fl. Ind. (1768) 10; Linn. f. Suppl. (1781) 85. "Crescit in Malabara, Amboina & Java."

A common and well-known species of wide distribution in the Indo-Malayan region.

* **JUSTICIA MORETIANA** Burm. f. Fl. Ind. (1768) 10. "Crescit in variis locis Indiae arenosis."

This is typified by *Adhatoda flore solitario,* etc., Burm. Thes. Zeyl. (1737) *t. 3, f. 1,* and is clearly a *Justicia.* Trimen, Fl. Ceyl. 3 (1895) 335, states that the figure, although good, does not agree with any known Ceylon species. The synonym "*Moretiana* Rumph. 6, p. 53, t. 23," must be excluded, as it represents *Ruellia repens* Linn.

RUBIACEAE

OLDENLANDIA Linnaeus

OLDENLANDIA CORYMBOSA Linn. Sp. Pl. (1753) 119.

Oldenlandia tenuifolia Burm. f. Fl. Ind. (1768) 37, *t. 14, f. 1.* "Habitat in Java."

This appears to be a form of *Oldenlandia corymbosa* Linn., with the inflorescences reduced to a single long-pedicelled flower, or it is possibly a reduced form of *Oldenlandia herbacea* (Linn.) Roxb. (*O. heynii* G. Don).

DENTELLA Forster

DENTELLA REPENS (Linn.) Forst. Char. Gen. (1776) 26, *t. 13*.

Oldenlandia repens Mant. 1 (1767) 40.

Oldenlandia repens Burm. f. Fl. Ind. (1768) 38, *t. 15, f. 2*. "Amat loca paludosa Coromandeli."

It is not certain that Burman's species is identical with the Linnean one, although there is nothing in the description or in the rather indefinite figure contrary to this interpretation of it.

BORRERIA G. F. Meyen

BORRERIA OCYMOIDES (Burm. f.) DC. Prodr. 4 (1830) 544.

Spermacoce ocymoides Burm. f. Fl. Ind. (1768) 34, *t. 13, f. 1*. "Sajor Babi Javanis." [That is, the type from Java, with the Javanese name *sajor babi*.]

The range of this species outside of Java is more or less confused by species of other authors that have apparently been erroneously reduced to it. It is, however, apparently of wide distribution in the Malayan region.

PAEDERIA Linnaeus

PAEDERIA FOETIDA Linn. Mant. 1 (1767) 52.

Apocynum foetidum Burm. f. Fl. Ind. (1768) 71. "Habitat in India."

While *Paederia tomentosa* Blume is generally recognized as a distinct species, there seem to be no constant characters by which it can be distinguished from the Linnean one.

CUCURBITACEAE

BLASTANIA Kotschy and Peyr.

BLASTANIA GARCINI (Burm. f.) Cogn. in DC. Monog. Phan. 3 (1881) 629.

Sicyos garcini Burm. f. Fl. Ind. (1768) 211 (err. typ. 311). "Habitat in Zeylona."

Sicyos garcini Linn. Mant. 2 (1771) 297.

Ctenolopis garcini C. B. Clarke in Hook. f. Fl. Brit. Ind. 2 (1879) 629.

A well-known species of southern India and Ceylon.

CAMPANULACEAE

LOBELIA Plumier

* LOBELIA PUMILA Burm. f. Fl. Ind. (1768) 186, *t. 60, f. 3*.

I suspect that this is a true *Lobelia* in spite of the leaves being described and figured as opposite; it is perhaps near *Lobelia zeylanica* Linn. The type was from Coromandel.

COMPOSITAE

VERNONIA Schreber

VERNONIA CINEREA (Linn.) Less. in Linnaea 4 (1829) 291.

Conyza cinerea Linn. Sp. Pl. (1753) 862.

Conyza ivaefolia Burm. f. Fl. Ind. (1768) 180, *t. 58, f. 4.* "Habitat in Java."

While the figure is not particularly good for *Vernonia cinerea* Less., I cannot suggest any other reduction of Burman's species. The description consists merely of the statement: "foliis alternis lanceolatis repando-dentatis."

EUPATORIUM Tournefort

* EUPATORIUM sp.

Erigeron pisonis Burm. f. Fl. Ind. (1768) 180, *t. 59, f. 2.* "Brasilia."

This was based on a Brazilian specimen collected by Piso, and is apparently a *Eupatorium.* Dr. B. L. Robinson, of the Gray Herbarium, who has an extensive knowledge of the tropical American Compositae, informs me that he does not recognize the species, but that the habit, foliage, and to some extent the inflorescence recall *Eupatorium ballotaefolium* HBK. and *Conyza anomala* DC., although Burman's positive statement "Caul. * * * glaberrimus" does not fit either of these species, since both always have a perceptible pubescence on the stems.

MIKANIA Willdenow

MIKANIA SCANDENS (Linn.) Willd. Sp. Pl. 3 (1804) 1743.

Eupatorium scandens Linn. Sp. Pl. (1753) 836.

Eupatorium cordatum Burm. f. Fl. Ind. (1768) 176, *t. 58, f. 2.* "Habitat in Java & Vera Cruce."

Burman's species is clearly referable to the common pantropic *Mikania scandens* (Linn.) Willd.

BLUMEA de Candolle

BLUMEA LACERA (Burm. f.) DC. Prodr. 5 (1836) 436.

Conyza lacera Burm. f. Fl. Ind. (1768) 180, *t. 59, f. 1.*

This was based on a Javan specimen and is supposedly the basis of *Blumea lacera* (Burm. f.) DC., Burman's species being indicated by de Candolle as var. *burmanni* DC.

EPALTES Cassini

EPALTES DIVARICATA (Linn.) Cass. in Bull. Soc. Philom. (1818) 139.

Ethulia divaricata Linn. Mant. 1 (1767) 110.

Ethulia divaricata Burm. f. Fl. Ind. (1768) 176. "Coromandeli."

Both descriptions were doubtless based on material of similar origin.

SPHAERANTHUS Vaillant

SPHAERANTHUS AMARANTHOIDES Burm. f. Fl. Ind. (1768) 186.

The type was a specimen from Coromandel. The species is a well-known one of India and Ceylon.

ANVILLEA de Candolle

ANVILLEA GARCINI (Burm. f.) DC. Prodr. 5 (1836) 487.

Anthemis garcini Burm. f. Fl. Ind. (1768) 183, *t. 60, f. 1* (as *Buthalmum garcini* Burm. f.).

This is the basis of *Anvillea garcini* (Burm. f.) DC. and is the type of the genus. It was based on a specimen from Persia, collected by Garcin.

GYNURA Cassini

GYNURA BIFLORA (Burm. f.) comb. nov.

Senecio biflorus Burm. f. Fl. Ind. (1768) 181. "Habitat in Java."

From the Javanese name cited, *blontas China*, it is suspected that this was a cultivated plant in Java, of Chinese origin. The description is definite and applies unmistakably to the species currently known as *Gynura pseudo-china* DC.

SENECIO Tournefort

SENECIO TENUIFOLIUS Burm. f. Fl. Ind. (1768) 181, *t. 60, f. 4*. "Habitat in Java."

This is a sufficiently well-known species of India and Java, of which *Senecio multifidus* Willd. is a synonym.

* SENECIO CORONOPIFOLIUS Burm. f. Fl. Ind. (1768) 181, *t. 60, f. 5*. "Habitat in Java."

Senecio javanicus Willd. Sp. Pl. 3 (1800) 1984.

Senecio javanicus Willd. is merely a new name for Burman's species. It is a species of doubtful status and is probably no *Senecio*.

LIGULARIA Cassini

LIGULARIA TUSSILAGINEA (Burm. f.) Makino in Bot. Mag. Tokyo 18 (1904) 52.

Arnica tussilaginea Burm. f. Fl. Ind. (1768) 182.
Tussilago japonica Linn. Mant. 1 (1767) 113, non *Ligularia japonica* (Thunb.) Less.
Senecio kaempferi DC. Prodr. 6 (1837) 363.
Ligularia kaempferi Sieb. & Zucc. Fl. Jap. 1 (1835) 77, *t. 35*.
Senecio tussilaginea O. Kuntze Rev. Gen. Pl. (1891) 364.
Farfugium kaempferi Benth. Fl. Hongk. (1861) 191.

Burman's species was based on Japanese material, possibly on the same collection that yielded the type of *Tussilago japonica* Linn. The latter typifies *Senecio kaempferi* DC. Burman's specific name should be retained for the species.

EMILIA Cassini

EMILIA JAVANICA (Burm. f.) C. B. Rob. in Philip. Journ. Sci. 3 (1908) Bot. 217.

Hieracium javanicum Burm. f. Fl. Ind. (1768) 174, *t. 57, f. 1.* "Java."
Prenanthes javanica Willd. Sp. Pl. 3 (1800) 1534.
Sonchus javanicus Spreng. Syst. 3 (1826) 648.
Emilia flammea Cass. in Dict. Sci. Nat. 14 (1819) 406, *t. 5.*

Burman's specific name should be retained for this species, which is allied to, but distinct from, *Emilia sonchifolia* DC.

SONCHUS Linnaeus

* SONCHUS sp.

? Senecio auriculatus Burm. f. Fl. Ind. (1768) 181. "Habitat in Java."

This is perhaps a species of *Sonchus*, possibly *S. oleraceus* Linn. or *S. arvensis* Linn.; but the description is too short to warrant a more definite reduction from it alone.

COMPOSITAE OF DOUBTFUL STATUS

* LAPSANA JAPONICA Burm. f. Fl. Ind. (1768) 174. "Habitat in Japonia."

This is clearly no representative of the genus *Lapsana*. The type was from Japan, and Dr. B. Hayata informs me that neither he nor any of the other Japanese botanists at Tokyo recognizes the species from the description.

* ERIGERON DENTICULATUM Burm. f. Fl. Ind. (1768) 180.

The type of this genus was a Javan specimen. From the very short description it is suspected that it is a synonym of *Pluchea indica* (Linn.) Less., but the correctness of this suggested reduction can scarcely be determined from the description alone.

* ERIGERON INDICUM Burm. f. Fl. Ind. (1768) 180. "Habitat in Java."

This is probably not an *Erigeron*, but Burman's description is altogether too short to warrant a definite reduction of it from the description alone.

SPECIES OF WHOLLY DOUBTFUL STATUS

* ACER PLATANUS Burm. f. Fl. Ind. (1768) 221. "Habitat in India."

Pax, in Engl. Pflanzenreich 8 (1902) 76, states regarding this species "Vix Aceris species." There is nothing in the description by which its identity can be determined, as Burman briefly describes only the leaves.

* **ACER JAVANICUS** Burm. f. Fl. Ind. (1768) 221. "Habitat in Java."

Pax makes the same comment for this species as for the preceding one. There is nothing in the description by which its identity can be even surmised. The leaves only are described.

* **LUDWIGIA (LUDWIGHIA) TRIFOLIA** Burm. f. Fl. Ind. (1768) 37. "Doedoek Javanis." [That is, type from Java, with the Javanese name *doedoek*.]

The Javanese name *doedoek* properly belongs with *Lumnitzera littorea* (Jack) Voigt, but Burman's description scarcely applies to this. I do not recognize the species or the group to which it belongs from the short and imperfect description.

* **MYRICA ASPLENIFOLIA** Burm. f. Fl. Ind. (1768) 211 (err. typ. 311). "Habitat in Indiis."

This was doubtless intended to represent the Linnean species of the same name, published in 1753, as Burman gives the same reference to Plukenet as does Linnaeus. The Linnean species is *Comptonia peregrina* (Linn.) Coulter, of North America. It would seem that at least the locality cited is an error on the part of Burman.

* **RHAMNUS VITIS IDAEA** Burm. f. Fl. Ind. (1768) 61. "Habitat in Zeylona & Java."

The reduction of this to *Breynia rhamnoides* Muell.-Arg. is not entirely satisfactory, as the descriptive sentence and most of the pre-Linnean references call for spiny branches. The figure cited by Burman f., Burman Thes. Zeyl. (1737) 198, *t. 88*, is, however, an excellent representation of *Breynia rhamnoides* (Willd.) Muell.-Arg. It is suspected that the several references refer to several different species. The actual type is apparently the Javan specimen for which the local name *boa massi* is given.

CONTENTS

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.

VOL. 19, No. 4 OCTOBER, 1921

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1921

181287

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science of the Government of the Philippine Islands

---

Manuscript intended for publication and books for review should be sent to the editor. One hundred separates of papers published in the Journal are furnished to authors without charge. Additional copies may be had at authors' expense.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

The Journal is issued twelve times a year. The subscription price is 5 dollars, United States currency, per year. Single numbers, 50 cents each.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 19 OCTOBER, 1921 No. 4

THE KAO PAN SEEDLESS SIAMESE PUMMELO AND ITS CULTURE

By O. A. REINKING [1] and G. W. GROFF [2]

SIXTEEN PLATES AND ONE TEXT FIGURE

Siam has long been noted for its production of delicious pummelos. These fruits find their way to many of the larger port cities of Asia, where they can often be purchased in open markets under the name of Bangkok or Siam pummelos. Many varieties are produced both for home consumption and for export. Residents of Bangkok and other parts of Siam refer to the so-called seedless Nakorn Chaisri or Kao Pan pummelo as the best.

Of late years the Kao Pan seedless pummelo, from Nakorn Chaisri, has created a good deal of interest in the United States, due primarily to the investigations and enthusiasm of Mr. Walter T. Swingle, of the Division of Crop Physiology and Breeding Investigations of the Bureau of Plant Industry, Washington, D. C. During the past eight years attempts have been made to introduce this form and other Siamese pummelos into the United States and the Philippines. Until the present investigation, however, no successful introduction of the true seedless form seems to have been made or, if made, the trees upon

[1] Professor of plant pathology and plant pathologist of the College of Agriculture and Agricultural Experiment Station, Los Baños, Laguna, Philippine Islands; and collaborator, Crop Physiology and Breeding Investigations, United States Department of Agriculture, Washington, D. C.

[2] Professor of horticulture and director of agricultural work, Canton Christian College, Canton, China, and field assistant, Crop Physiology and Breeding Investigations, United States Department of Agriculture, Washington, D. C.

coming into bearing under the new conditions of growth have produced a fruit poor in quality and abundant in seeds.

The present studies show that the "Siam seedless pummelo" reported in 1913 [3] as having been successfully introduced into the Philippines, and later in 1917 [4] as having produced fruits, was not the true seedless variety. The fruit described and illustrated in 1917 is of the best commercial type of Siamese pummelo, the Kao Phuang. It frequently happens that the Kao Phuang and other varieties produce a few fruits without seeds, but there is only one type that is generally recognized as being the seedless one. A direct result of the investigations has been our successful introduction of bud wood of the true Nakorn Chaisri seedless pummelo, into both the Philippine Islands and the United States. A small tree of the variety also was taken to the Philippines.

The investigations were made during the months of June and July, 1920, through the coöperation of the Division of Crop Physiology and Breeding Investigations of the Bureau of Plant Industry, Washington, D. C., with the College of Agriculture of the University of the Philippines, Los Baños, Philippine Islands, and the Canton Christian College, Canton, China. The primary objects of the investigations were: To obtain a first-class series of Siamese pummelos; to make a complete study of the real seedless pummelo; to determine the cultural methods by which the proprietors of the Siamese seedless pummelo orchards produce seedless fruits; to obtain varieties resistant to canker; to make a study of the plant diseases and insects attacking the trees; and to look into the salting and cultural practices in relation to quality and seedlessness.

The low-lying region of Nakorn Chaisri is well situated for the production of citrus fruits, and the inhabitants of this and other regions have a large number of recognized varieties. Their pummelos can readily be classified into two main types; the round and the elongated. The most characteristic and best fruit of the first class is the so-called seedless or Kao Pan. This is the fruit usually referred to when residents of Siam speak of the delicious Nakorn Chaisri pummelo. The second class is represented by the Kao Phuang, a pear-shaped, elongated fruit produced in the Dao Kanong region. The latter is not so

[3] Wester, P. J., Citriculture in the Philippines, Bull. Philip. Bur. Agri. 27 (1913) 1–71.

[4] Wester, P. J., New or noteworthy tropical fruits in the Philippines, Philip. Agri. Rev. 10 (1917) 21–22.

highly appreciated in Siam and is grown chiefly for export. The Kao Pan pummelo of Nakorn Chaisri is the more delicious of the two and is the favorite within Siam. While a study and collection of almost all of the important varieties of pummelos were made, we have confined the present paper to the true Siamese seedless pummelo, the Nakorn Chaisri or Kao Pan, grown in Ban Mai, Sarm Prarm, Nakorn Chaisri. Ban Mai is the only locality noted for its production of seedless pummelos and for the excellent flavor of the fruits.

The studies were made primarily on the plantation of Nang Nui and her husband, Nai Ha, and were greatly facilitated by the interest shown in the work by the Department of Agriculture, Ministry of Lands and Agriculture of Siam. We are indebted to Mr. W. A. Graham, adviser to the Ministry; to Phya Manopakor, secretary to the Minister of Agriculture; to Phra Kasetra Raksha, director of Agriculture; and to Luang Bhojakara, of the experiment station. The latter accompanied us on our investigational trips in the fruit sections and was most cordial and helpful as interpreter and general informant. The Governor of Tachin, Phya Sakoen Kanabhirako, also assisted by obtaining permission to make the studies on the plantations and sending a guide in order that no difficulty would be encountered in locating the best orchards. Besides these government officials, Dr. Yia S. Sanitwongse, an enthusiastic land owner and planter, aided by giving valuable information in regard to the location, history, and the general characters of the fruit. Without his help the study could not have been accomplished in such a short period of time.

HISTORY AND DEVELOPMENT

In Nakorn Chaisri the growers clearly recognize the Kao Pan as a distinct variety. They can describe the chief characteristics of both fruit and tree. Their claim, well substantiated throughout the country, is that, when grown under conditions other than those found in Nakorn Chaisri, the fruit soon loses its delicious qualities. The variety is widely known throughout the region, though a few growers along Tachin River are especially famous for their production of the Kao Pan pummelo.

The people of this part of Siam have been greatly influenced by the Chinese. Chinese from southern China have settled in the country for generations, bringing with them conspicuous features of the old Chinese civilization and thereby greatly influencing the life and customs of the people, as is shown in their manner of life, the Chinese inscriptions above their door-posts, and the type of citrus culture practiced by them. That there has been some interchange of citrus fruits between the two countries during past centuries is clearly evident, though this renowned Kao Pan pummelo is unquestionably of Nakorn Chaisri origin. The Chinese, through their advanced knowledge of cultural methods, have doubtless helped to develop and establish the strains that are to-day attracting the attention of the world.

As is often the custom in Siam, much of the business, especially in country districts, is managed by the women. One of these woman orchardists stated that this particular fruit had been known in Nakorn Chaisri for only two or three generations. Her mother had claimed that not more than one hundred years ago only a few trees grew on their side of Tachin River. This woman's family had grown the fruit for about fifty years and, about twenty years ago, had cleared the nipa swamp where their present grove is located.

As a distinct variety, the Kao Pan may therefore be of comparatively recent times. Other varieties grown in different districts, especially one known as the Koon Non, approximate the Kao Pan in general characteristics, but are not so seedless or of so fine a quality and flavor as is this delicious variety developed under the ideal conditions for citrus culture found in Nakorn Chaisri.

LOCATION AND GENERAL PHYSICAL ASPECTS OF THE COUNTRY

The Kao Pan pummelo is grown and produced in its best seedless and most excellently flavored form only in Ban Mai, Sarm Prarm, Nakorn Chaisri. The Ban Mai section is reported to have the best orchards in Nakorn Chaisri, and it is also stated that the plantations are most noted, being the ones to which the king and the queen mother send for their choice fruits.

The section is on Tachin River, 30 to 40 kilometers from the mouth, as is shown in fig. 1. It is located southwest of Bangkok and can be reached by traveling on a train from Bangkok to the town of Tachin, a distance of between 40 and 50 kilometers, and then by launch up the river for about 30 kilometers. The region can also be reached by boat, passing through the Pasi Cherern Canal from Bangkok to Tachin River and then up the river for about 12 kilometers.

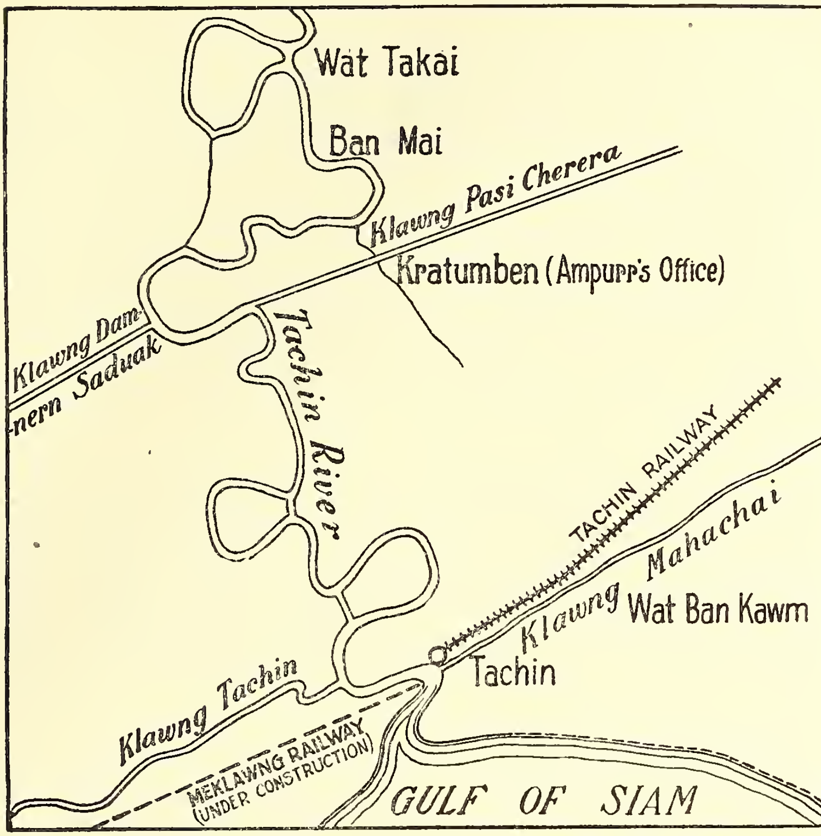


Fig. 1. Location of the pummelo orchards at Ban Mai on Tachin River; scale about 1 to 530,000.

Some of the plantations are situated on the banks of the river, the trees being planted about 7 to 10 meters from the river bank and separated from the river by a dike. During June at high tide the water rises to within 30 centimeters of the top of the dike; at low tide it sinks to about 2 or 2.5 meters below the top of the dike. Water for irrigation is taken directly from the river in such cases. Other plantings may be situated farther from the river, those studied being some 100 to 150 meters removed.

Tachin River was at one time a branch of the Menam Chao Phaya, but in recent years the source of the river has been almost entirely cut off from the main river. The severance of the connection, because of lack of a large supply of fresh water from its source, had a great influence upon the salty nature of the Tachin. According to Graham,[5]

From Paknampoh to the sea, 140 miles as the crow flies, the waters of the Menam Chao Phaya follow a number of tortuous courses. At Chainat, about 35 miles below Paknampoh, it throws off on the west side a branch known as the Suphan or Tachin river, which flows parallel with the parent stream to the sea.

The Nakorn Chaisri district is in the southern part of the central division of Siam. This division is characterized by being a vast plain of about 14,245,000 hectares (55,000 square miles), stretching from the mountainous border of Burma and extending eastward to the high ridges marking the boundary of Cambodia. The plain extends southward to the Gulf of Siam. According to Graham,[6]

The plain lies at a very slight elevation above the sea and is subject to regular annual river floods which, by the deposition of vast quantities of silt, are slowly raising the general level. The whole area has a gentle slope downwards from north to south and the land falls slightly away at right angles to the banks of the rivers which flow on slight ridges of their own alluvial accumulation. There is abundant evidence that within recent geological times the sea flowed over a great part of the plain and even now the northern shores of the gulf are advancing seawards at the surprising rate of almost a foot a year.

The Nakorn Chaisri section is in the delta region of the Menam Chao Phaya. In this region, according to Graham,

The waters usually begin to rise in May and continue to do so until about the end of October, when the river is in full flood. Subsidence is gradual and the lowest level is reached about April. Sudden freshets and high rises are unknown in the Menam Chao Phaya.

The river is subject to a strong tidal influence for a distance of 80 kilometers inland. The action of the tide is greatly influenced by the flood time, depending upon the rainy and dry seasons of the year. During dry weather the tidal flow extends far inland and in the lower parts of the river the water is brackish.

CLIMATE

TEMPERATURE

Graham gives the climate of Siam to be as follows:[7]

[5] Graham, W. A., Siam. A Handbook of Practical Commercial and Political Information. London (1912) 16.

[6] Op. cit. 8.

[7] Op. cit. 31–32.

The temperature of Siam, though the country lies entirely within the northern tropic, is considerably effected by peculiar local conditions and therefore varies very perceptibly in different localities. On the plains of Central Siam, between the months of February or March and October, the sea wind blows from the south or southwest almost continuously, mitigating the heat of the days and rendering the nights comparatively cool. During this period, which comprises the hot and the rainy seasons, the temperature rarely raises above 98° fahr. or falls below 79° fahr. From the end of October to February, the so-called cold season, the wind blows from the northeast when the maximum temperature may reach 92° fahr. and the minimum fall as low as 54° fahr. Formerly the climate of Bangkok city was very similar to that of the surrounding plains but during the past few years a change has become noticeable. Sir John Bowring in his book on Siam, gives statistics of the temperature of Bangkok over the period 1840 to 1847, during which the maximum temperature registered was 97° fahr. and the minimum 54° fahr. Observations of a much later date give results very similar to the above but the statistics of the last ten years or so show an almost continual increase in the average daily range and at the present time, while the minimum temperature remains much as it used to be, the maximum reaches 105° or 106° fahr. each year during the hot weather and 100° fahr. during almost every month of the other seasons. The causes of this climatic change have not hitherto been explained but it is possible that they may be found in increase of population, in the substitution of bricks and tiles for timber and thatch as house building materials, or in the draining of marshes in and around the city.

In Central, Northern, and Eastern Siam there are three distinct seasons, the hot weather, the rains, and the cold weather. The first extends from February, or March to May, the second from June to October, and the third covers the remaining four months of the year. When the northeast winds blow strong, the cold weather is very marked and, though the actual temperature is not below the average summer heat of Europe, causes some inconvenience to the people of the country. At times, however, the seasonal winds fail and when this happens the cold weather is scarcely to be distinguished from the hot.

The statistical yearbook of the Kingdom of Siam for 1919 [8] gives the following monthly meteorological reports, Tables 1, 2, and 3, on the mean temperature, the mean daily range, and the mean solar radiation, for ten years, from 1909 to 1918. These reports for Bangkok will give some indication of the temperature in the Nakorn Chaisri region, even though this region is somewhat removed.

[8] Statistical year book of the Kingdom of Siam, 1919. Fourth number. Published by the Department of Commerce and Statistics. Ministry of Finance. English Edition. December, 1919.

TABLE 1.—*Mean temperature for ten years, 1909–1918, at Bangkok, Siam.*

	°C.
January	25.2
February	27.4
March	29.1
April	30.7
May	29.8
June	29.1
July	28.8
August	28.5
September	28.1
October	27.7
November	26.6
December	25.1
Mean for ten years	28.0

TABLE 2.—*Mean daily range of temperature for ten years, 1909–1918, at Bangkok, Siam.*

	°C.
January	12.2
February	11.2
March	10.3
April	10.3
May	9.7
June	8.6
July	8.2
August	8.1
September	7.7
October	7.4
November	7.9
December	9.9
Mean for ten years	9.3

TABLE 3.—*Mean solar radiation for ten years, 1909–1918, at Bangkok, Siam.*

	°C.
January	58.9
February	61.3
March	63.7
April	65.7
May	65.7
June	64.6
July	65.9
August	63.8
September	63.3
October	62.1
November	60.4
December	59.1
Mean for ten years	62.7

Table 4, showing the average daily temperatures during 1919 was submitted by the Ministry of Lands and Agriculture of Siam. It is for Rajburi, which is west of the Nakorn Chaisri region.

TABLE 4.—*Average daily temperature for 1919, Rajburi Province, Montoln Rajburi, Siam.*

	°C.
January	24.4
February	28.5
March	30.6
April	32.1
May	30.9
June	29.9
July	29.4
August	28.9
September	27.4
October	28.8
November	27.7
December	26.9
Mean for ten years	28.7

From these reports it can readily be seen that the range in temperature, for the years indicated, was not great either for the region about Bangkok or in Rajburi Province, Montoln Rajburi. The lowest temperature in Bangkok was 25.1° C. in December, and the highest was 30.7° C. in April. The range in Rajburi Province was approximately the same, the lowest being 24.4° C. in January, and the highest 32.1° C. in April. Since the Nakorn Chaisri pummelo region is located between these two stations, it is highly probable that the temperature for that locality falls between the figures given for the two regions.

RAINFALL

Graham reports on the rainfall as follows: [9]

The rainfall of Siam varies a good deal in the different parts of the country. In Southern Siam and on the Chantaburi coast the average is not far short of 100 inches for the year; in Northern Siam it is about 60 inches, and in the neighbourhood of Bangkok about 50 inches. Until a few years ago the government collected no rainfall statistics but records have long been kept at the consulates, and by business firms and private

[9] Graham, W. A., Siam. A Handbook of Practical Commercial and Political Information. London (1912) 33–34.

individuals, and these having been carefully collected and tabulated by the Royal Irrigation Department, and compared with the regular statistics of recent years, give what appears to be a fairly correct average over a long period.

The comparative smallness of the rainfall in Central Siam is undoubtedly due to the influence of the great western mountain ranges which gather the clouds of the southwest or rain-bearing monsoon, and cause the precipitation on their summits and slopes of the greater part of the rain which would otherwise be distributed more equally over the whole country. The rainfall is not entirely confined to the wet season, for in the neighbourhood of Bangkok showers fall at intervals during the cold and the hot seasons, while towards the west and in Southern Siam the fall amounts sometimes to several inches during the hot weather months. Snow never falls anywhere in Siam, not even upon the highest mountain peaks of the north but hailstorms, though of very rare occurrence, are not altogether unknown. The beginning of the wet season is usually heralded by a series of severe squalls and thunder-storms accompanied by heavy rain, which sweep down from the western heights and sometimes cause damage to property on the plains. During the months of September and October, heavy gales almost of cyclonic violence are met with in the gulf, but accidents to the shipping constantly plying there to and from Bangkok are very rare. Waterspouts are occasionally seen both at sea and over the flooded marshes of the plains.

Tables 5, 6, 7, and 8, showing the mean rainfall, the mean of the number of days in which rain fell, and the mean rainfall on the delta of Chao Phaya River at Samutsakorn and Supanburi in Nakorn Chaisri Province, obtained from the statistical yearbook, give some idea of the rainfall in the regions near Ban Mai, Nakorn Chaisri.

TABLE 5.—*Mean rainfall for ten years, 1909–1918, at Bangkok, Siam.*

	mm.
January	10.2
February	16.9
March	65.1
April	30.0
May	160.0
June	150.7
July	158.2
August	206.2
September	305.0
October	241.4
November	76.8
December	11.8
Mean for ten years	1,433.0

TABLE 6.—*Number of days on which rain fell, mean for ten years, 1909–1918, at Bangkok, Siam.*

	Days.
January	1.6
February	2.7
March	6.2
April	5.0
May	16.5
June	18.9
July	22.0
August	22.8
September	22.1
October	18.6
November	8.0
December	3.4
Mean for ten years	147.0

TABLE 7.—*Mean rainfall on the delta of Chao Phaya River, Nakorn Chaisri Province, Samutsakorn, Siam, 1905–6 and 1912–13.*

	mm.
January	3.7
February	19.7
March	49.2
April	31.6
May	131.3
June	123.2
July	105.9
August	129.9
September	246.5
October	229.6
November	70.6
December	13.5
Yearly average	1,154.7

TABLE 8.—*Mean rainfall on the delta of Chao Phaya River, Nakorn Chaisri Province, Supanburi, Siam, 1905–6 and 1912–13.*

	mm.
January	15.5
February	22.0
March	19.0
April	37.3
May	164.6
June	77.8
July	177.3
August	157.7
September	294.7
October	257.2
November	63.1
December	0.1
Yearly average	1,286.3

Table 9, on the rainfall for 1919, submitted by the Ministry of Lands and Agriculture, for Nakorn Pratom, which is north of Ban Mai, gives a more comprehensive idea of the rainfall in a region near Ban Mai.

TABLE 9.—*Monthly report on rainfall, 1919, Nakorn Pratom, Siam.*

	mm.
January	0.0
February	180.4
March	26.9
April	148.4
May	351.4
June	111.6
July	199.6
August	197.9
September	348.7
October	90.2
November	79.2
December	0.0
Total rainfall	1,690.0

As indicated in the preceding tables, the average total rainfall in Bangkok for ten years was 1,433 millimeters. Rain fell during the same period on one hundred forty-seven days during the year. In Nakorn Chaisri Province, at Samutsakorn and Supanburi, which are north of the Ban Mai region, the average rainfall during the years indicated was 1,154.7 and 1,286.3 millimeters, respectively. The total rainfall for 1919 at Nakorn Pratom, which is north of Ban Mai, was 1,690 millimeters. The total rainfall for those districts indicated in the Nakorn Chaisri region varied from 1,154.7 to 1,690 millimeters. The rainfall at Ban Mai would undoubtedly be between these figures, probably being more nearly similar to those at Nakorn Pratom. The reports also show that a distinct dry season is present, which usually starts in November and continues through the months of December, January, February, March, and April.

IRRIGATION WATER

The water used for irrigation is, except during the rainy season, supplied entirely from Tachin River. As explained elsewhere, irrigation ditches are made from the river to the orchards. The water is rather muddy, being filled with clay loam, and is reported to be salty during the months between January or February and July. The saltness depends upon the beginning and the extent of the rainy season. In the dry season of 1920 the water was said to have been exceptionally salty. In order to obtain an accurate idea of the salt content of the water, samples were collected. The water was collected in June, and the analyses were made in August. The mineral constituent such as calcium may have separated out during the interval, but from a sodium chloride standpoint the contents, after long standing, should not have altered. Sample 1 was collected on June 7, 1920, at Ban Mai, Sarm Prarm, Nakorn Chaisri, from a ditch located in the center of the seedless-pummelo orchard under investigation. The sample was taken when Tachin River was at high tide. Sample 2 was collected on June 7, 1920, in the same section, but from the canal leading from Tachin River, at the intake into the orchard, about 300 meters from Tachin River. The sample was taken at high tide. Sample 3 was taken on June 8, 1920, in the same section, but from Tachin River at the entrance of the canal leading to the orchard. This sample also was taken at high tide. The results of the analyses are given in Table 10. The official method for the determination of the chlorine was used, and the total chlorides were computed as sodium chloride. The values given are averages of triplicate determinations.

TABLE 10.—*Analyses of water used for irrigation of pummelo orchards at Ban Mai, Nakorn Chaisri, Siam.*[a]

Sample.	Date.	Total chlorine.	Sodium chloride.	Location.
		Parts per million.	*Per cent.*	
1	June 7, 1920	11,820	1.95	Within orchard.
2	Do	12,802	2.11	Canal leading to orchard.
3	June 8, 1920	12,230	2.01	Tachin River.

[a] Determinations by Miss H. Kenward, of the department of chemistry, College of Agriculture, Los Baños.

As shown by Table 10 the water used for irrigation was extremely salty on June 7 and 8, 1920. The average sea water has approximately 3.5 per cent of solids in solution. Of this amount 2.7 per cent is reported as sodium chloride. The water in Tachin River at high tide at Ban Mai, Nakorn Chaisri, approaches sea water in salt content. The analyses of the three samples taken at different points agree very closely.

In order to get a comparison of the water used for irrigation in other pummelo sections of Siam, a sample was taken from the Menam Chao Phaya at Bang Bakok, near Bangkok. The Bang Bakok section is famous for its production of, chiefly, the Kao

Phuang variety of pummelo, but other varieties of Kao pummelos are also grown. The Nakorn Chaisri seedless, or Kao Pan, variety when grown at Bang Bakok does not produce fruits of the excellent flavor of those grown in Ban Mai, on Tachin River. The seedy character of the fruits is also reported to be greater when grown at Bang Bakok. The water at Bang Bakok was said to be salty from about February to May, depending upon seasonal conditions. Usually the water becomes fresh in June when the rains begin. A sample of water taken on June 14, 1920, from Menam Chao Phaya River, at Bang Bakok, at the entrance of a canal leading to a Kao Phuang orchard was used for analysis. The sample was taken at medium tide. The same method for analysis was used as that described for Tachin River water. The total chlorine was 283 parts per million, and the sodium chloride, 0.04 per cent.

The water, as shown by the analysis, used for irrigation of the Kao Phuang orchards at Bang Bakok, in June, contained only an amount of salt normal for river water.

The results obtained show that there is a great difference in the salt content of water used for irrigation, at least during the first part of June, in the two sections. This would indicate that the salt content of the two rivers is different throughout the year and that the salt has some influence on the quality and possibly the seediness of the fruits. Ban Mai is situated on Tachin River about 40 kilometers from the Gulf of Siam. The people reported that they can drink the river water for only six months of the year, as it is salty from January to June. At Tachin, which is 5 to 6 kilometers from the gulf, the people can drink the water for only about two months of the year. Sixty kilometers up the river from the gulf the people report that they drink the water for eight or nine months. These reports would indicate that the river is salty for at least six months of the year at Ban Mai; and, according to the analysis, it is extremely salty even during June, when it is supposed to begin to freshen. A further study of the salty nature of the water should be conducted to determine the exact time throughout the year during which the water contains salt. Such a study should be made of both regions; one at Ban Mai, on Tachin River, and the other at Bang Bakok, on the Menam Chao Phaya. In this way a comparison could be made of the salt content of irrigation water used in a section that produces a seedless fruit of excellent quality with that of the water used in a section that produces the same kind of fruit, but of a somewhat inferior quality. Before any definite statement can be made in regard to the effect of salt on the quality of fruit produced, careful control experiments will have to be conducted. Enough evidence has been collected, however, to indicate that the salt water does have some relation to the quality of the fruit.

SOIL

In general, the surface soil in the delta region is heavy, clayey, and of an entirely alluvial formation. The subsoil is a heavy, gray, brick clay, which is rather impervious to water. The topsoil in the orchards at Ban Mai is a dark gray to grayish brown (dark brown when wet), clay to clay loam soil. Some grit and sand are present. The subsoil for the same region is a very sticky, light slate brown clay. The canal mud, which is commonly used as a fertilizer, as it is composed of the decomposition products of organic material and the deposit of fine clay that has fallen into the canal, is light brown, with a slaty tint, clay to sandy clay, with some grit. The topsoil, collected in the region of Bang Bakok near Bangkok, which is noted for its production of the commercial Kao Phuang variety of pummelo, is not quite so clayey as the Ban Mai soil, being a light brown clay to sandy clay grit. The canal mud from the same region is a dark gray to light brown, heavy, clay soil. Samples of the topsoil, subsoil, and canal mud used for fertilization were collected for physical analysis from the Ban Mai and Bang Bakok regions. Samples 1 to 3 are from a Nakorn Chaisri orchard; and samples 4 and 5 are from a Bang Bakok orchard. The standard United States Bureau of Soils centrifuge method was used, and the results are given in Table 11.

TABLE 11.—*Physical analyses of soils in pummelo orchards at Ban Mai and at Bang Bakok, Siam.*[a]

Sample.	Clay.	Silt.	Sand.	Location.
	Per cent.	*Per cent.*	*Per cent.*	
1	73.7	21.4	4.9	Topsoil, Ban Mai.
2	78.8	18.4	2.8	Subsoil, Ban Mai.
3	55.2	33.6	11.2	Canal mud, Ban Mai.
4	56.98	31.1	11.92	Topsoil, Bang Bakok.
5	64.5	33.6	1.9	Canal mud, Bang Bakok.

[a] Determinations by Miss H. Kenward, of the department of chemistry, College of Agriculture, Los Baños.

The results of the physical analyses show that all of the soils are extremely clayey, containing over 50 per cent of clay. The subsoil contains a larger percentage of clay than does the topsoil. Little sand or coarser material was present in any of the samples. The soil in the Bang Bakok orchard is slightly coarser than that of the Nakorn Chaisri orchard.

Since the irrigation water used at Ban Mai is extremely salty, it would be expected that the orchard soil would also contain a large percentage of salt. In order to prove this point the soils of the various types from the Ban Mai region and, for comparison, those from the Bang Bakok district, where the water used for irrigation according to the analysis is not salty at that time of the year, were analyzed for their salt content. The following samples were analyzed from an orchard at Ban Mai: No. 1, topsoil; No. 2, subsoil; and No. 3, canal mud, obtained from the bottom of a canal leading from Tachin River to the orchard. The samples of soil analyzed from Bang Bakok, near Bangkok were from the following locations: No. 4, topsoil in an orchard; No. 5, canal mud from a canal in the orchard, leading from the Menam Chao Phaya. The soils were heated in an oven until weight was constant. Five-gram samples were taken, in triplicate. These samples were treated with water at 60° C. for three days, and the extract was then tested for chlorine by the silver nitrate titration method. Table 12 gives the results of the determinations. The parts per million of chlorine were determined from the water-soluble extract of the soils. From this was computed the percentage of sodium chloride present in the soils.

TABLE 12.—*Analysis of the water-soluble extract of soils in pummelo orchards at Ban Mai and at Bang Bakok, Siam.*[a]

Sample.	Date.	Total chlorine.	Sodium chloride.	Location.
		Parts per million.	*Per cent.*	
1	June 7, 1920	6,150	1.006	Topsoil, Ban Mai.
2	Do	5,100	0.8	Subsoil, Ban Mai.
3	Do	15,100	2.5	Canal mud, Ban Mai.
4	June 14, 1920	1,100	0.18	Topsoil, Bang Bakok.
5	Do	2,200	0.33	Canal mud, Bang Bakok.

[a] Determinations by Miss H. Kenward, of the department of chemistry, College of Agriculture, Los Baños.

The results given in Table 12 show that the topsoil, subsoil, and canal mud from Ban Mai were, all, extremely high in salt content. This is what would be expected, as the water used for irrigation was at that time very salty, as indicated in Table

10. The topsoil, which was collected under a tree in the orchard, proved to contain 1.006 per cent of salt; the clay subsoil contained 0.8 per cent of salt; and the canal mud, 2.5 per cent of salt. The canal mud was collected from the bottom of a canal, the water of which contained 2.11 per cent of salt, as shown in Table 10. The soil in orchards at Bang Bakok contained only a small amount of salt at the time of the year the samples were taken. The topsoil contained only 0.18 per cent of salt and the canal mud only 0.33. During June the water used for irrigation at Bang Bakok, as shown by analysis, contained only an amount of salt normal for river water; consequently the orchard soil and the canal mud would not be expected to contain a high percentage of salt. These comparative tests would seem to indicate that the difference in the salt content of soils in Ban Mai and soils in Bang Bakok has some bearing on the difference in the quality of the fruit produced in each region. As before stated, it has been the general belief that salt has a direct relation to the quality of the fruit produced. Tests on the salting of trees would seem to confirm this belief. The chemical tests of the water and the soil, at least for the month of June, give an accurate indication as to the presence of an excessive amount of salt in the soil that produces the best-quality pummelos, and would indicate that the salt content has some relation to the quality of the fruit produced.

CULTURAL METHODS

The type of citrus culture used in Nakorn Chaisri is exceedingly well adapted to the low, wet, mud flats and nipa swamps of the region. From the description of the general physical aspect of the country it is evident that unique treatment is required before any measure of success can be attained. The methods followed are very largely those employed by the Chinese in the successful planting of fruit in the flood-swept delta regions of southern China. This type of fruit culture, almost unknown in the West, deserves careful consideration as of possible use in the development of many of the otherwise useless swamp areas of other parts of the world.

Nakorn Chaisri is irrigated, drained, and sometimes flooded by the waters of Tachin River. Untouched by the hand of man, this swamp area is covered with nipa palm, *Nipa fruticans* Wurmb (Plate 1, fig. 1), or other plants adapted especially to wet and salty conditions. Much of the foreshore of Tachin River is still covered with this wild growth, giving the impression, when viewed from the stream, of undeveloped regions beyond. Occasionally the monotony of the view is broken by the thatched hut of some settler, probably a Chinese storekeeper catering to the needs of the people who are opening this watery jungle and very rapidly developing it.

DRAINAGE AND PREPARATION OF THE LAND

The first step necessary to conquer this fertile area for production is to provide drainage. For this the natural arteries leading into the main streams have been insufficient. Artificial channels have therefore been dug, until the whole area is now a network of small canals and waterways (Plate 1, fig. 2). These not only serve for drainage, but also provide a series of natural and artificial highways over which the inhabitants canoe, transporting themselves and their products to the main streams (Plate 1, fig. 3). The large Pasi Cherern Canal, dug within comparatively recent years, provides an important means of communication between Bangkok, the capital, and the outlying districts. It also serves to help drain the land, or to hold back the tidewaters for irrigation purposes during the dry season.

Open waterways serving as drainage channels are of little value in carrying off the surplus water when the main streams are in flood. Dikes must therefore be provided to hold these waters back from the cultivated areas. Before the nipa swamp (Plate 2, fig. 1) is made ready for cultivation, it must first be encircled by a system of mud dikes thrown up along both main and branch streams. In clearing the land along the shore of the river a narrow strip, 1.5 to 3 meters wide, next to the stream, is left in natural growth (Plate 2, fig. 2). Beyond this strip a small, shallow basin, 1 to 1.5 meters in width, is dug, the earth from which is thrown to the inside of the plot, forming a raised embankment a meter or less higher than the surface of the interior beds (Plate 2, fig. 2). Along the smaller waterways the extra strip of land and the basin are dispensed with, and the dikes are constructed next to the streams.

The plot is then laid out for a series of raised beds and open ditches. The beds encircling the plot are usually parallel to the streams and a meter or so wider than those within the plot. This allows an extra strip for the raised or diked portion which is sometimes held in place by a row of trees, possibly the jak, *Artocarpus integra* (Raderm.) Merr. (*Artocarpus integrifolia* Linn.), planted along the inside ridge. On the inner side of this row of trees, the ridge portion gradually slopes off to the level of the bed, down the middle of which at least one row of citrus trees is eventually planted (Plate 2, fig. 3).

Some idea of the layout of one of these Nakorn Chaisri pummelo orchards can best be had from a study of Plate 16, which represents an actual locality at Ban Mai along Tachin River. All stages of the various cultural methods are shown. In the lower left-hand corner is an area of virgin nipa palm and grass swamp in which canals have been dug from Tachin River for irrigation and drainage. After the canals have been dug, this land is prepared with ditches, as shown in the plot in the lower right-hand corner. The land here is set off in beds and ditches and has been planted to bananas, sugar cane, corn, beans, and peanuts. These or similar crops are grown for about five years, at the end of which time the beds have settled and the entire piece of ground is ready for the pummelo plantation. The permanent pummelo plantation, with its raised beds, trees, ditches, and irrigation canals, is clearly shown in the upper left-hand corner of the sketch. All these orchards and plantings are drained and irrigated by ditches within each plot that lead to canals running to Tachin River.

When first laid out, the interior beds are usually 5 to 5.5 meters wide. After all natural growth has been cleared and burned and tree stumps have been removed, shallow ditches are dug (Plate 3, fig. 1). All this work is done by hand, the sticky soil being cut in blocks by means of a special instrument devised for the purpose. These blocks are then tossed upon the surface of the beds (Plate 3, fig. 2). The plots will not be ready for the planting of the citrus trees for from three to five years, as sufficient shade has not been provided and the soil is not in good tilth. At first the trenches are made very narrow and shallow; and the beds are often first planted to sugar cane or, sometimes, to peanuts, as the soil becomes quite mellow after it has been properly drained (Plate 3, fig. 3). Bananas are sometimes planted as the first crop (Plate 4, fig. 1), as these provide ideal shade for the young pummelo or other citrus trees which may be planted later.

IRRIGATION

It will be seen at a glance that this system of canals, dikes, raised beds, and ditches provides not only for the drainage of the area, but also for its irrigation; as the water gates (Plate 4, fig. 2), constructed under the dikes at regular intervals, carry the high-tide waters of the dry season from the canals to the ditches, thus furnishing the growing plants on the beds with a constant supply of water. These plots are now ready for intensive cultivation and in the years to come will reveal the results obtainable on these low, otherwise useless, bottom lands when sufficient capital is available to clear the swamps and to control the waters.

CARE OF THE DIKES AND BEDS

After the land is cleared and planted, some years will elapse before the region assumes its new aspect of a cultivated area (Plate 4, fig. 3). It never appears to have the regularity of a systematically planted western orchard, though some of the best Nakorn Chaisri pummelo groves approximate it (Plate 5, fig. 1).

The dikes, first thrown up as small embankments, gruadually settle and are then broadened and strengthened by the fill from the main canals, which almost every year are deepened or cleaned. These eventually assume the proportions of heavy embankments upon which grass or cultivated vegetation soon takes hold. Along the main canals thatched huts are built on piles, often with cement steps leading down to the water (Plate 5, fig. 2). Simple bridges made of bamboo, the trunk of a coconut tree, or perhaps a single board are placed across the stream.

The earth at the base of the dikes is often held in place by the systematic planting of *Bruguiera sexangula* (Lour.) Pers., the roots of which endure constant flooding (Plate 5, fig. 3). The slope on the stream side of the dike frequently becomes an impenetrable growth; but an open strip, at least 60 centimeters in width, is maintained along the top as an attractive and useful walk. On the inside of this walk is the first bed of fruit trees (Plate 6, fig. 1). At some suitable place under the dike of the first bed there is laid the hollow trunk of a palm tree, through which water can pass from the canal to the ditches when the gate is opened (Plate 4, fig. 2). In some cases terra cotta pipe is used for this purpose.

Within the diked inclosure are the beds of pummelo. These have become narrower and higher through the gradual process of widening and deepening the trenches (Plate 6, fig. 2). This operation of trenching is most skillfully carried out by Chinese laborers, as they best understand the methods whereby it is most efficiently done (Plate 6, fig. 3). During the heavy rains there is considerable washing from along the slopes of the beds (Plate 7, fig. 1); therefore, the trenches are cleaned out each year, and the muck is smeared back over the beds. The whole region has thus become a labyrinth of beds and ditches across which one can pass with difficulty, either on narrow logs thrown across from bed to bed (Plate 7, fig. 2) or by hurdling the trenches.

PLANTING

The pummelos are not planted for at least five years after an inclosure is first plotted. This allows time for the raising and settling of the beds, the decay of organic matter in the newly cleared land, and the planting of some preliminary growth for shade. In well-planted orchards the young trees are eventually set out in the center of the beds with more or less irregular distances of from 3 to 4.5 meters between the trees. By the time the trees reach their most productive age, the constant deepening and widening of the trenches has reduced the width of the beds to at most 4.5 meters, and the ditches between them to a width of from 1 to 2 meters. The depth of the trench is now from 1 to 2 meters from the level of the bed.

SHADING AND INTERCROPPING

Little scientific experimental work has been done on the effect of shade upon citrus plantings. That some shade is advantageous in citrus growing under tropical conditions is evident from the experience of native growers. In Nakorn Chaisri there seems to be considerable intercropping, partly with the view to providing shade; and numerous trees of other species are found planted, sometimes with uniformity and sometimes at random in the groves. The coconut palm (*Cocos nucifera* Linn.), the betel palm (*Areca catechu* Linn.), and the banana (*Musa sapientum* Linn.) are the chief plants used. Betel palms are perhaps the most conspicuous in Nakorn Chaisri, and the trees are said to be very profitable. They seem to thrive under this raised-bed system of cultivation, and trees are often found growing along the edge of citrus beds (Plate 7, fig. 3). These are doubtless established some years before the pummelos are planted, and the center of the beds is left open for the citrus. Banana plants are often grown between the betel palms and the pummelos.

In some of the other lowland regions of Siam, especially in Dao Kanong, a shade tree, *Erythrina fusca* Lour., known locally as *thong lang*, is grown especially to shade fruit trees and to sweeten and enrich the soil. Some growers have so strong a belief in the thong lang as to maintain that successful fruit culture, under the raised-bed system of irrigation and drainage, is entirely dependent upon the culture of this tree, of which there are said to be several varieties. The tree at maturity is immense, with a trunk diameter at the base of 60 centimeters, and may attain a height of from 12 to 18 meters. The head shoots high above those of most fruit trees, is not very dense, and seems to provide a suitable amount of shade for the fruit. In Dao Kanong these trees are very commonly seen between citrus trees, but in the better Nakorn Chaisri groves they were not observed. The tree has an extensive fibrous root system which seems to thrive in wet soil, and a dense network of roots and rootlets extends throughout the beds and even into the ditches. The interesting claim of growers is that the roots of the fruit trees feed upon the decaying roots of these trees; they also claim that the leaves fall into the trenches of water and decompose, and when smeared upon the surface of the beds provide an excellent fertilizer.

There seems to be considerable difference of opinion among growers as to the extent to which intercropping and shading prove profitable. In the best Kao Pan pummelo groves of Nakorn Chaisri the growers do not make the error of excessive shading that often seems to be made elsewhere. In one of the best of these orchards it was interesting to note that, by the time the pummelo trees had attained the age of from ten to fifteen years and were nearly spread out over the surface of the beds, all betel palms and bananas had been removed, except the trees growing at the end of the beds or rows along particularly cherished walks extending through the heart of the pummelo orchard (Plate 8, fig. 1). In other groves the betel palms predominated, even after the pummelos reached maturity (Plate 8, fig. 2). In still another grove, betel palms were being newly planted between pummelos, after the latter were well grown. This might indicate that the betel palm was proving the more profitable of the two crops and was therefore supplanting the citrus.

No accurate observation regarding the practice of shading and intercropping was obtainable from the growers, except that they consider some shade necessary for the first few years after the pummelo has been planted. The manager of one of the best groves takes out all betel palms after the pummelo trees have attained an age of from three to five years. In other groves the plantings were very much mixed, with mature banana and citrus trees growing side by side and with large coconut palms growing along the borders of the dikes, casting their shade across the beds nearest to them. Tall betel palms, scattered throughout the planting, towered high above the citrus and banana and provided a condition of semishade which seemed highly advantageous (Plate 8, fig. 3). In still another grove twenty- to thirty-year-old pummelo trees, which apparently had outgrown their usefulness, were severely trimmed back and were being intercropped or replaced with young betel palms.

Another form of intercropping which is commonly followed is to grow rice in the ditches, a row or two down either side of the citrus beds. The rice is set out at the beginning of the rainy season and not only utilizes what would be otherwise wasted space, but helps to keep intact the sides of the beds. How this practice might well be followed can be noted by observing Plate 9, fig. 1. Doubtless these growers are unconsciously working out methods that should be of future value in indicating the lines along which scientific citrus culture should be conducted in the Tropics.

CULTIVATION

Clean culture is practiced on the orchard beds of Nakorn Chaisri. Little difficulty is experienced with weeds, for when the orchards are once clean there is practically no source of contamination. Rarely is any effort made to maintain an earth mulch, but the mulch which has been cleaned out from the trenches and smeared over the surface of the beds is allowed to crack during the dry weather. The constant supply of water in the trenches makes unnecessary any effort to prevent evaporation. During the dry season there are always at least 30 centimeters of water in these trenches, whereas during the wet weather the water will often rise to within 30 centimeters of the surface of the beds. During seasons of exceptional floods the water has been known to flow over the dikes and to cover the beds to a depth of 60 centimeters. All growers recognize the ill effects of these floods, especially when the roots are submerged for too long a period. During recent years the citrus industry has suffered very severely from floods. This system guarantees the proper amount of moisture for the roots of the trees and shows how remarkably well the waters are controlled. About the only implements of culture are the specially constructed Chinese spade, used for removing earth from the ditches; and a two-pronged hoe, which is sometimes used for weeding the beds.

FERTILIZATION

A most interesting system of soil conservation and fertilization is practiced by the growers. This consists of cleaning out from the trenches all organic matter and clay that may have rotted and accumulated there. Dead leaves, straw, branches, and other refuse naturally find their way to the bottom of these trenches where they decay, and by this process are made useful for fertilizer. All organic matter is carefully conserved, and one often sees under the trees (Plate 9, fig. 2) rice or sugar-cane leaves which, if they are not washed into the trenches, will soon be covered over with a coating of mud.

Canal mud is still more fertile than the mud in the trenches, and a practice very common in China is followed here also. During the dry weather, when the canals are low, mud from the bottom is removed, placed along the sides of the dikes, and allowed to dry in blocks. After the mud is thoroughly sun-dried, it is broken into pieces and carried in baskets to the citrus trees and distributed at the rate of about two large basketfuls to each tree. From what has already been said regarding the rise of water in the trenches, it is evident that the trees under this culture develop a surface root system. This fertile canal mud, together with the mud from the trenches, helps to keep these roots from exposure and to provide an important source of plant food.

Nakorn Chaisri pummelo growers recognize that the quality of the fruit is greatly influenced, not only by soil and water conditions, but also by artificial fertilization. Some very interesting theories have developed regarding the effect of salt and paddy ash upon the seediness and what is known as the *kao sarn,* or raw-rice, condition of the fruit.

One grower in the Dao Kanong region stated that, if salt and paddy ash are applied to trees bearing bitter fruits or fruits lacking in juiciness, the fruits of the following year would be much less bitter and more juicy. It was also mentioned that the fruits would contain fewer seeds.

The critical judge of a good pummelo in Siam will lay more stress upon what he calls the kao sarn, or raw-rice, condition of the fruit than upon seediness. There is a tendency in imperfect fruit for juice sacs to harden. These are not only unpleasant in the mouth but indigestible, and any fruit which develops this characteristic is considered inferior. Soil and fertilization, more than any other factors, are believed to influence this condition, and the application of paddy ash is said greatly to reduce the danger of its occurrence.

Paddy ash consists of the ash of burned rice husks, of which a plentiful supply is always obtainable in the vicinity of Bangkok. Many large rice mills operate within this region, and the husks of the grain are used as fuel. At the rice mills this paddy ash is often dumped, because it cannot be sold or even removed for fertilizer. It is naturally a valuable source of potash and is recognized by all successful pummelo growers as an important fertilizing element. It is usually applied to the surface of the beds, small piles being placed under the trees and allowed to work to the roots gradually. These piles can be found at the base of many pummelo trees in Nakorn Chaisri (Plate 9, fig. 3).

In addition to the above sources of fertilizer, night soil is sometimes used. Small holes are dug in the beds under the limbs of the tree, and the night soil is poured in and allowed to find its way to the roots. Apparently this practice is not followed to the same extent that it is in China.

PRUNING

Growers pay little attention to systematic pruning, except to cut out all dead branches. Shapely, low-headed trees are considered just as important in Nakorn Chaisri (Plate 10, fig. 1) as they are in any western citrus grove. Trees of this shape are obtained not by pruning, but by the careful selection of suitable branches of layering. These are so planted as to have the forked head only a few centimeters above the ground. The lower branches of the trees are then encouraged to lie almost flat along the surface of the bed, in many cases finally extending over the trench of water (Plate 10, fig. 2). In old pummelo groves very severe cutting back of trees is practiced. The question of the proper amount of pruning under tropical conditions is another interesting experimental field. Doubtless growers are erring on the safe side in not pruning too severely trees that have practically no period of rest.

PROPAGATION

Western methods of propagating citrus have never been introduced into Siam, and the methods followed are almost entirely those used by the southern Chinese in their fruit culture. In Nakorn Chaisri the pummelos are multiplied by *marcottage,* or Chinese air layering. In this way desirable parent plants are used for propagation and good strains of the variety are assured if selection is wisely made. By this method low-headed trees are also best obtained, but it has many drawbacks.

In Nakorn Chaisri there are no nurseries where carefully selected strains of the best varieties of pummelo can be purchased. In Bangkok there are a few nurseries that profess to sell desirable stock. Each grower usually propagates his own trees, rarely more than he will need for his own planting. His theory is that the method of layering large branches is costly; and that from the fruiting branch, which he must sacrifice for his new tree, he could actually secure fruit which in one year alone would bring him a higher price than the new tree when sold as nursery stock. The average price for a layered plant is from 75 satang to 1 tical each, or 30 to 40 cents in United States currency. At this rate it is readily seen that the nursery business will not prove profitable so long as this system of propagating is followed. Herein is found an inviting field for modern nursery methods.

Marcottage is practiced in June, July, and August, after the rains have begun. A strip of bark is removed from the branch chosen. After a slight callus has formed, coconut fiber or specially prepared earth is tied about the injured part. During dry weather this must be kept moistened. About one hundred days are necessary for the roots to form. The new plant is then removed from its parent and set out in a nursery bed or, more often, is planted directly in its permanent position. Branches chosen for this purpose are usually very much forked, and low-headed, spreading trees result (Plate 10, fig. 3). All growers consider these more desirable than the high-headed trees.

FLOWERING, FRUITING PERIODS, AGE, AND YIELD

The growers report that the Kao Pan, like most other citrus trees growing in this region, flowers in most abundance about four times each year. The largest number of flowers appears in June, at the beginning of the rainy season. This lot of flowers matures the largest crop of fruits. Five to six months are required to bring the fruits to maturity, and the largest crop is picked in November and sold direct or placed in storage.

Trees of this variety are said to reach their maximum production when about fifteen years old and to have outlived their period of usefulness at about thirty years. It is difficult to arrive at any very definite figures regarding yield, though judging by the number of fruits on the trees during an off season, the trees of this variety must be very heavy bearers.

The yield from a grove of about 400 bearing trees was, approximately, 18,000 fruits each year, which would give an average of 45 fruits for each tree. Of these about 10,000 were harvested in November, 4,000 about February, and 2,000 each in May and August.

HARVESTING

As has been noted, the Nakorn Chaisri seedless pummelo produces flowers and fruits the year around, but there appear to be four seasons at which most flowers are formed. Consequently there are four main picking seasons, the largest harvest coming during November. The crop that is picked in November is graded, as there is considerable variation in quality and seediness. The fruits picked at the other three seasons, about three to four months apart, are superior in quality, but less in quantity, and rarely have seeds. At these times less grading need be done. While there are these three or four natural picking times, harvesting is done at almost any time throughout the year, according to the demand.

Except when the fruit is picked for special, immediate sale to buyers who come to the plantation, care is taken to harvest at the proper stage of development. Color and size are the chief points considered in picking. The main crop is picked just before the fruit is mature. At this stage it has attained its natural size, but is still somewhat green and just starting to turn yellow. If the fruit is allowed to mature on the tree, the juice sacs are apt to develop a woody, or what is known as the kao sarn, or raw-rice, condition mentioned by Siamese. Some of the growers pick the fruits according to the sound produced when snapped with the finger. After picking, they are placed in one large pile; if no buyers are present at harvest time, the fruits are stored.

STORAGE

The storage and the care of the fruits are important factors in producing the best quality, as the better ones are those that have been stored. After storage of from one to two months the skin is soft, fragrant, distinctly yellow, and much wrinkled. The fruits can be kept in good condition for three months, if put in a dry place. After this long storage the much-wrinkled fruits often look as if they were spoiled, but the reverse is true; they have become juicer and have a better flavor than at the time of picking. They may become bitter when stored too long. Little or no rotting occurs during storage, except when the fruits are roughly handled. Storing is done at the plantations only when buyers are few during the main harvest, and when the fruits are used for local consumption.

The fruits are stored in a dry place, such as bamboo-strip baskets, which are placed on rafters under a nipa-palm roof of a house or a specially constructed storage room. The bamboo baskets are usually about 45 to 60 centimeters in diameter and 60 centimeters deep. A typical storage room is a bamboo house with a nipa roof, the floor space being 2.5 by 3.5 meters and the sides about 3 meters high to the eaves. It is boarded up on two sides and the other two sides are made of woven bamboo strips to allow for plenty of ventilation. No special precautions are taken in storing; the fruits are merely piled on the floor in a large heap. Partition boards may be used to separate the different grades.

MARKETING

Before the fruit is offered for sale it is graded, according to size, degree of cankeredness, and seediness. The grading as to the first two qualities may or may not be strict, and depends primarily on the buyer. In the November harvest an attempt is made to separate the fruits with seeds from those without. This is rather difficult, but some growers claim they can distinguish between these qualities. Fruits that are cankered do not necessarily sell at lower prices, because of the scarcity of this particular variety. This is especially apparent during the Chinese New Year, when the demand is great.

The fruit is most often carried to market in small native canoes or boats; middlemen come direct to the plantation to buy, and they then transport the fruit to market for sale. The selling price at the plantation varies according to the season. During the large harvest in November the first-grade fruit sells for from 12 to 15 ticals a hundred (5 to 7 dollars United States currency), and the second grade for from 4 to 5 ticals a hundred (1.75 to 2 dollars). At this time the fruit is apt to be seedy. At other seasons, as in June, it sells for from 20 to 25 ticals a hundred (8 to 10 dollars). The price of the seedless fruit produced in the off seasons is, therefore, 8 to 10 ticals a hundred, or more than that of the seeded. When the fruits are scarce, as in June, the Nakorn Chaisri seedless pummelo may sell on the Bangkok market at the rate of two fruits for 1 tical. The superior quality is recognized by the people, and they pay a handsome price. Little fruit is shipped out of the country, as the production is small and the home demand great.

The Kao Pan pummelo is not so good for shipping as the Kao Phuang pummelo, which is primarily the shipping variety. The seedless pummelo will, however, stand shipment if picked just before it is mature and then properly packed. Records of pummelos shipped from Bangkok to Denmark show that fruits may arrive in good condition after a voyage of from six to eight months. These fruits were individually wrapped in paper, so as to prevent infection at points of contact, and then packed in a box with slat sides to allow for ventilation. Trials with apparently good results were cited in which the fruits were sent to Denmark after being varnished and then packed as above. Fruits picked one month previous and then taken by us to Canton and the Philippine Islands arrived in good condition after having been packed for one and one-half months. They were wrapped in paper and then packed in a woven bamboo-strip basket. Fruits of the Kao Pan variety picked at Ban Mai, Siam, between May 11 and May 30, 1920, wrapped individually in paper, and packed in a bamboo-strip basket and shipped to Los Baños, Philippine Islands, arrived in excellent condition and remained so until August 25 (Plate 13, figs. 1 and 2). If properly picked, with good shipping conditions and ordinary storage conditions, the fruits will remain in excellent shape for two or three months.

DESCRIPTION OF THE KAO PAN PUMMELO

TREES

Most of the trees of this variety are well rounded and shapely (Plate 10, fig. 1). Ten-year-old trees, grown from air layers, attain a height of 2.5 to 3 meters and a spread of 3.5 to 4.5 meters. They are not so markedly upright as are most pummelo trees, but incline more to the rounded outline of the orange tree (Plate 10, fig. 1). As grown in Nakorn Chaisri, the trees are all low-headed, branching from the surface of the ground into two or more forks (Plate 9, fig. 2). As noted under pruning, this low-headed, forked characterestic is largely obtained by the growers through selection of branches for layering that are so shaped as to produce the type of tree they desire.

The branches vary somewhat in the angle of growth that they take (Plate 10, fig. 2), but in general they tend to spread rather than to shoot upright. Usually the young branches take an angle of about 45° from their main stem. The tree has a very dense growth of branches and twigs (Plate 10, fig. 2). The branches are almost thornless; when thorns do appear, they are very rudimentary and hardly noticeable. The bark of the tree, which is quite smooth, is brown and streaked with yellow lines. The young stems, somewhat downy, are of characteristic pummelo shape and color.

LEAVES

The leaves of the trees of the Kao Pan variety form somewhat densely on the trees, but do not appear to be of so hardy a character as does the foliage of other varieties perhaps nearer the wild stock. Leaves vary somewhat in size and shape, being from 7.5 to 14 centimeters long and 4.5 to 7 centimeters wide; the margin is slightly wavy or scalloped, especially on the upper half of the leaf. Most of the leaves are of the small type and are flattened at the tip and markedly indented. The petiole, with variable wings, varies in size and shape, in many leaves being distinctly narrowed and shaped somewhat like that of the orange leaf. The veining of the leaves is very prominent and extends from the midrib at an angle of almost 60°. There is a distinct marginal veining of the leaf.

FLOWERS

Trees of the Kao Pan pummelo in Nakorn Chaisri flower three or four times each year and are practically ever-bearing. The flowers are usually formed on young stems of considerable length, which shoot out quite upright from the branches of the previous year's growth (Plate 11, fig. 1). At the terminal end of the flower stem there may or may not appear a cluster of leaves (Plate 11, fig. 1). The number of flowers appearing on a single flower stalk varies; sometimes there are as many as fifteen or twenty in a cluster (Plate 8, fig. 4), which measures 7.5 centimeters in length and 4.5 centimeters across. There seems to be little difficulty for the flowers to set fruit, but as a rule not more than two or three fruits are allowed to mature in a cluster. The petals of the flowers are about 2 centimeters long and spread to a diameter of about 5 centimeters when the flower opens (Plate 11, fig. 3). The white color and the decided fragrance make a cluster of the flowers very attractive.

FRUIT

The fruit of this variety, unlike many of the pummelos growing in the Orient, is of a decidedly rounded, somewhat flattened form (Plate 13, fig. 2), with no evidence of neck formed by a raising of the calyx end of the fruit. Nearly mature fruits picked from the trees in June averaged 44 centimeters in latitudinal circumference, 40 in longitudinal circumference, 11 in latitudinal diameter, and 10 in longitudinal diameter. They are very solid. The pistil end is flat and smooth and, usually, only very slightly depressed or cupped; it is not even slightly furrowed. The calyx end is also usually quite flat or sometimes slightly cheeked on one side; the furrows, if any, are very short and shallow.

The rind is smooth for a pummelo, being only very slightly roughened by the numerous small oil cells which group themselves conspicuously over the surface (Plate 13, fig. 2). These are rounded, about half the size of a pinhead, and grouped more or less uniformly, averaging about 3 millimeters apart. Unlike many varieties of pummelos there are no bottle-shaped oil cells; although those embedded within the rind are large, they do not extend into the rind to a depth of more than about 1 millimeter. Oil exudes very slightly from the rind upon pressure of the thumb and fingers, and a very slight aroma is present in fruit which is still solid. The fruits tend to become somewhat shriveled when placed in storage. The softening and wrinkling of the rind, attended by reduction of size, detracts somewhat from its appearance (Plate 14, figs. 1 and 2). The rind is from 1 to 2 centimeters thick when the fruit is first picked. The thickness varies according to the maturity (Plates 13, fig. 1; and 14, fig. 1). It is very pithy, but in storage becomes somewhat reduced in thickness. The Kao Pan is a fine keeper, and residents of Siam purchase fruits of this variety in quantity and store them for months at a time, using them as needed.

The rind clings tightly to the sections, and considerable art is required in order to open the fruit in an attractive way for the table. The Siamese usually cut the fruit longitudinally into irregular pieces and then tear apart the fleshy sections, finally stripping off the rind (Plate 12, fig. 1). If one attempts to open the fruit as one would a navel orange, he will find not only that the rind sticks tightly to the sections, but that the sections adhere tightly to one another; and it is almost impossible to tear them apart neatly with the partition walls intact (Plate 12, fig. 2). When the fruit is opened in this way, the large core is at once evident and its tendency to stringiness is revealed. By cutting across a number of fruits latitudinally, almost closed cores are usually exposed (Plate 13, fig. 1). They are from 1 to 2 centimeters in diameter and are rounded or irregularly shaped. In some fruits the core forms a single string, while in others there is an open center with the core extending down one side (Plate 12, fig. 3).

There are from twelve to fifteen locules, or sections, in a fruit. These are uniform in size and shape and in some fruits have a slight tendency to extend into one another (Plate 10, fig. 2). The partition walls are thick and tough and usually are not allowed to enter the mouth, as they can be readily stripped from the juice sacs without bursting the latter or even tearing them apart. Sometimes a portion of the wall remains attached to the base end of the sections, and this may enter the mouth, producing the only rag noticeable.

The nature of the juice sacs is a characteristic feature of this fruit and unquestionably helps to make it attractive. They average about 2.5 centimeters in length and 4 millimeters at their greatest diameter. The long sacs are grouped more or less in parallel lines, and on the base of the section they are joined by shorter, more rounded or irregularly formed, juice sacs. Each little juice sac is a unit in itself and can be readily separated from the partition walls and from the others without breaking its tender walls. Thus each section of the fruit when opened by the hand reveals a large mass of attractive juice sacs, which readily crumble apart and can be carried to the mouth in any quantity desired without causing any of the juice to run out. A little pressure of the tongue will break these sacs, releasing the delicious juice contained therein and leaving little trace of rag, for the partition walls of the sections have already been removed and therefore never reach the mouth.

The flesh is white and very juicy, with a delightfully sweet, very mildly acid flavor. The bitter pummelo taste, which in many varieties is not altogether pleasing, is in this variety only slightly evident and blends very nicely with the sugars and acids of the juice. Those who eat the fruit for the first time commonly declare it to be one of the best fruits of this class they have ever tasted.

As has been stated, the Kao Pan is practically an ever-bearing variety, and the quality of the fruit varies with the season of production. In Nakorn Chaisri there is a decided tendency to seedlessness during a part of the year. Growers say that the same trees which bear seedless fruits in June, or fruits with very small abortive seeds, will bear fruits in November which often have large mature seeds, frequently considerable in number. The contention is that there are no individual trees which always carry seedless fruits, but fruits of the same tree vary greatly. The fact, that the same trees that produce seedless fruits at times are said to produce seedy fruits during other portions of the year, destroys the common theory that the Kao Pan is a true seedless variety. Moreover, when taken to other places it usually becomes seedy. There can be little question, however, that this variety has a greater tendency to seedlessness than many others. A strictly seedless strain might be secured through an extended study of tree and bud variation. In most of the fruits there is always some evidence of rudimentary seeds.

CLASSIFICATION

From the general description of this fruit and the tree upon which it grows, the likeness of some of its characteristics to those of the orange is apparent, though somewhat remotely hidden. This might possibly raise a question as to whether the variety might possibly be a natural hybrid of *Citrus maxima* (Burm.) Merr. (*Citrus grandis* Osbeck), the pummelo, and *Citrus sinensis* Osbeck, the common or sweet orange; or, at least, it might possibly possess some orange characters. Certainly, the nature of the tree, the shape of the leaf and the fruit, and the size and the shape of the oil cells would indicate a tendency in this direction; but this fruit is rightly classed as a variety of pummelo.

DISEASES

A study of citrus diseases of Siam was made during June and July and later published.[10] Though the season was still dry, it is believed that the major diseases were encountered. The severity of these is undoubtedly much greater during the rainy season, and some maladies, other than those noted by us, may be present.

Citrus canker is the same in general formation on the various species and varieties of citrus growing in Siam as on those growing in the Philippine Islands. *Citrus maxima* (Burm.) Merr. (*C. grandis* Osbeck) and *C. aurantifolia* (Christm.) Swin-

[10] Reinking, Otto A., Citrus diseases of the Philippines, Southern China, Indo-China and Siam, Philip. Agri. 9 (1921) 121–179.

gle are severely attacked in both regions. The Nakorn Chaisri seedless pummelo is extremely delicate and, consequently, most apt to be severely attacked by canker and other diseases. An extensive study of the several varieties may show some slight resistance, but in general all trees of this type are attacked. Fruit rots may take place while in storage, especially on fruits that have been injured during picking and handling. This trouble can, however, be entirely avoided by proper handling and shipping. In order to obtain the highest possible yield of unmarred fruits of this variety, the best of culture and care will have to be exercised. If this be done, it will be possible to produce the Nakorn Chaisri pummelo commercially. An intensive study of this type should be undertaken to determine whether or not a more resistant strain can be developed.

The diseases listed below may be found on all varieties of pummelos. However, the susceptibility to disease of varieties in the different groups seems to vary.

Algae; parasitic; undetermined. Parasitic algae may produce a leaf spotting which, however, is not serious.

Aschersonia aleyrodis Webber. Scale insects on citrus trees may be attacked by *Aschersonia aleyrodis* Webb. It is a beneficial fungus as it reduces the number of coccids. Scale insects of various species, as later listed, may be severe on stem, leaves, and fruit.

Bark rot; *Diplodia*. A common bark rot caused by a *Diplodia* may attack the pummelo, but does not appear to be serious. The same fungus produces the gummosis of trees and the black, sooty fruit rot.

Canker; *Pseudomonas citri* Hasse. On the Nakorn Chaisri seedless variety the canker is extremely serious, as it attacks leaf, stem, and fruit (Plate 15, fig. 2). There appears to be no individual variation as to susceptibility. Brownish, cankered areas are produced on the affected parts. The growers do not consider the disease to be a serious one and believe that it is due to a caterpillar or to some other insect. If only a few cankered infections develop on the fruits, the planters say that the sale is not hindered; but if the affection is severe, the price obtained for such fruits is somewhat lower. The great demand, especially among the Chinese, for the best types of fruit and their comparative scarcity account for their ready sale even though defaced. The growers recognize the fact that a rot does not start from the cankered area. The canker appears to be more prevalent in well-kept plantations where the trees are vigorous. In neglected orchards it is not so much in evidence. Counts of cankered* fruits of the Nakorn Chaisri seedless variety in storage give some indication of the severity of the disease. Of 128 fruits examined, 74, or 58 per cent, were found to be more or less severely cankered. Young plants, introduced and growing under Philippine conditions, at the College of Agriculture, Los Baños, are badly affected.

Epiphytes; parasitic; *Loranthus* species. The most serious trouble on citrus trees in general is caused by *Loranthus*, of which the following species were found to attack the Siamese pummelo: *Loranthus ferrugineus* Roxb., *L. parasiticus* (Linn.) Merr., and *L. pentandrus* Linn. If the epiphyte is not cut out, it soon envelops the entire tree. The parasite has a wide range; it is found on mangos, mangosteens, and durians, and on the native tree *Bruguiera sexangula* (Lour.) Poir. that is used to line dikes. Care should be taken to remove the epiphyte from all trees affected.

Fruit rot; *Diplodia*. Fruits in storage or those that have been allowed to decay on the ground are frequently subject to a black rot caused by a *Diplodia* (Plate 15, fig. 1). The trouble is not serious. It is not common on fruits on the trees or in storage. Rough handling in picking and storing makes the fruits more susceptible to rot. All black-rotted fruits should be collected and burned, as the fungus causing the disease is the same that produces bark rot and gummosis.

Fruit rot; *Sclerotium*. A *Sclerotium* may cause rot on fruits that have fallen to the ground. The disease is characterized by the formation of small, spherical, brownish, sclerotial bodies over the decayed area.

Gummosis; *Diplodia*. Gummosis may be severe in neglected orchards. It is of two kinds, that due to a *Diplodia* and that due to malnutrition.

Lichens; undetermined. Lichens of various sorts are found on trunk, branches, leaves, and fruits. Little damage is done by them.

Mottled leaf; nonparasitic. A typical mottled leaf with the yellowed areas between the green veins is common, but is not considered serious.

Russet; undetermined. Fruits may be russety. Whether this is due to injury caused by rubbing against branches or to fungi could not be determined. In some cases the disease appeared to be typical, due to the wither-tip fungus *Colletotrichum gloeosporioides* Penz.

Scaly bark; undetermined. Old neglected trees are subject to a rotting of the bark and a consequent sloughing of the dead parts. The trouble is only serious in older, poorly kept orchards. It is not a typical bark rot.

Septobasidium albidum Patouillard. A thick, brown, leathery growth of *Septobasidium albidum* Pat. may be produced over stems attacked by scales. Usually no damage is done by the fungus.

Sooty mold; *Meliola citricola* Sydow. A black mold may develop on leaves and stems, especially in the presence of scale insects. The trouble is not serious.

Witches' broom; nonparasitic. In poorly kept, improperly pruned orchards, witches' broom may develop on the branches. The trouble is not serious.

Yellowing, or chlorotic condition; nonparasitic. During the extreme dry season, the trees may look sickly, being yellowed. This condition is commonest where irrigation is not properly practiced. The Nakorn Chaisri seedless pummelo is not a hardy, robust tree; consequently it is easily weakened by unfavorable conditions. Often, due to neglect, the trees are old at ten years of age. Well-kept orchards have healthy trees, free from the majority of serious plant pests, and produce fruit for thirty years. The age of the tree is frequently dependent upon the care given it and upon the extent of the dry season. Healthy trees produce most abundantly between eight and fifteen years of age. In poorly kept orchards, during the extreme dry season, the trees are sickly, the leaves wilt and drop, and there is a die-back of the branches. The trees will not stand flooding. The greater number of seedless pummelo trees in the Ban Mai section that have died were lost either through lack of attention or through heavy floods. The owners do not replant with the Kao Pan trees, because they are delicate and require a good deal of attention. They recognize the hardiness of the Kao Phuang pummelo and are planting this variety.

On dead branches the following may develop: *Schizophyllum commune* Fr., *Tryblidiella rufula* (Spreng.) Sacc., and *Heterochaete tenuicula* (Lév.) Pat.

INSECTS

Insect attacks may cause great losses. The leaf miner, the flea beetle, ants, and scale insects do the most damage. The insects listed are those most generally found and, consequently, those that may cause the greatest amount of destruction.

Ant; mod dam; *Dolichoderus* species.[11] Harmless black ants are often found on the leaves, especially in the vicinity of scale insects. They attend the scale to obtain the sweet secretions of the latter, but cause no damage to the tree.

Ant; mod kan fie; *Pheidologeton* species. A reddish fire ant, so called because of its burning bite, may cause serious damage, even to the extent of killing some of the trees. The ant attacks and kills the young roots, and also is reported to attack the older roots, the trunk just below the ground surface, and even the young twigs and leaves. In some cases ants of this species girdle and kill the trees. Rot-producing and parasitic fungi frequently gain entrance to the tree through injuries caused by ants. Fruit touching the ground may be attacked by ants and other insects, thereby opening a way for fungi.

The control consists in flooding out the ants and burning them. In October and November when the water is high, during the flood periods, the growers allow the water to flow over and stand on the fields for from two to three days. By this method the ants are forced out of the ground. They come to the surface and seek the highest points of land. The owner then travels about with a lighted torch of long grass and burns them. Termites, small red ants, and black ants are also killed in this way.

Ant, red tree; mod dang; *Oecaphylla smaragdina* Fabricius. The large red, or cedar-colored, tree ant is common on the branches of trees. It does no damage to the tree directly, but makes nests of the living leaves. The ants of this species attend scale insects to obtain the secretions from the bodies of the latter, and are found throughout the East; they are a pest during harvest time, and attack and bite the pickers.

In the citrus groves about Canton it is reported that the orchardists import the ants and place nests of them on the trees to destroy caterpillars, probably tent caterpillars, which at times do serious damage. The trees in orchards are connected by bamboo poles to enable the ants to pass from tree to tree.

Flea beetle. Flea beetle attack on the leaves is characterized by the epidermal layer and the mesophyll being eaten away on one side of the leaf down to the epidermal layer on the other side. Severe injury may be done.

[11] The ants listed were determined by H. E. Woodworth, College of Agriculture, Los Baños.

Leaf miner; *Phyllocnistis citrella* Stainton. The leaf miner may cause much loss, especially on young nursery trees. The miner seems to prefer the young leaves. Badly attacked young leaves are stunted, wrinkled, and rolled up. On older trees the effect is not so noticeable. The insect may spread canker infections. The leaves of the various *Loranthus* species may also be attacked.

Scale insects. Scale insects may be present in abundance on stem, leaves, and fruit of pummelos. The following have been indentified: *Chrysomphalus aonidium* (Linn.), *C. aurantii* (Mask.), *Coccus hesperidum* (Linn.), *Lepidosaphes gloverii* (Pack.), *Parlatoria brasiliensis* sp. nov., *P. ziziphus* (Lucas), *Pseudaonidia trilobitiformis* (Green), and *Saissetia* sp.[12] An examination of fruits in storage, showed that of 37 only 2, or .05 per cent, had been attacked.

Termites; pluag. Termites do some damage by eating the roots. No serious losses are produced.

SALTING AND CULTURAL PRACTICES IN RELATION TO QUALITY AND SEEDLESSNESS

The Nakorn Chaisri seedless pummelo, Kao Pan, is only produced in its seedless form, with its excellent flavor and juiciness, in a restricted region on Tachin River about the section, or Tom Bol, of Ban Mai. If taken to regions other than Nakorn Chaisri it is said to deteriorate greatly, in that the fruits contain many seeds and the quality of the juice sacs is not so good. This deterioration is often attributed to lack of salt in the soil. As has been pointed out, the tidewaters of Tachin River in Nakorn Chaisri are salty for the greater part of the year, from January to June or July, depending upon the rains. Growers say that if the season of salty water is long, the fruits of the following year are better in flavor and have less seeds. They report that there is no danger, in the pummelo sections, of a too salty condition of the soil through this natural process of salting by means of the tidewater. In other regions there have been attempts to maintain the Nakorn Chaisri standard of perfection by the artificial application of coarse sea salt.

Some orchardists claimed that the trees grown away from Nakorn Chaisri had fruit without seeds; others stated that many seeds developed. It was impossible for us to ascertain defi-

[12] Determinations by Harold Morrison, of the United States Bureau of Entomology, Washington, D. C.

nitely which was the case in most instances; but the evidence obtained indicated that the trees produced fruits without seeds during certain seasons, and, at other seasons, fruits with many seeds. The quality of the fruits grown elsewhere was always much poorer. The Governor of Tachin, Phya Sakoen Kanabhirako, reported having sent one hundred marcots to various sections of the country about Bangkok, and that the fruits grown from these were poor. The first crop from such trees was reported to be fairly good, but in succeeding years the fruits deteriorated, becoming seedy and poor in quality. Direct evidence of such cases could not be thoroughly investigated; so, for the present, it is necessary to rely upon the evidence given by growers. Planters in Bang Sorn, a region above Bangkok, claimed that trees of the Nakorn Chaisri seedless pummelo taken from Ban Mai and planted in their section became very seedy and resembled in all respects a variety grown there called the Koon Non.

Various causes are given for the superior quality of the Kao Pan when grown in the section about Ban Mai. The theory that seems to be most commonly accepted by the growers is that the salty character of the water used for irrigation produces the exceptional quality of the fruit. Other possible causes immediately present themselves. The ones of most importance are general culture, such as the selection of a proper orchard site and the practice of proper irrigation, cultivation, fertilization, and cleanliness. The relation of seedless fruit to pollination, soil, meteorological conditions, curing, and storing may be factors.

The orchards in Ban Mai are located in reclaimed nipa-swamp areas. The nipa palm, *Nipa fruticans* Wurmb, grows only under salt conditions and is especially common along tidal streams. The orchards are all irrigated with river water, as discussed in full under culture. The growers allow the salty river water to flow into the ditches between the trees, even during the times that it is most salty, at each high tide, which is twice in every twenty-four hours. Intakes and outlets are supplied for the orchards; at low tide the water flows out and at high tide it runs in, as desired. During the extreme rainy season no river water is allowed to flow into the ditches. This is automatically regulated by the trapdoor intakes. The plantations are on land that at high tide is approximately 60 centimeters above the water and at low tide between 2 and 2.5 meters above. It can readily be seen that the trees are constantly, throughout the main part of the year, supplied with salty water. During November, at which time the crop is the heaviest, the river is reported to be free from salt. At this season the fruit is poorer in quality and is more or less seedy.

The chemical analyses of water and water extraction of orchard soil from the Nakorn Chaisri region showed that in June the salt content is great; and the analysis from the Bang Bakok region showed only a trace of salt to be present. This would indicate that there is a difference in the salt content of the water throughout the year in both localities. The difference in quality of the Kao Pan grown in these regions may then be due to the variance in the salt content of the soil and the water used for irrigation. According to the people at Tachin, 5 or 6 kilometers from the gulf, the fruit cannot be produced there because of the extreme salt content of the river water.

The salty character of the water used for irrigation appears to account for the superior flavor of the Nakorn Chaisri pummelo. The commercial pummelo, Kao Phuang, grown in the Dao Kanong region of the Menam Chao Phaya just below Bangkok, seems to react to the salt influence when grown in Nakorn Chaisri, where it produces a better quality of fruit. The flavor is reported to be improved also when the Kao Phuang is grown down Menam Chao Phaya River near the Gulf of Siam where the water is saltier. In these regions, the system of irrigation with salt water is similar to that practiced in the Nakorn Chaisri region, and the water of the Menam Chao Phaya would undoubtedly be somewhat of the same salty character as that of the Tachin.

Experiments have been conducted in various parts of Siam to test the relation of salt to fruit production. The salting of pummelo trees to produce better quality is by no means a new practice, nor is it restricted to Siam. Cameron [13] cites a case of salting in India. Under *Citrus decumana* Linn. and the Canton pummelo he writes the following:

> A dressing of salt to the roots of the trees I have been told by a friend, who tried it upon several in his garden, has a surprising effect in improving the quality of the fruit, renderng it tender as an orange, and all but bursting with juice.

An instance of salting a Nakorn Chaisri seedless pummelo tree at Bangkok was given us by Dr. Yia S. Sanitwongse. The

[13] Cameron, J., Firmingers Manual of gardening for India. Thacker Spink and Co., Calcutta (1904) 280–281.

complete history of this tree could not be obtained, but it is reported as being a seedless pummelo from the Ban Mai district. The tree in its new locality had been producing fruits that were seedless but not juicy, having woody juice sacs. Raw salt was scattered around the base of the tree. The salt application was reported to have produced a better-flavored and juicier fruit. There was no effect upon the seedy character. Other trials about Bangkok produced the same result. People in the northern part of Siam, at Chieng Mai, also practiced the salting of trees and reported an improvement in juiciness and flavor. The seedy character in these cases was not changed, as the fruits always remained seedy.

The application of salt along with rice-paddy ash is practiced. This method was reported in every case, after the first year's application, to decrease the bitterness of the fruits and to increase their juiciness. Some reported that the treatment had the effect of producing seedlessness, but no direct evidence on this point could be given. Two systems of application are practiced. The first method consists in applying the salt and rice-paddy ash directly to the trunk of the tree by digging the soil away from its base. In the second one the salt and paddy ash are scattered about the base of the tree, away from the trunk. Ordinary sea salt is used. It is recognized that too much salt will kill a tree. Usually only one application is made each year. These methods have not been practiced on a large scale; only a few trees, here and there, were so treated. Without a doubt the salt treatment produces fruit of better quality as to flavor and juiciness, but there is no effect, so far as any evidence shows, upon its seediness.

It has long been known that common salt, sodium chloride, has a marked effect on certain soils. The cause of this is not clearly understood. The addition of sodium and chlorine as soil constituents undoubtedly has no effect, as there is usually an excess of these elements in available form in soils. It is known that the addition of sodium chloride, especially to clay soil, liberates certain plant nutrients such as calcium, magnesium, potassium, and phosphorus. It may be that such action is responsible for some of the beneficial effects observed in the regions under discussion, as the soil in those regions is primarily clayey. Soil structure also is improved by the addition of salt, and salt has the effect of conserving and distributing the soil moisture. Transpiration is retarded and the film movement increased by salt in solution. The movement of water is increased in this way; consequently, the roots are always well supplied, especially in locations where the irrigation ditches are constantly filled with salty water. Experiments elsewhere have shown that not all soils are benefited by salt application.

It would seem that the beneficial effect of salt in the Nakorn Chaisri orchards is primarily due to liberation of certain plant nutrients and increase in the film movement whereby the roots are constantly kept abundantly supplied with water. The chemical effect of salt, when taken into the plant, especially in relation to sugar transport, may also have some bearing on the quality of the fruit. Further experiments would have to be conducted to determine these points.

Another important point in the production of high-quality fruit is general culture. The Kao Pan is not an extremely hardy and robust tree and responds readily to culture. The orchardists who produce the very best fruits are those that use the most careful orchard practices, such as the selection of a proper orchard site and the practice of proper irrigation, cultivation, fertilization, and cleanliness. The best orchards have been located in the Ban Mai region where the salty character of the Tachin River appears to be at its best. The growers in these regions have small holdings and take exceptionally good care of their trees. The nearness to the river does not appear to make any difference, as orchards located on the banks and others a hundred meters from the bank produce fruit of equal quality. The height of the land above the water, according to the growers, has some effect on the fruit; for, if the land is a little too high above the water, the best pummelos cannot be developed. This would indicate that irrigation with a constant supply of water is essential. Keeping down weeds and the production of a dust mulch are practiced in the best plantations. The application of fertilizer, such as wood ashes or paddy ash and canal mud, at least once each year, is essential. Pruning of all dead branches and removal of parasites such as *Loranthus* must be done to obtain the best results. Trees in neglected orchards, even in the heart of Ban Mai district, are sickly and dying, and they produce a distinctly inferior fruit, with thicker skin and poorer flavor, than do neighboring orchards where the best attention is given.

It appears from these investigations, that Kao Pan trees grown out of the Nakorn Chaisri region, even when the salt requirements were right, have not been given proper culture and care. The orchardists gave the same treatment as is given to the Kao Phuang tree, which is hardy and can withstand lack of attention. Therefore, after the other essential needs such as salt application have been provided for, proper culture is undoubtedly an important requirement for the production of a Kao Pan seedless pummelo of good quality. Careful experimentation in the use of proper culture will have to be conducted to prove whether or not the true quality and seedless characters can be retained when the pummelo is grown in any other than the Nakorn Chaisri region.

The relation of seedless fruit to pollination and the presence or the absence of the foreign pollen will have to be carefully investigated before any definite statements can be made. Whether the pollen of the Kao Pan is not viable for the main part of the year, or whether the stigma is not receptive, cannot be stated. All that is known is that the fruit contains only abortive seeds in every month except November. During this month the greatest crop is produced, and the fruit is apt to be seedy. Wild bees are present in the orchards at all times, and provide a method for the interchange of pollen. Frequently interplanted with the seedless pummelos are other varieties of pummelos, such as the Kao Phuang, that are extremely seedy, as well as seedy limes, and mandarin and other oranges. In no case was there any indication that the seedless pummelo trees adjacent to the other seedy citrus trees were any different from the rest of the Kao Pan trees, from the standpoint of seediness. Seeds were never developed in the fruits of these trees except as reported, in November. From all observations it appears that the Kao Pan is a distinct variety, which is characterized by its seedless nature throughout most of the year. Frequently the fruit of the Kao Phuang and other seedy pummelos grown about Bangkok are seedless. This is generally true of the fruits that have developed from adventitious flowers, those flowers that have come latest and have been produced out of the usual flowering season.

The very restricted area of about 48 square kilometers, devoted to the production of the Nakorn Chaisri seedless pummelo, would indicate that the soil or the meteorological conditions are of a special nature in this section. The topsoil is a loose clay loam and the subsoil is a heavy gray clay which seems to be characteristic for the entire delta region.

Some growers contend that the quality of the Nakorn Chaisri pummelo is due to the method of curing and storing. While this undoubtedly is a factor in producing a better flavor and aroma in all varieties of pummelos, it cannot account for the superiority of the Kao Pan over the other varieties.

SUMMARY AND CONCLUSIONS

The Siam seedless pummelo, sometimes called the Nakorn Chaisri or Kao Pan pummelo, appears to be a distinct variety developed in a restricted region of the delta area in Ban Mai, Sarm Prarm, Nakorn Chaisri, Siam. Through the main part of the year it produces seedless fruits, but during November the fruit is reported to incline to seediness.

The temperature in this region ranges between 24.4 and 32.1° C., the coolest months being December and January, and the hottest about April. The mean daily range is about 9.3° C. The total rainfall for the district varies between 1,154.7 and 1,690 millimeters during the year. A distinct dry season is present, usually starting in November and continuing through December, January, February, March, and April.

The water used for irrigation in the Ban Mai orchards is taken directly from Tachin River. This water is extremely salty during at least six months of the year. In June analyses showed the presence of 2 per cent of salt, which approaches the salt content of sea water, with approximately 2.7 per cent of sodium chloride.

The water used for irrigation in the Bang Bakok fruit section near Bangkok is obtained from the Menam Chao Phaya. The fruit produced in this section is seedy and its quality is inferior to that produced in the Ban Mai region. Analyses of this water showed that in June it contained only 0.04 per cent of salt, which is normal for ordinary river water. The water is reported to be less salty throughout the year than that of Tachin River at Ban Mai.

The surface soil in all of the orchard sections in the delta region is heavy, clayey, and entirely of an alluvial formation. The subsoil is a heavy, gray, brick clay, which is rather impervious to water.

Analyses of the salt content of the soils in Ban Mai show that the surface soil, subsoil, and canal mud used for fertilization, are extremely salty in June, containing between 0.8 and 2.5 per cent of salt. The soil in the Bang Bakok region showed only a normal sodium chloride content, between 0.18 and 0.33 per cent.

The presence throughout the greater part of the year of a large amount of salt in the irrigation water, and consequently in the soil, of the Nakorn Chaisri region at Ban Mai seems to have a direct relation to the quality of fruit produced, and may have some relation to its seedlessness. The fruit produced in the Bang Bakok district, where the water is less salty throughout the year, is inferior in quality and very seedy.

The cultural methods used in the best pummelo sections of Siam are well adapted to the low, wet, mud flats and nipa swamps of the region. The raised-bed methods followed are very largely those employed by the Chinese in the successful plantations of the flood-swept delta regions of southern China.

The seedless pummelo trees flower and fruit throughout the year, but in most abundance four times each year. The largest number of flowers appear in June, at the beginning of the rainy season; from this lot of blossoms is produced the largest crop, ripening in November. The fruit in this crop is reported to have seeds. During the rest of the year no seeds, or only small, abortive ones, are produced. The fruit is well suited to storage and shipping. Records of storage and shipments covering a period of from six to eight months have been made. The fruit will remain in excellent condition for two or three months.

The Kao Pan, or Nakorn Chaisri, pummelo has a well-rounded, usually low-headed, shapely tree. In form, shape of leaf and of fruit, and size and shape of oil cells, it somewhat resembles an orange. It is, however, a true pummelo. The fruit is fleshy, very juicy, white, and has a delightfully sweet, mildly acid flavor. It is probably the best of the pummelo types.

The Nakorn Chaisri seedless pummelo is extremely delicate and, consequently, apt to be severely attacked by canker and other diseases and pests. The tree needs constant attention and care, but with such care excellent results can be obtained.

Salting and cultural practices seem to have a direct relation to the quality of the fruit produced and possibly some relation to the seedlessness.

The relation of seedless fruit to pollination was not fully determined. The soil and meteorological conditions may be factors in the production of excellent-quality fruit.

Curing and storage undoubtedly are factors in the production of better flavor and aroma in all varieties of pummelos.

With the selection of a proper site and with proper cultural methods, the Nakorn Chaisri seedless pummelo could undoubtedly be grown successfully in the Philippine Islands and in the United States. The swamp lands near nipa-palm sections afford an excellent location for experimentation with this fruit in the Philippines. Regions in the Everglades of Florida should be desirable for the production of the Kao Pan, or Nakorn Chaisri, seedless pummelo.

ILLUSTRATIONS

Plate 1

Fig. 1. Tachin River near Ban Mai, showing nipa, *Nipa fruticans* Wurmb, swamp and thatched hut of an orchardist.

2. Canal leading from Tachin River to the inland orchards. The river is at low tide.

3. Irrigation and drainage canal in the Nakorn Chaisri orchard section.

Plate 2

Fig. 1. Grass and nipa swamp at Ban Mai, Nakorn Chaisri. The land in the foreground has been cleared and is ready for the preparation of mud dikes and canals.

2. A raised dike along a canal in the Ban Mai region. The land is being prepared for pummelo culture. The embankment is a meter or less higher than the surface of the interior beds.

3. Jak trees, *Artocarpus integra* (Raderm.) Merr. (*A. integrifolia* Linn.), planted along the edge of a dike. Pummelo trees are planted within, on the first bed.

Plate 3

Fig. 1. Digging ditches in the preparation of the beds for the citrus orchard. The soil is used in the construction of the raised beds between the ditches.

2. Preparation of ditches in the process of forming raised beds for pummelo culture. The soil is removed by hand after being cut into blocks with a special spade.

3. Prepared beds in a newly developed plot planted to sugar cane before being ready for the citrus.

Plate 4

Fig. 1. Newly prepared beds planted to bananas before being ready for the citrus.

2. Automatic water gate, leading from the canal through the dike into the ditches in the orchard. The pipe is made of a palm-tree trunk. The water is at low tide.

3. An older cultivated area in the Nakorn Chaisri region, showing the irrigation and drainage canal and the orchard land on both sides.

Plate 5

Fig. 1. One of the best-managed Nakorn Chaisri pummelo groves at Ban Mai.

2. Cement steps leading from a main canal up to the orchard house.

3. *Bruguiera sexangula* (Lour.) Pers. and pineapples planted on a dike along a canal. The roots of the trees help to keep the earth at the base of the dikes in place.

PLATE 6

FIG. 1. A walk on top of a dike; the side toward the canal is thickly planted with trees.
2. A much-widened and deepened ditch in an old Nakorn Chaisri pummelo orchard.
3. Trenching as carried on by Chinese labor in a Nakorn Chaisri orchard.

PLATE 7

FIG. 1. Network of trenches, showing the effect of washing by rain in a Nakorn Chaisri orchard.
2. Logs and bamboo poles thrown across the ditches to serve as foot bridges.
3. Betel palms, *Areca catechu* Linn., growing along the edge of citrus beds.

PLATE 8

FIG. 1. Betel palms, *Areca catechu* Linn., growing along a walk in the citrus orchard.
2. Betel palms, *Areca catechu* Linn., interplanted with citrus trees.
3. Tall betel palms, *Areca catechu* Linn., scattered throughout a citrus plantation, providing a semishade for the pummelo trees.

PLATE 9

FIG. 1. A much-widened ditch along the edges of which rice may be planted during the rainy season.
2. Dead leaves, straw, and removed wood allowed to rot under the trees. Low-headed pummelo tree, branching from the surface of the ground.
3. A pile of rice-paddy ash at the base of a pummelo tree in Nakorn Chaisri.

PLATE 10

FIG. 1. A shapely, well-rounded, low-headed tree of a Nakorn Chaisri seedless pummelo.
2. The lower branches of a Nakorn Chaisri seedless pummelo lying almost flat along the surface of the bed and extending over the trench of water.
3. A low-headed, spreading tree of a Nakorn Chaisri seedless pummelo.

PLATE 11

FIG. 1. Flowers and newly developed fruits formed on young stems, which shoot out quite upright from the branches of the previous year's growth.
2. A mass of old flowers and newly developed fruits produced from a single flower stalk.
3. A flower of a Nakorn Chaisri seedless pummelo.

PLATE 12

FIG. 1. A Nakorn Chaisri seedless pummelo cut longitudinally and prepared ready for eating.

2. A Nakorn Chaisri seedless pummelo cut open and each locule separated.

3. A Nakorn Chaisri seedless pummelo cut longitudinally, showing thickness of skin, sections, and open center with the core extending down one side. The fruit is not quite mature.

PLATE 13

FIG. 1. Latitudinal section of the Nakorn Chaisri seedless pummelo shown in fig. 2.

2. A Nakorn Chaisri seedless pummelo picked at Ban Mai about June 1, 1920; purchased at the orchard storehouse on June 8 and shipped to the Philippine Islands. The picture was taken at Los Baños on August 25, 1920. The fruit is still of excellent quality and flavor after long storage; diameter, 12.5 centimeters; skin, 8 to 10 millimeters thick; no seeds.

PLATE 14

FIG. 1. Longitudinal section of the Nakorn Chaisri seedless pummelo shown in fig. 2.

2. A Nakorn Chaisri seedless pummelo picked at Ban Mai between May 11 and 30, 1920; purchased at orchard storehouse on June 8 and shipped to the Philippine Islands. The picture was taken at Los Baños on August 25. Fruit old and shriveled, but still of excellent quality and flavor; diameter, 11 centimeters; skin 8 to 10 millimeters thick; no seeds.

PLATE 15

FIG. 1. Black rot caused by a *Diplodia* on the fruit of a Nakorn Chaisri seedless pummelo. Rot produced in storage.

2. Citrus canker caused by *Pseudomonas citri* Hasse on the fruit of a Nakorn Chaisri seedless pummelo.

PLATE 16

Plat showing the cultural methods for the Siam Nakorn Chaisri seedless pummelo. Scale about 1 to 1,500.

TEXT FIGURE

FIG. 1. Map showing the location of the pummelo orchards at Ban Mai on Tachin River; scale, about 1 to 530,000.

181287——4

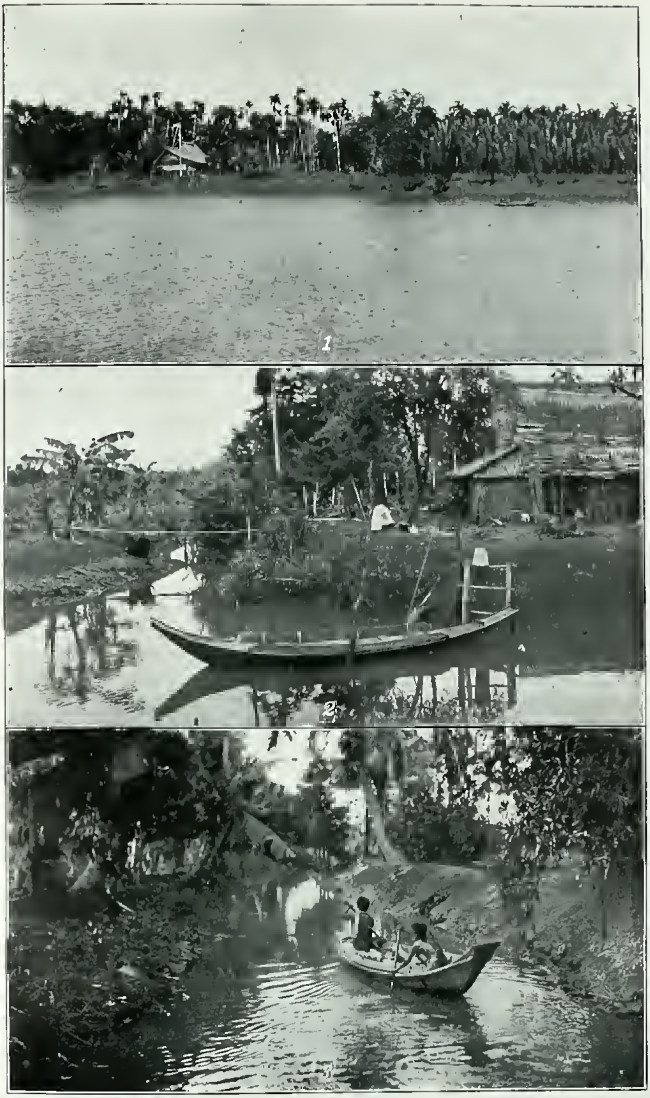


PLATE 1.

PLATE 2.

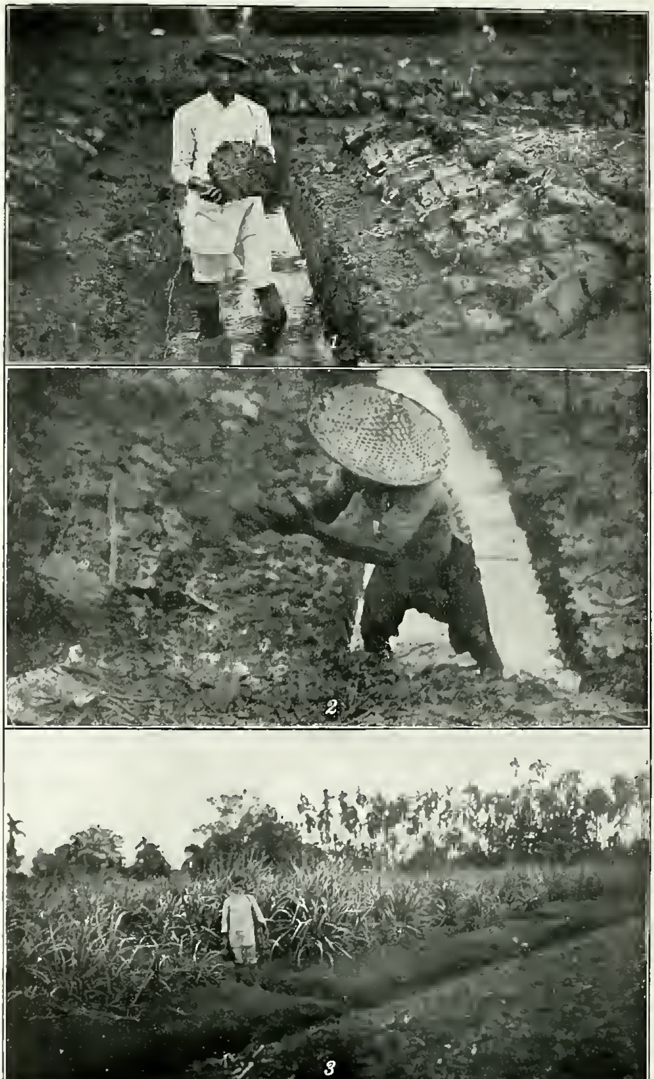


PLATE 3.

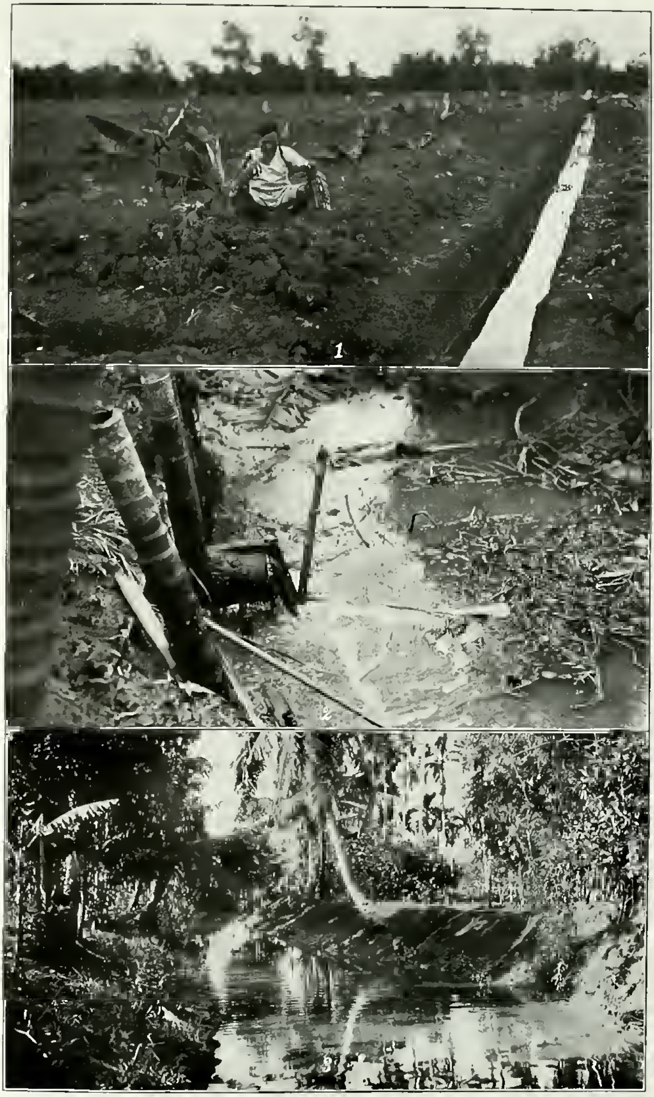


PLATE 4.

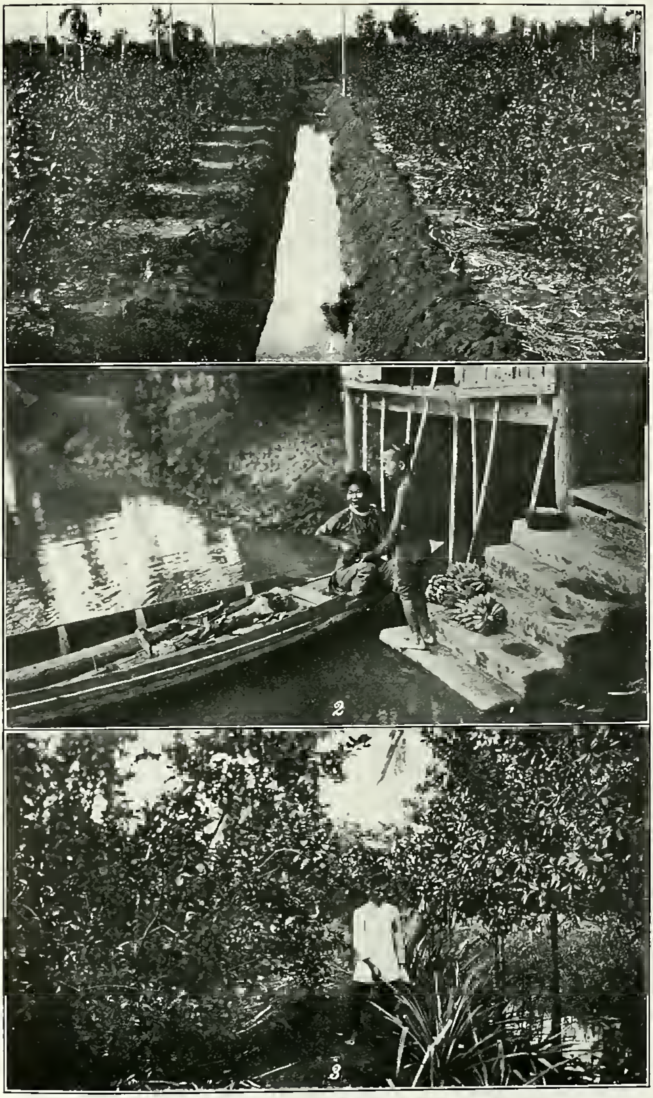


PLATE 5.

PLATE 6.

PLATE 7.

PLATE 8.

PLATE 9.

PLATE 10.

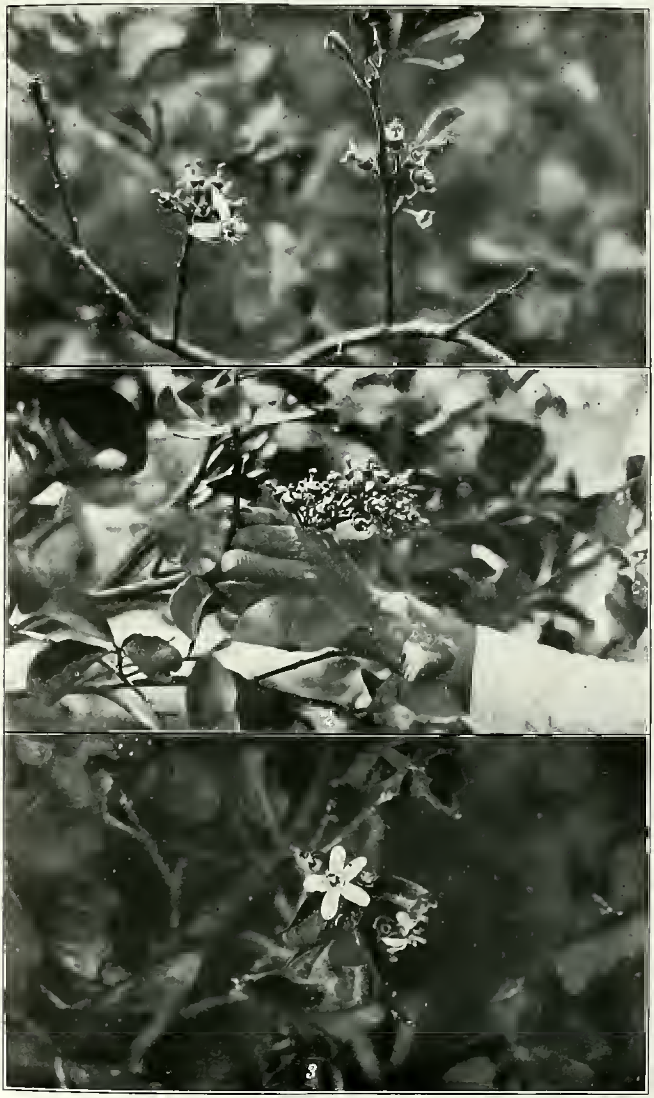


PLATE 11.

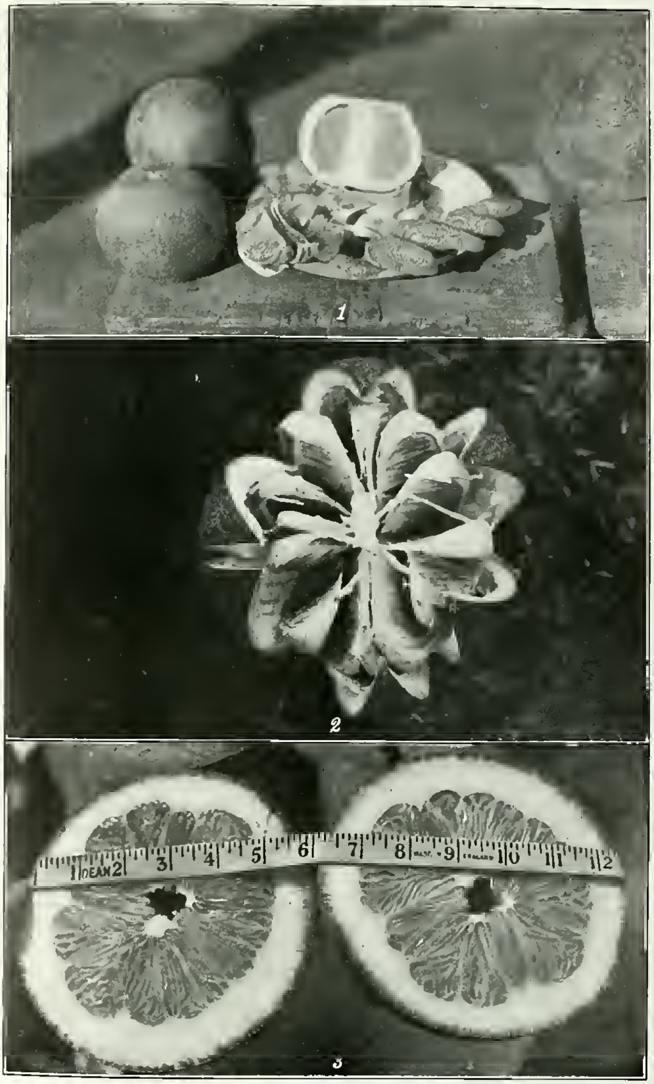
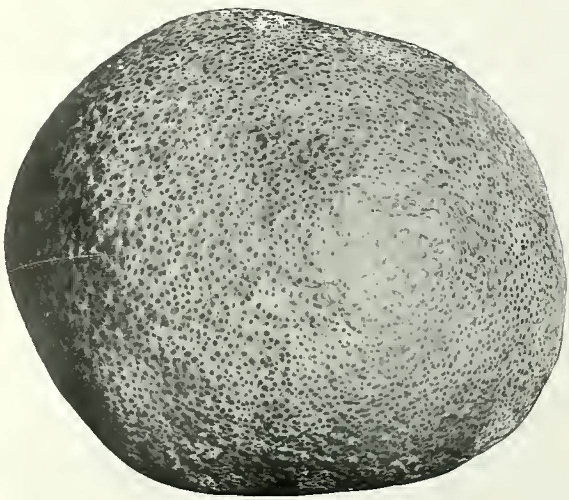


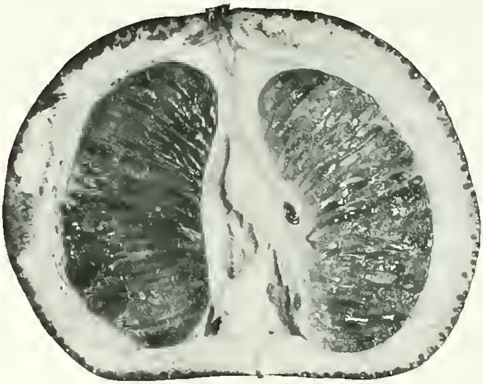
PLATE 12.

1

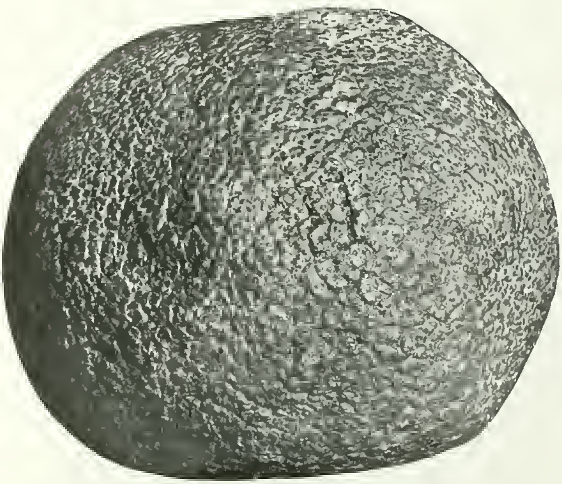


2

PLATE 13.

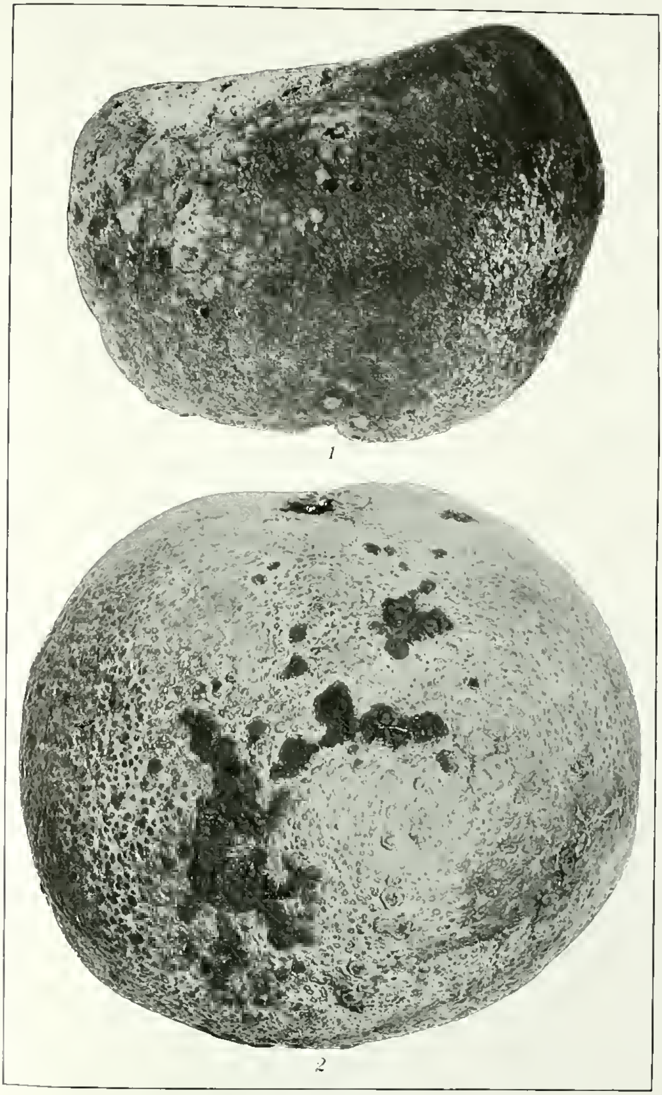


1



2

PLATE 14.



1

2

PLATE 15.

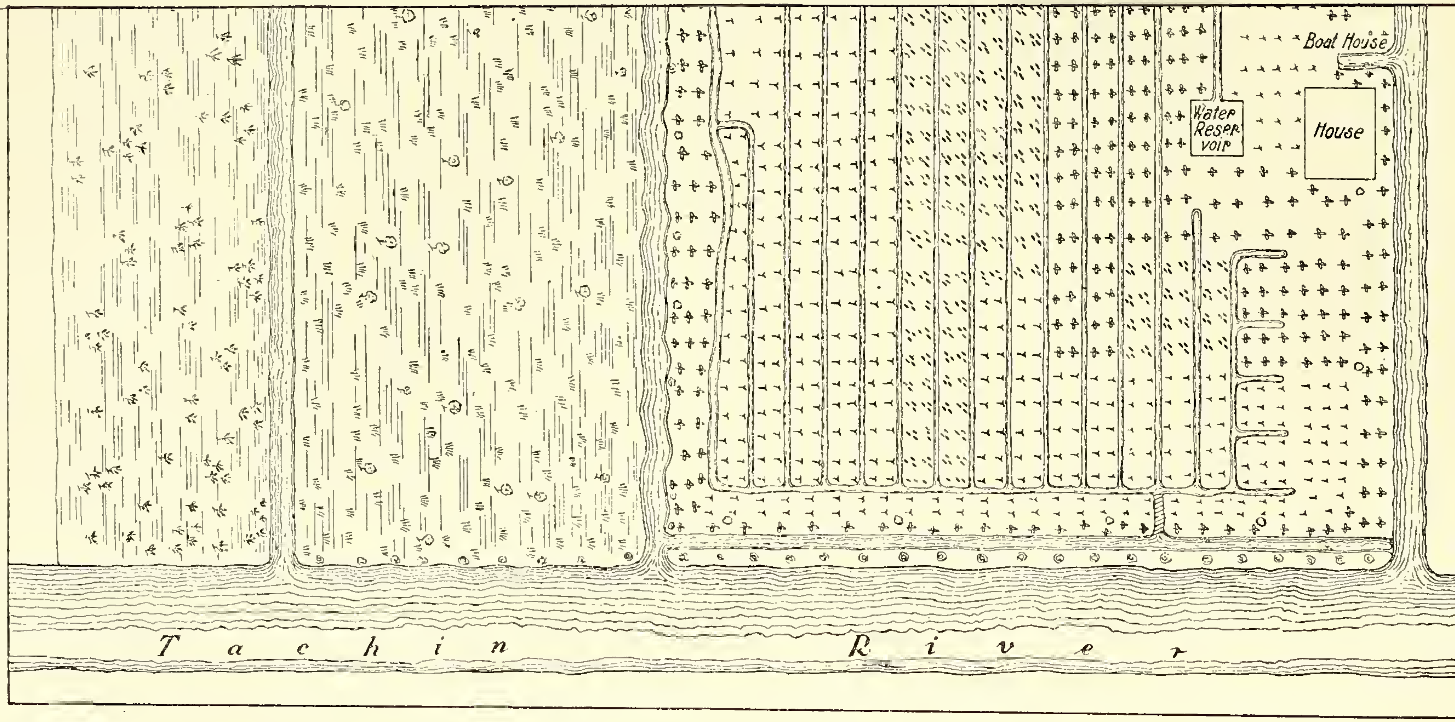


PLATE 16. THE CULTURAL METHODS FOR THE SIAM NAKORN CHAISRI SEEDLESS PUMMELO; SCALE, ABOUT 1 TO 1,500.

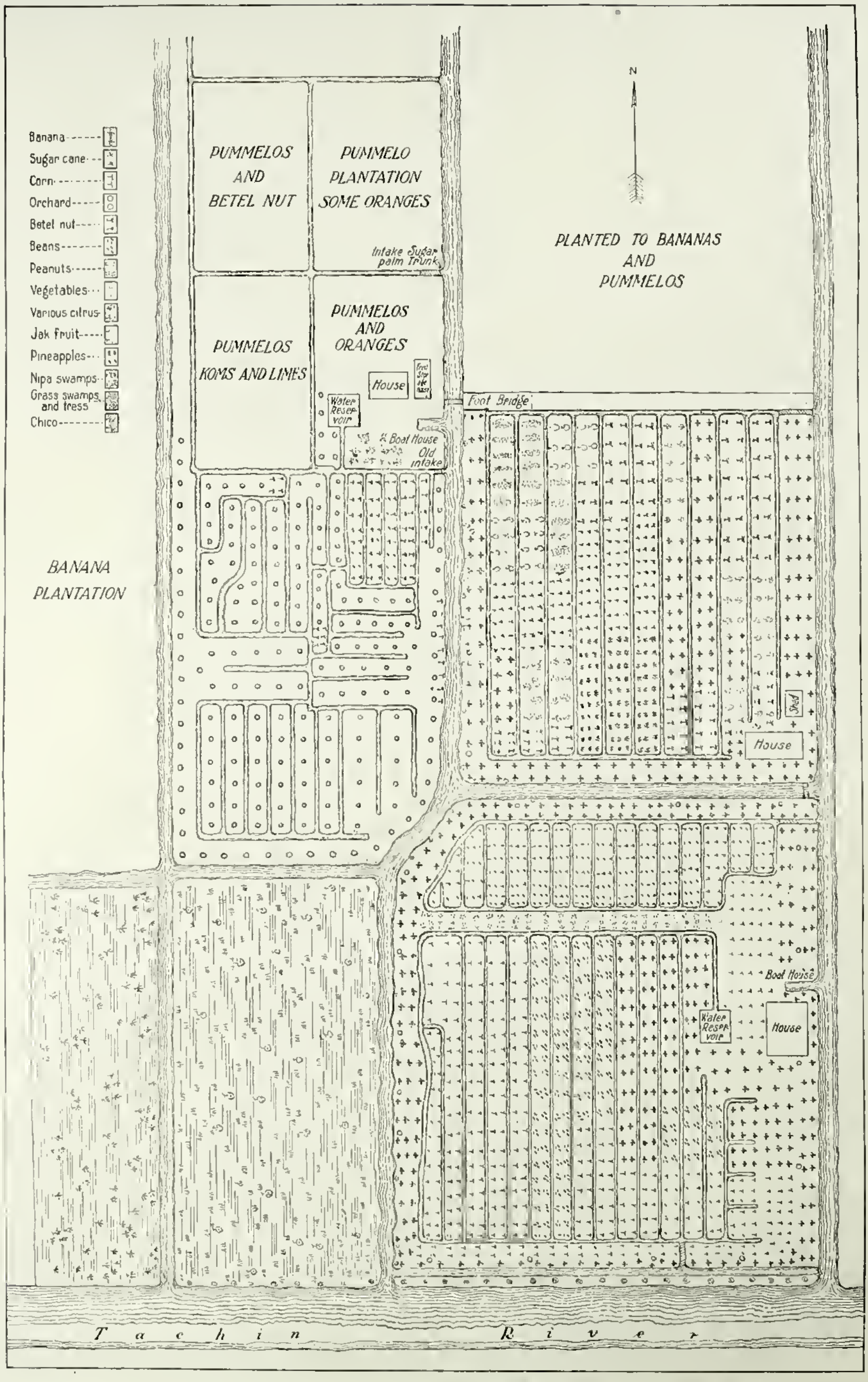


PLATE 16. THE CULTURAL METHODS FOR THE SIAM NAKORN CHAISRI SEEDLESS PUMMELO; SCALE, ABOUT 1 TO 1,500.

PHILIPPINE TENEBRIONIDÆ, II [1]

By HANS GEBIEN

Hamburg, Germany

TWO PLATES

The great activity of Prof. C. F. Baker, as a collector on many of the islands comprising the Philippine Archipelago, has resulted in bringing so much new material in the Tenebrionidæ to the attention of science that it is believed worth while to make this material the subject of a special paper. I regret that I cannot, with the Philippine material collected up to the present, comply with Professor Baker's request to make a synopsis of the Philippine Tenebrionidæ. The fact that this zealous collector has succeeded in the short space of three years [2] in bringing together so large a number of new species demonstrates that it would be premature to undertake this task at present; very much more new material will surely be found when the mountainous and inaccessible parts of the Islands, especially those that are infrequently visited, shall have been explored. It is especially necessary, for zoögeographical reasons, that the more remote islands be explored—that is, such as lie near other faunal regions—in order to determine to what extent the forms from those regions intergrade with those of our own. Furthermore, systematic work on Indo-Malayan Tenebrionidæ is still very obscure and cannot be attempted with material from a restricted faunal area.

As we now have more than one hundred fifty species of Tenebrionidæ a fairly clear idea can be formed of the Philippine tenebrionid fauna. Evidently we are here dealing with a pure Indo-Malayan fauna. Naturally, there is no lack of genera that are restricted to the Philippines. Where such is the case the nearest relationship must be sought, almost without exception, on the neighboring islands. To these endemic genera belong *Oedemutes*, *Pseudostrongylium*, *Aptereucyrtus*, *Pseudabax*, and *Lophocnemis*. Only a few genera stand entirely isolated, no related genera being found in other faunal regions;

[1] For Part I, see Philip. Journ. Sci. § D 8 (1913) 373–433.

[2] This paper was completed early in 1916.

for instance, *Allopezus* and *Bolitrum*. These, of course, do not lend themselves to zoögeographical study. By far the greater number of genera is represented only on the Sunda Islands, or possibly in the interior of India, Formosa, and Ceylon. These are *Bolitoxenus, Leiochrodes, Setenis, Encyalesthus, Catapiestus, Artactes, Scotaeus, Pseudeumolpus, Platycrepis, Eucyrtus, Simalura, Hemicera, Psydus, Camarimena, Pseudonautes, Gauromaia, Dietysus*, and *Aediotorix*. There remains a considerable number of genera the species of which extend over a wider region. These genera, to which belong *Mesomorphus, Bradymerus, Byrsax, Ceropria, Cossyphus*, and *Lyprops*, extend partially from Africa to Australia. *Scleron* finds here its most easterly extension, *Cnemodasus* its most westerly.

Only two genera fall entirely beyond these limits. As to the first one, *Ethas*, I doubt that it occurs in the Philippines; despite exhausted search in the Islands it has not been found again since Eschscholtz's time. It is possible that the habitat was incorrectly reported and that the animals in question were found in India, where it occurs. Such an oversight can easily be understood when we consider that Kotzebue in his journey around the world touched many different regions. The second genus, *Leptoscapha*, I have discussed elsewhere.

The foregoing remarks lead to the conclusion that the fauna of the Philippines must belong to the Indo-Malayan region.

I am greatly indebted to Professor Baker, whose untiring activity as a collector made possible the preparation of this paper, and who most generously presented to me single specimens for my own collection. To express to him here my hearty thanks is an agreeable duty. Further, several new species were found in the museums of Stettin, Dresden, and Hamburg, as well as in my own collection. I am also greatly indebted to Mr. P. Timm, member of the Chamber of Audits in Zoppot, who not only presented me with several species from his fine collection but also, by means of excellent photographs taken by him for me at the expenditure of much time, enhanced the value of this work not a little.[3]

PEDININÆ

Mesomorphus maquilingius sp. nov.

Klein, sehr gewölbt, dunkel, matt schwarzbraun, Fühler und Beine gelblich braun. Der Clypeus ist halbkreisförmig ausge-

[3] The introduction was translated from the German by the Bureau of Science.—EDITORS.

schnitten, die Seitenlappen halbkreisförmig, der Vorderrand des Kopfes also wie bei *M. villiger;* die Oberlippe mit feinem Ausschnitt am Vorderrand. Der Kopf ist flach, der Quereindruck sehr schwach begrenzt; am Innenrand der Augen befindet sich eine schmale, aber kräftig erhöhte Längsfalte, viel stärker als bei *villiger,* die durch darauf gestellte Wimperborsten noch deutlicher wird, und namentlich bei der Ansicht von der Seite auffällig ist. Die Skulptur besteht aus groben, flachen Punkten, deren Zwischenräume ein feines, ziemlich regelmässiges Netzwerk von glänzenden Erhabenheiten bildet; jeder Punkt hat im Zentrum eine kurze, fast aufrechte Borste. Die Wangen sind vor den Augen viel breiter als bei *villiger,* ihre Ecken abgerundet; die Bildung erinnert mehr an *Gonocephalum* als an *Mesomorphus.* Die Fühler sind kürzer als bei *villiger,* ihre vorletzten Glieder stärker quer und das letzte ist nicht verlängert, sondern nur so lang wie breit.

Der Halsschild ist der Quere nach stark gewölbt, seine Seitenränder sind gleichmässig, ziemlich stark verflacht, die Vorderecken sind verrundet rechtwinklig, die grösste Breite liegt hinter der Mitte, die seitliche Rundung ist sehr stark, die Hinterecken sind scharf rechtwinklig, jederseits des Mittellappens findet sich eine breite Ausbuchtung, so dass die Winkel nach hinten gerichtet erscheinen; der basale Mittellappen reicht weiter zurück als die Ecken. Die Punktierung und Beborstung ist wie auf dem Kopf, die Borsten sind halb aufrecht, nach hinten gekrümmt und viel kürzer als bei *M. villiger,* so dass eine vordere Borste den Grund der hinteren nicht bedeckt. Das Schildchen ist ziemlich blank und fein punktiert.

Die Flügeldecken sind kurz und sehr stark der Quere nach gewölbt, ihr Seitenrand von oben nicht sichtbar; die Beborstung ist unregelmässig zweizeilig, vor der Spitze aber in den etwas schmäleren zweiten, vierten, und sechsten Zwischenraum einzeilig, bei *M. villiger* dagegen ebenfalls zweizeilig, wenn auch unregelmässig.

Die Unterseite ist nicht heller als die Oberseite, aber viel feiner, anliegend beborstet. Die Vorderbrust ist vorn und an den Pleuren mit scharfen, glänzenden, runden Körnern versehen (bei *M. villiger* punktiert), der Prosternalforstsatz ist hinten niedergedrückt; im übrigen ist die Unterseite ganz ähnlich; die Vorderschienen sind schmäler als bei dieser Art.

LUZON, Laguna, Mount Maquiling, 1 Exemplar.

Länge, 5.6 Millimeter; Breite, 2.7.

Ich habe diese Art mit *M. villiger* verglichen, weil diese in allen Sammlungen vertreten und sehr gemein ist, sich auch auf den Philippinen findet; näher aber steht ihr eine neue Art von Birmah aus meiner Sammlung, die einen schmalen Canthus hat und deren Zwischenräume hinten deutlich punktiert sind, auch bei dieser ist die Vorderbrust deutlich gekörnt. Sehr ähnlich ist auch *M. picescens* aus Abessinien aber schmäler, matt schwarz, die Streifen sind an der Spitze grob punktiert, und das Mentum ist nicht gehöckert.

Mesomorphus villiger Blanch.

Weiteres Material liegt mir vor von Palawan, Puerto Princesa; (*2457*)[4] auch von Luzon, Mount Banahao, Mount Maquiling.

OPATRINÆ

Cnemodasus rectangulus Geb.[5]

Davon liegen mir zwei Exemplare von Los Baños vor (*1437*), ferner ein Exemplar von Manila (Hallier leg. XI.–XII. 1903) im Mus. Hamburg.

Gonocephalum bilineatum Walk.

LUZON, Benguet, Baguio (*4990*). PALAWAN, Puerto Princesa (*4051*). Auch von Mindanao (*Peters* leg.).

BOLITOPHAGINÆ

Genus **BRADYMERUS** Perroud

Obgleich die Arten dieser Gattung im allgemeinen in der Skulptur und Kopfbildung sehr gute Merkmale haben, ist ihre Deutung durchaus nicht immer leicht, da die Beschreibungen von Fairmaire und Schaufuss meist ganz unzureichend sind. Meine Auffassung von *B. crenulicollis* ist, durch die mangelhafte Beschreibung verursacht, eine falsche. *B. crenulicollis* ist durch die spitzig vorragenden Wangen und die Skulptur sehr ausgezeichnet.[6] Ich habe ihn noch einmal als *B. denticeps* beschrieben. Die von mir als *B. crenulicollis*[7] aufgefasste Art steht dem *B. elongatus* Perty (=*B. javanus* Fairm.) nahe und wird hier neu beschrieben als:

[4] Die hier angegebenen Nummern sind diejenigen unter denen mir Herr Baker die Arten mitteilte.

[5] In meiner Arbeit im Philip. Journ. Sci. § D 8 (1913) 373 gehört Zeile 25–31 ("Die verkürzten Epipleuren–unterscheidet") zur Gattungsbeschreibung von *Cnemodasus*. Ich hatte seinerzeit keine Korrektur gelesen.

[6] Bull. Sarawak Mus. 2 (1914) 11.

[7] Philip. Journ. Sci. § D 8 (1913) 379.

Bradymerus mcgregori sp. nov.

Schmal, parallel, gewölbt, hellbraun, Flügeldecken glänzend. Der Kopf ist flach, die Clypealsutur breit und flach eingedrückt, die Wangen sind ganz verrundet und nicht breiter als die Augen, die Augenfalten sind schmal, wenig deutlich, und gehen im Bogen um das Auge herum. Die Punktierung ist dicht und deutlich, die Zwischenräume der Punkte sind kurze, scharf erhabene Längskielchen; der Nacken ist fein gekörnt, der Clypeus vorn ganz gerade abgestutzt. Die Fühler sind schlank und haben eine starke, 6-gliedrige Keule, die vorletzten Glieder sind reichlich anderthalbmal so breit wie lang, das letzte so breit wie lang. Die Mandibeln sind an der Spitze tief gefurcht, das Mentum scharf gekielt.

Der Halsschild ist doppelt so breit wie lang, die Scheibe hoch gewölbt, aber die Mitte der Länge nach flach gedrückt. Die Seiten sind schwach gerundet, nach hinten wenig verengt, daher die Basis viel breiter als die Spitze, der Rand ist fast glatt, die Mitte des Vorderrandes ist breit lappenförmig nach vorn gezogen, die Vorderwinkel ragen spitz und lang vor, die Seiten sind schmal und in der Mitte etwas grubig vertieft abgesetzt. Die Punktierung ist grob, ganz dicht gedrängt, doch bilden die Zwischenräume keine Körner, aber vorn in der Mitte feine Längserhabenheiten. Die Hinterwinkel sind scharf rechtwinklig, die Basis ist stark, in der Mitte breiter gerandet.

Der Seitenrand der Flügeldecken ist von oben sichtbar, die alternierenden zwischenräume sind scharf kielförmig erhaben, der achte läuft hinten bis in die Spitze, wo er sich mit dem ersten verbindet; der scharfe Kiel des ersten Interstitiums beginnt im letzten Drittel, die Kiele des dritten, fünften, und siebenten beginnen hart an der Basis, sie sind nahezu glatt. Im vierten und sechsten Zwischenraum zeigen sich sehr schwache Spuren von Zwischenkielen, der Grund der Flügeldecken zeigt mikroskopische Nabelpunkte.

Die Unterseite, besonders das Abdomen, ist staubartig behaart, die Vorderbrust und die Propleuren sind sehr grob punktiert, das Prosternum ist der Länge nach gewölbt, der Absturz aber zuletzt senkrecht; das Mesosternum ist breit U-förmig ausgerandet, die Hinterbrust vorn und seitlich grob punktiert. Die Beine sind schlank, die Schienen dünn, die hinteren zeigen in ihrer Endhälfte einen feinen Haarstreifen.

Länge, 7.6 Millimeter; Breite, 3.1.

LUZON, Benguet, Irisan River. Ein zweites Exemplar muss sich in der Sammlung des Bureau of Science befinden. Ferner, vier Exemplare aus dem Museum Stettin von den Philippinen (*Semper* leg.).

Ich hielt diese Art zuerst nach der Beschreibung für *B. crenulicollis* Fairm.; sie steht ihm aber wegen der schmalen Wangen sehr fern. Am Nächsten verwandt ist *B. elongatus* Perty (=*B. javanus* Fairm.), der aber einen krenulierten Halsschildseitenrand hat, kräftig und scharf entwickelte Zwischenrippen, und dessen Hinterschienen einfach sind.

Bradymerus pertyi nom. nov.

Bradymerus elongatus Geb. muss wegen *B. elongatus* Perty neu benannt werden; ich nenne ihn *B. pertyi* nom. nov.

Bradymerus ferruginipes Fairm.

LUZON, Mount Banahao (*4040*), 2 Exemplare.

Bradymerus alternicostis Geb.

LUZON, Mount Maquiling (*2933*).

Bradymerus clathratus Schauf. (=*aequecostatus* Fairm.).

PALAWAN, Puerto Princesa (*4023*). LUZON, Tayabas, Malinao (*5430*), Mount Banahao. MINDANAO, Dapitan. Weiteres Material.

Bradymerus eschscholtzi sp. nov.

Schwarzblau, fast schwarz, die Decken blaugrün, Unterseite und Beine glänzend schwarzbraun; lang gestreckt, fast parallel. Der Kopf ist lang und nahezu flach, doch ist die Clypealsutur fein und deutlich eingedrückt und ihre Ausmündungsstelle am Seitenrand des Kopfes durch einen feinen Ausschnitt gekennzeichnet, der Vorderrand ist ganz gerade abgestutzt, nicht wie bei *B. carinatus* deutlich ausgebuchtet. Die Augenfurchen sind sehr tief und laufen hinten in den Nacken, nicht um das Auge herum. Die ersten Glieder der Fühler sind rotbraun, die letzten fünf bilden eine gut abgesetzte Keule. Das Mentum ist fein der Länge nach gekielt, die Mandibeln an der Spitze nur sehr undeutlich gefurcht.

Der Halsschild ist reichlich anderthalbmal so breit wie lang, die Seiten sind schwach gerundet und fast glatt, nur ganz undeutlich uneben, der Rand ist sehr schmal abgesetzt, die Vorderwinkel ragen lang und spitz vor, die Hinterecken sind scharf rechtwinklig, die Seiten sind nach hinten nur ganz schwach und fast geradlinig verengt, die Mitte des Vorderrandes ragt nicht vor, die Scheibe ist gleichmässig stark gewölbt und hat keinen Längseindruck, die Punktierung ist ziemlich grob und nur in den Vorderwinkeln gedrängt, zwischen den Punkten befinden sich zahlreiche kleine, flache Körnchen, die ein mikroskopisches Pünktchen tragen; die Punktierung ist etwas gröber und weitläufiger als die des Kopfes, die Basis ist nicht deutlich gerandet, nur in der Mitte etwas verflacht abgesetzt.

Der Seitenrand der Flügeldecken ist in der hinteren Hälfte von oben nicht sichtbar, sie sind stark gewölbt; die Punkte der Streifen sind kräftig, gleichmässig und durch eine feine, eingedrückte Linie miteinander verbunden. Von den Streifen ist der erste hinten nur stark gewölbt, der dritte in der Endhälfte, der fünfte vollständig gekielt, der sechste ebenfalls aber hinten abgekürzt, der siebente ganz gekielt, der achte in der Endhälfte; dieser ist aber nicht bis zur Spitze fortgesetzt wie bei sehr vielen Arten, sondern es findet sich dort nur eine quere Wölbung; der dritte und vierte tragen in der vorderen Hälfte sehr flache, längliche Körnchen.

Die Unterseite zeigt keine Spur von Härchen, die Vorderbrust ist in der Mitte und auf den Pleuren grob punktiert, das Prosternum ist breit gefurcht, der Fortsatz etwas niedergedrückt, die Hinterschienen sind in der Mitte der ganzen Länge nach glatt und jederseits mit einem mikroskopischen Haarstreifen versehen.

Länge, 9.2 Millimeter; Breite, 4.

LUZON, Manila (*Eschscholtz*), 2 Exemplare, in meiner Sammlung und im Berliner Museum.

Ich hielt diese Art ursprünglich für eine Varietät des veränderlichen *B. carinatus* Fairm. Eine genauere Prüfung zeigt jedoch, dass wir es sicher mit einer guten Art zu tun haben, deren Hauptmerkmale die tiefen, in den Nacken gehenden Augenfurchen, der geradlinig abgestutzte Clypeus, der feine Kiel des etwas anders gestalteten Mentums, und etwas andere Skulptur sind.

Bradymerus carinatus Fairm.

LUZON, Mount Banahao (*5429*) : Tayabas, Malinao.

Tabelle der Bradymerus-Arten der Philippinen.

Die vorstehenden Bemerkungen über *Bradymerus* und die Wiederauffindung von *B. ferruginipes* Fairm. lassen eine neue Bestimmungstabelle von den philippinischen Arten wünschenswert erscheinen. Die Arten lassen sich folgendermassen auseinanderhalten) :

1. Blaue oder metallische Arten, Fühlerkeule 5-gliedrig.................................. 2.
   Oberseite schwarz oder braun, Fühlerkeule 6-gliedrig.............................. 5.

2. Halsschild weitläufig punktiert, sein Vorderrand gerade abgeschnitten, Flügeldecken ungekielt, die Punkte der Streifen sehr grob, seitlich grübchenartig.......... B. cæruleipennis Geb.
   Halsschild grob und dicht punktiert, Vorderwinkel vorragend, Flügeldecken gekielt, die Punkte fein.......... 3.
3. Oberseite leuchtend blau, Prosternum hinten ganz niedergedrückt. B. violaceus Pasc.
   Oberseite grünlich oder bronzefarben, Prosternum nicht niedergedrückt.......... 4.
4. Augenfalten fein und um das Auge herumgehend, Clypeus deutlich ausgerandet, Vorderkörper grünlich, Flügeldecken bronzefarben. B. carinatus Fairm.
   Augenfalten sehr grob und hinten sich von den Augen entfernend, Vorderrand des Kopfes gerade abgestutzt, Körper vorn schwarzblau, Flügeldecken blaugrün.......... B. eschscholtzi sp. nov.
5. Die Wangen sind seitlich scharfwinklig vorgezogen; sehr gedrungene Art mit breit abgesetzten Seitenrändern, die Beine ganz rot, die Schienen aussen fein gekielt, Oberseite matt schwarz. B. ferruginipes Fairm.
   Die Wangen verrundet und nicht breiter als die Augen; schlanke Arten mit schmal abgesetzten Halsschildrändern, die Schienen ungekielt.. 6.
6. Langgestreckte Arten, Stirn fein längsstrigos.......... 7.
   Kürzere, gedrungenere, normal gestaltete Arten, Stirn körnig punktiert.......... 9.
7. Halsschild in der Mitte mit Eindruck, Vorderwinkel ziemlich spitz vorragend, alle Streifen vorn gekielt, Fühlerkeule schwarz. B. impressicollis Geb.
   Halsschild gleichmässig flach gewölbt, Vorderwinkel schwach, gerundet vorragend, die abwechselnden Streifen erhabener, Fühler ganz rot.... 8.
8. Grund der dunkelbraunen Flügeldecken spiegelglatt, die Rippen auf der Scheibe fast glatt.......... B. alternicostis Geb.
   Grund der schwarzen Flügeldecken sehr fein lederrunzlig, die Rippen fein gekörnt (*elongatus* Geb.).......... B. pertyi nom. nov.
9. Die alternierenden Streifen stark erhaben; rotbraune Art. B. mcgregori sp. nov.
   Alle Zwischenräume bis auf die inneren gleichmässig stark erhaben; oben fast schwarze Art.......... B. aequecostatus Fairm.

Bolitoxenus ditylus sp. nov.

Kurz zilindrisch, oben etwas abgeflacht, matt schwarz. Der Kopf ist flach ausgehöhlt, die Clypealsutur sehr fein und kaum eingeschnitten; Hörner finden sich nicht auf dem Kopf, dagegen verschiedene Erhebungen, die folgendermassen angeordnet sind: auf dem geradlinig abgestutzten Clypeus finden sich beim Männchen zwei kurze konische Tuberkeln, beim Weibchen zwei quere, auf der oberen Kante krenulierte Kiele, die durch einen schmalen Zwischenraum getrennt sind, also auch als ein unterbrochener Kiel angesehen werden können, die Wangen treten spitz zahnförmig nach aussen, die Seiten des Kopfes davor haben einige stumpfere Zähne und sind etwas buckelig. Am Hinterkopf befindet sich eine quere Reihe von vier spitzen Tuberkeln, von denen die beiden äusseren am inneren Hinterrand der Augen stehen. Beim Weibchen finden sich vor den beiden mittleren auf der Stirn noch zwei kleinere. Die Punktierung der Stirn ist fein und sehr dicht, die des Hinterkopfes hinter den Körnern grob und sehr dicht. Die Wurzel der Fühler und die Taster sind braunrot, die Fühler sind scheinbar 10-gliedrig da das kleine Endglied in dem breiten Spitzenausschnitt des zehnten Gliedes eingefügt ist und mit ihm zusammen etwa halbkreisförmigen Umriss hat, die Glieder sind vom fünften an mehr oder weniger nach innen erweitert. Das Endglied der Maxillarpalpen ist zilindrisch, das Mentum flach gewölbt; der Aussenrand des Unterkopfes neben den Augen its hoch gekielt und durch eine tiefe Rinne von den Augen getrennt.

Der Halsschild ist ungefähr doppelt so breit wie lang, hoch gewölbt, der Rand sehr breit verflacht und auch hinten scharfkantig. In der Mitte des Vorderrandes erheben sich zwei starke, kurze, an der Spitze verrundete Hörner deren Zwischenraum beim Männchen ein parallelseitiger Schlitz ist, beim Weibchen sind es zwei über halbkreisförmige Beulen, beide Bildungen einander sehr ähnlich, nur beim Weibchen kürzer als beim Männchen; die Hörner stehen beim Männchen am Vorderrand, beim Weibchen etwas entfernt davon. Der Rand ist hinter der Mitte am breitesten, mit neun bis zehn starken Sägezähnen versehen, die vorn etwas kleiner werden; die spitzen Vorderecken ragen weit vor, die Hinterecken sind scharf stumpfwinklig, hinter jedem vorderen Hörnchen findet sich eine fast kreisförmig angeordnete Gruppe von runden, scharfen Körnchen und jederseits am Absturz noch einige einzeln stehende Körnchen; der Grund des Pronotums zeigt nur beim Männchen auf der Mitte zeimlich feine Punkte.

Die Flügeldecken sind hoch gewölbt, oben etwas abgeflacht, sie haben Reihen regelmässiger, grober Punkte, welche meist durch die Tuberkeln aus ihrer Richtung gedrängt werden; der Seitenrand ist kräftig, etwas ungleichmässig gezähnt, die Zähne aussen kurz verrundet, die Zahnreihe durch eine feine vertiefte Linie abgesetzt. Alle Zwischenräume sind gekörnt oder gehöckert, die beiden haben eine ziemlich regelmässige Reihe feiner spitzer Körner, der dritte und der fünfte längliche scharfe Tuberkeln, der vierte, siebente, und so weiter, sind ähnlich wie die beiden ersten skulptiert, der siebente hat gröbere Körner; im übrigen sind die Interstitien unpunktiert. Die Zähne des Seitenrandes laufen, immer feiner werdend, bis zur Spitze.

Das Prosternum ist wagerecht, fast kielförmig, und fällt hinten fast senkrecht ab, nach vorn noch steiler als hinten; das Mesosternum hat in der Mitte und das Metasternum dicht dahinter vorn eine spitze Tuberkel. Die ganze Unterseite ist ziemlich grob und wenig dicht punktiert. Alle Schenkel haben unten zwei scharfe Leisten, die Schienen sind aussen scharf gekielt und werden gegen die Spitze dünner, die Füsse sind sehr zart.

Länge: Männchen, 7.8 Millimeter; Weibchen, 9.8. Breite: Männchen, 4 Millimeter; Weibchen, 5.

LUZON, Laguna, Mount Maquiling, ein Pärchen.

Ich glaube die beiden Tiere richtig als Angehörige einer Art zu bezeichnen. Die Geschlechtsunterschiede liegen in der Kopf- und Halsschildbildung.

Die beiden andern Arten von den Philippinen, *Bolitoxenus* (*Atasthalus*) *serratus* Geb. und *B. timmi* sp. nov., haben zwei lange Hörner auf dem Halsschild, grobe Höcker und spitze Tuberkeln auf den Decken und ein ganz anderes Prosternum. Aehnlicher ist *B. spectabilis* Geb. von Borneo, aber viel breiter, beim Männchen mit zwei spitzen hörnchenartigen Tuberkeln auf dem Halsschild ausgezeichnet, und hat anderes Prosternum und andere Kopfbildung.

Bolitoxenus timmi sp. nov. Tafel 1, Fig. 1 und 1*a*.

Gross, gewölbt, parallelseitig, ganz mit den braunen Ueberresten des Wirtspilzes bedeckt, Fühler und Beine braun.

Der Kopf ist breit, flach ausgehöhlt, der Clypeus aufgebogen und mit zwei stumpfen Winkeln am Vorderrande versehen; die Wangen treten blattförmig, zackig nach aussen, zwischen ihnen und den Winkeln des Clypeus finden sich ausser einem grossen stumpfen Winkel einige feine Zähnchen. Bei schwächer entwickelten Männchen erscheint der Vorderrand einfach sehr schmal aufgebogen und fein krenuliert, auch sind die Wangen nicht so scharf ausgezogen. Auf der Stirn finden sich keine Tuberkeln, nur am Innenrand der Augen ein spitziges Höckerchen in beiden Geschlechtern. Die Fühler sind scheinbar 10-gliedrig, schlank, zu einer kräftigen Keule verdickt; das zehnte Glied ist auf der Spitze tief ausgeschnitten und nimmt das elfte, sehr kleine, fast kugelige Glied in seinem Ausschnitt auf. Die Taster sind gelbrot, das Endglied der Labialpalpen ist nackt, nicht wie bei *B. serratus* beim Männchen mit einem langen Haarpinsel versehen; das Kinn ist flach gewölbt.

Der Halsschild hat beim Männchen zwei lange, wagerechte, nach vorn gerichtete, mit der Spitze gegeneinander gewendete Hörner, die bei wohlentwickelten Exemplaren an der Spitze ein Haarbüchsel tragen und in der Endhälfte innen ebenfalls goldbraun behaart sind. Das am schwächsten entwickelten Männchen ist asymmetrisch und trägt nur auf dem linken Horn viel schwächere Behaarung. Beim Weibchen finden sich zwei über halbkreisförmige, kräftige, etwas divergierende, nach vorn gerichtete Höcker, die wie die Hörner stark gekörnt sind. Die Scheibe ist ebenfalls stark, etwas unregelmässig gekörnt, und nur die äussersten Seiten sind frei, diese sind sehr breit verflacht abgesetzt, der Seitenrand selbst mit etwa 9 bis 10 kräftigen, rechtwinkligen, also nicht fingerförmigen Zähnen versehen, die Hinterecken sind scharf stumpfwinklig.

Die Flügeldecken haben einen sehr fein gekerbten Basalrand, sie sind auf der Scheibe etwas flach bis zum dritten Zwischenraum, ihre Skulptur ist durch die anhaftenden Teile des Wirtspilzes ganz bedeckt und nur nach gründlicher Reinigung sichtbar, sie lassen sich aber am trockenen Käfer leicht mit einer spitzen Nadel abkratzen. Dann erkennt man, dass ziemlich regelmässige Reihen grober, runder, tief eingedrückter Punkte vorhanden sind, deren glatte Zwischenräume sämmtlich gekörnt sind, und zwar mit je einer Reihe von verschieden grossen Körnern oder Höckern; der Nahtstreifen mit sehr feinen, wenig engen, runden Körnern, der zweite mit etwas gröberen, spitzen, konischen, der dritte mit etwa 4 etwas länglichen bis zum Absturz und einigen kleineren dahinter; von diesen ist der Höcker an der Basis stark länglich und besteht aus 2 bis 4 eng gestellten Körnern. Vom vierten ab sind die alternierenden Zwischenräume mit gröberen und feineren sehr weitläufig gestellten Körnern besetzt. Der Seitenrand ist einfach kräftig gesägt, die Sägezähne etwa rechtwinklig, nicht fingerartig.

Das Prosternum ist ganz wagerecht, der Länge nach scharf gekielt, ebenso die Mittelbrust; beide fallen steil, aber nicht senkrecht ab, so dass ein kleiner Winkel zwischen den Kielen entsteht, wodurch sich eine Neigung des Vorderkörpers gegen den Hinterkörper ermöglichen lässt, die Pleuren sind scharf und fein gekörnt, das Abdomen ist grob punktiert. Die Schenkel unten mit doppelten Kielen, die Schienen sind gerade, aussen mit 3 scharfen Kielen versehen, die Tarsen sind kurz.

Länge, 7.8 bis 9.2 Millimeter (ohne Hörner); Breite, 4.3 bis 5.

Sieben Männchen, elf Weibchen von Manila aus der Sammlung von Rechnungsrat Timm in Zoppot, Klimowitz, Zoppot, Strecker, Zoppot (von Herrn Peters gesammelt).

Ich benenne diese Art zu Ehren des tüchtigen Entomologen und Photographen, der diese Arbeit durch seine Sammlung und die Herstellung der schönen Bilder reich unterstützte.

Nur mit *B. serratus* verwandt, aber grösser, der Clypeus ohne Hörner, die Reihen der Punkte auf den Decken nicht durch die Höcker unterbrochen, die Seitenränder einfach und eng gezähnt, die Höcker bis auf die des dritten Zwischenraumes klein.

Byrsax satanas Geb. Tafel 1, Fig. 2 und 3.

Neues Material liegt nicht vor.

DIAPERINÆ

Platydema marseuli Lew.

LUZON, Laguna, Mount Maquiling, 1 Männchen. In Japan häufig, auch von Tonkin, und Borneo bekannt.

Platydema malaccum Mars.

PALAWAN, Puerto Princesa, 2 Weibchen; auch von Borneo, Java, Sumatra. Das Männchen hat charakteristisch gekrümmte Mittel- und Hinterschienen wie *P. umbratum* Mars. Ich glaube, dass *P. annamitum* sich von unserer Art nicht trennen lässt. Sicher ist auch *P. laticorne* Fairm. nichts anderes.

Ceropria induta Wied.

PALAWAN, Puerto Princesa (*4050*). MINDANAO, Butuan (*4046*). LEYTE, Tacloban. Weiteres Material.

Ceropria subocellata D. & Br.

MINDANAO, Butuan und Iligan (*4045*, *4047*, *4048*, *4049*).

LEIOCHRINÆ

Leiochrodes (subg. Leiochrota) philippinensis sp. nov.

Von fast kreisförmigem Umriss, nur nach vorn etwas verlängert, glänzend rotbraun, durchscheinend, auf der Scheibe etwas dunkler, die Fühler schwarz mit rotbraunen Basalgliedern und gelbem Endglied.

Der Kopf ist flach und in eine parallelseitige Schnauze ausgezogen, vollkommen unpunktiert, die Fühler sind sehr lang und überragen die Basis des Halsschildes weit, Glieder 3 und 4 sind nicht erweitert, die folgenden Glieder sind gleich, etwas länger als breit, sämmtlich dick und ziemlich lang gestielt.

Der Halsschild ist stark nach vorn verengt, seitlich fast geradlinig, der Vorderrand von oben gesehen kaum ausgeschnitten, die Vorderecken kurz verrundet stumpfwinklig, die Hinterecken sehr spitz und etwas nach hinten gezogen, die Oberfläche ist ganz glatt, ohne Spur von Punkten.

Die Flügeldecken sind kreisförmig, an der Basis so breit wie der Halsschild, setzen aber seinen Umriss nicht fort, sie sind spiegelglatt, der Seitenrand ist an der Schulter schwach verbreitert. Das Prosternum ist breit, wagerecht und glatt, die übrige Unterseite unpunktiert, die Tarsenglieder sind kurz gelappt, an den Hintertarsen ist der Lappen des vorletzten Gliedes kaum halb so lang wie das letzte Glied.

Länge, 4.4 Millimeter.

LUZON, Laguna, Los Baños, 1 Exemplar.

Die langen Fühler weisen dieser Art einen Platz in der Untergattung *Leiochrota* an. Sie steht der *L. uniformis* Westw. sehr nahe, aber die Fühler sind noch länger, die Glieder stark gestielt, und die ganze Oberseite ist glatt, anstatt punktiert.

Uloma orientalis Cast.

PALAWAN, Puerto Princesa. LUZON, Tayabas, Malinao; 2 Weibchen.

Uloma contracta Fairm.

LUZON, Laguna, Mount Maquiling.

Alphitobius diaperinus Panz.

LUZON, Laguna, Mount Maquiling.

Alphitobius laevigatus Fabr.

Spec. Ins. (1781) 90; Syst. El. 1 (1801) 117; BLAIR, Ann. & Mag. Nat. Hist. VIII 13 (1914) 486, Syn. *piceus* Oliv. (v. Gebien, Col. Cat. p. 405 J).

Genus PHAYLLIDIUS novum

Parallelseitig, sehr flach, elliptisch, geflügelt. Kopf ungehörnt, ziemlich flach, die Augen sind breit und gross, grob fazettiert, quer, ihr Abstand etwas breiter als der Querdurchmesser eines Auges; hinter den Augen befindet sich eine sehr feine Augenfurche, die Wangen sind viel schmäler als die Augen, der Clypeus ist nicht ausgerandet, Fühler schlank, die Glieder zur Spitze verbreitert, ohne eigentliche Keule, die Mandibeln sind zweispitzig, scharf, ragen aber nicht vor; das Mentum ist quer trapezisch mit erhöhter Mittellinie, die beim Männchen einen Porenpunkt trägt, das Endglied der Maxillarpalpen ist abgestutzt oval, nicht beilförmig.

Der Halsschild ist ganz quer, die Vorderwinkel treten durchaus nicht vor, die Basis ist gerandet und kräftig doppelbuchtig, die Breite ist beim Männchen grösser als die der Decken, beim Weibchen so gross, bei ersterem findet sich vorn jederseits eine flache Schwiele. Das Schildchen ist quer. Die Flügeldecken haben vollständige Epipleuren, Oberfläche mit Punktstreifen, der Seitenrand ist von oben nicht sichtbar, das Pygidium ist bedeckt.

Das Prosternum ist hinter den Hüften etwas verbreitert, nicht wie bei *Phayllus* ganz parallel, das Mesosternum ist sehr tief und hoch V-förmig ausgeschnitten, die sehr grossen Gelenkhöhlen der Mittelhüften sind seitlich offen, Hinterbrust und Abdomen sind vorn scharf und vollständig gerandet, der Abdominalfortsatz ist ziemlich spitz, die Beine sind kurz, die Schenkel mässig dick, ungezähnt, die Schienen gerade, aussen äusserts fein gesägt, Füsse schlank.

Die kleine in diese Gattung gehörige Art ist *Phayllus* aus Südamerika sehr ähnlich und hat fast gleiche Kopfbildung; sie unterscheidet sich durch den sexuellen Dimorphismus an Halsschild und Mentum, durch das tief ausgeschnittene Mesosternum und das schmale letzte Tasterglied. Aeussere Aehnlichkeit zeigt auch *Epipedodema* Geb. von Westafrika, hat aber sehr breite Epipleuren, dicke Schenkel, andere Fühler, und seine Wangen sind viel breiter als die Augen. Von den bekannteren Gattungen dürfte *Sitophagus* am nächsten stehen, der aber durch andere Taster und die Bewaffnung des Kopfes beim Männchen verschieden ist.

Phayllidius dispar sp. nov.

Einem kleinen *Alphitobius diaperinus* an Gestalt sehr ähnlich, gelbbraun, glänzend, nackt, ziemlich depress, der Rand des Körpers ringsum aber ziemlich steil.

Kopf mit queren Augen, an derem Innenrand beim Männchen und Weibchen ein stumpfes Winkelchen sich befindet, wodurch der Innenrand etwas erhöht erscheint; hinten findet sich eine sehr schmale Furche und ein äusserst feines Kielchen. Die schmalen Wangen verengen sich von den Augen an, der Vorderrand ist gerade abgestutzt, die Punktierung des Kopfes ist fein und dicht, die Clypealsutur ist gut ausgeprägt. Die Fühler überragen die Mitte des Halsschildes etwas, Glied 3 ist kaum länger als 4, die letzten 7 Glieder bilden eine sehr schlanke

Keule, die vorletzten Glieder sind fast doppelt so breit wie lang, das letzte so lang wie breit.

Der Halsschild ist fast doppelt so breit wie lang, die doppelbuchtige Basis äusserst fein und vollständig gerandet, die Vorderecken treten nicht vor, die Seiten sind in beiden Geschlechtern stark gerundet, etwas hinter der Mitte am breitesten, beim Männchen breiter als die Flügeldecken in der vorderen Hälfte. Das Pronotum ist oben schwach depress, fällt aber besonders beim Männchen nach den Seiten zu steil ab, und ist in diesem Geschlecht vorn hinter den Augen jederseits stumpfbeulig gewölbt und dazwischen schwach eingesattelt. Die Punktierung ist sehr fein und mässig dicht, die Hinterwinkel sind verrundet stumpfwinklig.

Die Flügeldecken sind auf zwei Drittel ihrer Länge parallel, sie haben kräftige Punktstreifen, die gegen die Spitze vertieft sind, Streifen 1 und 2 sind an der Basis miteinander verbunden. Die vorn mehr order minder flachen Zwischenräume sind sehr fein aber deutlich punktiert.

Das Prosternum ist überall deutlich punktiert, ebenso das Abdomen auf den ersten Segmenten. Das erstere hat vorn beim Männchen eine anliegende, goldgelbe, nicht sehr dichte Behaarung. Die Schenkel sind mässig dick, die Schienen in beiden Geschlechtern gerade, der Aussenrand aller Schienen ist sehr fein und regelmässig gekerbt, an den Hintertarsen ist Glied 1 so lang wie 2 und 3 zusammen.

Länge: Weibchen, 3.7 bis 7.4 Millimeter; Männchen, 4 bis 4.5.

LUZON, Laguna, Los Baños, 4 Männchen und 3 Weibchen.

Leptoscapha subpubescens sp. nov.

Glänzend gelbbraun, flach, mässig gestreckt, Fühler und Beine hellgelb, der ganze Körper fein und wenig dicht, kurz behaart.

Der Kopf ist flach, dicht und fein punktiert, die Augen viel kleiner als bei *L. spissicornis,* hinter ihnen befindet sich eine schwach abstehende Behaarung, sie sind vorn kaum eingeschnürt und etwas feiner fazettiert als bei der madegassischen Art; die Clypealsutur ist eine fein eingegrabene Linie; die Fühler sind schlank und gegen das Ende deutlich kompress, die Glieder aber besser von einander abgesetzt als bei *spissicornis,* die vorletzten so lang wie breit, sie sind vom vierten Gliede an schwach erweitert.

Der Halsschild ist flach, an den Seiten stark gerundet, anderthalbmal so breit wie lang, an der Basis am breitesten, die Seiten

181287——5

im starken Bogen nach vorn verengt, die Vorderecken ragen kurz spitzig vor, die Mitte des ungerandeten Vorderrandes ist gerade, die Basis sehr fein gerandet; die Oberfläche ist sehr fein, gleichmässig, wenig eng punktiert und äusserst fein anliegend behaart, nur vorn jederseits sind die Härchen aufrecht, und nahe dem Rande befinden sich zwei aufrechte Haare. Das Schildchen ist stark quer.

Die Flügeldecken sind vor der Mitte am breitesten, nach vorn wenig verengt, flach, die Seiten stark gerandet abgesetzt, die Schultern deutlich gewinkelt; Punktstreifen fehlen, scheinen aber als dunkle Linien durch. Die ganze Oberfläche ist sehr fein, gleichmässig, wenig eng, verworren punktiert und anliegend behaart, nahe den Schultern sind die Härchen deutlich aufrecht. Die Epipleuren sind abgekürzt.

Die Unterseite ist ebenfalls fein behaart, das Prosternum ist stumpf gekielt, zwischen den Hüften ungefurcht, das Mentum ist flach, fein punktiert, das Mesosternum steigt flach an. Die Beine sind mässig lang, die Hinterschenkel verdickt, die Tarsen sind dünn, an den hinteren ist Glied 1 kaum länger als 2.

Länge, 4 Millimeter.

LUZON, Laguna, Mount Maquiling, 1 Exemplar.

Ich stelle nur mit Vorbehalt diese Art in die Gattung, von welcher bisher nur zwei madegassische Arten bekannt sind. Mir liegt nur *L. spissicornis* vor. Die weite Entfernung der Vaterländer würde eine Trennung auch auf geringere Merkmale rechtfertigen. Ich erinnere mich aber, dass die Abor-Expedition eine Art aus dem nördlichen Indien mitgebracht hat, leider liegt mir das Material augenblicklich nicht vor. Von *spissicornis* ist unsere Art sofort durch den behaarten Körper, die verworren punktierten Flügeldecken, den nicht trapezischen Halsschild, die geringe Grösse und die gelbe Färbung zu trennen.

Hypophloeus sulcifrons sp. nov.

Dünn zilindrisch, von der Gestalt und ungefähren Grösse des *H. unicolor*. Glänzend schwarzbraun, die Flügeldecken kastanienbraum, Beine, Taster und Fühlerspitze gelblich. Der Kopf ist flach, die Clypealnaht sehr fein angedeutet, die Augen gross, rund, der Canthus den Augen vorgelagert und deutlich abgesetzt, nicht wie bei *H. analis* gegen das Auge verschwindend, der Vorderkopf von den winklig abgesetzten Wangen an parallelseitig. Seine Seiten sind von vorn bis hinten gleichmässig aufgebogen, so dass innen, hart am Rande, eine lange, furchige Vertiefung entsteht, die aber nicht eingedrückt ist; die Mittelpartie ist sanft gewölbt. Die Fühler erreichen die Mitte des Halsschildes, sie sind ziemlich schlank, Glied 3 anderthalbmal so lang wie 4, die folgenden quer, die vorletzten ein und zweidrittelmal so breit wie lang, das letzte ist schmäler als das vorletzte, der Vorderrand des Kopfes ist sanft ausgeschnitten, die Punktierung dicht und sehr deutlich. Das Mentum ist quer trapezisch, flach, sehr dicht punktiert, es ist aber nicht annähernd so stark quer wie bei *unicolor*, die Aussenlade der Maxillen ist sehr gross und bei normaler Lage der Mundteile stark sichtbar. Die Augen reichen unten fast bis an die Wurzel der Maxillen.

Der Halsschild ist viel länger als breit, im grossen und ganzen parallel, aber eben vor der Mitte am Seitenrand sanft eingebuchtet und direkt vor den Hinterecken eingezogen, so dass diese selbst schwach aber deutlich vorspringen, die Vorderecken sind deutlich, der Vorderrand gerade abgestutzt, die Basis in weitem Bogen nach hinten vorgezogen, vollständig gerandet, die Punktierung gleichmässig fein und wenig dicht. Das Schildchen ist quer elliptisch.

Die Seitenrandkante der Flügeldecken hört an der Schulterbeule auf; die Skulptur besteht aus feinen Reihen nicht eingedrückter, runder Punkte, die Reihen sind stellenweise etwas unregelmässig, die ganz flachen Interstitien mit einer unregelmässigen Reihe von fast ebenso grossen Zwischenpunkten, an der Spitze sind die Decken ganz verworren punktiert. Das Pygidium ist stark gewölbt, ohne Auszeichnung.

Das Prosternum ist vor den Hüften flach querrunzlig, zwischen den Hüften parallel, schmal und nach hinten schwach gesenkt. Die Mitte des Abdomens ist sehr dicht und ziemlich grob punktiert und dadurch matt, das Analsegment ist ohne Eindruck, seitlich finden sich die gewöhnlichen starken Längseindrücke. Die Beine sind mässig lang, die Schienen gerade, die vorderen zur Spitze sanft verbreitert, mit spitzen Aussenendwinkeln, ihre Innenseite ganz sanft S-förmig geschwungen, ohne Behaarung.

Länge, 5.5 Millimeter.

LUZON, Laguna, Mount Maquiling (*1205*), 1 Weibchen.

Die zweite Art von den Philippinen, wie es scheint, viel seltener als die verbreitete *Hypophloeus analis*, von dem unsere Art sofort durch den dunklen Vorderkörper, einfaches Analsegment, langen Vorderkopf mit stark aufgeworfenen Rändern und anderen Halsschild verschieden ist. Aehnlich ist auch *H. colydi-*

oides Lew. von Japan, hat aber eine einfarbig schwarzbraune Oberseite, ganz andere Kopfbildung und weitläufig punktiertes Abdomen.

Hypophloeus analis Geb.

LUZON, Mount Banahao (*4029*) und Mount Maquiling, weiteres material.

Eutochia lateralis Boh.

LUZON, Laguna, Los Baños (*1193*).

TENEBRIONINÆ

Setenis sulcigera Boisd. Tafel 1, Fig. 4, Männchen.

Setenis aequatorialis Blanch.

MINDANAO, Iligan (*4038*). LUZON, Tayabas, Malinao.

Setenis manillarum Fairm. Tafel 1, Fig. 5, Männchen.

Encyalesthus bisinuatus sp. nov. Tafel 1, Fig. 6, Männchen.

Glänzend kohlschwarz, ohne Spur von Metallschimmer, gross, robust. Der Kopf is flach, ausserordentlich fein, nur vorn etwas gröber punktiert, die Clypealsutur ist sehr tief, ihr oberer Rand zweibuchtig, ihr Unterrand gerade, dadurch bilden sich zwei mondartige Vertiefungen; die Ausmündungsstelle ist nicht durch einen feinen Ausschnitt gekennzeichnet, der Vorderrand ist ganz sanft ausgeschnitten; die Augenfurche ist fein und geht, sich verflachend, um das Auge herum, Augenfalten fehlen. Das Mentum ist scharf längsgekielt und mit einzelnen langen Haaren besetzt, die Mandibeln sind gerade abgestutzt. Die Fühler sind schlank und erreichen die Basis des Halsschildes, sie haben eine schlanke 5-gliedrige Keule, die vorletzten Glieder sind nur wenig breiter als lang; Glied 3 ist anderthalbmal so lang als 4.

Der Halsschild ist anderthalbmal so breit wie lang, kugelig gewölbt, aber oben abgeflacht, die Mitte der Länge nach ganz leicht angedeutet, die Seitenrandkante ist sehr fein, die Basis sehr dick, in der Mitte noch stärker gerandet, die Randlinie vorn in der Mitte undeutlich; die Punktierung ist sehr fein und wenig weitläufig, die Pleuren sind glatt.

Die Flügeldecken sind fast zilindrisch, ihr Seitenrand ist von oben nicht sichtbar, sie sind tief gestreift, die Zwischenräume, besonders zur Spitze, kräftig gewölbt, äusserst fein punktiert; die Punkte der Streifen sind gleichmässig fein, regelmässig und bis zur Spitze deutlich.

Die Unterseite ist nackt, das Prosternum ist hinten ganz niedergebogen, aber nicht plötzlich, der Lappen breit, zwischen den Hüften ist die Brust flach vertieft, nicht deutlich gefurcht. Das Mesosternum ist sanft eingedrückt, das Metasternum ist vorn mit querer Furche versehen; das Abdomen ist äusserst fein punktiert, das Analsegment ungerandet. Die Schenkel sind mässig stark gekeult, nackt, die Vorderschienen etwas gekrümmt und innen in den letzten zwei Dritteln stark gelb behaart, die Mittelschienen dort schwächer, die Hinterschienen im letzten Drittel sehr fein; an den Hintertarsen ist Glied 4 so lang wie 1 bis 3, 1 so lang wie 2 und 3 zusammen.

Länge, 17 Millimeter; Breite 6.5.

Ein Männchen von Mindanao: Butuan. Zwei Männchen und drei Weibchen von Mindanao, von Herrn Timm, Zoppot, erhalten. (*Peters* leg.)

Diese Art ist von den anderen beiden philippinischen sofort durch die Grösse und die ganz schwarze Färbung überdies auch durch die Stirnfurchen und die Beinbildung geschieden. Nahe verwandt ist *E. morio* Geb. von Borneo, aber grösser, mit ganz flachen Zwischenräumen, kürzeren Fühlern und ganz anderer Beinbildung.

Encyalesthus nitidipennis Fairm.

MINDANAO, Butuan, 1 weiteres Exemplar.

Derosphaerus rotundicollis Cast.

LUZON, Laguna, Los Baños (*2120*).

Toxicum erythromerum sp. nov. Tafel 1, fig. 7 und 7*a*.

Schwarz, matt, die Schenkel leuchtend gelbrot, verhältnismässig flach, ziemlich gedrungen.

Der Kopf hat den bei den Männchen gewöhnlichen, sehr tiefen, halbkreisförmigen Eindruck, der hoch und sehr scharfkantig hinten begrenzt ist, die Punktierung ist ganz hinten grob, in der Mitte feiner, und fehlt am Vorderkopf ganz, die Wangen sind ausserordentlich fein und dicht punktiert, ganz verrundet, und nur so breit wie die Augen. Am Vorderrand finden sich beim Männchen zwei, im Winkel von etwa 80 Grad auf einander stehende, nackte, ziemlich lange Hörner, die am Grunde stark verflacht sind und innen miteinander verbunden, ihre äusserste Spitze ist etwas nach hinten gerichtet. Am Innenrand der Augen finden sich zwei sehr lange, dünne, mit der Spitze gegeneinander gerichtete, und sich fast berührende Hörner, die in ihren letzten zwei Dritteln lang goldgelb behaart sind. Die Fühler haben eine starke, 4-gliedrige Keule, Glieder 6 bis 8 sind innen beim Männchen mit einzelnen langen Haaren versehen, das Mentum ist flach, sehr fein punktiert und nackt.

Der Halsschild ist auffallend flach, die Vorderecken treten weit vor, ihre Spitzen sind kurz verrundet rechtwinklig und etwas nach innen gerichtet, die Hinterwinkel scharf recht- oder gar etwas spitzwinklig, die Mitte ist fein angedeutet, die Punktierung ist ziemlich fein, nach den Seiten hin gröber, aber am Seitenrand ganz fehlend.

Die Flügeldecken sind ganz flach, ihr Seitenrand ist von oben nicht sichtbar; die Punkte der Streifen sind fein, regelmässig, zur Spitze etwas deutlicher. Das Prosternum ist vorn fein, an den Pleuren in der Mitte sehr grob punktiert und etwas gerunzelt, es ist ganz flach und in einen wagerechten, spitzen, etwas überhängenden Fortsatz ausgezogen, oben deutlich doppelt gefurcht, das Mesosternum ist tief, senkrecht eingedrückt und oben mit starker Doppelfurche versehen; das Abdomen nackt, fein und wenig dicht punktiert, das zweite und dritte Segment an der Seite gerandet, das Analsegment ungerandet; Beine ausser der Färbung ohne Auszeichnung.

Länge, mit Hörnern, 15 Millimeter; Breite, 5.

LUZON, Tayabas, Malinao (*4022*), und Mount Maquiling, Männchen.

Noch eine hübsche Art aus der Gruppe *T. flavofemoratum* und dem *T. planicolle* Geb. auf den ersten Blick sehr ähnlich, aber kleiner und mit ganz anderer Bewaffnung des Kopfes versehen, auch hängt das Prosternum hinten über. Die Art ist hinter *planicolle* in meiner Tabelle [8] einzureihen.

Toxicum quadricorne Fabr.

MINDANAO, Butuan (*4018*, *4019*, *4020*). LUZON, Tayabas, Malinao.

Anthracias elongatus Schauf.

PALAWAN, Puerto Princesa. MINDANAO, Butuan. LUZON, Tayabas, Malinao. Weiteres Material.

HETEROTARSINÆ

Lyprops subangulatus sp. nov.

Gross, breit, flach, oben glänzend schwarz mit äusserst kurzen, anliegenden, goldgelben Härchen bekleidet; Unterseite und Beine schwarzbraun, Füsse und Taster rotbraun.

[8] Philip. Journ. Sci. § D 8 (1913) 400.

Der Kopf ist grob und sehr dicht punktiert, auf dem Scheitel mit blanker Stelle; die Wangen sind so breit wie die Augen und ebenso lang wie diese hinter ihnen, die Oberfläche ist nahezu flach, der Clypeus nicht dick, die Querfurche nur angedeutet. Die Fühler sind schlank, sie erreichen die Basis des Halsschildes nicht ganz; Glied 3 ist nur sehr wenig länger als 4, dieses und die folgenden sind an Länge fast gleich, das vorletzte so lang wie breit, das letzte ist das grösste, etwas länger als breit. Das Mentum ist stark gekielt, der Kiel vorn in eine vorragende, spitze Beule auslaufend.

Der Halsschild ist etwa anderthalbmal so breit wie lang, flach gewölbt, die Seiten in der Mitte am breitesten, nach vorn und hinten gleichmässig verengt, die Spitze sanft ausgeschnitten, alle Winkel kurz verrundet, die hinteren rechtwinklig, die Basis ist sehr fein gerandet, die Punktierung ist grob und an den Seiten sehr dicht; auf der Scheibe finden sich zwischen den Punkten zahlreiche glatte Schwielen.

Die Flügeldecken sind flach gewölbt, der Seitenrand sehr scharf glatt und in der Vorderhälfte von oben sichtbar; die Randkante setzt sich nach innen um die ganze Schulterbeule herum fort. Die Skulptur ist derjenigen von *L. picinus* sehr ähnlich, die Decken sind grob punktiert, die Zwischenräume der Punkte sind überall zu ganz kurzen Längsfältchen ausgezogen, die besonders seitlich und vor der Spitze deutlich sind, die Bekleidung besteht in ganz kurzen, fast staubartigen, goldgelben Härchen viel kürzer als bei *picinus*.

Das Prosternum fällt hinter den Hüften gerundet steil ab, das Mesosternum ist vorn senkrecht, seine Ecken verrundet, etwas schwielenartig, die Propleuren sind seitlich, in der Höhe der Hüften querüber fast glatt, das Abdomen ist sehr fein punktiert und äusserst kurz behaart, nur an den letzten beiden Segmenten etwas länger. Die Beine sind dünn und schlank, an den Hintertarsen ist das erste Glied länger als der Rest, nur das vorletzte Glied mit schwammiger Sohle, an der Spitze kaum ausgeschnitten, es ist nicht breiter als die vorhergehenden Glieder.

Länge, 11.7 Millimeter; Breite, 4.8.

MINDANAO, Iligan, 1 Weibchen.

Die Art sieht einem *Anaedus punctatissimus* von Südamerika sehr ähnlich. Ihr nächster Verwandter ist *Lyprops picinus* Fairm. von Simalur, Sumatra, aber unsere Art ist oben schwarz, die Haare der Flügeldecken sind staubartig, sehr kurz, der Seitenrand ist von oben in der Vorderhälfte sichtbar und geht scharfkantig um die Schulter herum, der Halsschild ist hinten deutlich gewinkelt, seitlich viel weniger gerundet, das Mentum schärfer gekielt.

Lyprops striatopunctatus sp. nov.

Glänzend kastanienbraun, oben lang abstehend, aber sparsam behaart, die Fühler schwarz, die Kniee dunkel; Körper ziemlich schlank, der Hinterkörper nach hinten erweitert.

Der Kopf ist ziemlich flach, die Quernaht etwas eingedrückt, der Vorderrand gerade abgestutzt und vereinzelt lang behaart; die Augen sind mässig gross, ihr Abstand viel grösser als ein Auge im Querdurchmesser, die Wangen sind viel schmäler als die Augen. Die Fühler überragen mit den letzten beiden Gliedern die Basis des Halsschildes; Glied 3 ist so lang wie 4, beide länger als breit, die vorletzten sind quer, das letzte reichlich so lang wie 9 und 10 zusammen.

Der Halsschild ist fast doppelt so breit wie lang, seitlich stark gerundet, vor der Mitte am breitesten, dahinter eingezogen verengt, die Hinterecken scharf, die vorderen verrundet. Das Pronotum ist querüber stark gewölbt, die Basis stark gerandet, die Punktierung wie die des Kopfes ziemlich grob und wenig dicht.

Die Flügeldecken erweitern sich von der Basis bis über die Mitte, wo sie zusammen doppelt so breit sind wie der Halsschild, die Schultern sind kurz verrundet, der Seitenrand ist von oben nicht sichtbar. Es sind starke Punktstreifen vorhanden, die vertieft sind, ihre Punkte stehen dicht aneinander, die gewölbten Zwischenräume sind einzeln, ziemlich grob punktiert. Die Unterseite ist kaum behaart, die Beine sind schlank, das vorletzte Tarsenglied breiter als die vorhergehenden, und auch seitlich sehr deutlich behaart, an den Hintertarsen ist Glied 1 so lang wie der Rest.

Länge, 6 Millimeter; Breite, 2.

LUZON, Mount Banahao, 1 Exemplar.

Die Art ist ganz abweichend von allen mir bekannten, durch die starken scharf ausgeprägten Punktstreifen der Decken, welche, da fast alle Arten verworren punktierte Flügeldecken haben, zur Aufstellung einer eigenen Gattung berechtigen würden.

Die drei Arten von den Philippinen sind weit von einander getrennt und lassen sich leicht so übersehen:

1. Flügeldecken tief punktiertgestreift, einzeln lang abstehend behaart, letztes Fühlerglied so lang wie die beiden vorhergehenden zusammen. **L. striatopunctatus sp. nov.**
   Flügeldecken verworren punktiert, sehr kurz behaart, letztes Fühlerglied viel kürzer .... 2.
2. Körper gross und sehr flach, schwarz, vorletztes Tarsenglied kaum breiter als die vorhergehenden, Halsschild vorn im breiten Bogen ausgeschnitten .... **L. subangulatus sp. nov.**
   Körper klein, gewölbt, braun, vorletztes Tarsenglied viel breiter als die vorhergehenden, Halsschild vorn abgestutzt .... **L. luzonicus Geb.**

PYCNOCERINÆ

Aediotorix petersi sp. nov.

Von der Gestalt der andern Arten, gross, schwarzbraun, matt.

Der Kopf ist grob, zusammenfliessend punktiert, die stark erhabenen Zwischenräume der Punkte bilden verworrene, stellenweise körnige Runzeln, der Grund ist äusserst fein lederrunzlig. Die Quernaht ist leicht gebogen, deutlich eingedrückt und jederseits in Grübchen auslaufend. Die Wangen sind breiter als die Augen, und etwas länger, so lang wie die Schläfen, das Epistom ist fast parallelseitig, vorn in einen Viertelkreis ausgeschnitten. Die Fühler sind ziemlich dick. Glieder 4 bis 7 sind deutlich quer, 8 und 9 noch stärker, 10 ist so breit wie lang, 11 ist an der längeren Unterkante fast so lang wie 9 und 10 zusammen. Das Mentum hat jederseits eine längliche, tiefe Grube, der Unterkopf hat eine sehr lange, breite, tiefe Längsfurche.

Der Halsschild ist kaum breiter als lang, die Seiten sind kräftig gebogen und stark krenuliert, Basis und Spitze sind gleichbreit, der Vorderrand ist gerade abgeschnitten, die Vorderecken sind deutlich, etwas flach, gedrückt, die Hinterecken heruntergedrückt. Die Mitte ist der Länge nach etwas verflacht, jederseits hinter der Mitte findet sich ein schräger, länglicher Eindruck. Der Grund ist äusserst fein lederrunzlig, eigentliche grobe Punkte sind nicht mehr ausgebildet, sondern nur glänzende, unregelmässige Körner oder Runzeln, ausserdem sind aber, besonders vorn, deutlich getrennte, feinere, runde Körner vorhanden.

Jede Flügeldecke viel schmäler als der Halsschild (4.7 bis 3.5 Millimeter). Der Skutellarkiel its schwach erhaben, die übrigen sind sehr scharf, schwach, blank, 1 laüft fast in die Spitze, 2 ist stark verkürzt, 2, 3, 4 enden hintereinander in einer gedachten Linie welche Kiel 1 parallel läuft, die Kiele (bis auf

4) entspringen unmittelbar hinter der Basis. Die Zwischenräume haben 3 unregelmässige Punktreihen, von denen die mittlere am Vorderrand jedes Punktes eine aufrechte kurze Borste, aus einem Körnchen entspringend trägt, die beiden anderen haben nur die Körnchen, der erste Zwischenraum ist unregelmässig punktiert.

Prosternum flach, am Ende mit aufgesetzter Tuberkel, Hinterbrust, hinter dem Vorderrand ohne Querfurche, hinten jederseits neben der Mitte mit starker, runder Tuberkel. Abdomen an den Seiten und an der Spitze grob punktiert. Epipleuren hinten glatt. Vorderbeine viel dicker als bei irgend einer der andern Arten, besonders die Schenkel, deren Unterkante nicht gekrümmt ist; diese hat, nahe der Mitte, einen starken, scharfen, aber stumpfwinkligen Zahn, nur die Vorderkante ist scharf ausgeprägt, die hintere ganz verflacht. Mittel- und Hinterschenkel am Ende rundlich, aber kräftig gezähnt. Vorderschienen sehr krumm, ziemlich dick. Mittelschienen an der Basis stark gekrümmt, dann verbreitert und gerade. Hinterschienen, von innen gesehen, an der Basis stark gekrümmt, dann plötzlich verbreitert und gerade, die Verbreiterung beginnt mit einem scharfen, breiten, abgestuzten Zahn, darunter befinden sich 5 lange, starke, aber nicht spitze Zähne.

Länge, 20.8 Millimeter; Breite, 7.

Ein Männchen von Mindanao erhielt ich von Herrn H. Peters, Danzig, der sie neben andern schönen Tieren auf Mindanao entdeckte.

Die grösste bekannte Art; an den dicken Vorderbeinen, deren Schenkel unten nicht gekrümmt sind und nahe der Mitte, nicht nahe der Basis, einen starken Zahn tragen, an den mit langen Zähnen versehenen Hinterschienen und an den zwei Schwielen auf der Hinterbrust sicher von den Artgenossen zu unterscheiden ist.

Ich dediziere diese schöne Art dem Entdecker, der in der bereitwilligsten Weise mir sogar die Einzelstücke seiner Sammlung überliess.

CNODALOMINÆ

Hemicera artactoides sp. nov.

Sehr breit, fast halbkugelförmig, wegen der Gestalt und bunten Färbung auf den ersten Blick einem *Artactes* sehr ähnlich, aber hinter der Mitte am breitesten. Die Oberseite ist sehr bunt gefärbt, die Unterseite dunkel blaugrün, nur das Ende des Abdomens etwas bunt.

Der Kopf ist sehr kurz, der Clypeus etwa ein Drittel so breit wie der Abstand der Augen vorn, er ist gerade abgestutzt, die Naht scharf ausgeprägt. Die Punktierung ist sehr fein und wenig dicht, die kurzen Fühler haben eine starke 6-gliedrige Keule, die vorletzten Glieder sind fast anderthalbmal so breit wie lang, das zehnte ist an der Spitze sanft ausgeschnitten, die Mandibeln sind an der Spitze ganz fein ausgerandet.

Der Halsschild ist an der Basis ungerandet, die Seiten dick gerandet, in der Basalhälfte fast parallel, die Vorderrandlinie ist in der Mitte kurz unterbrochen, die Vorderecken breit verrundet. An der Basis findet sich jederseits ein flacher, schräger Eindruck, die Punktierung ist auf glattem Grund äusserst fein, die Färbung sehr bunt, der Grund dunkel blaugrün; jederseits, ferner vorn und hinten findet sich ein kupfriger, feurig rot umflossener Fleck. Das Schildchen ist viel länger als breit.

Die Flügeldecken sind viel breiter als bei irgend einer bekannten Art, weit hinter der Mitte am breitesten. Es sind Punktreihen vorhanden, die nicht vertieft sind, die Punkte sind grob und weitläufig, werden aber gegen die Spitze sehr fein, die Punktierung der ganz flachen Zwischenräume ist kaum wahrnehmbar. Die Färbung ist so bunt wie bei *Hemicera splendens,* aber nicht an die Streifen gebunden.

Das Prosternum ist flach, ganz wagerecht, jederseits breit und wenig scharf gefurcht, vorn steil, aber gerundet abfallend; in der Mitte des Vorderrandes findet sich eine aufgesetzte, von der Seite gesehen etwas zahnförmig vortretende Ecke, doch ist nicht wie bei *Hemicera splendens* und anderen die Prosternalplatte selbst vorn spitz gezähnt. Das scharf V-förmig ausgeschnittene Mesosternum hat vorn scharfe Ecken, der Abdominalfortsatz ist vorn vollständig gerandet, der Hinterleib selbst sehr breit und äusserst fein punktiert und lederrunzlig, das Analsegment hat keinen Fortsatz. Die Vordertarsen des Männchens sind kräftig verbreitert.

Länge, 6 bis 7 Millimeter; Breite, 3.9 bis 4.9.

MINDANAO, Butuan, Männchen und Weibchen.

Eine Art, die durch den sehr breiten Körper, die groben Punktreihen, bunte Färbung und die Bildung des Prosternums sehr ausgezeichnet ist.

Hemicera chalcea sp. nov.

Breit oval, hoch gewölbt, Oberseite einfarbig bronzebraun, stark glänzend, Unterseite und Beine schwarzblau, die Epipleuren bunt, die Wurzel der Vorderschenkel rötlich.

Der Kopf ist flach, der Clypeus sanft ausgebuchtet, er ist etwa ein Drittel so breit wie der Abstand der Augen, die Punktierung ist sehr fein und regelmässig, die Fühler sind sehr kurz und haben eine ausserordentlich breite 6-gliedrige Keule, deren letzte Glieder geschlossen sind. Die Ausbuchtung des zehnten Gliedes ist sehr breit und nimmt das letzte Glied ganz auf, das vorletzte Glied ist über doppelt so breit wie lang.

Der Halsschild ist nicht ganz halb so lang wie breit, die Vorderecken kurz verrundet stumpfwinklig, die hinteren scharf. Die Seiten sind fast geradlinig nach hinten verbreitert, der Mittellapen der Basis gerade abgestutzt. Die Punktierung ist fein aber deutlich, hinten etwas gröber, der Grund der Oberfläche ist nahezu glatt, das Schildchen ist so breit wei lang.

Die Flügeldecken sind eben hinter der Mitte am breitesten, der Rand ist von oben ganz sichtbar; es sind Reihen ziemlich grober, runder Punkte vorhanden, zwischen je zwei Punkten steht ein feiner Zwischenpunkt, genau von der Grösse der feinen, weitläufigen Punkte der Interstitien, diese sind vollkommen flach, kein Streifen ist vertieft, hinten wohl feiner aber nicht erloschen.

Die Prosternalplatte ist fast doppelt so lang wie breit, flach, jederseits gefurcht, vorn am senkrechten Absturz mit spitzigem Zähnchen. Das Mesosternum ist tief V-förmig ausgeschnitten und fällt scharfwinklig senkrecht ab. Der Abdominalfortsatz ist vollständig gerandet, das Analsegment ohne Anhang. Die Punktierung ist äusserst fein.

Länge, 7.7 Millimeter; Breite, 5.

LUZON, Laguna, Mount Maquiling, 1 Weibchen.

Auch diese Art ist sehr breit und ähnelt dadurch der vorigen, die aber ganz bunt ist und noch gröbere Punkte der Flügeldecken hat. Von allen bekannten Arten unterscheidet sie sich durch die ganz flachgedrückte, stark verbreiterte Fühlerkeule, und einfarbige Oberseite.

Hemicera iridicolor sp. nov.

Diese Art ist der gemeinen *H. splendens* Cast. & Br. von Java und Sumatra sehr ähnlich in Gestalt und Färbung, so dass es genügt, die Unterschiede hervorzuheben. Die Stirn ist etwas breiter, die sehr feine Augenfurche reicht etwas weiter nach vorn, der Grund des Halsschildes ist unter dem Mikroskop viel deutlicher lederrunzlig, die Streifen der Flügeldecken sind durchaus nicht vertieft, nur an der äussersten Spitze eingedrückt, die Punkte der Streifen sehr viel gröber als die der

Zwischenräume, während sie bei *splendens* kaum wahrnehmbar sind. Die Unterseite ist wie bei der javanischen Art, also das Prosternum in ein nach vorn etwas überragendes Zähnchen ausgezogen, der Abfall der Mittelbrust ist von der Seite gesehen verrundet.

Länge, 6 bis 8 Millimeter; Breite, 3.2 bis 4.3.

MINDANAO, Butuan, 3 Exemplare.

Aehnlich unserer Art ist auch die von Fairmaire als *Eucyrtus gloriosus* (wegen *E. gloriosus* Kraatz in *helleri* umgetaufte) beschriebene, aber sofort durch die matt glänzende Oberseite, den fast einfarbigen Vorderkörper geschieden; sie stammt von Celebes.

Die philippinischen Arten von *Hemicera* lassen sich wie folgt unterscheiden:

1. Das Analsegment ist in einem kurzen Schwanz ausgezogen, Prosternum vorn ungezähnt; sehr schmale Art .... **H. caudata** Geb.
   Analsegment einfach verrundet, Prosternum vorn mit mehr oder weniger spitzer Ecke; breitere Arten .... 2.
2. Oberseite ganz einfarbig kupferbraun, die Fühlerkeule geschlossen, ganz flach .... **H. chalcea** sp. nov.
   Oberseite mehr oder minder bunt, oder mindestens auf den Flügeldecken mit einem grünen Längsstreifen, Fühlerkeule locker, weniger flach .... 3.
3. Körper fast halbkugelförmig, Flügeldecken mit Reihen grober Punkte, sehr bunt .... **H. artactoides** sp. nov.
   Körper oval, Flügeldecken mit sehr feinen Punktreihen .... 4.
4. Oberseite sehr bunt gefärbt, der Halsschild mit querer, bunter Binde. **H. iridicolor** sp. nov.
   Oberseite einfarbig, nur die Flügeldecken mit einem grünen Längsstreifen, zuweilen auch die Naht grünlich .... **H. bivittata** Geb.

Zu *Hemicera* gehören auch die folgenden Arten:

Eucyrtus pyrozonius Fairm., Ann. Soc. Ent. Belg. 40 (1896) 29, von Indien.

Ceropria pulchra HOPE, Proc. Ent. Soc. London (1842) 63; Trans. Ent. Soc. 4 (1845) 16.

Hemicera zigzaga MARS., Ann. Soc. Ent. Fr. (5) VI (1876) 111; LEW., Ann. & Mag. Nat. Hist. VI 13 (1894) 474, von Japan.

Eucyrtus multicolor FAIRM., Notes Leyd. Mus. 15 (1893) 40, von Borneo und Sumatra. Von voriger Art kaum zu unterscheiden.

Eucyrtus auripennis sp. nov.

Klein, schmal, parallel, einem kleinen *Tenebrio* an Gestalt nicht unähnlich, ziemlich flach; der Vorderkörper ist prachtvoll blaugrün, die Flügeldecken goldig, die Naht hinten grünlich, die Unterseite ist schwarz, die Beine blaugrün, die Wurzel der Fühler rot.

Der Kopf ist breiter als lang, vor den Augen nicht verkürzt, Augenfurchen sehr fein und hinten um das Auge herum gehend, fast grübchenförmig und zwischen ihnen undeutlich, die Clypealsutur ist tief eingedrückt aber nicht eingeschnitten, der Vorderrand gerade abgestutzt, die Wangen sind etwas schmäler als die Augen und verengen sich von diesen an in flachem Bogen, die Punktierung ist ziemlich dicht und deutlich, vorn viel feiner als auf der Stirn. Die Fühler haben eine gut abgesetzte, 6-gliedrige Keule, die vorletzten Glieder sind doppelt so breit wie lang; die Mandibeln sind an der Spitze scharf gefurcht.

Der Halsschild ist anderthalbmal so breit wie lang, querüber kräftig gewölbt, die Seiten sehr schmal verflacht und fein gerandet, die Mitte des Vorderrandes ist breit vorgezogen, die Vorderecken sind kurz verrundet, die hinteren scharf rechtwinklig, die Seiten sind nicht sehr stark gerundet und ganz schwach gewellt, hart an der Basis findet sich eine kräftige Querimpression, die Punktierung ist wie die des Kopfes sehr deutlich, ziemlich dicht und regelmässig.

Die Flügeldecken sind etwas breiter als der Halsschild, mit scharfen Schultern versehen, ihr Seitenrand ist der ganzen Länge nach überwölbt. Es sind Streifen feiner, regelmässiger Punkte vorhanden, die nicht vertieft sind, nur die seitlichen zeigen hinten eine äussere etwas höhere Kante, ganz schwach, aber ähnlich wie bei *Eucyrtus subcostatus*, die flachen Zwischenräume sind deutlich aber sehr fein punktiert, der Nahtstreif ist hinten vertieft, der Rand der Decken ist blaugrün.

Die Unterseite ist glänzend, das Prosternum ist vorn und hinten ganz niedergedrückt, am Absturz scharf doppelt gefurcht, die Spitze etwas vorragend, die Mittelbrust mässig tief eingedrückt, die Ecken aber scharf. Das Abdomen ist kräftig und ziemlich dicht punktiert, das Analsegment ungerandet. Die Beine sind kurz und ohne Auszeichunung (im Weibchen), an den Hintertarsen ist Glied 1 so lang wei 2 und 3 zusammen.

Länge, 7.3 Millimeter; Breite, 2.8.

LUZON, Laguna, Mount Banahao (*2805*), 1 Weibchen.

Eine kleine, gestreckte, bunte Art, die von den echten *Eucyrtus* durch die Gestalt, den langen Vorderkopf, das ganz niedergedrückte Prosternum abweicht und mit den meisten Arten in eine andere Gattung gebracht werden muss. Am nächsten verwandt scheint *E. excellens* Geb., von den Philippinen, ist aber grösser, anders gefärbt und hat einen sehr flachen Kopf.

Eucyrtus excellens Geb.

Vier weitere Exemplare von Los Baños, die sämmtlich prachtvoll blau gefärbt sind (*861* und *1599*). Die Männchen haben einen feinen Haarstreif an der Innenseite der Hinterschienen und einen kaum wahrnehmbaren Haarfleck an den Hinterschenkeln.

Eucyrtus crenatus sp. nov.

Mit *E. auripennis* verwandt und ihm in der Gestalt sehr ähnlich, nur etwas gedrungener. Die Oberseite bläulichgrün oder mit bronzefarbenen Flügeldecken, die Unterseite braun, die Fühler und Beine rotbraun.

Die Stirn ist gewölbt, die Quernaht tief eingedrückt, auch der Clypeus ist sanft gewölbt, der Vorderkopf ist äusserst fein, der Hinterkopf viel gröber punktiert, die Wangen sind etwas breiter als die Augen, sehr stark gerundet und etwas aufgeworfen; die Fühler haben nur eine deutlich 3-gliedrige Keule, deren Endglied sehr gross und fast kugelig ist, Augenfurchen und Augenfalten fehlen.

Der Halsschild ist anderthalbmal so breit wie lang, in der Mitte am breitesten, die Seiten sind etwas vor den Hinterwinkeln deutlich eingezogen, seitlich stark gerundet, die Mitte des Vorderrandes ist nicht vorgezogen, die Vorderwinkel treten vor und sind ziemlich scharf rechtwinklig, der Seitenrand ist nicht uneben, die Seiten selbst sind nicht abgesetzt, sondern die Querwölbung reicht fast bis an den Rand, nur die Hinterwinkel sind deutlich verflacht, die Mitte ist vorn durch ein sehr kleines, undeutliches Grübchen gekennzeichnet, die Punktierung ziemlich grob und dicht; die Basis ist dick und deutlich gerandet, davor findet sich keine Verflachung.

Die Flügeldecken sind lang gestreckt, ganz parallel, ihr Seitenrand ist in der Mitte etwas überdeckt, sonst von oben sichtbar. Es sind Streifen grober, tiefer Punkte vorhanden, die bis zur Spitze fast gleichartig sind, die Zwischenräume sind gewölbt, sehr fein aber deutlich punktiert.

Das Prosternum ist sehr breit und tief gefurcht, die Seiten fast kielartig, hinten ist es kaum gesenkt. Die Pleuren sind grob punktiert, die Mittelbrust tief und senkrecht, breit U-förmig ausgeschnitten, die Ecken scharf rechtwinklig. Das Abdomen ist sehr fein punktiert, das Analsegment ist ungerandet, die Beine sind sehr kurz, die Schenkel dick, die Schienen gerade, an den Hintertarsen ist Glied 1 kaum so lang wie 2 und 3 zusammen. An den Vorderschienen findet sich beim Männchen an der Innenkante unter der Mitte ein winziges Winkelchen, die anderen Schienen sind ohne Auszeichnung.

Länge, 7.1 bis 7.5 Millimeter; Breite, 2.6 bis 2.8.

MINDANAO, Iligan, 1 Männchen mit einfarbiger Oberseite. LUZON, Tayabas, Malinao, 1 Weibchen mit kupfrigen Decken.

Ich zweifle nicht, dass beide Tiere zusammengehören. Die Art steht dem *E. auripennis* am nächsten, unterscheidet sich aber durch Färbung, robustere Gestalt, grobe Punktstreifen, hinten fast wagerechtes Prosternum, 3-gliedrige Fühlerkeule.

Eucyrtus semirufus sp. nov.

Violett, bei Ansicht gegen das Licht leuchtend purpurn, die ganze Unterseite, Fühler, Beine gelbrot, die Kniee etwas dunkler; klein, mässig schlank, parallel.

Der Kopf ist quer, vor den Augen lang, diese sind klein, rund; die Augenfurchen sind fein und nur hinten deutlich, die Stirn liegt also nicht höher als die Augen, sondern ist flach, die Quernaht ist angedeutet, die Punktierung direkt oberhalb derselben ist sehr deutlich und fein längsrissig, besonders neben den Augen, sonst getrennt; der Clypeus ist äusserst fein punktiert, gerade abgestutzt, die Wangen schmäler als die Augen, von diesen an nach vorn verengt. Die Fühler erreichen die Basis des Halsschildes nicht, sie sind schlank und haben eine gestreckte 6-gliedrige Keule, deren erstes Glied aber schwach abgesetzt ist.

Der Halsschild ist stark quer, deutlich schmäler als die Decken, die Seiten nach vorn nur wenig mehr als zur Basis verengt, der Vorderrand von oben gesehen ganz gerade abgestutzt, die Ecken treten also durchaus nicht vor, sondern sind verrundet, die Hinterwinkel sind scharf rechtwinklig, die Vorderecken sind aber nicht heruntergedrückt, die Seiten nahe den Hinterecken dagegen sind deutlich verflacht, die Basis ist ungerandet aber in der Mitte verflacht, der Mittellappen tritt kaum weiter zurück als die Ecken.

Die Flügeldecken sind parallel, der Seitenrand ist von oben kaum sichtbar, die Skulptur besteht aus feinen, eingeschnittenen Linien, die hinten stärker vertieft sind, dort sind die Zwischenräume stark gewölbt, vorn dagegen fast flach, die Punkte der Streifen sind sehr fein und ganz undeutlich, die der Zwischenräume äusserst fein; die äusseren Zwischenräume sind normal.

Die Unterseite ist matt glänzend, nackt, das Prosternum ist tief und breit gefurcht, hinten niedergedrückt, die Pleuren sind ziemlich grob punktiert und mit einigen Längsrunzeln versehen, die Mittelbrust ist wenig hoch eingedrückt, die Ecken ganz verrundet. Das Abdomen ist sehr deutlich punktiert, die Beine sind kurz und ohne Auszeichnung.

Länge, 6 Millimeter.

LUZON, Laguna, Los Baños (*1194*), 1 Exemplar.

Diese Art gehört ebenfalls nicht zu *Eucyrtus* im engeren Sinne. Ihre Unterschiede von den Verwandten werden in der Tabelle klargelegt.

Eucyrtus pauperatus sp. nov.

Klein, gewölbt, Flügeldecken kaum parallelseitig, Vorderkörper schwarz, Flügeldecken dunkelviolett, Unterseite dunkelbraun, Fühler und Beine rotbraun.

Der Kopf ist gross, etwa so breit wie lang, vor den Augen lang, die Wangen so breit wie die Augen, der Vorderrand ganz gerade abgestutzt, die Stirn ist gewölbt, und liegt etwas höher als die Augen, von denen sie durch eine tiefe, etwas um das Auge herum laufende Furche abgetrennt ist, die Quernaht ist gerade und deutlich, aber nicht eingeschnitten, die Punktierung direkt oberhalb derselben sehr deutlich, ganz vorn sehr fein. Die Fühler sind schlank und haben eine gut abgesetzte 5-gliedrige Keule.

Der Halsschild ist wenig quer, stark gewölbt, besonders vorn, so dass die Vorderecken heruntergedrückt erscheinen, der Seitenrand ist nahezu glatt, nicht verflacht, auch nicht bei den Hinterwinkeln, die Spitze ist ganz gerade abgeschnitten, die Seiten sind in der Mitte am breitesten und nach vorn nur wenig mehr als nach hinten verengt. Alle Ecken sind fast rechtwinklig und ziemlich scharf, die Spitze ist auch an den Seiten ungerandet, ebenso findet sich auch an der Basis nicht die Spur einer Randlinie, vor der Mitte der Basis eine Verflachung. Die Punktierung is sehr deutlich und wenig dicht.

Die Flügeldecken sind in der Mitte am breitesten, der Rand ist von oben nicht sichtbar, die Schultern sind kurz verrundet, die Skulptur besteht aus kräftigen Punktstreifen, deren Punkte, namentlich die äusseren, ziemlich grob sind, alle Interstitien sind deutlich gewölbt, äusserst fein punktiert, die äusseren sind nicht schief.

Das Prosternum ist breit und tief gefurcht, oder anders ausgedrückt, die Ränder sind scharfkantig; nach vorn ist es wagerecht, nach hinten etwas gesenkt, aber mit prononzierter Spitze versehen, die Pleuren sind ziemlich weitläufig und grob punktiert. Das Mesosternum ist breit V-förmig ausgeschnitten, der Ausschnitt senkrecht, die Ecken scharf stumpfwinklig. Die Hinterbrust ist vorn grob punktiert und deutlich längsrunzlig, die ersten Abdominalsegmente sind ebenfalls grob punktiert, während die Punktierung der letzten Segmente äusserst fein ist. Die Beine sind sehr kurz, ohne Auszeichnung, die Vordertarsen sind ziemlich breit.

Länge, 5.4 Millimeter; Breite, 2.2.

Luzon, Laguna, Mount Maquiling, 1 Exemplar.

Die Art ähnelt etwas der vorigen, besonders in der Färbung und Grösse, unterscheidet sich aber sofort unter anderem durch die sehr breiten Wangen, die groben Punkte der Streifen, die gewölbten Interstitien, die Brustbildung.

Eucyrtus frontalis sp. nov.

Sehr klein, schmal, parallel, in der Anlage fast zilindrisch; Vorderkörper dunkelgrün-metallisch, Flügeldecken bronzefarben, Unterseite und Beine schwärzlich braun.

Der Kopf ist kurz, aber vor der Quernaht nicht verkürzt, sondern wohl entwickelt, die Stirn stark gewölbt, sie liegt viel höher als die Augen, die Augenfalten sind grob und tief und laufen hinten geradlinig in den Nacken; die Quernaht ist gerade, tief eingedrückt, der Vorderkopf flach, von der gewölbten Stirn stark getrennt, die Wangen verengen sich im Bogen von den Augen an, sie sind kräftig entwickelt und verflacht; die Fühler fehlen dem Exemplar, das mir vorliegt.

Der Halsschild ist anderthalbmal so breit wie lang, querüber sehr stark bis an den Seitenrand gewölbt, dieser auch hinten nicht verflacht, die Vorderecken sind stark heruntergedrückt, von oben gesehen ist der Vorderrand in der Mitte in flachem Bogen vorgezogen und die Ecken treten zurück, diese sind wie auch die hinteren scharf stumpfwinklig, die Seiten in der Endhälfte fast parallel, nur nach vorn verengt, der Rand nicht krenuliert. Basis und Spitze sind ganz ungerandet, die erstere in der Mitte etwas verflacht, die Punktierung ist dicht und sehr fein, aber weniger dicht als die auf dem fast gedrängt punktierten Kopf.

Die Flügeldecken haben eine grünliche Naht, ihr Seitenrand ist von oben nicht sichtbar. Es sind Punktstreifen vorhanden, deren Punkte sehr fein sind und dicht gedrängt stehen, nur der erste ist, besonders in der Endhälfte, kräftig vertieft, die Interstitien sind flach, deutlich, aber fein und dicht punktiert, die

Streifen werden gegen die Spitze nicht feiner, die äusseren Zwischenräume sind normal.

Die Unterseite ist nackt, glänzend; das Prosternum ist hinten wenig gesenkt, mit prononzierter Spitze versehen, in der Endhälfte stark und breit gefurcht, die Pleuren sind grob und weitläufig punktiert und schwach gerunzelt, die Mittelbrust ist breit U-förmig ausgeschnitten, das Abdomen ist auf den ersten Segmenten in der Mitte kräftig punktiert, an den Seiten und zur Spitze dagegen sehr fein. Die Beine sind sehr kurz und nicht ausgezeichnet.

Länge, 5.5 Millimeter.

LUZON, Manila, 1 Exemplar.

Diese kleine Art ist von allen anderen weit getrennt durch die Stirnbildung. Eine gewölbte Stirn hat auch *E. pauperatus*, aber ihm fehlen die starken, hinten gerade in den Nacken gehenden Furchen; ausserdem unterscheidet sie sich durch die Färbung, Skulptur, und so weiter, weit von unserer Art.

Eucyrtus subcostatus Fairm.

LUZON, Laguna, Mount Maquiling. MINDANAO, Iligan, 2 Exemplare.

Das erstere hat dunkelgrünen Halsschild und purpurne Flügeldecken, deren Schulterbeule und Spitze violett ist, die Naht ist grün. Das zweite hat leuchtend violette Flügeldecken.

Eucyrtus lobicollis sp. nov.

Klein, parallel, Vorderkörper schwarz, Flügeldecken bronzebraun mit etwas grünlicher Naht, Unterseite und Beine braunschwarz, Füsse und Fühler rot.

Der Kopf ist stark entwickelt, der Vorderkopf nicht verkürzt, die Augen gross, zum grossen Teil aber von den Vorderwinkeln des Halsschildes bedeckt, die Augenfalten sind sehr fein, die Wangen stark entwickelt, so breit wie die Augen, etwas aufgebogen, und vor den Augen fast halbkreisförmig; statt einer Quernaht findet sich ein breiter, querer Eindruck, der Clypeus ist gerade abgestutzt, die Punktierung ist sehr fein, im Eindruck fehlend, die dünnen Fühler haben eine schlanke, 6-gliedrige Keule.

Der Halsschild ist circa anderthalbmal so breit wie lang, mässig gewölbt, die Seiten breit verflacht, besonders an den Hinterecken, die grösste Breite liegt in der Mitte, dahinter sind die Seiten deutlich geschweift, die Hinterecken sind scharf rechtwinklig und treten ebenso weit nach aussen wie die Mitte, die Vorderecken sind weit vorgezogen, in der Anlage spitz, aber die äusserste Spitze verrundet. Von vorn gesehen erscheint der Ausschnitt des Halsschildes halbkreisförmig, die Basis ist ungerandet, die Punktierung ist deutlich, weitläufig, die Punkte stellenweise etwas in die Länge gezogen.

Die Flügeldecken sind ziemlich parallel, die Schulter gut entwickelt, fast etwas nach vorn vortretend, der Rücken ist flach, die Seiten fallen steil ab, der fünfte Zwischenraum ist der Länge nach stark gekielt und begrenzt die Scheibe der Decke, der sechste ist vorn noch stärker gekielt, dieser und der siebente sind nach aussen schräg erhaben, ganz ähnlich wie bei *E. subcostatus*. Der Kiel des fünften Zwischenraumes läuft nicht ganz bis in die Spitze, die ersten Interstitien sind vorn flach, hinten deutlich gewölbt.

Das Prosternum ist breit und tief gefurcht, hinten wenig gesenkt mit prononzierter Spitze, die Mittelbrust hat im Eindruck einen senkrechten Absturz, doch sind die Ecken ganz verrundet, die Propleuren sind grob und wenig dicht punktiert, die Punktierung der übrigen Unterseite ist feiner, aber überall sehr deutlich. Die Beine sind länger als bei den verwandten Arten, ohne Auszeichnung.

Länge, 5 Millimeter.

LUZON, Mount Banahao, 1 Exemplar.

Die kleine Art ist sehr auffällig durch die Bildung der Flügeldeckenstreifen; sie ähnelt dadurch etwas dem *E. subcostatus*, einer Art von der sie weit entfernt ist, durch Grösse, Färbung, Bildung des Halsschildes, des Kopfes und so weiter.

Eucyrtus gloriosus Kraatz.

PALAWAN, Puerto Princesa, 2 weitere Exemplare.

Eucyrtus clypealis Geb.

Von Baker in einem Exemplar bei Los Baños gefunden (*865*).

Tabelle zur Bestimmung der philippinischen Arten von Eucyrtus.

1. Der Kopf ist vorn in der Höhe der Fühlerwurzeln stark verkürzt; meist grosse Arten, deren Hinterkörper nach hinten stark erweitert ist, Seiten des Halsschildes dick gerandet.. 2.
   Kopf mit wohl entwickeltem Vorderteil; kleine oder sehr kleine, meist parallele Arten; Seiten des Halsschildes fein gerandet.................... 4.
2. Basis des Halsschildes gerandet, Epistom breit und flach ausgeschnitten. E. lisae Kr.
   Basis des Halsschildes ungerandet, Epistom gerade abgestuzt........... 3.

3. Flügeldecken mit feinen, seitlich fast erloschenen Punktreihen, Halsschild hinter der Mitte eingezogen, Basis wenig breiter als die Spitze. E. nigripes Kr.
   Flügeldecken mit feinen eingeschnittenen Linien, Halsschild hinten nicht deutlich eingezogen, Basis viel breiter als die Spitze. E. gloriosus Kr.
4. Die äusseren Zwischenräume sind schief gerippt.. 5.
   Alle Zwischenräume normal.. 6.
5. Körper schwarz, Flügeldecken braun-bronze, die Vorderecken des Halsschildes treten weit vor, die Wangen sind so breit wie die Augen. E. lobicollis sp. nov.
   Körper blau, Flügeldecken blau, purpurn oder bunt, die Vorderecken des Halsschildes treten nicht vor, Seitenrand schwach krenuliert, die Wangen schmäler als die Augen.................... E. subcostatus Fairm.
6. Die Stirn mit groben, geraden, in den Nacken laufenden Furchen. E. frontalis sp. nov.
   Stirn ungefurcht, oder mit feinen Furchen, die um das Auge herumgehen .... 7.
7. Die Vorderecken des Halsschildes treten weit und spitz vor, Körper bis auf die blaugrünen Flügeldecken schwarz.... E. acutangulus Geb.[a]
   Die Vorderecken des Halsschildes treten kaum oder nicht vor, Vorderkörper metallisch oder blau.. 8.
8. Epistom ausgeschnitten, über 12 mm lang.................... E. clypealis Geb.
   Epistom gerade abgestutzt, unter 9 mm gross.. 9.
9. Die Stirn ist gewölbt und liegt höher als die Augen, Augenfurchen sehr deutlich, Hinterkörper nicht parallelseitig; schwarz, Flügeldecken blau.. E. pauperatus sp. nov.
   Die Stirn ist flach und liegt nicht höher als die Augen, Augenfurchen sehr fein oder fehlend, Hinterkörper meist parallel........................ 10.
10. Flügeldecken oval, mit äusserst feinen Punktlinien, Beine und Fühler korallenrot, Propleuren unpunktiert............................ E. ovipennis Geb.
   Hinterkörper parallel, Flügeldecken mit Punktstreifen, Beine schwarz oder rotbraun oder metallisch, Propleuren grob punktiert............ 11.
11. Flügeldecken grob gestreift, Zwischenräume gewölbt, Halsschild grob punktiert.. E. crenatus sp. nov.
   Flügeldecken mit feinen Streifen, Zwischenräume flach, Halsschild weitläufig und sehr fein punktiert.. 12.
12. Körper oben blau, unten rot, die Punkte auf der Stirn fein längsrunzlig. E. semirufus sp. nov.
   Körper oben bunt oder einfarbig grünblau, unten schwarz, Stirn getrennt punktiert.. 13.
13. Sehr schmal, Körper zweifarbig: vorn blaugrün, Flügeldecken goldig. E. auripennis sp. nov.
   Robustere Art, Körper bunt oder einfarbig blaugrün.... E. excellens Geb.

Eucyrtus planifrons sp. nov.

Klein, schlank, nach hinten etwas erweitert, glänzend schwarz, die Flügeldecken bräunlich purpurn, mit schwachem Metallschein, Unterseite schwarzbraun.

[a] Mir ist noch die nachfolgende Art bekannt geworden.

Der Kopf ist sehr gross, ganz flach, Augenfalten fehlen, die Augenfurchen sind sehr fein und gehen um das Auge herum. Der Vorderkopf ist stark entwickelt, die gerundeten Wangen sind breiter als das Auge, das Epistom ist gerade abgestutzt, die Punktierung ist fein und dicht. Die Fühler sind schlank und dünn, mit 5-gliedriger, lockerer Keule versehen, das letzte Glied ist oval, die dreieckigen vorletzten sind so lang wie breit.

Der Halsschild ist doppelt so breit wie lang, querüber mässig stark gewölbt, die seitliche Randung ist sehr fein, die der Spitze und der Basis ist in der Mitte breit unterbrochen, die Hinterecken sind scharf rechtwinklig, die Vorderecken sind heruntergebogen und sehr weit vorgezogen, an der Spitze aber verrundet, der Vorderrand ist also stark ausgeschnitten. Die Seiten sind in der Mitte am breitesten, sie sind nach hinten wenig, nach vorn stärker verengt. Vor der Basis befindet sich ein querer, kräftiger Eindruck, der Seitenrand ist nicht verflacht, die Punktierung ziemlich grob und mässig dicht.

Die Flügeldecken haben schwache Schulterbeulen, sie sind nach hinten erweitert, im letzten Drittel am breitesten, ihr Seitenrand ist von oben sichtbar, nur in der Mitte überdeckt; die Epipleuren sind vor der Spitze verkürzt. Die Skulptur besteht aus feinen Punktstreifen, deren runde, feine Punkte sehr dicht stehen und bis zur Spitze deutlich sind; die Zwischenräume sind kräftig punktiert, vorne ganz flach, zur Spitze, besonders seitlich aber gewölbt.

Die Unterseite ist blank, das Prosternum hinter den Hüften wagerecht, der Fortsatz gerundet senkrecht abfallend, tief gefurcht, vorn fällt es mässig steil ab. Die Mittelbrust ist tief U-förmig ausgeschnitten, mit scharfen, von der Seite gesehen rechtwinkligen Ecken. Die Pleuren, Hinterbrust und das Abdomen sind kräftig, nicht sehr eng punktiert. Die Beine sind sehr kurz, die Schienen gerade, die vorderen dick und rund, ohne Auszeichnung.

Länge 6.3, Breite 3.2 Millimeter.

Ein Exemplar von Luzon (*Roeseler* leg.), im Mus. Hamburg.

Wegen den vorstehenden Vorderecken des Halsschildes lässt sich unsere Art nur mit *E. acutangulus* vergleichen, mit der sie nur flüchtige Aehnlichkeit hat; sie ist anders gefärbt, stärker gewölbt, die Seiten des Halsschildes sind nicht parallel, sondern deutlich gebogen, das Abdomen stark punktiert, die Fühlerkeule 5- statt 6-gliedrig.

Simalura luzonica sp. nov.

Breit, gewölbt, nach hinten kräftig erweitert, Oberseite schwärzlich purpurn, der Halsschild mit sehr breiter, querer Binde, auf dem Kopf zuweilen ein grünlicher Fleck, die Streifen, die Naht und der Seitenrand der Flügeldecken ebenfalls grün; Unterseite, Fühler und Beine glänzend schwarz.

Der Kopf ist sehr breit, die Quernaht kräftig eingedrückt und beiderseits nach vorn umgebogen, an ihrer Ausmündungsstelle befindet sich kein Einschnitt, die Wangen sind nur wenig schmäler als die Augen, der Hals hinter diesen ist fast rechtwinklig abgeschnürt, die Augenplatte daher sehr deutlich; das Epistom ist kräftig ausgeschnitten, die Punktierung vorn sehr fein, auf der Stirn viel gröber, es sind sehr feine Augenfurchen und die Andeutung von Augenfalten vorhanden; die Fühler haben eine gut abgesetzte 7-gliedrige Keule.

Der Halsschild ist stark quer, ziemlich flach, der Vorderrand mit den Vorderecken in breitem Bogen ganz verrundet, die Seiten sind sehr dick, etwas abgesetzt, fast furchig gerandet, die Basalrandung ist vollständig und sehr fein, vor der Basis befindet sich ein flacher Quereindruck. Die Hinterecken sind scharf rechtwinklig, die Punktierung ist ziemlich grob und wenig dicht, nahe den Vorderecken dagegen sehr fein. Der Absturz hinten, also der Anschluss an die Basis der Flügeldecken ist nicht senkrecht wie bei *Eucyrtus* und anderen Gattungen, sondern schräg, ist also von oben zu sehen, eine Bildung, wie sie übrigens auch *S. jacobsoni* hat.

Die Flügeldecken haben verrundete Schultern, ihr Seitenrand ist von oben ganz sichtbar, die grösste Breite liegt im letzten Drittel. Es sind eingeschnittene Punktstreifen vorhanden, deren Punkte auf der Scheibe äusserst fein sind und gegen die Spitze ganz verschwinden, nur die seitlichen Streifen sind deutlicher punktiert, die Zwischenräume sind vorn flach, gegen die Spitze aber stark gewölbt, sie sind sehr fein, aber deutlich und wenig dicht punktiert.

Die Unterseite ist nackt, die Propleuren sind unpunktiert, das Prosternum ist breit und flach gefurcht; das Mesosternum ist breit U-förmig, senkrecht ausgeschnitten, die Ecken aber, von der Seite gesehen, ganz stumpf, die Hinterbrust ist nur an den Seiten fein punktiert, die Punktierung der ersten Abdominalsegmente dagegen ziemlich grob, Analsegment ungerandet. Die Beine sind kurz, ohne Auszeichnung beim Weibchen, die Vordertarsen sind deutlich verbreitert. Beim Männchen sind die Vorderschienen etwas gekrümmt, im letzten Viertel mit einem winzigen Winkelchen versehen und darunter mit einem ganz leichten Ausschnitt, ähnlich wie beim Männchen von *jacobsoni*, nur deutlicher.

Länge, 9.1 bis 9.6 Millimeter; Breite, 4.6 bis 4.8.

LUZON, Laguna, Mount Maquiling, 1 Männchen und 1 Weibchen; Los Baños (*858*), 1 Weibchen.

Die Art ist dem Typus der Gattung, *S. jacobsoni* sehr ähnlich aber ausser durch die Färbung besonders der Flügeldecken, durch die hinten stark gewölbten Zwischenräume, durch etwas anderen Halsschild und etwas bedeutendere Grösse verschieden, auch ist die männliche Geschlechtsauszeichnung viel deutlicher.

Simalura elongata sp. nov.

Sehr klein, gestreckt, mässig gewölbt. Vorderkörper glänzend dunkelgrün, Vorderkopf und Hinterrand des Halsschildes blaugrün, Flügeldecken stark glänzend kupferbraun, ihr Rand bläulich wie die Epipleuren, Unterseite und Beine schwarz.

Der Kopf hat eine kräftige Querimpression, die aber sehr schlecht begrenzt ist, die Stirn ist flach, Augenfalten und Augenfurchen fehlen, die Wangen sind etwas schmäler als die Augen, die Einschnürung des Halses ist stark aber nicht so scharf als bei *Simalura luzonica*. Die Fühler haben eine gut abgesetzte 6-gliedrige Keule.

Der Halsschild ist auffällig schmäler als die Flügeldecken, etwa so breit wie eine der Decken; er ist flach mit deutlicher, flacher Impression vor der Basis, der gerade Vorderrand ist mit den Vorderecken ganz verrundet. Die Hinterecken sind scharf stumpfeckig, die Seiten sind nach hinten kaum verengt und nahezu gerade.

Die Flügeldecken sind im letzten Drittel am breitesten, die Schultern verrundet, der Seitenrand von oben sichtbar. Die Punktstreifen sind scharf ausgeprägt, aber nicht eingedrückt und gegen die Spitze ganz geschwunden; alle Zwischenräume sind flach und nicht deutlich punktiert.

Die Unterseite ist glänzend schwarz, die Propleuren sind unpunktiert, das Prosternum ist hinten ganz wagerecht und spitz, der Länge nach flach gefurcht, das Mesosternum ist scharf V-förmig ausgeschnitten, der Ausschnitt senkrecht, die Ecken sind von der Seite gesehen ganz stumpf. Die ersten Segmente des Abdomens sind sehr deutlich punktiert; die Beine sind kurz, die Vorderschienen des Weibchens ohne Auszeichnung.

Länge, 5.8 Millimeter.

PALAWAN, Puerto Princesa, 1 Weibchen.

Diese Art ist von der vorigen durch geringere Grösse, schmäleren Körper, ganz andere Färbung, gerade abgestutztes Epistom, 6-gliedrige Fühlerkeule, und hinten ganz flache Interstitien unterschieden.

Genus APTEREUCYRTUS novum

Ungeflügelt, breit, gewölbt, der Kopf ist lang und vor den Augen kräftig entwickelt, nicht verkürzt, kurze, tiefe Augenfurchen sind vorhanden, Augenfalten fehlen, die Augen sind quer und kräftig eingeschnürt, das Epistom ist leicht ausgebuchtet. Die Fühler sind kurz und gegen das Ende gekeult. Das Kinn ist ziemlich flach, die Mandibeln sind am Ende ungefurcht und gerade abgestutzt, der Unterkopf ist tief gefurcht, Kehle und Unterkopf sind rechtwinklig aufeinandergesetzt. Der Halsschild ist so breit wie die Flügeldecken, seitlich sehr dick gerandet, die Vorderrandlinie unterbrochen. Das Schildchen ist spitz dreieckig. Die Flügeldecken sind hoch gewölbt und fallen hinten ziemlich steil ab, sie sind nach hinten erweitert, die Schulterecken sind deutlich und etwas vorgezogen, die Unterflügel sind ganz rudimentär, die Epipleuren sind verkürzt, das Prosternum ist wagerecht, die Mittelbrust ausgeschnitten. Die Hinterbrust ist sehr kurz, zwischen den Hüften etwa zwei Drittel so breit wie eine Hüfthöhle. Die Beine sind kurz, die Schenkel ungezähnt, die Schienen rund, die Tarsen sehr kurz, ihre Glieder nicht ausgerandet.

Die nachfolgende Art in die Gattung *Eucyrtus* einzureihen, kann ich mich nicht entschliessen, trotzdem diese Gattung die heterogensten Elemente enthält; die Flügellosigkeit ist ein Charakter, der sich bei allen anderen Cnodaloniden nicht findet. Im übrigen ist die Gattung *Pseudabax* sehr ähnlich, hat aber keine knotigen Verdickungen der Interstitien.

Aptereucyrtus hemichalceus sp. nov. Tafel 1, Fig. 8.

Breit, stark gewölbt, glänzend schwarz, die Flügeldecken schwärzlich bronzefarben. Der Kopf ist gross und breit, fast flach, nur auf der gut ausgeprägten Quernaht eingedrückt; die Wangen sind ebenso wie die Vorderecken des Kopfes kurz verrundet, ganz wenig schmäler als die Augen. Augenfalten fehlen, Augenfurchen kurz und sehr tief, sie gehen hinten, sich verflachend nach aussen, aber nicht um die Augen herum. Die Stirn zwischen den Augen ist doppelt so breit wie ein Auge im

Querdurchmesser; die Punktierung ist hinter der Querfurche kräftig und eng, davor dagegen sehr fein. Die Fühler erreichen die Mitte des Halsschildes nicht, sie haben eine 6-gliedrige Keule, deren vorletzten Glieder fast doppelt so breit wie lang sind, auch das letzte Glied ist quer, die Fühler sind wie die Tarsen rotbraun. Das Kinn ist mit einem feinen mittleren Längskiel versehen und jederseits mit flacher Grube, die vordere Partie ist dünn, lang abstehend behaart.

Der Halsschild ist anderthalbmal so breit wie lang, querüber stark, in der Längsrichtung schwächer gewölbt, die Seiten sind stark gerundet, in der Mitte am breitesten, nach hinten etwas eingezogen verengt, die Vorderecken sind kräftig, kurz verrundet vorgezogen, die Basis ist dick gerandet, die Randlinie in der Mitte breiter, die Hinterecken sind spitzwinklig. Die Punktierung ist sehr fein und nicht sehr dicht, regelmässig.

Die Flügeldecken sind wenig breiter als der Halsschild, hinter der Mitte am breitesten, die Schulterecken sind nach vorn vorgezogen, der Seitenrand ist nur ganz vorn und an der Spitze von oben sichtbar. Es sind kräftige, aber nicht sehr vertiefte Punktstreifen vorhanden, die Zwischenräume sind auf der Scheibe fast flach, zur Spitze stärker gewölbt und dort kaum wahrnehmbar, vorn dagegen, wenn auch sehr fein, aber deutlich punktiert.

Das Prosternum ist wagerecht oder sanft gebogen, vorn ungerandet, jederseits zwischen den Hüften tief gefurcht, die Spitze ist etwas prononziert, die Pleuren sind ganz erloschen punktiert. Die Mittelbrust ist von der Seite gesehen stumpfeckig, breit U-förmig, aber nicht senkrecht eingedrückt, das Abdomen ist äusserst fein punktiert, das Analsegment mit querer Spitzenfurche versehen. Die Beine sind kurz, die Tarsen mit 4 respektiv 3 dick behaarten Sohlengliedern versehen, das Klauenglied ist sparsam behaart, an den Hintertarsen ist es so lang wie das erste Glied.

Länge, 13.1 bis 14.5 Millimeter; Breite, 6.1 bis 6.3.

Zwei Männchen von Mittelluzon (*Warburg* leg.) aus dem Zoologischen Museum, Hamburg, von denen mir eines für meine Sammlung überlassen wurde.

Gauromaia laticeps sp. nov.

Ziemlich schlank, gewölbt, etwa von der Gestalt des *G. dives*. Flügeldecken und Halsschild kupfrig braun, die Deckenstreifen leicht purpurn, der Vorderrand des Halsschildes schmal, der

Hinterkopf breit violett, der übrige Kopf schwarz kupfrig, die Unterseite braun, die Ränder etwas bläulich, Beine schwach blaugrün, die Fühler braun.

Der Kopf ist auffällig breit und ganz flach, die Stirn zwischen den Augen über viermal so breit wie ein Auge von oben gesehen, die Augenfurchen sind sehr fein und hören am Hinterrand des Auges auf, schnüren also nicht wie bei *G. dives* eine Platte hinter den Augen ab. Der Hals ist stark verengt, etwas enger als die Stirn und ist fast rechtwinklig von dem Kopf abgesetzt, die Wangen sind so breit wie die Augen, auf ihnen vor den Augen befindet sich kein Eindruck, sondern sie sind selbst hinunter gedrückt. Das Epistom ist sehr breit und ganz gerade abgestutzt, de Quernaht ist gut ausgeprägt, nicht eingeschnitten, die Fühler sind kurz und ziemlich dünn, mit 5-gliedriger Keule versehen, deren vorletzte Glieder fast doppelt so breit wie lang sind; das Kinn ist querüber flach und gleichmässig gewölbt, sein Vorderrand halbkreisförmig, die Mandibeln sind an der Spitze ausgeschnitten, der Unterkopf mit dreifach geschwungener Furche, welche am Hinterrand der Augen beginnt, jederseits nach vorn gebogen ist und in der Mitte breitbogig nach hinten ausweicht.

Der Halsschild ist fast doppelt so breit wie lang, die Seiten sind in den letzten drei Vierteln parallel, die Seitenränder von oben breit sichtbar, die Spitzenrandung ist in der Mitte unterbrochen, die Basale fein aber vollständing, der Vorderrand ist gerade, die Vorderecken sind ganz verrundet, die Punktierung ist kräftig, wenig dicht, seitlich viel feiner, etwas unregelmässig weit, die Hinterecken sind kurz verrundet stumpfwinklig.

Der Seitenrand der Flügeldecken ist von oben gerade noch sichtbar, es sind Streifen ziemlich grober Punkte vorhanden, die nicht durch eine eingeschnittene Linie verbunden sind, die Punkte sind zart purpurn umflossen, nach hinten viel feiner, aber nicht geschwunden. Die Zwischenräume sind leicht gewölbt, mikroskopisch fein punktiert, die Epipleuren sind neben der Hinterbrust scharf und dick gerandet, vom Beginn des letzten Abdominalsegments an verkürzt.

Das Prosternum ist vorn sanft gebogen, nach hinten ebenfalls etwas hinuntergedrückt, aber am Ende mit senkrechtem Absturz; es ist nicht spitz, oben tief gefurcht, die Mittelbrust fällt von der Seite gesehen ganz stumpfwinklig ab, sie ist schwach senkrecht eingedrückt, die Hinterbrust ist oben dicht und etwas runzlig punktiert, die drei ersten Abdominalsegmente sind dicht und rauh punktiert, die beiden letzten Segmente nahezu glatt. Die Vorderschenkel sind unten in der Endhälfte scharf doppelkantig, unten weder gezähnt noch mit winkliger Erweiterung versehen, nackt. Die Vorderschienen sind fast gerade, alle Tibien sind kurz, die Tarsen schmal.

Länge, 12 Millimeter.

Ein Männchen von Mittelluzon (*Warburg* leg.) im Zoologischen Museum, Hamburg.

Die Gattung *Gauromaia* ist auf das indo-malayische Gebiet beschränkt, und hat zahlreiche, meist unbeschriebene Arten auf den benachbarten Inseln. Ihr Vorkommen auf den Philippinen war daher anzunehmen. Unsere Art ist ausgezeichnet durch den sehr breiten Kopf mit geradem Epistom, den dünnen Hals, die eigentümlichen Furchen des Unterkopfes, den parallelseitigen Halsschild, die Färbung, und kann mit keiner Art näher verglichen werden.

Camarimena robusta sp. nov. Tafel 1, Fig. 9.

Sehr kräftig und gedrungen gebaut; Oberseite braun bronzefarben, der Vorderkörper mehr messingfarben, Unterseite sehr bunt: goldig, grünlich und kupfrig.

Der Kopf ist grob und ziemlich weitläufig punktiert, das Epistom vorn wesentlich feiner, die Augenfurchen sind kurz und sehr deutlich, tief, der Innenrand der Furchen geht etwas über die Augen hinauf, so dass die Furchen nicht hart an den Augen liegen, doch ist dieses Merkmal nicht auffällig, die Quernaht ist tief eingedrückt, besonders vor den Augen, die Wangen sind kaum schmäler als die Augen und durch einen sehr winzigen Einschnitt von ihnen getrennt: die feine Ausmündungsstelle der Augenfurche. Der Vorderrand ist gerade abgestutzt. Die Fühler sind kurz und mit 4-gliedriger, gut abgesetzter Keule versehen, deren vorletzte Glieder fast doppelt so breit wie lang sind. Das Kinn ist mit lockerem, langhaarigem Bart versehen, die Oberkiefer sind gerade abgestutzt.

Der Halsschild ist trapezisch, die Seiten aber deutlich etwas gebogen, vor den Hinterwinkeln schwach ausgeschweift, der feine Seitenrand ist von oben nicht sichtbar, die Randung der Basis ist sehr fein und vollständig, aber tief eingeschnitten, die Spitze ist ungerandet, die Punktierung ist tief und grob, weitläufig, es finden sich zerstreute, feine Zwischenpunkte, der Vorderrand erscheint ganz gerade abgestumpft, die Vorderecken sind stumpfwinklig.

Die Flügeldecken sind hinter der Mitte am breitesten, zwischen dieser Stelle und den Schultern ganz schwach eingezogen;

es sind feine, nur hinten etwas vertiefte Punktstreifen vorhanden, deren Punkte sehr fein sind, zwischen je zwei Punkten befindet sich ein sehr feiner Zwischenpunkt, die Zwischenräume sind flach und weitläufig und sehr fein punktiert, die Nahtwinkel sind in einem sehr kurzen, spitzen Dorn ausgezogen.

Das Prosternum fällt nach vorn sehr steil ab, der Abfall lässt nur den Rand schmal frei, auch unmittelbar hinter den Hüften fällt es steil ab, und ist dann ganz verflacht, die Spitze verrundet; die Pleuren sind grob und sehr tief punktiert. Die Mittelbrust ist breit bogig, senkrecht eingedrückt, der Eindruck rund, die Punktierung der Hinterbrust und des Abdomens ist sehr fein und wenig dicht, das Analsegment ist sehr zart gerandet. Von den Schenkeln sind die vorderen am stärksten gekeult, die Vorderschienen sind innen ganz schwach ausgeschnitten und im Ausschnitt sehr kurz beborstet, die Innenecke der Mittel und Hinterschienen ist sehr kurz lappenförmig ausgezogen, die drei ersten Glieder der Vordertarsen sind kräftig erweitert.

Länge, 16.2 Millimeter; Breite, 6.5.

LUZON, Mount Banahao, 1 Exemplar.

Eine sehr robuste Art, die in der Skulptur der Decken am ehesten mit *C. parabolica* verglichen werden kann, sie ist aber grösser und viel gedrungener gebaut, und hat nur sehr feine Punktlinien statt der Streifen. Viel ähnlicher ist die folgende Art.

Camarimena iripides sp. nov.

Der vorigen Art ähnlich, so dass auf eine ausführliche Beschreibung verzichtet werden kann, aber kleiner und viel schmäler, die Färbung der Stammform oben ähnlich, aber die Unterseite sehr bunt, kupfrig, grünlich, die Beine aussen kupfrig rot, innen leuchtend violett, die Dornen der Flügeldecken sind kaum wahrnehmbar, und die Basis des Halsschildes ist breit gerandet, der Rand selbst ist nicht schmal rund, sondern verflacht, die Flügeldecken sind fast gestreift, die Punkte der Streifen gröber.

Länge, 13 bis 13.5 Millimeter; Breite 5.

Zwei Exemplare (*4026*) von Mount Banahao, Luzon, und Iligan, Mindanao. Dieses Exemplar ist kräftiger gebaut.

Var. violacea var. nov.

Durch besonders schmalen Körper und einfarbig violette Flügeldecken geschieden und vielleicht eine eigene Art.

Länge, 11.2 Millimeter; Breite, 4.

LUZON, Mount Banahao, 1 Exemplar.

Psydus philippinensis sp. nov. Tafel 1, Fig. 10.

Gross, stark gewölbt, robust, Vorderkörper blaugrün, Flügeldecken kupfrig braun-bronze.

Der Kopf ist flach, stark quer, die Stirn zwischen den Augen etwas breiter als der Querdurchmesser eines Auges, die Clypealsutur fehlt, wird aber durch einen Wechsel der Punktierung vorgetäuscht, die Stirn ist nämlich grob und ziemlich weitläufig, der Vorderkopf plötzlich abgesetzt äusserst fein punktiert, fast glatt, das Epistom ist kräftig gewölbt, der Vorderrand erscheint also etwas niedergebogen. Die Wangen sind schmäler als die Augen, stark gewölbt, Augen-falten und -furchen fehlen. Die ziemlich langen Fühler haben eine gut abgesetzte 6-gliedrige Keule, die vorletzten Glieder sind fast anderthalbmal so breit wie lang, das letzte von fast kreisförmigem Umriss. Das Kinn ist ungekielt, aber nach vorn scharf gehöckert.

Der Halsschild ist fast ein und dreiviertelmal so breit wie lang, etwas vor der Mitte am breitesten, von dort nach hinten sehr schwach, geradlinig, nach vorne stark in breitem Bogen, ohne Andeutung von Vorderecken verengt, der Vorderrand in der Mitte gerade. Die Hinterecken sind scharf rechtwinklig, sogar mit der äussersten Spitze etwas nach hinten gerichtet, der Mittellappen ist schmal, die Randlinie der Basis sehr fein und vollständig, in der Mitte etwas breiter, davor findet sich eine feine quere Impression, die Punktierung ist nur auf der Scheibe deutlich, rund herum aber erloschen. Der Seitenrand ist aufgebogen, daneben findet sich nicht eine kantig abgesetzte Partie.

Der Rand der Flügeldecken ist von oben überall sichtbar, die starke, quere Basalfurche reicht innen bis zum ersten Streifen, mit dem sie sich verbindet. Die Punkte der Streifen sind rund, tief eingestochen, nicht durch eine eingeschnittene Linie miteinander verbunden, die Zwischenräume vollkommen flach, glatt, der achte ist innen, hart neben dem siebenten Streifen im letzten Drittel scharf gekielt, der Kiel läuft zur Spitze bis zum zweiten Streif und ist dort nach vorn von einer Furche begrenzt; alle Punktstreifen werden gegen die Spitze sehr fein.

Die Unterseite ist glänzend schwarzblau, das Prosternum breit, wagerecht, zwischen den Hüften nach vorn sehr tief und breit gefurcht, der Fortsatz ist spitz, die Propleuren sind glatt, das Mesosternum ist im Grunde scharf längsgekielt, der Ausschnitt hoch und breit, scharfkantig U-förmig, die Ecken sind rechtwinklig. Das Abdomen ist fein längsstrigos, äusserst fein punktiert, das Analsegment scharf und vollständig gerandet. Die Beine sind sehr lang, die Mittelschenkel schwach gebogen, die Mittel- und Vorderschienen sind im Enddrittel fein behaart. An den Hintertarsen ist Glied 1 so lang wie 2 und 3 zusammen, das Endglied etwas kürzer als der Rest.

Länge, 15.5 Millimeter; Breite, 6.8.

MINDANAO, Dapitan, 1 Männchen.

Die Gattung ist bisher von den Philippinen nicht bekannt. Die nächstverwandte Art ist *P. marginicollis* Geb. von Formosa, aber kleiner, robuster, mit viel kürzeren Beinen, seitlich kantig begrenztem Halsschild, schmälerer Stirn, ganz anderer Punktierung von Kopf und Pronotum, schlecht ausgeprägtem Kiel des achten Interstitiums, ungerandetem Analsegment, und so weiter.

Pseudabax prosternalis sp. nov. Tafel 1, Fig. 11.

Robust, kräftig gewölbt, Körper glänzend schwarz, Flügeldecken purpurn, vorn neben der Naht und vor der Spitze seitlich grünlich, die Naht selbst in den ersten zwei Dritteln violett, Fühler, Mundteile und Tarsen rotbraun.

Der Kopf ist lang, die Wangen so breit wie die Augen, in flachem Bogen nach vorn verengt, das Epistom ist kräftig ausgerandet, die Quernaht ist fein eingeschnitten, ihre Ausmündungsstelle an den Wangen durch einen feinen Ausschnitt gekennzeichnet, die feinen aber tiefen Augenfurchen laufen um das Auge herum, die Fühler haben eine wenig gut abgesetzte 6-gliedrige Keule, deren vorletzte Glieder fast doppelt so breit wie lang sind. Die Punktierung ist sehr deutlich, hinten viel gröber als vorn, auf der Stirn deutlich längsstrigos. Das Kinn ist der Länge nach stumpf gekielt, mit einzelnen, sehr langen Haaren besetzt.

Der Halsschild ist viel schmäler als die Flügeldecken, kaum anderthalbmal so breit wie lang, vor der Mitte am breitesten, von dort ganz geradlinig nach hinten verengt, nach vorn in starkem Bogen, mit einwärts gerichteten Vorderecken, die Hinterecken sind scharf rechtwinklig. Die Basis ist in der Mitte breit ungerandet, dort aber verflacht, die Punktierung ist sehr fein und weitläufig, nur an den Seiten und am Hinterrand findet sich ein Saum gröberer Punkte.

Die Flügeldecken sind in der Längsrichtung kräftig gewölbt, in der Mitte am höchsten, der Seitenrand ist an der Schulter und an der Spitze von oben sichtbar, die Punktstreifen sind kräftig entwickelt, die Punkte grob, die Zwischenräume sind vorn flach, zur Spitze gut gewölbt, die Verdickungen sind also nicht knotenartig wie bei den anderen Arten, die Punktierung der Zwischenräume ist ausserordentlich fein und kaum wahrnehmbar.

Die Unterseite ist schwarz, glänzend, das Prosternum hinter den Hüften ganz niedergedrückt, die Spitze tritt vor und ist kräftig gerundet, es ist zwischen den Hüften ziemlich lang, goldgelb behaart, die Behaarung aber nur locker, die Pleuren sind flach und grob punktiert und schwach längsrunzlig, die Mittelbrust ist tief, aber nicht hochkantig eingedrückt, die Kanten nicht scharf, die Ecken sind verrundet. Das Abdomen ist auf den ersten Segmenten ziemlich grob, auf den letzten sehr fein punktiert. Die Beine sind lang, die Schienen gerade, in der Endhälfte innen goldgelb behaart; an den Hintertarsen ist Glied 1 etwas länger als 2 und 3 zusammen, die mittleren Glieder der Vordertarsen sind so breit wie lang.

Länge, 14.5 Millimeter; Breite, 5.7.

LUZON, Laguna, Mount Maquiling, 1 Weibchen.

Eine ausgezeichnete Art, auf der später einmal eine neue Gattung gegründet werden muss; sie unterscheidet sich von allen Gattungsgenossen sofort durch das hinten niedergedrückte Prosternum; die verdickten Interstitien an der Spitze der Decken sind nicht knotenförmig. In der Färbung ähnelt die Art nur dem *P. nigricollis*, der ebenfalls einen schwarzen Halsschild hat, sie unterscheidet sich aber durch einen ganz anderen Körperbau, behaartes Kinn, die Prosternalbildung, die Punktierung des Halsschildes, dessen viel feiner gerandete Seiten, und so weiter.

Pseudabax bakeri sp. nov.

Einfarbig stark glänzend braunmetallisch, Fühler und Füsse rötlich. Lang gestreckt, mässig gewölbt.

Der Kopf ist lang, bei einem Exemplar mit einigen grossen, knittrigen Falten auf der Stirn versehen, die dem anderen mir vorliegenden Tier fehlen. Die Wangen sind etwas schmäler als die Augen, sehr lang, der Clypeus ist in sanftem Bogen, aber deutlich ausgeschnitten, die Quernaht ist gut ausgeprägt, die Augenfalten sind fein aber deutlich, die Fühler sind von denen des *P. chalceus* nicht verschieden, das Kinn ist weniger deutlich gekielt.

Der Halsschild ist an der Basis am breitesten und zuerst schwach, dann stärker nach vorn verengt, die Hinterecken sind etwas spitzwinklig, aber nicht so weit nach hinten gezogen wie bei *P. chalceus*, die Seiten sind wie bei dieser Art kräftig aufgebogen, die Vorderecken treten ebenfalls vor, sind aber an der

Spitze verrundet, die äusserst feine Punktierung ist kaum sichtbar, die Basis ist in der Mitte ungerandet und dort verflacht, bei der verwandten Art dagegen dick gerandet.

Die Flügeldecken sind denen von *P. chalceus* gleich, also mit Reihen kräftiger Punkte versehen, die nicht durch eine vertiefte Linie miteinander verbunden sind; die knotigen Erhebungen sind ebenso, nur etwas schwächer, der Seitenrand ist von oben nicht sichtbar, die Zwischenräume erscheinen bei zehnfacher Vergrösserung unpunktiert.

Die Unterseite ist wie bei *P. chalceus,* nur fällt das Prosternum vorn steiler ab, das erste Tarsenglied der Hinterfüsse ist etwas kürzer, die feine Behaarung der ersten Segmente beim Männchen ist kaum sichtbar.

Länge, 14.2 bis 16.8 Millimeter; Breite, 6 bis 6.8.

LUZON, Mount Banahao, 1 Männchen und 1 Weibchen.

Dem *P. chalceus* täuschend ähnlich, aber kleiner und durch andere Halsschildbildung sicher artlich verschieden.

Pseudabax frater Geb.

LUZON, Mount Maquiling, Mount Banahao: Tayabas, Malinao. Weiteres Material.

Pseudabax formosus Kr. Tafel 2, Fig. 22.

LUZON, Mount Banahao (*2606*), 1 Exemplar.

Neue Tabelle der Arten von Pseudabax.

1. Prosternum hinten ganz niedergebogen, Körper glänzend schwarz, Flügeldecken purpurn .... **P. prosternalis** sp. nov.
   Prosternum hinten wagerecht, Körper meist anders gefärbt .... 2.
2. Der Clypeus ist gerade abgestutzt, die Zwischenräume der Flügeldecken bis auf die Schwielen vor der Spitze flach, Oberseite einfarbig glänzend braun-bronze .... 3.
   Der Clypeus ist ausgerandet, die Zwischenräume mehr oder minder gewölbt, Oberseite mehrfarbig, oder bunt oder matt schwarz .... 4.
3. Der Halsschild ist an der Basis dick gerandet, die Vorderwinkel sehr spitz. **P. chalceus** Geb.
   Halsschild an der Basis in der Mitte nur verflacht, ungerandet, Winkel an der äussersten Spitze verrundet .... **P. bakeri** sp. nov.
4. Körper einfarbig pechschwarz, matt, Kopf auf der Stirn rauh punktiert (ex Kraatz) .... **P. opacus** Kr.
   Körper stark glänzend, mehrfarbig .... 5.
5. Grosse Arten (16 Millimeter und darüber); Kopf und Halsschild stark iridierend, Vorderwinkel des Halsschildes schwach niedergebogen .... 6.
   Kleinere Arten (12 Millimeter); Kopf und Halsschild schwarz oder sehr schwach metallisch, Vorderwinkel des Halsschildes stark heruntergezogen .... 7.

6. Abdomen auf den ersten Segmenten mit gelbem Haartoment, Interstitien auf der Scheibe flach........ P. formosus Kr.
   Abdomen nackt, Interstitien gewölbt........ P. purpureomicans Geb.
7. Körper bis auf die Flügeldecken glänzend schwarz, Stirn runzlig punktiert........ P. nigricollis Geb.
   Körper deutlich metallisch, besonders der Kopf. Stirn einfach punktiert........ P. frater Geb.

Pseudonautes analis sp. nov.

Gross, gedrungen, sehr gewölbt, stark glänzend, die Oberseite grünlich erzfarben, bei Ansicht gegen das Licht leuchtend purpurn, der Halsschild querüber kupferrot, ebenfalls die Naht, auch der Kopf mit Kupferflecken, die Beine grün, die Unterseite regenbogenfarben.

Der Kopf ist breit, die Stirn zwischen den Augen doppelt so breit wie der Querdurchmesser eines Auges, die Augenfurchen sind sehr fein aber scharf und verlieren sich hinten am Auge, die Quernaht ist gut ausgeprägt, aber nicht eingeschnitten, der Clypeus gerade abgestutzt, die Seiten des Kopfes geradlinig nach vorn verengt, die Wangen sind schmäler als die Augen, die Fühler sind lang aber nicht so auffällig wie bei manchen Arten, die Glieder deutlich etwas zum Grunde verjüngt; Glied 3 ist anderthalbmal so lang wie 4, die vorletzten Glieder ein und zweidrittelmal so lang wie breit.

Der Halsschild ist stark quer, bis an den Seitenrand gewölbt, ohne deutliche Eindrücke, zwei und einhalbmal so breit wie lang, die grösste Breite liegt in der Mitte, nach hinten ist er schwach, nach vorn stark verengt, die Hinterecken sind scharf stumpf-, die Vorderecken kurz verrundet rechtwinklig, die Punktierung ist ziemlich fein, regelmässig, die Randung vorn ist sehr breit unterbrochen.

Der Rand der Flügeldecken ist nur in der Mitte von oben sichtbar, die Punktstreifen sind fein eingeschnitten, ihre Punkte sehr fein und dicht gedrängt, die Interstitien sind nur an der Spitze gewölbt, unpunktiert. Die Spitze jeder Decke ist scharf markiert, fast etwas ausgezogen.

Die Unterseite ist nackt, stark glänzend, die Pleuren des Halsschildes glatt, der Rand kräftig heruntergebogen, das Prosternum ist glatt, ungefurcht und nach hinten gerade, vorn aber senkrecht abfallend. Die Mittelbrust ist tief U-förmig ausgeschnitten, fällt aber vorn ganz gerundet ab, die übrige Unterseite ist sehr fein punktiert. Das Analsegment hat an der Spitze einen kleinen winkligen Ausschnitt. Die Beine sind lang, die

Schenkel nackt, die mittleren beim Männchen deutlich gekrümmt, die Schienen in diesem Geschlecht unbewimpert, nur die vorderen an der Innenseite der Endhälfte, mit feinem Haarbesatz; Winkel und Zähne fehlen. Das vorletzte Tarsenglied ist wie gewöhnlich asymmetrisch, der äussere Lappen, an den Vordertarsen der innere, ist etwas grösser als der andere; die Vordertarsen sind breit.

Länge, 11.2 bis 12.6 Millimeter; Breite, 4.8 bis 5.3.

LUZON, Los Baños (*859*), Mount Banahao (*2609*). Zwei Weibchen.

Die Gattung ist bisher von den Philippinen nicht bekannt. Die Arten sehen auf den ersten Blick einander ziemlich ähnlich, sind aber zum Teil durch sexuellen Dimorphismus ausgezeichnet. Unsere Art unterscheidet sich von allen mir bekannten durch den Ausschnitt im Analsegment. Sie gehört zu den stattlicheren; ihr nächster Verwandter ist die nächste Art.

Pseudonautes fimbriatus sp. nov. Tafel 2, Fig. 13.

Der vorigen Art sehr ähnlich und ihr am nächsten verwandt, so dass es genügt, die Unterschiede hervorzuheben. Kleiner, schlanker, die Stirn nur anderthalbmal so breit wie ein Auge, die Glieder der Fühler fast zilindrisch. Die Interstitien der Decken sind deutlich gewölbt und sehr fein punktiert. Die Vorderschenkel sind beim Männchen verdickt und gekrümmt, die Mittelschenkel stark gebogen, die Vorderschienen etwas gebogen und in der Endhälfte verdickt und dort innen behaart. Die Mittelschienen mit etwas S-förmig gekrümmter Innenseite, innen lang abstehend bewimpert, die Hinterschienen eben vor der Mitte innen mit stumpfem Winkel und der ganzen Länge nach mit langen, abstehenden Wimpern besetzt, der Forceps ist von oben nach unten flachgedrückt.

Länge, 10.8 bis 11.2 Millimeter; Breite, 4.3 bis 4.6.

MINDANAO, Surigao (*4033*). LUZON, Mount Banahao (*2610*). Ein Männchen und ein Weibchen.

Pseudonautes sulcipennis sp. nov.

Mässig schlank, nach hinten deutlich etwas erweitert, oben einfarbig leuchtend grün, Unterseite braun, die Schenkel bis auf die grünen Spitzen rotbraun.

Der Kopf ist fast glatt, die Stirn kaum anderthalbmal so breit wie ein Auge, die Augenfurchen sehr schmal aber scharf, die Quernaht ist eingeschnitten und sehr deutlich, tief, die Wangen sind geradlinig nach vorn verengt, viel schmäler als ein Auge, die Fühler sind mässig lang, kräftig, die Glieder stark konisch, die vorletzten anderthalbmal so lang wie an der Spitze breit.

Der Halsschild ist sehr stark quer, die Seiten sind hinter den Vorder- und vor den Hinterecken ganz leicht geschwungen, so dass die Ecken schärfer hervortreten, die Vorderecken sind fast spitzwinklig, die Hinterecken scharf rechtwinklig, die Spitze ist vollständig gerandet; die Scheibe ist vor der Basis querüber kräftig eingedrückt, die Punktierung sehr fein und wenig eng.

Der Seitenrand der Flügeldecken ist von oben gar nicht sichtbar, sie sind nach hinten deutlich erweitert, tief gefurcht, die Zwischenräume stark gewölbt, nicht deutlich punktiert, die Punkte der Streifen kräftig und sehr eng stehend, die Spitze ist einfach.

Die Unterseite ist bis auf die grünen Seitenanhänge der Brust nicht metallisch. Das Prosternum fällt vorn senkrecht, hinten schräge, aber ganz ab, es ist tief gefurcht, die Mittelbrust ist verhältnismässig flach, V-förmig eingedrückt, die Ecken sind ganz verrundet. Die Unterseite ist fast glatt, das Analsegment nicht ausgerandet. Die Vorderschenkel sind schwach verdickt, die Mittelschenkel kaum gekrümmt, die Schienen fast gerade, nur die mittleren am Ende etwas nach innen gebogen, ihre Innenseite ist an allen Beinen nackt; die Asymmetrie an den vorletzten Tarsengliedern ist nur schwach.

Länge, 7 Millimeter; Breite, 3.

Ein Männchen von Mount Maquiling, Luzon.

Die kleine Art weicht in zahlreichen Merkmalen von den vorigen ab. Die Unterschiede der drei Arten gehen aus folgender Tabelle hervor:

1. Grössere Arten, Unterseite bunt gefärbt, Prosternum hinten nicht gesenkt, ungefurcht; der Vorderrand des Halsschildes ist in der Mitte breit ungerandet, die Zwischenräume der Flügeldecken flach oder sanft gewölbt .... 2.

   Kleine Art, Unterseite braun, nur die Seiten der Hinterbrust grün, Prosternum hinten ganz niedergebogen, tief gefurcht; Halsschild vorn vollständig gerandet, die Zwischenräume der Decken stark gewölbt........ P. sulcipennis sp. nov.

2. Stirn doppelt so breit wie ein Auge, Zwischenräume der Decken ganz flach, Hinterschienen der Männchen ohne Winkel, die mittleren und hinteren innen fast nackt, Analsegment ausgerandet. P. analis sp. nov.

   Stirn anderthalbmal so breit wie ein Auge, Zwischenräume sanft gewölbt; Hinterschienen innen mit Winkel, diese und die mittleren innen stark bewimpert, Analsegment einfach.... P. fimbriatus sp. nov.

AMARYGMINÆ

Platolenes angustus Geb.

Diese von mir als *Amarygmus* beschriebene Art[10] gehört in die Gattung *Platolenes*. Mir lag seinerzeit nur ein Weibchen vor. Ich besitze jetzt sieben Exemplare beider Geschlechter. Die Männchen unterscheiden sich vom Weibchen durch stark erweiterte Vorder- und schwach verbreiterte Mitteltarsen. Das letzte Abdominalsegment hat in beiden Geschlechtern fast anliegende, goldbraune Behaarung am Spitzenteil; beim Männchen ist die Spitze einfach ausgeschnitten und daher mit zwei Ecken versehen; die Mittelschienen sind hier an der Spitze schwach verdickt und behaart.

Länge, 8 bis 8.9 Millimeter.

LUZON, Laguna, Mount Banahao, Mount Maquiling, Los Baños.

Platolenes spectabilis sp. nov.

Schlank oval, erzfarben, nackt, ziemlich flach.

Die Augen sind sehr gross, ihr Abstand ist kaum halb so gross wie das dritte Fühlerglied an der Wurzel dick; die Wangen sind sehr schmal, aber deutlich etwas aufgeworfen, nicht wie bei voriger Art flach anliegend; der Vorderkopf ist in eine lange, parallelseitige Schnauze ausgezogen, abweichend von den beiden bekannten Arten der Philippinen, die Clypealsutur ist schwach angedeutet, die Punktierung sehr fein und dicht, die Fühler sind lang, ihre Glieder gut abgesetzt, die vorletzten zilindrisch, dreimal so lang wie dick, das dritte Glied ist fast doppelt so lang wie das vierte, die Mandibeln sind an der Spitze gefurcht. Der Halsschild ist ziemlich flach, in der Mitte am breitesten, nach hinten ganz schwach verengt, nach vorn viel stärker, die Vorderecken sind ziemlich scharf rechtwinklig, heruntergebogen; von oben gesehen erscheint der Vorderrand schwach ausgeschnitten; er ist sehr fein und vollständig gerandet, die Basis ist ganz ungerandet, die Hinterecken sind stumpf, die Punktierung ist sehr fein und wenig eng.

Die Flügeldecken sind von den Schultern an gleichmässig nach hinten erweitert, ihr Seitenrand ist von oben der ganzen Länge nach übersehbar; es sind sehr feine Punktstreifen vorhanden, die vorn schwach, hinten stärker vertieft sind, dementsprechend sind die Zwischenräume vorn fast flach, hinten gewölbt; sie sind sehr fein und wenig eng punktiert.

[10] Philip. Journ. Sci. § D 8 (1913) 419.

Die Unterseite ist blank, das Prosternum ist sanft der Länge nach gewölbt, gefurcht, und das Ende schwach dreiteilig, die Propleuren sind glatt, die Mittelbrust ist senkrecht, aber nicht scharf ausgeschnitten, die ganze Oberseite vom Prosternum bis zum Anus ist beim Männchen in der Mitte ganz fein sparsam und wenig deutlich behaart, die Behaarung am besten von der Seite sichtbar, nur das Analsegment zeigt deutlichere Bekleidung auch beim Weibchen. Die Beine sind lang, die Schenkel kräftig, auf der Unterseite mit doppelter Kante versehen, beim Männchen sind die Mittel- und Hinterschenkel unten mit länglichem Fleck, anliegender, goldbrauner Haare versehen. Die Schienen sind gerade, ohne Auszeichnung, nur die hinteren haben zwei kurze Enddornen; die Vordertarsen sind beim Männchen deutlich, aber viel schwächer als bei den anderen beiden Arten verbreitert, an den Hintertarsen ist Glied 1 so lang wie 3 und 4 zusammen.

Länge, 12.6 Millimeter; Breite, 6.5.

LUZON, Mount Banahao, 1 Männchen und 1 Weibchen.

Sehr ähnlich dem gemeinen *Amarygmus morio* F. (=*foveostriatus* Frm.) von Queensland und Neu-Guinea, aber von den beiden vorhergehenden Arten generisch verschieden, durch Grösse, Färbung, lange Schnauze, schwach erweiterte Vordertarsen, zusammenstossende Augen.

Die drei Arten von den Philippinen lassen sich folgendermassen unterscheiden:

1. Kopf in eine lange, parallele Schnauze ausgezogen, einfarbig, bräunlich grün erzfarben, Vordertarsen des Männchens schwach erweitert, die Augen stossen fast zusammen................................ **P. spectabilis sp. nov.**
   Kopf von den Wangen an kurz und schnell verengt, bunte oder blaugrüne Arten, in letzterem Falle mit roten Beinen, Vordertarsen des Männchens stark erweitert, Augen weit getrennt................................ 2.
2. Bunt längsgestreifte Art, Halsschild punktiert, Beine schwarz, erstes Tarsenglied der Hintertarsen so lang wie der Rest.... **P. angustus Geb.**
   Schwärzlich blaugrüne Art mit purpurnem Schimmer, Halsschild glatt, Beine korallenrot, erstes Glied der Hintertarsen kürzer als der Rest. **P. rufipes Geb.**

Amarygmus callichromus Fairm.

MINDANAO, Butuan (*4044*), 1 herrlich gefärbtes Exemplar.

Amarygmus pilipectus sp. nov.

Oval, einfarbig grünlich oder kupfrig metallisch, Unterseite, Beine und Fühler glänzend schwarz.

Die Stirn zwischen den Augen in beiden Geschlechtern so breit wie das dritte Fühlerglied an der Wurzel dick. Die Wangen sind sehr kurz, etwas aufgeworfen, so dass der Kopf zwischen den Augen eingedrückt erscheint, die Querfurche ist kaum angedeutet, der Vorderkopf in eine lange, parallele Schnauze ausgezogen; die Fühler sind lang und dünn, Glied 1 ist so lang wie 3, dieses ein und zweifünftelmal so lang wie 4, die folgenden fast zilindrisch, zur Spitze nur wenig verbreitert, die vorletzten doppelt so lang wie breit, die Antennen sind nicht flachgedrückt; die Punktierung ist sehr fein und dicht.

Der Halsschild ist querüber stark gewölbt, die Vorderecken sind ganz herunter gedrückt, in der Randlinie rechtwinklig, die Hinterecken sind fast verrundet stumpfwinklig, die Spitze ist sehr fein und vollständig gerandet, die grösste Breite liegt an der Basis, von dort sind die Seiten zuerst schwach, dann stärker nach vorn verengt; die Punktierung ist ausserordentlich fein und wenig dicht.

Der Seitenrand der Flügeldecken ist leicht überdeckt; es sind sehr feine Punktstreifen vorhanden, deren Punkte durch eine sehr feine eingeschnittene Linie miteinander verbunden sind; die Zwischenräume sind vorn flach, hinten deutlich gewölbt und ausserordentlich fein punktiert.

Die Unterseite hat bei dem grünlichen Exemplar an jeder Seite leichten bläulichen Seidenglanz. Das Prosternum ist zwischen den Hüften nicht sehr breit, in der Längsrichtung sanft gebogen, tief eingedrückt, der Vorderrand ist in der Mitte leicht winklig eingezogen, die Mittelbrust ist senkrecht, nicht sehr tief U-förmig eingedrückt, die Kanten des Ausschnitts sind verrundet, vor den Mittelhüften befindet sich eine lange, feine Querfurche, die Hinterbrust ist auf der Scheibe fein rauh punktiert und leicht anliegend goldbraun behaart; das Abdomen ist auch auf dem Analsegment kahl, auf den ersten Segmenten fein längsstrigos; die Schenkel sind auf der Unterseite nicht gekantet, die Beine mässig lang, die Schienen bis auf die schwach gekrümmten hinteren gerade, am Ende aller Schienen finden sich kurze Sporen, an den Hintertarsen ist Glied 1 etwas länger als der Rest.

Länge, 9 bis 9.5 Millimeter; Breite, 5.

LUZON, Mount Banahao: Benguet, Baguio (*4992*). MINDANAO, Iligan. Drei Exemplare.

Mit der folgenden verbreiteten Art verwandt, aber grösser, schmäler, mit ganz anderem Fühlerbau, längerem Metatarsus der Hinterschienen, schmälerer Stirn, behaarter Hinterbrust.

Amarygmus filicornis sp. nov. = *aereus* Eschsch. in litt.

Dietysus amplicollis Geb. nec Fairm.

Sehr breit oval und stark gewölbt, schwärzlich erzfarben, der Vorderkörper mehr grünlich, Unterseite und Beine schwarz.

Der Kopf ist flach, die Quernaht leicht angedeutet, nicht eingeschnitten; die Wangen sind etwas aufgeworfen, die Stirn ist zwischen den Augen so breit wie das dritte Fühlerglied lang, der Vorderkopf ist in eine kurze, parallele Schnauze ausgezogen, die Punktierung ist sehr fein, ziemlich dicht und gleichmässig. Die Fühler sind kurz, deutlich flachgedrückt und erscheinen von der Schmalseite fast ungegliedert, aber auch von der Breitseite gesehen sind die Glieder schwach von einander abgesetzt, die vorletzten Glieder sind anderthalbmal so lang wie breit, Glied 3 ist anderthalbmal so lang wie 4, dieses deutlich kürzer als 5; die Mandibeln sind an der Aussenseite scharf und tief gefurcht.

Der Halsschild ist an der Basis am breitesten, zuerst schwächer, dann stärker nach vorn verengt, die Vorderecken sind scharf recht-, die Hinterecken stumpfwinklig, die Wölbung ist gleichmässig stark, die Vorderecken sind heruntergebogen, von oben gesehen erscheint der vordere Ausschnitt deutlich und die Ecken treten etwas vor, die Randlinie vorn ist vollständig; die Punktierung sehr fein und regelmässig, aber deutlich.

Die Flügeldecken sind hinter der Mitte am breitesten, es sind Linien sehr feiner, runder, tiefer Punkte vorhanden, nur die äussersten Streifen sind mit gröberen Punkten versehen, die Zwischenräume sind vollkommen flach, oder ganz undeutlich gewölbt, sehr fein und weitläufig, aber deutlich punktiert, die Punktstreifen werden gegen die Spitze nicht feiner, aber die Punkte etwas verschwommener.

Die Unterseite ist unbehaart, die Propleuren sind glatt. Das Prosternum ist wagerecht, mehr order minder stark gefurcht, zwischen den Hüften breit. Die Mittelbrust ist oben ungefurcht, vorn sehr breit V-förmig ausgeschnitten, der Absturz von der Seite gesehen fast senkrecht, die Hinterbrust ist sehr fein und dicht, rauh punktiert, das Abdomen fast glatt. Die Beine sind kurz, die Schenkel ungekeult, unten nackt, die Schienen sind fast gerade, die mittleren und hinteren auf der Innenseite der Endhälfte sehr kurz bewimpert, die Sporen sind sehr klein, die Tarsen sind sehr kurz, an den hinteren ist Glied 1 so lang wie der Rest.

Länge, 7 bis 8.5 Millimeter; Breite, 4 bis 4.5.

LUZON, Laguna, Los Baños (*2119*); Paete; Mount Maquiling (*1601*): Manila. PALAWAN, Iwahig (*Schultze*).

In den meisten Sammlungen vertreten, in meiner eigenen.

Diese Art habe ich zuerst für *Dietysus amplicollis* Fairm. gehalten, eine Art, die ich nicht sicher deuten kann, sie ist aber viel kleiner (nicht 9 bis 10 Millimeter gross) und hat mit *D. longicrus,* mit dem Fairmaire seine Art vergleicht, keine Aehnlichkeit. Ihr nächster Verwandter ist *A. aeneus* Wied. der aber noch breiter ist, lebhafter gefärbt, dessen Streifen fein eingeschnitten sind, so dass die Punkte ganz undeutlich werden, auch sind die Fühler gut gegliedert.

Amarygmus longitarsis sp. nov.

Oval, gewölbt, metallisch braun, mattglänzend, die Tarsen und Fühler braun, die Unterseite und Beine schwarz.

Der Kopf ist flach, die Wangen sind sehr klein, flach angedrückt, die Quernaht ist leicht angedeutet, nicht eingeschnitten, der Vorderkopf ist gut entwickelt, der Augenabstand ist kaum halb so gross wie das vierte Fühlerglied lang. Die Fühler sind sehr lang und sehr dünn, das dritte Glied ist etwas länger als das vierte, vom fünften an sind die Glieder gleich lang, alle sind zilindrokonisch, gut von einander abgesetzt, die vorletzten sind viermal so lang als am Ende dick.

Der Halsschild ist stark gewölbt, die Vorderecken sind ganz heruntergedrückt, kurz verrundet rechtwinklig, die hinteren stumpfwinklig, die grösste Breite liegt an der Basis, die Punktierung ist sehr fein und wenig eng.

Die Flügeldecken haben fein eingeschnittene Linien, deren Punkte fein aber doch viel breiter als die Linien sind, nur gegen die Spitze verschwinden die Punkte, während die Linien nicht feiner werden, die Zwischenräume sind fast flach, sehr fein und ziemlich eng aber deutlich punktiert.

Die Unterseite ist nackt, die Prosternalplatte is kaum länger als breit, flach, undeutlich gefurcht, das Ende verrundet, die Lage ganz wagerecht. Die Mittelbrust ist in sehr kleinem Bogen ausgeschnitten, der Ausschnitt hochkantig, senkrecht, seine Ecken aber verrundet. Hinterbrust und Abdomen sind in der Mitte weitläufig, fein, etwas rauh punktiert, das letztere ausserdem etwas längsrunzlig, die Beine sind lang und auffällig dünn, namentlich die Schienen und Füsse, die Hinterschienen sind leicht gekrümmt, die Endsporen sind kräftig entwickelt, auch an den Vordertibien; an den Hintertarsen ist Glied 1 wesentlich länger als der Rest.

Länge, 8.2 Millimeter; Breite, 4.8.

LUZON, Mount Banahao, 1 Exemplar.

Eine Art, die durch die sehr dünnen Beine sehr auffällig ist. Aehnlich ist ihr *A. pilipectus,* aber unter anderen durch die kürzeren Fühlerglieder, die behaarte Brust, die tief gefurchte Vorderbrust gut geschieden.

STRONGYLIINÆ

Strongylium foveostriatum Geb. Tafel 2, Fig. 17.

Strongylium mindorense Geb. Tafel 2, Fig. 18.

Strongylium alternicolor sp. nov.

Klein, gedrungen, stark der Länge nach gewölbt, sehr bunt: Vorderkörper kupferbraun, die Flügeldecken mit abwechselnden kupfrigen und violetten Zwischenräumen, Unterseite und Beine metallisch braun, die Füsse und Fühler gelbrot.

Der Kopf ist in der Gegend der Querfurche kräftig vertieft, sie selbst ist sehr fein eingeschnitten und gebogen und liegt unmittelbar vor den Augen, vor ihr, auf dem Clypeus finden sich drei kurze, quere Grübchen, die aber vielleicht nur individuell sind, die Stirn zwischen den Augen ist beim Männchen nicht ganz halb so breit wie das dritte Fühlerglied lang, eine Grube auf ihr ist kaum angedeutet, die Punktierung ist ausserordentlich fein. Die Fühler überragen die Mitte des Körpers, sie sind lang und fast fadenförmig, gegen das Ende nicht verdickt, die Glieder sind vom dritten an fast gleich lang, die mittleren zur Spitze etwas verbreitert, die vorletzten nahezu zilindrisch.

Der Halsschild ist ein und dreiviertelmal so breit wie lang, ziemlich flach, sein Seitenrand ist von oben sichtbar, die Seiten sind gerade, nur im letzten Drittel nach vorn verengt, die Seitenrandkante ist scharf, der Vorderrand erscheint in kräftigem Bogen ausgeschnitten, die Vorderecken treten also stark, aber ganz verrundet vor, die Hinterecken sind stumpfwinklig, oben flach, also ohne die charakteristische Falte, welche die verwandte Art auszeichnet, die basale Randung ist in der Mitte breiter und sehr scharf, die Spitzenrandung in der Mitte breit unterbrochen, dort nicht verflacht; die Mittellinie des Pronotums ist kaum angedeutet, jederseits vor der Basis findet sich ein ganz leichter Quereindruck; die Punktierung ist mässig dicht und sehr fein, viel weitläufiger als bei *S. cupreolineatum.*

Die Flügeldecken sind in den ersten zwei Dritteln fast parallel, ihr Seitenrand ist von oben nicht sichtbar, hinter dem Schildchen findet sich ein leichter, breiter, gemeinsamer Quereindruck. Es sind Linien sehr feiner, gleichmässiger Punkte vorhanden, die zur Spitze kaum feiner werden, die Zwischenräume sind flach, nur ganz hinten schwach gewölbt, unpunktiert, die Schulterbeule ist kräftig entwickelt, die Epipleuren sind neben der Hinterbrust scharf gerandet.

Das Prosternum ist wagerecht, zwischen den Hüften kräftig eingedrückt, der Fortsatz spitz, die Mittelbrust ist hoch eingedrückt, die Bildung also ähnlich wie bei *Pseudostrongylium;* die Propleuren sind kräftig und weitläufig punktiert und von der Mitte an längsrunzlig. Die ersten Abdominalsegmente sind fein punktiert und deutlich längsrunzlig, das Analsegment ist beim Männchen flach, aber nicht eingedrückt. Die Beine sind mässig lang, die Spitze der Flügeldecken wird durch die Hinterschenkel nicht erreicht; alle Schenkel sind in der Endhälfte stark gekeult, die Vorderschienen des Männchens haben eine gerade Aussen- und eine sehr schwach S-förmig gekrümmte Innenkante, die in der Endhälfte sehr kurz behaart ist, die Mittelschienen sind ohne Auszeichnung, die hinteren sind dicht unter der Basis etwas nach vorn gekrümmt, dann gerade; die Füsse sind lang, die Behaarung der Sohlen, namentlich des letzten Gliedes, ist an der Spitze sehr lang, an den Vordertarsen sind die drei ersten Glieder deutlich verbreitert, an den Hintertarsen ist das erste Glied wenig kürzer als das Klauenglied.

Länge, 9.6 Millimeter; Breite, 3.6

LUZON, Mount Banahao, 1 Männchen.

In Färbung, Grösse und Gestalt dem *S. cupreolineatum* Geb. täuschend ähnlich, aber in zahlreichen Merkmalen von dieser Art abweichend, Fühler und Füsse sind viel länger, der Halsschild ist vorn kräftig bogig ausgeschnitten statt gerade abgestutzt, die Hinterecken sind normal, es fehlt ihnen also die Längsfalte, seine Punktierung ist sehr viel feiner, das Prosternum nicht niedergedrückt, sondern steht wagerecht nach hinten, die Schenkel sind stark gekeult, und so weiter.

Strongylium cupreolineatum Geb.

Das Weibchen hat viel kürzere, robustere Fühler, der Augenabstand ist so breit wie das dritte Fühlerglied lang.

Zwei Weibchen von Mount Banahao, Luzon.

Strongylium laeve sp. nov. Tafel 2, Fig. 14.

Kurz und gedrungen, in der Anlage zilindrisch, schwarz, matt glänzend, die Flügeldecken mit sehr schwach metallischem Schein.

Der Kopf ist in der Gegend der Querfurche ausgehöhlt, die Stirn beim Männchen so breit wie das dritte Fühlerglied lang, die nahezu halbkreisförmig gebogene, feine, an den Seiten verschwindende Querfurche ist von den Augen entfernt, vor ihr liegt ein kleiner, querer Eindruck. Die Wangen sind stark aufgeworfen, etwas schmäler als die Augen hinter ihnen, eine Stirngrube fehlt oder ist sehr klein, die Punktierung ist sehr dicht und fein. Die Fühler sind zur Spitze nicht verdickt, die Glieder zilindrisch, das dritte ist anderthalbmal so lang wie breit, die vorletzten sind doppelt so lang wie breit.

Der Halsschild ist an der Basis flach, vorn sehr stark gewölbt, die Seitenrandkante ist von oben nicht sichtbar, die grösste Breite liegt vor der Mitte, dahinter ist der Halsschild eingezogen, davor in starkem Bogen gerundet; der Vorderrand ist gerade abgestutzt, die Basis ist dick gerandet, vor ihr in der Mitte findet sich eine kleine Verflachung, die Hinterecken sind kurz längsgefaltet, die Randkante dort ist also von oben nicht zu sehen, die Mittellinie ist nicht eingedrückt, die Punktierung ist sehr fein aber dicht und tief.

Die Flügeldecken sind nicht parallelseitig, sondern nach hinten kräftig erweitert, im letzten Drittel am breitesten; die Schultern sind verrundet, die Unterflügel sind rudimentär, etwa zur Hälfte entwickelt, hinter der Basis findet sich ein leichter Eindruck, die Skulptur besteht aus Linien sehr feiner, runder, tief eingestochener, nicht durch eine vertiefte Linie verbundener Punkte, die nur hart an der Basis und ganz aussen etwas gröber sind und gegen die Spitze nicht verschwinden, die Spitze selbst ist durch eine Verflachung abgesetzt. Die Zwischenräume sind flach oder nur ganz undeutlich gewölbt, nicht wahrnehmbar punktiert, die Epipleuren sind neben der Hinterbrust scharf gerandet.

Das Prosternum ist kräftig der Länge nach gewölbt, die Spitze ganz heruntergebogen und prononziert, die Pleuren sind grob punktiert, die Mittelbrust ist kräftig gerundet eingedrückt, das Abdomen sehr fein punktiert. Das Analsegment ist beim Männchen ganz leicht flachgedrückt, der Penis ist gross, einfach zugespitzt. Die Beine sind schlank, die Schenkel nicht gekeult, alle Schienen gerade, nur die vorderen beim Männchen mit undeutlich S-förmig gekrümmter Innenkante, die Vordertarsen in diesem Geschlecht nicht erweitert, an den Hintertarsen ist das erste Glied so lang wie das Klauenglied.

Länge, 10.3 Millimeter; Breite, 3.9.

LUZON, Laguna, Mount Maquiling, 2 Männchen.

Die einzige, einfach schwarze Art von den Inseln, besonders ausgezeichnet durch die rudimentären Flügel und in Verbindung damit, die robuste Körperform, die verrundeten Schultern, die kurze Hinterbrust, sonst dem *S. cupreolineatum* am ähnlichsten, auch in der Bildung der Hinterwinkel des Halsschildes.

Strongylium forticoste sp. nov.

Matt dunkelbraun, zilindrisch, gestreckt. Der Kopf ist stark gewölbt, die Augen sind sehr gross und stossen beim Weibchen fast zusammen, ihr stark gewölbter Zwischenraum ist kaum grösser als das zweite Fühlerglied lang, die Wangen sind viel schmäler als die Augen und verhältnismässig kurz. Die Quernaht ist fein eingeschnitten und liegt stark vertieft, auf dem Hinterkopf findet sich kein Grübchen; sehr feine Augenfurchen sind vorhanden, die Fühler sind kurz, zur Spitze aber nicht keulig verdickt, die Glieder vom vierten an gleich lang, die vorletzten nur sehr wenig länger als breit.

Der Halsschild ist viel breiter als lang, die Seiten sind stumpf gewinkelt, in der Mitte am breitesten, die Seitenrandkante von oben ganz sichtbar, der Vorderrand ist gerade abgeschnitten, die Randung dort vollständig, die Basis ist fein gekielt, hat aber keine deutlich vertiefte Randlinie, die Mittellinie ist leicht furchig vertieft, die Punktierung ist grob und dicht gedrängt.

Die Flügeldecken sind parallelseitig, fast zilindrisch, oben nicht flachgedrückt, ohne Eindruck hinter der Basis, mit scharf gekielten Rippen versehen, und zwar auf dem ersten, dritten, fünften, siebenten, achten, und neunten Zwischenraum, diese Kiele laufen scharf von der Basis zur Spitze, der zweite, vierte, und sechste Zwischenraum sind flach, alle sehr schmal, da die Punkte sehr grob, quadratisch, tief sind, ihr Boden ist flach, und jedes Grübchen ist an jeder Seite durch ein kleines Körnchen eingeengt, sie sind voneinander durch schmale Querrippen getrennt, die abwechselnd auf den neben einander liegenden Streifen angeordnet sind, also feine Leitern bilden; die Epipleuren sind zur Spitze verjüngt, aber nicht verkürzt, etwas gerunzelt.

Die Unterseite und die Beine sind fein anliegend, kurz gelbgrau behaart. Das Prosternum ist vorn und hinten niedergedrückt, die Mittelbrust kräftig eingedrückt, die Propleuren sind grob punktiert, die Hinterbrust und das Abdomen gleichmässig, ziemlich grob, etwas raspelartig punktiert, die Beine sind kurz, die Schenkel nicht gekeult, die Tarsen dünn, an den hinteren ist das erste Glied so lang wie das Klauenglied.

Länge, 10.5 Millimeter; Breite, 3.

LUZON, Laguna, Mount Maquiling, 1 Weibchen.

Die Art ist durch die scharfgekielten Zwischenräume von allen anderen philippinischen weit getrennt, sie gehört in die Verwandtschaft von *S. clathratum*, *S. cultellatum*, *S. marseuli* und steht der ersten am nächsten, der sie täuschend ähnlich ist. Sie unterscheidet sich besonders durch die Form des Halsschildes, da bei *clathratum* die Seitenrandkanten des Pronotums ganz niedergebogen sind; ferner ist das letzte Glied der Hintertarsen viel kürzer als das erste.

Strongylium embryonale sp. nov. Tafel 2, Fig. 15.

Sehr klein, gedrungen, Hinterkörper fast parallel, dunkelgrün, matt, der Vorderkörper etwas mehr bronzefarben, die Beine rotbraun, die Kniee und Schienen schwach grünlich.

Der Kopf ist breit, aber viel schmäler als der Halsschild, die Augen sind gross, der Zwischenraum beim Weibchen fast so gross wie das vierte Fühlerglied lang, die Clypealnaht ist sehr fein, vom Auge entfernt, gleichmässig gebogen, davor ist ein querer Eindruck. Die Punktierung ist ausserordentlich fein und ziemlich weitläufig, die Fühler sind dünn und lang, die vorletzten Glieder zwei und einhalbmal so lang wie breit, zilindrisch, sie sind vom dritten an gleich lang.

Der Halsschild ist kaum anderthalbmal so breit wie lang, die Seiten sind in der Mitte stumpf gewinkelt, die Basis ist nicht breiter als die Spitze, die Ecken sind, wenn auch ganz kurz verrundet, so doch scharf ausgeprägt und treten ganz leicht vor, so dass die Spitze sanft ausgeschnitten erscheint; die Seitenrandkante ist vorhanden und von oben gerade noch sichtbar, die Basis ist vollständig, in der Mitte etwas breiter gerandet, der Rand glatt, die Mitte davor weitläufiger punktiert, die Mittellinie nicht eingedrückt, die Punktierung sonst sehr fein und dichtgedrängt.

Die Flügeldecken sind fast parallel, nur ganz leicht nach hinten erweitert, die Schulterbeulen sind kräftig entwickelt, die Punktstreifen sind tief, ihre Punkte kräftig aber nicht grübchenförmig. Die Zwischenräume sind matt, hin und wieder quergerunzelt und bis zur Spitze gewölbt. Die Epipleuren sind vorn bis zum Ende der Hinterbrust scharf gerandet.

Die Unterseite ist nackt, das Prosternum nach vorn und hinten leicht gesenkt, der Fortsatz verrundet, breit, die Propleuren sind gröber und viel weitläufiger punktiert als die Oberfläche des Pronotums. Die Mittelbrust ist kräftig und tief, senkrecht eingedrückt, die Ecken aber, von der Seite gesehen, verrundet. Das Abdomen ist sehr fein punktiert, und undeutlich längsrunzlig; die Beine sind dünn und mässig lang, die Hinterschenkel erreichen lange nicht die Spitze der Flügeldecken; die Schienen sind beim Weibchen nicht ausgezeichnet, die Tarsen sehr zart, an den hinteren ist das erste Glied so lang wie das Klauenglied.

Länge, 4.8 Millimeter; Breite, 1.85.

MINDANAO, Butuan, 1 Weibchen.

Diese sehr kleine Art ist durch Färbung, gedrungene Gestalt, Halsschildform von allen Arten weit getrennt und mit keiner zu verwechseln.

Strongylium styraciforme (Hell. in litt.) sp. nov. Tafel 2, Fig. 16.

Ausserordentlich lang und dünn zilindrisch, oben flach gedrückt, dunkelgrün glänzend, die Spitze der Flügeldecken grünlich blau, die Epipleuren, die Kniee und Schienen violett, die Schenkel rotbraun, ihre Wurzel gelb wie die Taster, die Unterseite grün, die Fühler mehr oder weniger braun.

Der Kopf ist viel breiter als der Halsschild, die Augen sind stark vorgequollen und stossen beim Männchen zusammen, so dass der Zwischenraum enger ist als das dritte Fühlerglied dick, der Vorderkopf ist ganz senkrecht, fast etwas untergebogen, die Gegend der Quernaht ist stark vertieft, die Naht selbst eingeschnitten, gebogen und von dem Vorderrand der Augen entfernt, der Vorderkopf ist flach und sehr fein punktiert, zwischen den Augen findet sich ein ganz leichtes Grübchen; die Fühler sind sehr dünn und fadenförmig, alle Glieder sind dünn zilindrisch, die vorletzten dreimal so lang wie dick, die Glieder vom dritten an allmählich an Länge abnehmend. Das letzte Glied der Maxillarpalpen ist stark beilförmig.

Der Halsschild hat keine Seitenrandkante, statt ihrer nur einen Längsstreifen, der unpunktiert ist; er ist ein und eindrittelmal so lang wie breit, die Seiten sind in der Mitte am breitesten, aber nur schwach gerundet erweitert, dahinter leicht eingezogen verengt, Winkel fehlen an der Basis und Spitze, da keine Randkante vorhanden ist. Die Mitte ist der Länge nach breit furchig vertieft, Basis und Spitze sind scharf und vollständig gerandet, die erstere in der Mitte leicht winklig nach hinten gezogen, die Punktierung ist kräftig und sehr dicht, stärker als die des Kopfes.

Die Flügeldecken haben gut entwickelte Schulterbeulen und sind von den Schultern an leicht nach hinten verengt, die Seiten sind senkrecht, die Seitenrandkante ist von oben nicht sichtbar, die Scheibe ist begrenzt durch den erhabenen dritten Zwischenraum, flach; die Skulptur ist eigenartig: es sind grobe, grübchenartige Punktreihen vorhanden, die durch quere, hoch erhabene, zuweilen seitlich verbundene Falten unterbrochen sind und die Längsstreifen erlöschen machen; an der Basis sind der dritte und fünfte Zwischenraum stark erhaben, der erstere der ganzen Länge nach; dicht vor der Spitze werden die groben Punkte plötzlich sehr fein und bilden feine Punktstreifen mit schwach gewölbten Zwischenräumen. Jede Flügeldecke ist am Ende in eine scharfe, nicht sehr lange Spitze ausgezogen; die Epipleuren sind glatt und innen ohne Spur von Randkante.

Das Prosternum ist zwischen den Hüften tief eingedrückt und hinten flach verrundet, die Pleuren sind grob und weitläufig punktiert, die Mittelbrust ist mässig tief eingedrückt, der Eindruck nicht scharfkantig. Die Beine sind ausserordentlich lang und ungemein dünn, die Mittelschenkel erreichen fast die Spitze des Abdomens, die hinteren überragen sie weit, nur die Vorderbeine sind verhältnismässig kurz. Die Schienen sind dünn, rund, gerade, nur die vorderen gegen das Ende, beim Männchen schwach gebogen; die Tarsen sind fadenförmig, an den hinteren ist das erste Glied etwas länger als der Rest, das Klauenglied so lang wie das zweite. Der Penis ist einfach, dünn und stark zugespitzt.

Länge, 12.2 bis 12.6 Millimeter; Breite, 2.7.

LUZON, Mount Banahao (*4035*, *2871*) 2 Männchen; je eins in meiner Sammlung (Type!) und im Museum Dresden (Cotype!). Ein drittes Männchen mit dem Fundort Philipp. (Semper) und der Bezeichnung, "4-costatum Mäkl." ist ganz dunkel blaugrün.

Diese ungewöhnliche Art ist mit keiner anderen zu verwechseln und eine der interessantesten Formen der Gattung.

Strongylium pauperulum sp. nov.

Ziemlich schlank, matt glänzend, klein, lang abstehend, aber sehr dünn weisslich behaart, der Vorderkörper schwarz, die Flügeldecken braungelb.

Der Kopf ist von normaler Grösse, die Wangen sind schmäler als die Augen, die Stirn ist flach, die Augen beim Weibchen klein, ihr Abstand auf der Stirn so gross wie ein Auge im Querdurchmesser von oben gesehen. Augenfurchen fehlen, die Querfurche ist eingeschnitten, einfach, davor befindet sich kein Eindruck; die Oberfläche ist sehr fein und ziemlich weitläufig punktiert. Die Fühler erreichen die Mitte des Körpers nicht ganz, sie sind durch die Grössenverhältnisse ihrer Glieder sehr ausgezeichnet. Glied 3 bis 5 zusammen sind so lang wie 6 und die folgenden einzeln, diese letzten sechs Glieder sind schwarz, dreieckig, anderthalbmal so lang wie breit.

Der Halsschild ist schwach quer, querüber kräftig gewölbt, in der Längsrichtung schwach, die Seitenrandkante fehlt ganz, die Seiten erscheinen von oben gesehen schwach gerundet, die Spitze ist gerade abgeschnitten, ganz ungerandet, die Basis ist dick gerandet, die Mittellinie nicht vertieft, die Punktierung ist grob und sehr dicht, die Behaarung lang abstehend.

Die Flügeldecken haben kräftige Schulterbeulen, sie sind der Länge nach stark gewölbt, ihr Seitenrand ist von oben nicht sichtbar; es sind Streifen grober, hinten sehr fein werdender Punkte vorhanden, deren Zwischenräume schmal und stark gewölbt sind, die Spitzen sind nicht ausgezogen.

Die Unterseite ist trotz der Behaarung ziemlich blank, das Prosternum ist der Länge nach gewölbt, zwischen den Hüften kräftig eingedrückt, das Ende verflacht, die Pleuren sind neben den Hüften blank, zur Seite ziemlich grob und dicht punktiert, die Mittelbrust ist in der Mitte niedergedrückt, das Abdomen fein punktiert, die Beine sind schlank, aber mässig lang, die Schienen gerade, die Schenkel sind grob punktiert, an den Hintertarsen ist Glied 1 so lang wie 4.

Länge, 8.8 Millimeter; Breite, 3.

LUZON, Mount Banahao, 1 Männchen.

Die lang abstehende Behaarung lässt diese Art von allen anderen der Philippinen gut unterscheiden, sie steht *villosum* Mäkl. nahe, unterscheidet sich aber von allen behaarten Arten durch den eigentümlichen Fühlerbau und durch den seitlich ungerandeten Halsschild.

Strongylium bakeri sp. nov. Tafel 2, Fig. 20.

Sehr gedrungen, schwärzlich grün, nackt, die Seiten des Unterkörpers bläulichgrün, die Beine bis auf die Wurzelhälfte der Schenkel violett. Der Kopf ist dick, vorn senkrecht, die Augen stossen beim Männchen fast zusammen, ihr Abstand ist kaum so gross wie das dritte Fühlerglied an der Wurzel dick, der Hals ist sehr dick, die Querfurche ist fein, gerade, eingeschnitten und dicht ans Auge gerückt, die Punktierung ist sehr fein, aber am Hinterkopf viel gröber, die Fühler sind dünn und mässig lang, Glied 3 ist weitaus das längste, anderthalbmal so lang wie 4; vom dritten an nehmen die Glieder an Länge ab, die dreieckigen vorletzten Glieder sind kaum länger als breit.

Der Halsschild ist schwach quer, in der Längsrichtung nicht, querüber sehr stark gewölbt, die Seitenrandkante ist vollständig, aber wenig stark ausgeprägt, von oben sichtbar, die Seiten sind in der Endhälfte fast parallel, unmerklich eingezogen, von der Mitte nach vorn stark verengt, die Mittellinie ist der Länge nach stark furchig vertieft, hinter der Mitte findet sich jederseits eine quere starke Grube, welche mit der korrespondierenden durch einen gebogenen, queren Eindruck schwach und undeutlich verbunden ist, die basale Randung ist dick und vollständig, die vordere breit dreieckig, verflacht, die Punktierung ist fein und tief, nicht sehr dicht.

Die Flügeldecken haben starke Schulterbeulen und jederseits hinter der Basis eine starke, runde Schwiele wie bei *S. gravidum*, dahinter befindet sich ein querer Eindruck, der Seitenrand ist von oben nur an der Spitze sichtbar; es sind Streifen tief eingestochener, runder Punkte vorhanden, deren Zwischenräume schief sind, also nach aussen plötzlich, nach innen flach abfallen, die ersten Interstitien sind flach, die Punktierung auf ihnen ist äusserst fein, jede Spitze ist einzeln verrundet.

Das Prosternum ist sehr breit und sehr tief eingedrückt, es tritt lappenförmig auf die Hüften und ist vorn ungerandet, der Fortsatz ist querüber stark gewölbt, also nicht flach, die Mittelbrust ist eingedrückt und fällt nach vorn wenig steil ab, die Hinterbrust ist kräftig, aber sehr breit vertieft, das Abdomen ist sehr fein punktiert, blank, das Analsegment beim Männchen mit tiefem, scharfkantigem, bis zur Wurzel reichendem, über halbkreisförmigem Eindruck, der am Ende ausgeschnitten ist, der Penis ist sehr spitz. Die Beine sind lang, die Hinterschenkel überragen die Spitze des Hinterleibes, alle Schenkel sind mässig gekeult, die Vorderschienen des Männchens sind gegen das Ende stark nach innen gekrümmt, innen dicht unter der Basis schwach gerundet erweitert, die Mittelschienen sind schwach gekrümmt und gegen das Ende etwas verdickt, die Hinterschienen sind verflacht und um ihre Längsachse gedreht, nahezu gerade.

Länge, 11.8 bis 12.5 Millimeter; Breite, 4 bis 4.6.

LUZON, Mount Banahao (*3806*), 2 Männchen; in meiner Sammlung (Type!) und im Museum Dresden (Cotype!).

Eine Art aus der nächsten Verwandtschaft des *S. gravidum*, durch andere Färbung, glänzende Flügeldecken, das stark verlängerte dritte Fühlerglied und die starken antebasalen Eindrücke des Halsschildes verschieden.

Strongylium gravidum Mäkl.

LUZON, Tayabas, Malinao, 1 Weibchen.

Bestimmungstabelle der Philippinischen Strongylien.

1. Vordertarsen (wenigstens beim Männchen) 4-gliedrig; kleine Art; Halsschild hinten flach, Flügeldecken mehrfarbig längsgestreift. S. **insolitum** Geb.
   Vordertarsen 5-gliedrig ... 2.
2. Halsschild an den Seiten ohne Randkante ... 3.
   Halsschild an den Seiten mit vollständiger Randkante ... 4.
3. Kopf breiter als der Halsschild, dieser gefurcht, Beine ausserordentlich dünn und lang, die Mittelschenkel erreichen die Spitze der Flügeldecken, grüne oder blaugrüne Art, Fühlerglieder vom dritten an an Länge abnehmend, jede Flügeldecke in eine Spitze ausgezogen. S. **styraciforme** sp. nov.
   Halsschild breiter als der Kopf, Beine kurz, die Hinterschenkel erreichen die Spitze der Flügeldecken nicht, mattbraune, lang behaarte Art; die Fühlerglieder 6 bis 11 stark verlängert und jedes so lang wie 3 bis 5 zusammen; Flügeldecken nicht in eine Spitze ausgezogen. S. **pauperulum** sp. nov.
4. Sehr gedrungene Arten, Flügeldecken mit je einer Beule hinter der Basis; Vorderschienen der Männchen in der Endhälfte fast winklig gekrümmt, die Hinterschienen um ihre Längsachse gedreht ... 5.
   Schlanke Arten oder gedrungene, dann aber ohne Beule auf den Flügeldecken, die Vorderschienen der Männchen nicht gekrümmt ... 7.
5. Oberseite zweifarbig, Flügeldecken golden, seitlich violett, Vorderkörper blaugrün, 17 mm. lang, die Hüftbeulen der Vorderhüften sind von oben zu sehen ... S. **elegantissimum** Geb.
   Oberseite einfarbig, 10 bis 12 mm. gross, die Hüftbeulen sind von oben nicht zu sehen ... 6.
6. Bläulich, schwarz oder kupfrig, Flügeldecken oben matt, das dritte Fühlerglied ist kaum länger als das vierte; Halsschild vor der Basis ohne starkem queren Eindruck, höchstens leicht eingedrückt. S. **gravidum** Mäkl.
   Grünlich, glänzend, das dritte Glied anderthalbmal so lang wie das vierte, Halsschild jederseits vor der Basis mit starkem queren Eindruck ... S. **bakeri** sp. nov.
7. Basis des Halsschildes innerhalb der Ecken gekielt und daneben nach aussen gefurcht; robuste, stark gewölbte Arten ... 8.
   Basiswinkel des Halsschildes einfach ... 9.
8. Körper einfarbig mattglänzend schwarz, Flügel rudimentär, Schulterbeulen undeutlich ... S. **laeve** sp. nov.
   Flügeldecken mit alternierenden bunten Streifen, Körper glänzend, Flügel gut entwickelt, Flügeldecken daher mit starken Schultern. S. **cupreolineatum** Geb.

9. Flügeldecken mit abwechselnd bunten Streifen, Schenkel stark gekeult, Vorderrand des Halsschildes ausgeschnitten ... **S. alternicolor** sp. nov.
   Flügeldecken einfarbig, Schenkel nicht gekeult, Vorderrand des Halsschildes abgestutzt ... 10.
10. Flügeldeckenzwischenräume stark gekielt; mattbraune, nicht metallische Art ... **S. forticoste** sp. nov.
   Flügeldeckenzwischenräume ungekielt; metallische Arten ... 11.
11. Vorderwinkel des Halsschildes sehr deutlich, Basis so breit wie die Spitze, die Mittellinie nicht gefurcht; sehr kurze Art von 5 mm Länge ... **S. embryonale** sp. nov.
   Vorderwinkel des Halsschildes ganz verrundet, die Spitze daher viel schmäler als die Basis, die Mitte meist stark gefurcht; lange Arten von 10 mm. und mehr ... 12.
12. Halsschild sehr fein und weitläufig punktiert, blaue Art mit roten Beinen ... **S. erythrocephalum** F.
   Halsschild grob und dicht punktiert; metallische Arten mit schwarzen oder metallischen Beinen ... 13.
13. Flügeldecken mit 4 queren Eindrücken an der Naht. **S. mindorense** Geb.
   Flügeldecken ohne Eindrücke ... 14.
14. Flügeldecken hinter der Basis bucklig erhaben, mit sehr grossen länglichen Gruben, Halsschild tief gefurcht; grosse Art von 20 mm. **S. foveostriatum** Geb.
   Flügeldecken auf dem Rücken flach, mit kleineren runden Grübchen, Halsschild flach gefurcht oder ungefurcht; kleinere Arten ... 15.
15. Bronzefarben, die vorletzten Glieder der Fühler breiter als lang. **S. ambiguum** Mäkl.
   Bläulich oder grünlich, die vorletzten glieder der Fühler doppelt so lang wie breit ... **S. foveolatum** Mäkl.

Genus **ALLOPEZUS** novum

Kurz und gedrungen, geflügelt, stark gewölbt. Kopf mit kleinen Augen, die Wangen sind stark entwickelt und aufgeworfen, die Kopfnaht ist eingeschnitten, das Epistom nicht ausgerandet, die Fühler sind dünn, ungekeult. Die Mandibeln sind am Ende abgestutzt, ungefurcht, das Endglied der Maxillarpalpen ist stark beilförmig. Der Halsschild ist ziemlich flach, seitlich also sehr scharf und flach gekantet, die Vorderecken sind spitz vorgezogen, die Seiten krenuliert, die Basis ist fein gerandet. Die Flügeldecken haben gut entwickelte Schultern und sind nach hinten erweitert, das Ende ist nicht in Spitzen ausgezogen, die Epipleuren sind verkürzt; die Skulptur besteht aus Punktstreifen. Vorder und Mittelbrust sind sehr flach, die Abdominalsegmente 2 bis 4 sind gleich breit, der Abdominalfortsatz zwischen den Hinterhüften ist breit verrundet. Die Schenkel sind deutlich gekeult, ungezähnt, auf der Unterseite ungekantet, den Schienen fehlen die Enddornen. Die Tarsen sind schlank, das letzte Tarsenglied ist auf dem vorletzten, nahe dem Grunde eingelenkt, und dieses ist am Ende schräg abgeschnitten; das heist es ist nur *ein* stark entwickelter Lappen und zwar der äussere an den Hinterfüssen, der innere an den Vorderfüssen vorhanden.

Eeine ausgezeichnete Gattung, deren Tarsenbildung mit der keiner anderen Tenebrionidengattung verwechselt werden kann. Eine ähnliche Bildung zeigt nur *Pseudonautes.* Auch hier ist das vorletzte Glied ausgerandet, aber es sind beide Lappen vorhanden, wenn auch der eine grösser ist als der andere; hier dagegen fehlt der eine Lappen ganz. Im übrigen ist die Gattung neben *Phymatosoma* zu stellen, von welcher sie sich ausser durch die Tarsenbildung durch ungekeulte Fühler, und so weiter, unterscheidet, auch die Halsschildbildung ist ganz anders.

Allopezus miritarsis sp. nov. Tafel 2, Fig. 21.

Kurz gewölbt, matt schwarzbraun, der ganze Körper mit gelbgrauen Schuppenhärchen, die staubartig fein sind, bekleidet, die Flügeldecken mit je zwei gelbroten Flecken.

Der Kopf ist etwas länger als breit, die Augen sind klein, die Stirn ist flach, ohne Auszeichnung, die Wangen sind halbkreisförmig, sehr gross und treten weit vor die Augen, sehr feine Augenfurchen sind vorhanden. Der Vorderkopf ist parallelseitig, so dass der Seitenrand des Epistoms und die Wangen winklig aufeinander treffen, die Quernaht ist scharf ausgeprägt, halbkreisförmig, die Wangen sind stark aufgeworfen, der Vorderkopf ist flach, das Epistom gerade abgestutzt. Die Oberfläche erscheint durch äusserst dichte Punktierung fein verworren gerunzelt; die Fühler sind mässig lang, im Grunde sehr zart, zur Spitze etwas kräftiger entwickelt, die Glieder stark voneinander abgesetzt, Glied 3 ist ein und eindrittelmal so lang wie 4, die vorletzten Glieder sind länger als breit, das letzte oval.

Der Halsschild ist flach, ein und dreiviertelmal so breit wie lang, seitlich stark gerundet, aber im letzten Sechstel parallel, die Basis ist so breit wie die Spitze, der Seitenrand ist etwas verflacht, nicht durch eine feine Linie gerandet, die Mitte ist durch drei kleine, dicht aneinanderliegende Bogen etwas erweitert, die Vorderecken treten sehr lang und spitz vor, die Hinterecken sind scharf rechtwinkling. Der Vorderrand erscheint in der Mitte gerade, die basale Randung ist sehr fein aber vollständig; vor der Basis findet sich eine leichte, quere Impression, die Punktierung ist äusserst fein und verworren.

Die Flügeldecken haben kräftige Schultern, sie sind hinter der Mitte am breitesten, der Länge und Quere nach stark gewölbt, der Seitenrand ist von oben nirgends sichtbar. Es sind sehr feine, aber scharfe Punktstreifen vorhanden, deren Punkte fein sind, die Zwischenräume sind gewölbt, der zweite, vierte, sechste und die äusseren beiden sind etwas schmäler und mit äusserst kurzen, rundlichen, kaum sichtbaren Schuppenbörstchen besetzt, die vorn mehrzeilig, im vierten und sechsten Streif hinten aber einzeilig stehen, der dritte, fünfte und siebente Zwischenraum sind deutlich breiter und mit feinen, rundlichen, ganz flachen, wie abgeschliffenen Körnchen besetzt. Jede Decke hat zwei gelblichrote Flecke, welche den dritten bis siebenten Zwischenraum einnehmen, der vordere ist halbmondförmig, der hintere mehr gerade, beide sind auf dem dritten, fünften und siebenten Raum deutlicher.

Die Unterseite ist matt, das Prosternum flach gebogen und hinten ganz niedergedrückt, das Mesosternum ist schwach und wenig tief V-förmig eingedrückt, das Abdomen matt; die ganze Unterseite ist äusserst fein beschuppt. Die Schenkel sind deutlich gekeult, ziemlich lang, sehr dicht und grob punktiert; die Schienen sind dünn, ungefurcht, gerade, nur die vorderen und mittleren zur Spitze etwas nach innen gekrümmt; an den Vordertarsen sind die mittleren Glieder quer dreieckig. Der Penis ist zart und zur Spitze schwach löffelförmig erweitert.

Länge, 5 Millimeter.

LUZON, Mount Banahao, 1 Männchen.

Eine auffällige Art, die mit keiner einer anderen Gattung verglichen werden kann.

Pseudostrongylium bakeri sp. nov.

Kurz und gedrungen, herrlich gefärbt und wohl die schönste Tenebrionide der Philippinen. Vorderkörper leuchtend blaugrün oder violett, die Unterseite ist grün, die Beine mehr oder minder violett, besonders die Kniee.

Der Kopf ist glatt, mässig gross, die Augenfurchen sind fein und laufen hinten, sich verbreiternd und verflachend und sich von den Augen entfernend, in den Nacken zur Seite. Auf der Stirn findet sich bei einem Exemplar ein kräftiger Längseindruck, beim andern ein Doppelgrübchen; die Quernaht ist scharf eingeschnitten, stark gebogen, die Wangen sind schmäler als die Augen und so lang wie diese hinter ihnen, das Epistom ist parallelseitig, die Stirn ist auffallend breit, etwas schmäler als das dritte Fühlerglied lang, die Punktierung ist nur auf dem

Vorderkopf zu sehen, äusserst fein und weitläufig. Die vorletzten Fühlerglieder sind dreieckig, etwa anderthalbmal so lang wie breit, die beiden letzten Glieder sind fast parallelseitig.

Der Halsschild ist viel schmäler als die Flügeldecken, die Seiten sind kräftig gerundet, die Hinterwinkel scharf, die Spitze ist kaum ausgeschnitten, die Vorderwinkel kurz verrundet, die Randung vorn und hinten tief und vollständig, nur bei einem Exemplar in der Mitte etwas schwächer, die Seitenrandlinie ist von oben nicht sichtbar; die Längsfalte an der Basis steht im Niveau der Oberfläche, reicht etwa bis zu zwei Fünftel der Länge und ist sehr scharf, die Punktierung ist kaum sichtbar.

Die Flügeldecken haben sehr stark entwickelte Schultern, die schwielig nach der Seite heraustreten, dahinter sind sie deutlich etwas eingezogen; der Seitenrand ist von oben nicht zu sehen, die Basis ist dick abgesetzt gerandet, die Skulptur besteht aus Linien sehr feiner, nicht sehr enger, scharf eingestochener Punkte, die gegen die Spitze fast erloschen sind, die Zwischenräume sind absolut flach, unpunktiert. Die Farbe ist leuchtend goldig, hinter der Mitte mit stahlblauer Querbinde, die Basis ist schmal, die Schulterbeulen hell stahlblau oder blaugrün. Der vordere Goldfleck ist in der Mitte kupfrig.

Das Prosternum ist tief der Länge nach eingedrückt und ganz wagerecht, in eine lange Spitze ausgezogen, die Propleuren sind ganz glatt. Die Mittelbrust ist tief und breit U-förmig, fast senkrecht, aber gerundet eingedrückt, die Ecken treten schwielig vor. Das Abdomen ist äusserst fein punktiert und kaum sichtbar längsgestrichelt. Die Beine sind lang und dünn, die Schienen sind nicht flachgedrückt; die Innenseite der Vorderschienen ist ganz undeutlich S-förmig gekrümmt, an den Hintertarsen ist Glied 1 so lang wie 3 und 4 zusammen.

Länge, 10.8 bis 12.8 Millimeter; Breite an der Schulter, 4.5 bis 5.2.

LUZON, Tayabas, Malinao: Laguna, Paete (*2607*). Zwei Exemplare.

Dieses wundervolle Tier ist durch die lebhaften Farben von allen anderen geschieden, auch die starken Schulterbeulen sind ein auffallendes Kriterium, das nur die folgende Art auch zeigt.

Pseudostrongylium callosum sp. nov. Tafel 2, Fig. 22.

Gross, robust, Vorderkörper schwärzlich erzfarben mit schwachen purpurnen und grünlichen Reflexen, Flügeldecken mit schwärzlich blaugrünem Sattel, der aussen von einem, nicht an die Punktreihen gebundenen Streifen von kupfrig roter und etwas goldiger Farbe begrenzt ist; der Seitenrandteil ist wieder grünlich, neben der Naht, besonders hinten ist ein kupfriger Längsstreif, die Schulterschwielen sind blaugrün, die Unterseite ist grünlich, Prosternum, die Kniee und die Schienenspitzen violett.

Der Kopf hat sehr deutliche, nach hinten sich verflachende, und etwas von den Augen sich entfernende Augenfurchen, die Quernaht ist scharf eingeschnitten, etwa viertelkreisförmig, die Stirn zwischen den Augen ist ungefähr so breit wie ein Auge, auf ihr befindet sich eine flache Grube. Die Fühler sind dünn, Glied 3 deutlich länger als 4, die vorletzten Glieder sind etwa anderthalbmal so lang wie breit, zur Spitze deutlich erweitert. Die Punktierung ist ausserordentlich fein, auf der Stirn weitläufig.

Der Halsschild hat von oben gesehen fast geradlinige Seiten, die nur schwach nach hinten verengt sind, die Hinterecken sind spitz, der Vorderrand ist gerade abgestutzt, die Vorderecken treten also nicht oder kaum merklich vor, sie sind in der Randkante heruntergedrückt. Die Randung vorn ist vollständig und setzt sich in der Mitte als winziges Zipfelchen nach hinten fort, die Basis ist dick und vollständig gerandet, die Randlinie wie der Rand doppelbuchtig, die Längsfalte liegt in einer Furche, nicht wie bei *P. semperi* etwas über dem Niveau des Halsschildes; sie reicht von hinten her bis über ein Drittel der Länge nach vorn, die Punktierung ist fast erloschen, die Hinterecken haben einen flachen queren Eindruck.

Die Flügeldecken fallen wie bei voriger Art durch sehr starke, fast etwas hakige, nach hinten und aussen gerichtete Schulterschwielen auf. Dahinter sind die Decken deutlich verengt; die Spitzen sind durch einen flachen Eindruck deutlich etwas aufgebogen. Es sind Reihen feiner Punkte vorhanden, deren mikroskopisch fein, kaum sichtbar punktierte Zwischenräume kräftig gewölbt sind, die Punkte der Streifen stehen also in einer Furche, sind aber nicht miteinander durch eine eingeschnittene Linie verbunden.

Das Prosternum ist zwischen den Hüften eingedrückt und fällt vorn fast senkrecht ab, der Fortsatz ist querüber stark gewölbt, die Propleuren sind glatt. Die Mittelbrust ist fast halbkreisförmig senkrecht eingedrückt, die Kanten ganz rund, der Absturz von der Seite gesehen senkrecht. Die ersten Segmente des Abdomens sind schwach längsrunzlig. Alle Schienen sind flachgedrückt, die vorderen beim Männchen mit kräftig S-förmig geschwungener Innenkante. An den Vordertarsen sind die drei ersten Glieder verbreitert; die Tarsen sind viel kürzer als bei voriger Art, an den hinteren ist Glied 1 nicht länger als 4.

Länge, 14.5 Millimeter; Breite, 5.6.

LUZON, Benguet, Baguio, 1 Männchen.

Eine ausgezeichnete Art. Mit der vorigen übereinstimmend in den gewaltigen Schulterbeulen, von ihr durch ganz andere Färbung, gewölbte Interstitien, ganz andere Beinbildung verschieden.

Uebersicht über die mir bekannten Pseudostrongylien der Philippinen.

1. Flügeldecken mit sehr starken, fast etwas hakenförmig nach aussen tretenden Schulterbeulen .... 2.
   Flügeldecken mit normalen Schulterbeulen .... 3.
2. Zwischenräume gewölbt; düster erzfarben, jede Flügeldecke mit breitem, dünklem Längsstreif, der seitlich und an der Naht purpurrot gesäumt ist, Schienen dick, die vorderen flach, innen deutlich S-förmig gekrümmt .... P. callosum sp. nov.
   Zwischenräume ganz flach, leuchtend grün, oder blaugrün, Flügeldecken mit goldiger Spitze und grossen goldigen oder kupferroten Querfleck vor der Mitte, Schienen dünn, rund, die vorderen kaum gekrümmt. P. bakeri sp. nov.
3. Die vertiefte Mittellinie des Pronotums findet sich auch auf der vorderen Hälfte, die Fühlerglieder vom siebenten an verbreitert. P. aberrans Kr.
   Die vertiefte Mittellinie des Pronotums ist auf die Endhälfte beschränkt, Fühler bis zur Spitze dünn .... 4.
4. Oberseite matt, Pronotum sehr dicht und grob punktiert.. P. opacum Geb.
   Oberseite glänzend, Pronotum glatt, oder fein und wenig dicht punktiert .... 5.
5. Halsschild glatt .... P. banksi Geb.
   Halsschild sehr deutlich punktiert .... 6.
6. 12.5 Millimeter lang, der Länge nach stark gewölbt, Zwischenräume stark gewölbt, Beine blau, Glied 4 der Hintertarsen so lang wie 1. P. cyanipes Geb.
   15 bis 16 Millimeter lang, viel schwächer gewölbt, Zwischenräume schwach gewölbt, Beine kupfrig, Glied 1 der Hintertarsen kürzer als 4 .... P. viride Kr.

LITERATURVERZEICHNIS

In folgenden Arbeiten sind Tenebrioniden von den Philippinen beschrieben. Die mit einem * versehenen haben ausschliesslich die Fauna der Philippinen zum Gegenstand. Die namhaft gemachten Arten sind die, welche in der betreffenden Arbeit zuerst beschrieben wurden.

BLANCHARD, E. Voyage de M. Dumont d'Urville. Zool. (Voy. Pol. Sud) 4 (1853) (Tenebrioniden 143–182).
Mesomorphus villiger, Setenis aequatorialis.

CASTELNAU, F. L. DE LAPORTE DE. Hist. Nat. des Insectes, Coléoptères 2 (1840).
Uloma orientalis, Derosphaerus rotundicollis.

ESCHSCHOLTZ. Zool. Atlas. Enthaltend Abbildungen und Beschreibungen neuer Tierarten während des Flottkap. Kotzebue's Reise um die Welt beobachtet. Berlin Heft 3 (1829) 5 bis 15; 4 (1831) 8 bis 14.
Ethas carinatus.

FABRICIUS, J. C. Syst. Eleuth. sec. ordines. genera, spec. 1 Kiel (1801).
Scleron ferrugineum, Gonocephalum depressum, Toxicum 4-corne, Strongylium erythrocephalum, Amarygmus splendidulus.

FAIRMAIRE, L. Coléoptères Hétéromères de Sumatra. Notes Leyden Mus. 4 (1883) 219–265.
Uloma contracta.

FAIRMAIRE, L.* in G. A. Baer. Ann. Soc. Ent. France 6 (1886).
Setenis manillarum (= *brevicornis* Schauff. nec. Westw. = *penicilligera* Geb.), *Derosphaerus simillimus* (= *rotundicollis* Cast.), *Eucyrtus* (jetzt *Bradymerus*) *carinatus* (= *corinthius* Fairm.), *Dietysus luzonicus, Dietysus amplicollis.*

FAIRMAIRE, L. Coléoptères nouveaux des Indes orientales. Notes Leyden Mus. 15 (1893) 17–64.
Bradymerus aequecostatus, Ceropria dolorosa, Eucyrtus subcostatus.

GEBIEN, H.* Die Tenebrioniden der Philippinen. Philip. Journ. Sci. § D 8 (1913) 373–433.
Zahlreiche neue Arten.

GERMAR, E. F. Insectorum species novae aut minus cognitae. Halle (1824).
Gonocephalum adpressum.

KRAATZ, G. Beitrag zur Kenntnis der asiatischen Cnodaloniden. Berl. ent. Zeitschr. 24 (1880) 97–120.
Eucyrtus nigripes, E. gloriosus, E. violaceus, E. lisae, Pseudabax formosus, P. opacus, Pseudeumolpus superbus, Oedemutes viridulus, Pseudostrongylium semperi, P. aberrans.

MÄKLIN, F. W. Monograph. Strongylium (1864) 109–410, t. 1–3; Act. Soc. Faun. 8^1 (1867).
Lophocnemus amabilis, Strongylium gravidum, S. ambiguum, S. foveolatum.

PASCOE, F. P. Notes on Coleoptera with new genera and species, part V. Ann. & Mag. Nat. Hist. V 2 (1883) 436–442.
Bradymerus violaceus.

REDTENBACHER, L. Reise der österreichischen Fregatte "Novara" um die Erde: Coleoptera. Wien (1867) 116–132.
Toxicum flavofemoratum.

SCHAUFFUSS, L. W. Beitrag zur Fauna der niederländischen Besitzungen auf den Sundainseln. Horae Soc. Ent. Ross. 19 (1885).
Anthracias elongatus.

WIEDEMANN, C. R. W. 200 neue Käfer von Java, Bengalen und dem Vorgebirge der guten Hoffnung. Zool. Mag. 2 (1823) 1–133.
Ceropria induta, Cossyphus striatus.

SYSTEMATISCHES VERZEICHNIS DER TENEBRIONIDEN VON DEN PHILIPPINEN

STENOSINÆ

1. Ethas carinatus Eschscholtz, Zool. Atl. 4 (1831) 12.

PEDININÆ

2. Mesomorphus villiger Blanchard, Voy. Pôle Sud 4 (1853).
3. Mesomorphus maquilingius sp. nov.

OPATRINÆ

4. Scleron ferrugineum Fabricius, Syst. El. 1 (1801) 118.
5. Nesocaedius schultzei Kolbe, Deut. ent. Zeitsch. (1913) 263.
6. Cnemodasus rectangulus Gebien, Philip. Journ. Sci. § D 8 (1913) 374.
7. Gonocephalum depressum Fabricius, Ent. Syst. Suppl. (1798) 41.
8. Gonocephalum bilineatum Walker, Ann. & Mag. Nat. Hist. III 2 (1858) 284.
9. Gonocephalum adpressum Germar, Ins. spec. nov. (1824) 145.

BOLITOPHAGINÆ

10. Bradymerus pertyi nom. nov. pro *B. elongatus* Geb. nec. Perty.
11. Bradymerus alternicostis Gebien, Philip. Journ. Sci. § D 8 (1913) 377.
12. Bradymerus impressicollis Gebien, op. cit. 378.
13. Bradymerus mcgregori sp. nov.
14. Bradymerus clathratus Schauffuss, Horae Soc. Ent. Ross. 2 (1887) 134.
15. Bradymerus carinatus Fairmaire, Ann. Soc. Ent. France VI 6 (1886) 188; Notes Leyden Mus. 19 (1897) 218.
16. Bradymerus violaceus Pascoe, Ann. & Mag. Nat. Hist. V 11 (1883) 437.
17. Bradymerus eschscholtzi sp. nov.
18. Bradymerus caeruleipennis Gebien, Philip. Journ. Sci. § D 8 (1913) 380.
19. Bradymerus ferruginipes Fairmaire, Notes Leyden Mus. 18 (1896) 229.
20. Byrsax satanas Gebien, Philip. Journ. Sci. § D 8 (1913) 381.
21. Bolitoxenus serratus Gebien, op. cit. 383.
22. Bolitoxenus timmi sp. nov.
23. Bolitoxenus ditylus sp. nov.

DIAPERINÆ

24. Ceropria induta Wiedemann, Zool. Mag. I 3 (1819) 164.
25. Ceropria dolorosa Fairmaire, Notes Leyden Mus. 5 (1883) 34.
26. Ceropria subocellata Delaporte et Brullé, Ann. Sci. Nat. 23 (1831) 398.
27. Platydema marseuli Lewis, Ann. & Mag. Nat. Hist. VI 13 (1894) 393.
28. Platydema malaccum Marseul, Ann. Soc. Ent. France V 6 (1876) 108.

LEIOCHRINÆ

29. Leiochrodes philippinensis sp. nov.

ULOMINÆ

30. Tagalus impressicollis Gebien, Philip. Journ. Sci. § D 8 (1913) 389.
31. Tagalus schultzei Gebien, op. cit. 390.
32. Bolitrium crenulicolle Gebien, op. cit. 391.
33. Tribolium ferrugineum Fabricius, Für ausführliche Synonymie siehe Gebien, Cat. Col. 394.
34. Uloma orientalis Castelnau, Hist. Nat. 2 (1840) 220; Gebien, Philip. Journ. Sci. § D 8 (1913) 392.
35. Uloma fracticollis Gebien, op. cit. 393.
36. Uloma contracta Fairmaire, Notes Leyden Mus. 4 (1882) 226.
37. Alphitobius diaperinus Panzer, Für ausführliche Synonymie siehe Gebien, Cat. Col. 405.
38. Alphitobius laevigatus Fabricius, Spec. Ins. 1 (1781) 90; Blair, Ann. & Mag. Nat. Hist. VIII 13 (1914) 486.
39. Diaclina 4-maculata Gebien, Philip. Journ. Sci. § D 8 (1913) 394.
40. Hoplopeltis tricornis Fairmaire.
41. Eutochia lateralis Boheman, Res. Eug. (1858) 94.
42. Phayllidius dispar sp. nov.
43. Doliema spinicollis Fairmaire, Ann. Soc. Ent. France 62 (1893) 27.
44. Leptoscapha subpubescens sp. nov.
45. Hypophloeus analis Gebien, Philip. Journ. Sci. § D 8 (1913) 395.
46. Hypophloeus sulcifrons sp. nov.

COSSYPHINÆ

47. Cossyphus striatus Wiedemann, Zool. Mag. II 1 (1823) 81.

TENEBRIONINÆ

48. Pediris sulcigera Boisduval, Voy. Astrol. 2 (1835) 256, taf. 9, fig. 11.
49. Pediris longipes Motschoulsky, Bull. Mosc. 45 (1872) 28.
50. Setenis manillarum Fairmaire, Ann. Soc. Ent. France VI 6 (1886) 187.
51. Setenis aequatorialis Blanchard, Voy. Pôle Sud 4 (1853) 161, taf. 11, fig. 11.
52. Derosphaerus rotundicollis Castelnau, Hist. Nat. 2 (1840) 67.
53. Encyalesthus nitidipennis Fairmaire, Ann. Soc. Ent. France 67 (1898) 394.
54. Encyalesthus bisinuatus sp. nov.
55. Encyalesthus striatus Gebien, Philip. Journ. Sci. § D 8 (1913) 404.
56. Catapiestus mediocris Guérin, Rev. Zool. (1841) 124.
57. Toxicum quadricorne Fabricius, Syst. El. 1 (1801) 153.
58. Toxicum ramiferum Gebien, Philip. Journ. Sci. § D 8 (1913) 397.
59. Toxicum flavofemoratum Redtenbacher, Reise Novara 2 (1868) 126.
60. Toxicum planicolle Gebien, Philip. Journ. Sci. § D 8 (1913) 398.
61. Toxicum erythromerum sp. nov.
62. Anthracias elongatus Schauffuss, Horae Soc. Ent. Ross. 19 (1885) 202.

HETEROTARSINÆ

63. Lyprops luzonicus Gebien, Philip. Journ. Sci. § D 8 (1913) 405.
64. Lyprops subangulatus sp. nov.
65. Lyprops striatopunctatus sp. nov.

CYPHALEINÆ

66. Artactes latreillei Castelnau, Hist. Nat. 2 (1840).

PYCNOCERINÆ

67. **Aediotoria petersi** sp. nov.

CNODALONINÆ

68. **Scotaeus seriatopunctatus** Heller, Abh. Mus. Dresden 7 (1898–99) nr. 8, 8.
69. **Oedemutes purpuratus** Pascoe, Ann. & Mag. Nat. Hist. IV 7 (1871) 355.
70. **Oedemutes physopterus** Gebien, Philip. Journ. Sci. D 8 (1913) 405.
71. **Oedemutes viridulus** Kraatz, Deut. ent. Zeitschr. 24 (1880) 114.
72. **Oedemutes pretiosus** Pascoe, Ann. & Mag. Nat. Hist. IV 8 (1871) 355.
73. **Oedemutes varicolor** Gebien, Philip. Journ. Sci. § D 8 (1913) 407.
74. **Pseudeumolpus superbus** Kraatz, Deut. ent. Zeitschr. 24 (1880) 114.
75. **Pseudeumolpus iridipennis** Gebien, Philip. Journ. Sci. § D 8 (1913) 408.
76. **Pseudeumolpus polychromus** Gebien, op. cit. 409.
77. **Platycrepis violaceus** Kraatz, Deut. ent. Zeitschr. 24 (1880) 103.
78. **Eucyrtus lisae** Kraatz, op. cit. 105.
79. **Eucyrtus nigripes** Kraatz, op. cit. 100.
80. **Eucyrtus gloriosus** Kraatz, op. cit. 100.
81. **Eucyrtus subcostatus** Fairmaire, Notes Leyden Mus. 15 (1893) 44.
82. **Eucyrtus lobicollis** sp. nov.
83. **Eucyrtus frontalis** sp. nov.
84. **Eucyrtus acutangulus** Gebien, Philip. Journ. Sci. § D 8 (1913) 416.
85. **Eucyrtus clypealis** Gebien, op. cit. 415.
86. **Eucyrtus pauperatus** sp. nov.
87. **Eucyrtus planifrons** sp. nov.
88. **Eucyrtus crenatus** sp. nov.
89. **Eucyrtus semirufus** sp. nov.
90. **Eucyrtus auripennis** sp. nov.
91. **Eucyrtus excellens** Gebien, Philip. Journ. Sci. § D 8 (1913) 417.
92. **Eucyrtus ovipennis** Gebien, op. cit. 416.
93. **Simalura luzonica** sp. nov.
94. **Simalura elongata** sp. nov.
95. **Hemicera caudata** Gebien, Philip. Journ. Sci. § D 8 (1913) 387.
96. **Hemicera chalcea** sp. nov.
97. **Hemicera artactoides** sp. nov.
98. **Hemicera iridicolor** sp. nov.
99. **Hemicera bivittata** Gebien, Philip. Journ. Sci. § D 8 (1913) 385.
100. **Aptereucyrtus hemichalceus** sp. nov.
101. **Pseudabax prosternalis** sp. nov.
102. **Pseudabax chalceus** Gebien, Philip. Journ. Sci. § D 8 (1913) 413.
103. **Pseudabax bakeri** sp. nov.
104. **Pseudabax formosus** Kraatz, Deut. ent. Zeitschr. 24 (1880) 108.
105. **Pseudabax purpureomicans** Gebien, Philip. Journ. Sci. § D 8 (1913) 410.
106. **Pseudabax opacus** Kraatz, Deut. ent. Zeitschr. 24 (1880) 109.
107. **Pseudabax frater** Gebien, Philip. Journ. Sci. § D 8 (1913) 412.
108. **Pseudabax nigricollis** Gebien, op. cit. 411.
109. **Psydus philippinensis** sp. nov.
110. **Camarimena robusta** sp. nov.

111. Camarimena iridipes sp. nov.
112. Camarimena iripides var. violacea var. nov.
113. Pseudonautes fimbriatus sp. nov.
114. Pseudonautes sulcipennis sp. nov.
115. Pseudonautes analis sp. nov.
116. Gauromaia laticeps sp. nov.

AMARYGMINÆ

117. Platolenes angustus Gebien, Philip. Journ. Sci. § D 8 (1913) 419.
118. Platolenes rufipes Gebien, op. cit. 421.
119. Platolenes spectabilis sp. nov.
120. Amarygmus callichromus Fairmaire, Bull. Soc. Ent. France (1897) 70.
121. Amarygmus splendidulus Fabricius, Syst. El. 1 (1801) 440.
122. Amarygmus pilipectus sp. nov.
123. Amarygmus filicornis sp. nov.
124. Amarygmus longitarsis sp. nov.
125. Dietysus luzonicus Fairmaire, Ann. Soc. Ent. France VI 6 (1886) 189.
126. Dietysus amplicollis Fairmaire, op. cit. 189.

STRONGYLIINÆ

127. Lophocnemis amabilis Mäklin, Mon. Strong. (1864) 398 (506).
128. Enganodia sanguinicrus Fairmaire, Ann. Soc. Ent. France 77 (1898) 398.
129. Strongylium insolitum Gebien, Philip. Journ. Sci. § D 8 (1913) 429.
130. Strongylium styraciforme sp. nov.
131. Strongylium pauperulum sp. nov.
132. Strongylium elegantissimum Gebien, Philip. Journ. Sci. § D 8 (1913) 427.
133. Strongylium gravidum Mäklin, Mon. Strong. (1864) 334 (442).
134. Strongylium bakeri sp. nov.
135. Strongylium laeve sp. nov.
136. Strongylium cupreolineatum Gebien, Philip. Journ. Sci. § D 8 (1913) 428.
137. Strongylium alternicolor sp. nov.
138. Strongylium forticoste sp. nov.
139. Strongylium embryonale sp. nov.
140. Strongylium erythrocephalum Fabricius, Syst. El. 1 (1801) 156.
141. Strongylium mindorense Gebien, Philip. Journ. Sci. § D 8 (1913) 430.
142. Strongylium foveostriatum Gebien, op. cit. 425.
143. Strongylium ambiguum Mäklin, Mon. Strong. (1864) 335 (443).
144. Strongylium foveolatum Mäklin, op. cit. 364 (472).
145. Pseudostrongylium semperi Kraatz, Deut. ent. Zeitschr. 24 (1880) 116.
146. Pseudostrongylium viride Kraatz, op. cit. 117.
147. Pseudostrongylium aberrans Kraatz, op. cit. 118.
148. Pseudostrongylium opacum Gebien, Philip. Journ. Sci. § D 8 (1913) 422.
149. Pseudostrongylium cyanipes Gebien, op. cit. 424.
150. Pseudostrongylium banksi Gebien, op. cit. 423.
151. Pseudostrongylium bakeri sp. nov.
152. Pseudostrongylium callosum sp. nov.
153. Allopezus miritarsis sp. nov.

TAFELERKLÄRUNG

Tafel 1

Fig. 1. *Bolitoxenus timmi* sp. nov., Männchen; 1*a*, Weibchen.
2. *Byrsax satanas* Gebien, Männchen.
3. *Byrsax satanas* Gebien, Männchen.
4. *Setenis sulcigera* Boisduval, Männchen.
5. *Setenis manillarum* Fairmaire, Männchen.
6. *Encyalesthus bisinuatus* sp. nov., Männchen.
7. *Toxicum erythromerum* sp. nov., Männchen; 7*a*, Dasselbe von der Seite gesehen.
8. *Aptereucyrtus hemichalceus* sp. nov.
9. *Camarimena robusta* sp. nov.
10. *Psydus philippinensis* sp. nov.
11. *Pseudabax prosternalis* sp. nov.

Tafel 2

Fig. 12. *Pseudabax formosus* Kraatz.
13. *Pseudonautes fimbriatus* sp. nov.
14. *Strongylium laeve* sp. nov.
15. *Strongylium embryonale* sp. nov.
16. *Strongylium styraciforme* sp. nov., Männchen.
17. *Strongylium foveostriatum* Gebien, Weibchen.
18. *Strongylium mindorense* Gebien, Männchen.
19. *Strongylium foveolatum* Mäklin.
20. *Strongylium bakeri* sp. nov., Männchen.
21. *Allopezus miritarsis* sp. nov., Männchen.
22. *Pseudostrongylium callosum* sp. nov.

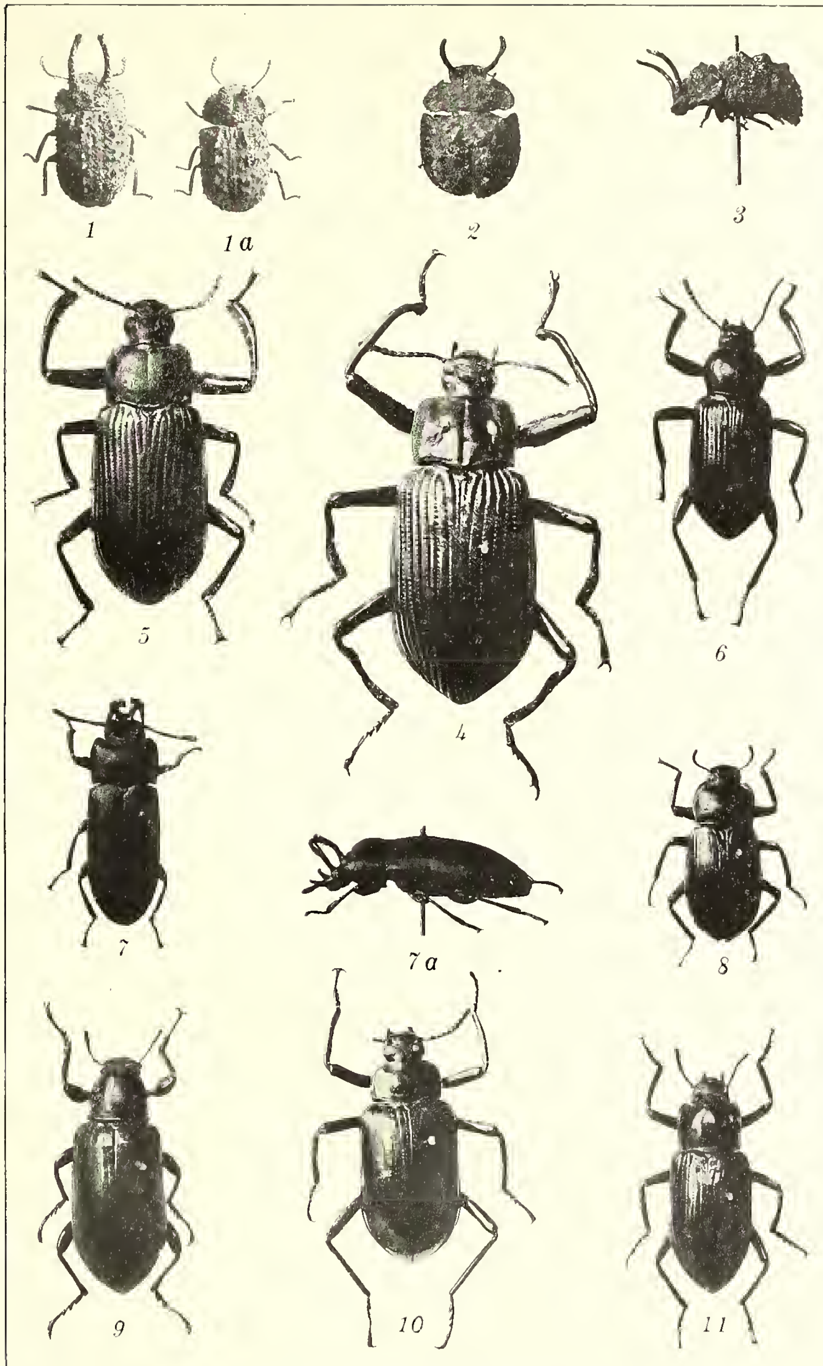


PLATE 1. PHILIPPINE TENEBRIONIDÆ.

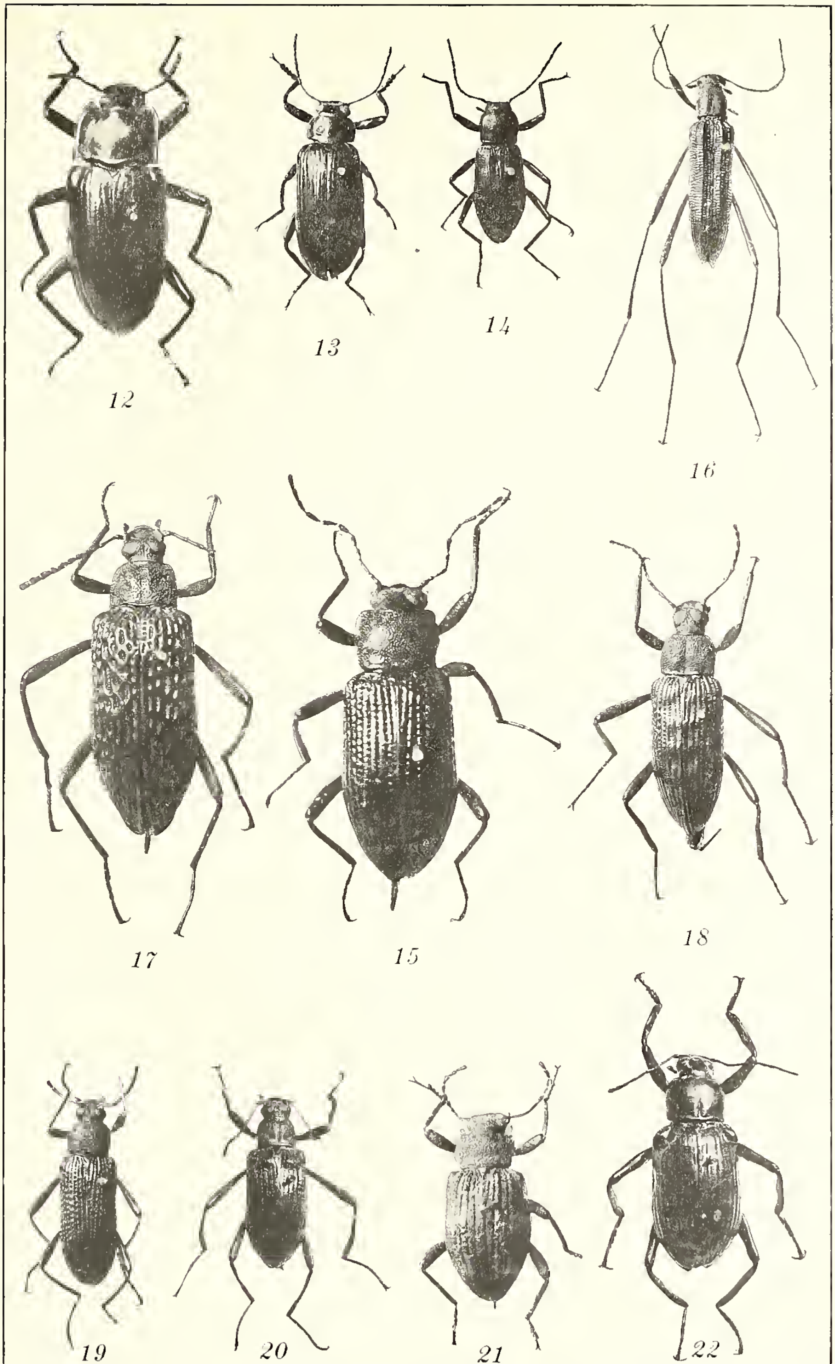


PLATE 2. PHILIPPINE TENEBRIONIDÆ.

A PHILIPPINE NEMESTRINID (DIPTERA)

By Charles S. Banks

Chief, Division of Entomology, Bureau of Science, Manila

ONE PLATE

That a family of insects, containing representatives so large and so conspicuous both in coloring and habits as the Nemestrinidæ, should have escaped the attention of collectors in these Islands is certainly one of the best evidences of the vagaries of natural-history exploration. However, the fact that no member of this family has been hitherto reported from the Philippines is not so remarkable in the light of the further fact that since Kertész's [1] work was published in 1909, but eight species in five genera, one of which is new, have been described from the Oriental region: three from Ceylon, one from Formosa, one from New Guinea, and three from Australia. Two of the species from Ceylon and the one from Formosa belong to the genus which has come to light in the Philippine Islands, namely *Hirmoneura*. That other species of this genus will be found in the Philippines is almost certain, since it is now known to be distributed through from Australia to Formosa along what we may term a natural bridge. We should likewise expect to find members of the closely related genera: *Trichopthalmus*, most of the species of which are from Australia but so far only reported from that country, Tasmania, and Chile, with one doubtful African record, and *Atriadops* reported from Sumatra, Java, and China in addition to a single species recorded from Africa.

The species here recorded is described as new, its characteristics being quite unlike those of any species noted from this region, in fact it bears little resemblance to any other member of the genus, especially in size.

The type specimen was taken by me in a clearing in rather dense forest on a bright day in June, flying near the ground much after the fashion of the Bombylidæ. It was at first supposed to be a member of this family, and it was only when the

[1] Kertész, Cat. Dipt. hucus. Descr., Budapestini 4 (1909) 22–32.

specimens in the Bureau of Science were being sorted that its true nature was discoverd, with considerable surprise, it must be admitted. Had I at the time realized what a real treasure it was, I should have been on the alert for more specimens. As it is, we have but a single male, intact, but with much of the pubescence worn from the notum and tergum.

Hirmoneura philippina sp. nov.

Male large, robust, brown, pubescent, legs brownish yellow, with coarse, adpressed auburn pile; wings uniformly semi-opaque brown, each longer than body.

Head wider than thorax, slightly more than hemispherical, nearly holoptic, the face and vertex one-seventh of the head-width, sides of vertex converging slightly caudad in region of ocelli (Plate 1, fig. 3); eyes bare, red-brown with garnet reflections, occupying nearly whole of head in profile; occiput slightly convex near eye margins, dark tawny, pilose; ocelli placed on two prominent tubercles separated by a shallow, wide, transverse sulcus, the anterior ocellus at cephalic margin of anterior tubercle, each posterior ocellus at lateral margin of posterior tubercle and contiguous with eye (Plate 1, fig. 3); vertex from region of ocellus, and face to buccal cavity bisinuous in profile and with black and tawny, semierect, silky hairs growing more tawny at antennæ and continuing shorter along lateral margins of buccal cavity (Plate 1, fig. 1).

Antennæ stout, tawny, covered with heavy, tawny to golden bristles proximad, rather bare distad; of seven segments, first oval, three times length of second which is concave distad to receive segment 3, the latter being one-third longer and very broadly and bluntly fusiform; segments 4 to 7 form the style which is as long as segments 1 to 3 together, segments 4 to 6 tawny, 7 opaque black-brown; segment 1 with heavy, tawny bristles, 2 with fewer scattered ones and 3 with an equatorial row of about seven stout black setæ in addition to a very fine, closely adpressed golden pile; segments of style finely pubescent (Plate 1, fig. 5).

Palpi reddish tawny, long, erect, partially concealed in longitudinal sulci close to eye-margins, first segment subarcuate, second sinuate, slender, five-ninths length of first, entire palpus twice length of antenna excluding style, geniculate at base, strongly hairy on anterior margin, no hairs basad, hairs semi-erect, those on second segment pointing proximad (Plate 1, fig. 4).

Labellæ wide and flat with circular, naked margins, proboscis slightly chitinized, dark brown, somewhat shrivelled in this specimen (Plate 1, figs. 1 and 2).

Thorax compactly subquadrate, mesonotum convex with a transverse sulcus on caudal third, pilosity crenulate, worn on notum except laterad, where it is golden, a tuft of golden pile on mesopleuron cephalad of spiracle and another caudad of wing-base; scutellum lenticular, transversely striate, its lateral margins circularly excised, its caudal margin with a broad elevated callosity, a fine crenulate golden pile just caudad of its margin on metanotum (Plate 1, fig. 6); abdomen as long as head and thorax, broadly oval in outline, segmentation prominent by reason of inflation of interstitial membranes; tergites brownish yellow, glabrous and with fine, black, scant, adpressed pile, worn off in patches, sternites as tergites, but paler glabrous and with much scantier pile; interstitial membranes with black pile; genitalia prominent, glabrous, brown (Plate 1, figs. 8 and 9).

Legs normal, fore femora nearly as long as tibiæ and tarsi, mid femora slightly longer, hind femora as long as hind tibiæ, all pale rufous brown with uniform, coarse, reddish brown or auburn pile, hind tarsi swollen basad and curved (Plate 1, fig. 7); fore and mid femora paler.

Wings uniformly shaped and typically veined, longer than entire body, of a uniform pale, semiopaque brown, veins only slightly darker and more opaque. Halteres gray buff with black knobs.

Length, 17.5 millimeters; width of thorax, 4.75; length of wing, 20, width, 5.

Type, male, No. 18619, in entomological collection, Bureau of Science, Manila.

MINDANAO, Lanao, Kolambugan, Latitude 8° 10′ north, longitude 123° 55′ east. June 15, 1914, *Charles S. Banks.*

This species falls naturally with *H. annandalei* Licht., and *H. basalis* Licht., because of its bare eyes, there being not a vestige of pubescence, even under the microscope. From *H. annandalei* it differs in size, in the color of the hairs, there being no "yellowish" abdominal hairs, in the color of legs and wings and in width of vertex and frons with respect to eye width.

Another remarkable thing concerning this insect is that it was taken at sea level in latitude 8° 10′ north, while those species recorded from British India come from altitudes of from 3,000 to 9,000 feet, about 1,000 to 3,000 meters.

Hirmoneura philippina adds another link in the chain of evidence of a former strong connection between Australia and the Asiatic continent through the Philippines and Formosa. I have little doubt that other species, perhaps in other genera of this interesting and little-known family will be found, not only in Mindanao, but likewise in northern Luzon, perhaps in the mountainous regions.

LITERATURE CONSULTED

MACQUART, J. Diptères exotiques nouveaux ou peu connus, Parts I, II, and Suppl. 1–5 (1838–1855).

BRAUER, E. Zwei Parasiten der Rhizotrogus solstitialis aus der Ordnung der Dipteren, mit 2 Tafeln. Sitzungsberichte der Mathematisch-Naturwissenschaftlichen Classe der Kaiserlichen Academie der Wissenschaften, Abteilung I, **88** (1883) 865 et seq., pl. 1.

KERTÉSZ, C. Catalogus Dipterorum Hucusque Descriptorum Museum Nationale Hungaricum, Budapestini **4** (1909) 22 et seq.

LICHTWARDT, B. Beitrag zur Kenntnis der Nemestriniden. Deutsche Entomologische Zeitschrift, Teile I bis V, mit Textfiguren (1909) 113, 507, 643; (1910) 371, 589.

LICHTWARDT, B. Nemestriniden (Dipt.) aus dem Indian Museum in Calcutta, Records of the Indian Museum **9** (1913) 333 et seq.

BRUNETTI, E. Nemestrinidae; Fauna of British India, Diptera Brachycera **1** (1920) 144 et seq.

ILLUSTRATION

[Drawn by the author and Macario Ligaya.]

PLATE 1. HIRMONEURA PHILIPPINA sp. nov.

FIG. 1. Head, profile, showing palpus extruded from its groove; × 8.5.
2. Head, cephalic, view, proboscis half extruded; × 8.5.
3. Head, dorsal view, showing ocelli and occiput; × 8.5.
4. Right palpus, position when at rest; × 20.
5. Right antenna, showing three of seven spines on third segment; × 35.
6. Mesonotum and scutellum of thorax, with wing bases and halteres; × 8.5.
7. Tarsus of right hind leg, showing curved first tarsal segment, pulvillus, and unguis; × 24.
8. Abdomen, profile of caudal segments, showing genitalia, including lateral claspers and recurved ventral claspers; × 8.5.
9. Abdomen, caudal view of genitalia, showing dorsal and ventral claspers between which is seen the penis; × 8.5.

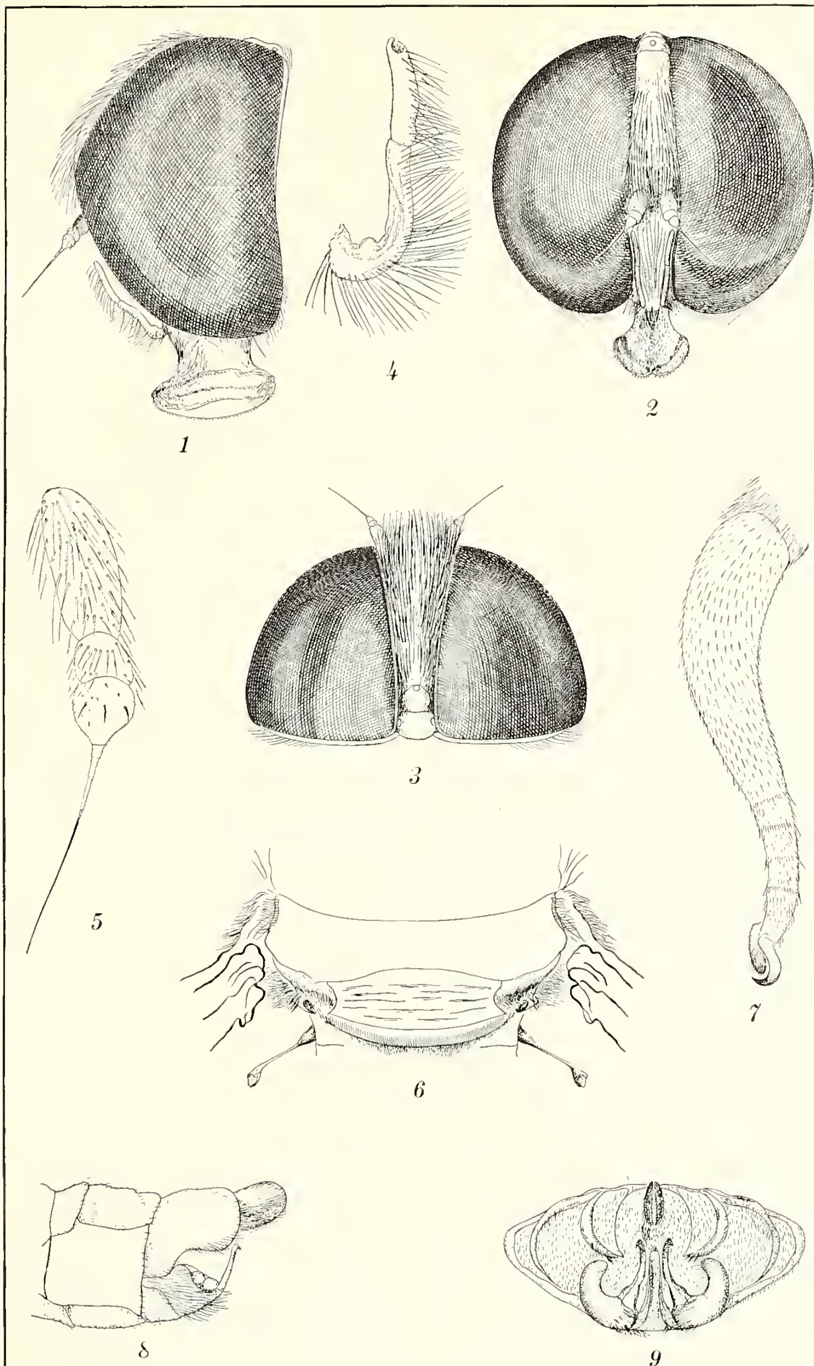


PLATE 1. HIRMONEURA PHILIPPINA SP. NOV.

CONTENTS

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.

VOL. 19, NO. 5 NOVEMBER, 1921

THE PHILIPPINE JOURNAL OF SCIENCE

MANILA
BUREAU OF PRINTING
1921

182517

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science of the Government of the Philippine Islands

---

Manuscript intended for publication and books for review should be sent to the editor. One hundred separates of papers published in the Journal are furnished to authors without charge. Additional copies may be had at authors' expense.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

The Journal is issued twelve times a year. The subscription price is 5 dollars, United States currency, per year. Single numbers, 50 cents each.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 19 NOVEMBER, 1921 No. 5

NEW PHILIPPINE COLEOPTERA

By K. M. HELLER

Zoölogical Museum, Dresden

THREE PLATES

In continuation of my studies upon the coleopterous fauna of the Philippine Islands I describe, in the present paper, further new species and varieties, for the greater part of which I am indebted to Prof. C. F. Baker, dean of the College of Agriculture, Los Baños. These species are recorded herein without indication of the name of collector; but, where a species is represented by more than one specimen, the number that corresponds with other specimens at Professor Baker's disposal is given.

Besides this important and excellent collection, I have had in hand for some time a part of the material belonging to the Bureau of Science, Manila, which I shall work up later. Among the latter is a weevil, imported with seeds from Australia into the Philippine Islands, which I believe is new; this is described, as are also some other Malayan Curculionidæ that are so nearly allied to Philippine species that their inclusion here seemed desirable. Moreover, it was necessary to erect a new Australian genus *Riboseris* upon *Petosiris pars* and to correct the systematic position of my *Endymia apicalis*[1] which is a *Blepiarda*.

The following is a list of the new species dealt with in this paper, those marked with an asterisk being extra-Philippine. For practical reasons the families are not arranged in strictly

[1] Philip. Journn. Sci. § D 10 (1915) 29.

systematic order, but the Curculionidæ are placed at the end, preceding the Brenthidæ.

CARABIDÆ

Euschizomerus rufipes.
Phloeodromus (?) sellatus.
Phloeodromus (?) hastatus.
Hoplomenes g. nov. *davaonis.*
Callida discoidalis.
Thlibops intermedius.

CLERIDÆ

Diplopherusa g. nov. *tumidipes.*
Cladiscus bacillus.
Callimerus octopunctatus.
Ommadius aurulentus.
Ommadius bakeri.
Tillus quadricolor.

CERAMBYCIDÆ

Ceresium (?) geniculatum.
Zosne cachila.
Doliops humerosus.
Doliops humerosus var. *subfasciatus.*
Planodes simplicicornis.
Anancylus vicarius.
Heteroclytomorpha davaona.
Micromulciber ochrosignatus.
Euclea tagala var. *tricolor.*
Agelasta violaceicornis.
Glenea caraga.
Glenea scalaris.

CURCULIONIDÆ

LEPTOPSIDINÆ

Celebia philippinica.

PACHYRRHYNCHINÆ

Pachyrrhynchus bakeri.
Pachyrrhynchus pavonius.
Pachyrrhynchus psittaculus.
Pachyrrhynchus modestior var. *transversatus.*
Pachyrrhynchus rugicollis var. *aurinius.*
Macrocyrtus pseudopolitus.
Nothapocyrtus basifasciatus.
Nothapocyrtus subpilosulus.
Metapocyrtus pseudomandarinus.
Metapocyrtus proteus.
Metapocyrtus pseudoelegans.
Metapocyrtus rufotibialis.

RHYNCHITINÆ

Deporaus nigrifrons.
Deporaus galerucoides.
Deporaus galerucoides var. *uniformis.*
Deporaus nigricornis.
Deporaus exophthalmus.
Deporaus dimidiatus.

HYLOBIINÆ

Scaphostethus cylindricollis.

ALCIDINÆ

Alcides (Metallalcides) chalcomorphus.
Alcides aeratus.
Megarhinus validirostris.
Megarhinus curvipes.
Menechirus fuscodorsalis.

CRYPTORHYNCHINÆ

COLOBODES, DERETIOSUS, AND APRIES

Eucolobodes horribilis.
Deretiosomimus angulicollis.
Deretiosomimus angulicollis subsp. *lactifrons.*
Solobrachius modestus.
Perrhaebius x-album.
Perrhaebius delicatus.
Perrhaebius elegans.
Perrhaebius directus.
Brachycolobodes undulatus.
Colobodellus alboscutellatus.
Lobocodes g. nov. for *Colobodes turbatus.**
Ocoblodes lineola.
Ocoblodes conspersus.
Ocoblodes (?) cionoides.
Ocoblodes (Eprias) vana.
Ocoblodes (Eprias) binotata.
Deretiosus venustus.
Micrapries nanna.
Micrapries echinus.
*Dinapries salebrosa.**
Nannocolobodes mus.
Therebus (?) bifasciatus.
Dyspeithes seriatopunctatus.
Dyspeithes dentipes subsp. *punctatostriatus.*
Mecistocerus montanus.
Mecistocerus (Rhadinomerus) setosipes.
Mecistocerus modestus.
Mecistocerus latiusculus.
Mecistocerus compressipes.
Mecistocerus albohumeralis.
Mecistocerus maculipes.
Mecistocerus pictithorax.
Mecistocerus laesipes.
Tragopus albicans.
Tragopus sablanicus.
Tragopus ornaticollis.
Tragopus vitticollis.
Cydostethus obliquesignatus.
Cyamobolus definitus.
Zeugenia rosacea.
Rhadinopus pseudofrigidus.
*Rhadinopus borneonis.**
*Rhadinopus javanicus.**
Coelosternus philippinensis.
*Coelosternus javanus.**
Sybulus calidus.
Nechyrus bifasciculatus.
Nechyrus humerosus.
Nechyrus lineicollis.
Odosyllis albolinea.
Odosyllis subsulfurea.
Odosyllis chlorizans.
Odosyllis sellata.
Odosyllis bilineola.
Odosyllis octopunctata.
Odosyllis octopunctata var. *cervina.*
Odosyllis eubuloides.
Odosyllis albifrons.
Odosyllis leucometopus.
Odosyllis pauxilla.
Odosyllis similis.
Odosyllis alboscutellaris.

ZYGOPINÆ

Agametis proba.
Emexaure suturalis.
Emexaure septempunctata.
Metialma nigritana.
Nauphaeus carbonarius.
Nauphaeus manobo.
Mecopus niveoscutellaris.
Mecopus nigroplagiatus.
Othippia impexa.

CALANDRINÆ

Otidognathus pictus.
Sphenophorus (?) basilanus.

BRENTHIDÆ

Schizoeupsalis kleinei.

CARABIDÆ

Euschizomerus rufipes sp. nov.

Aterrimus, vix atro-coeruleus, elytris obscure æneis, mandibulis, labro pedibusque rufis; antennis, articulo primo fuscescenti excepto, nigricentibus, articulo tertio primo multo longiore, fronte transversa, indistincte ruguloso-punctata, callositate oblonga, mediana, glabra; prothorace longitudine perpaulo latiore (3.5 : 4), maxima latitudine ante medium, rude inaequaliterque punctato, longe parceque griseo hirsuto, sulco mediano tenui; elytris latitudine plus sesqui longioribus, fortiter punctato-substriatis; corpore subter rude inaequaliterque, sternitis tres ultimis subtiliter punctatis.

Long. 8.5 mm., lat. 3.5.

LUZON, Laguna Province, Mount Maquiling.

Smaller than any of the known species of the genus and readily distinguished by the red legs. Head, prothorax, and underside black, the last subobsoletely bluish; elytra dark brassy green, like the rest of the body sparsely and finely yellowish pubescent; transverse, emarginate labrum and other parts of mouth dark red brown, remainder of head deep black; transverse clypeus very smooth; front between eyes as broad as between insertion of antennæ; posterior margin of eyes long; a large, smooth callosity in the center confluent with clypeus; antennæ long, extending beyond middle of body; first joint brown, three and one-half times longer than thick; remaining joints black, pubescent from fourth joint, third hardly longer than first, but as long as the two following; prothorax somewhat shorter than wide (3.5:4 rounded hexagonal, the sides posteriorly more punctate; fourth joint of hind tarsi somewhat longer than second and shortly forked.

Phloeodromus (?) sellatus sp. nov. Plate 1, fig. 1.

Rufo-castaneus, elytris plaga postmediana, communi, antrorsum in sutura producta, nigra; capite prothorace aequilato; labro longitudine fere duplo latiore ut clipeo, transverso, margine laterali elevato, illo margine anteriore circiter punctis sex, hoc utrinque ad basin puncto singulo setigero, fronte in dimidia parte anteriore impressione longitudinali ac puncto (setigero?) supraorbitale; antennis sat robustis, prothoracis basin vix attingentibus, articulis 3.5 basalibus glabris, reliquis tomentosis; prothorace cordato-transverso, basi apiceque truncato, linea mediana impressa, margine laterali reflexo, ante medium et in angulo obtuso, postico, puncto setigero; scutello triangulari, minuto; elytris subtilissime punctato-striatis, striis apicem haud attingentibus, stria scutellari abbreviata distincta, stria tertia ante medium et ad apicem foveolata, sutura apicem versus attenuata, spatiis seria singula remote punctata, secundo reliquis latiore; corpore subter vix punctulato; epipleuris basin versus valde dilatatis; unguiculis septem-pectinatis.

Long. 8 mm., lat. 4.

MINDANAO, Davao Province, Davao.

At present it is impossible to point out the definite systematic position of this and the following closely allied species of the group of Truncatipennes which are before me in only single specimens. Both possess strikingly short antennæ, a character not found in any other Lebiini except *Phloeodromus* M'Leay.[2] Supposing that this is a true lebiid, the male, as given by Chaudoir,[3] has the intermediate tibiæ deeply emarginate on inner edge near apex, an essential character which is not mentioned of *Phloeodromus* by M'Leay. This is lacking in the Philippine specimen, which I believe to be a male because of the enlarged anterior tarsi, but it differs from *Phloeodromus* in the oblong, nonmoniliform fifth to eighth joints of the antennæ; the transverse, hairless (except a marginal series of five setigerous punctures) labrum; and the lobes of mentum forming mediad not a right, but an obtuse angle; moreover, these lobes bear an epilobium[4] and a middle tooth is wanting in the emargination of mentum; elytra very finely seriate-punctate, the second interval ("interstitium tertium" of Chaudoir) at the base before the middle with a larger, and near the apex with an obsolete puncture; spurs of tibiæ minute, tarsi strong, first and second joints equal in length, the third trigonate, on the middle tarsi transverse, on the hind tarsi a little longer, claw joint exceeding the long bilobed fourth by half its length; claws 7-pectinate.

Phloeodromus (?) *sellatus* is reddish castaneous, paler on margin of prothorax, on legs, and especially on epipleura, which are yellowish. Dorsum shining, impunctate, a black spot on elytra extending posteriorly beyond the seventh stria, submarginal (seventh) interval broader than the preceding, like it with

[2] Proc. Linn. Soc. New South Wales 1 (1876) 167.

[3] Bull. Soc. Nat. Moscow 63 (1871) 115.

[4] Cf. Chaudoir, loc. cit. By this character one may be led (following Chaudoir) to the African genus *Camaroptera*, but this has much longer antennæ, etc.

a few, very minute, indistinct punctures; the punctures of the marginal series also proportionately minute.

Phloeodromus (?) **hastatus** sp. nov. Plate 1, fig. 2.

Praecedenti affinis, sed paulo minor, prothorace latiore lateribus in parte posteriore, convergenti, rectis; elytris plus elongatis, interstitio septimo sexto haud multo latiore, post medium macula suturali, in fronte bilobata, apice acuminata, utrinque striam tangente ac sagittae mucrone simili nigra.

Long. 8 mm., lat. 3.

MINDANAO, Davao Province, Davao (*7243*).

Closely allied to *P. sellatus* and of the same color, but prothorax broader, its lateral margin in the posterior, converging part straight; elytra more elongate, the penultimate interval not broader than the sixth, the black sutural spot hastate, as shown in Plate 1, fig. 2.

Genus **HOPLOMENES** novum

Coptoderinarum prope Amphimenes Bates

Ligula, apice sinuato-truncata quadrisetosa, paraglossis eam perpaulo superantibus, annalis, plurisetulosis. Palpi longiusculi, labiali articulo secundo tertio longiore hoc crassitudine quadruplo longiore subfusciformi. Mentum lobis acutis margine interno antrorsum divergentibus, fundo bisinuato dente mediano brevi acuto. Labrum, rectangulare, transversum, sexsetosum, angulis anticis subrotundatis. Antennae articulis tribus basalibus basique quarti glabris. Oculi hemisphaerici. Prothorax transversus, subsemicircularis, lateribus basin versus paulo convergentibus, basi parte mediano subproducto. Elytra depressiuscula fortiter striata, ad striam tertiam, integram, punctis impressis tribus, ultimo apice exteriore, margine apicali oblique sinuato-truncato, ad suturam et extrinsecus dentem acutam formante. Pedes tibiis canaliculatis, apice sat longe bicalcaratis,[5] tarsis sat robustis articulo secundo primo dimidia parte breviore, tertio quartoque aequilongis, hoc subconico, bilobo, unguiculis novem pectinatis (dente apicali haud computato) dentibus apicem versus longitudino decrescentibus.

The single specimen before me does not permit a sufficiently careful examination of the mouthparts; but as far as the other characters indicate, the species described here can be placed in

[5] By this character *Hoplomenes* pertains to the Sarothrocrepidæ Chaudoir, Bull. Soc. Nat. Moscow 51 (1876) 2, but the single American genus of this family has the claws pectinate only in the broader basal half, and the fourth tarsal joint roundish bilobate.

no known genus. It seems to me to come nearest to *Amphimenes* Bates which I know only from the description.[6] The new genus differs from *Amphimenes* by the hemispheric eyes, by the elytra being much broader than the prothorax and spinous on each edge of the apical truncation, and by the less elongate tarsi. *Oxydontus* Chaud. also seems related to it, but shows an extremely long middle tooth on the mentum, thicker labial palpi, and unspined apical truncation of the elytra.

The form of the ligula in *Hoplomenes* shows a great resemblance to that in the Tetragonoderidæ,[7] but among these no one genus has similarly pectinate unguiculi.

Hoplomenes davaonis sp. nov. Plate 1, fig. 3.

Fulvus, ore, antennis prothoraceque rufescentifulvis, capite reliquo, elytris marginibus suturaque, hac triente apicali excepta, basi fere semicirculariter medio utrinque triangulariter usque ad striam quintam dilatata, nigris; capite vix punctulato, fronte utrinque margine antico puncto maiore; prothorace subcoriario, vix punctato, fere semicirculari-transverso, lateribus in dimidia parte basali postrorsum perpaulo convergentibus, angulis posticis seta perlonga gerentibus, margine basali in triente mediano subproducto; elytris striatis, spatiis convexiusculis, spatio secundo in primo tertioque quinto puncto impresso, apice late sinuato-truncatis angulo suturali externoque acutis, unguiculis novem pectinatis.

Long. 10 mm., lat. 4.8.

MINDANAO, Davao Province, Davao.

Fulvous, prothorax and abdomen more rusty; mandibles, labrum, and clypeus dark red; head above and margins and sutural markings of elytra black; clypeus on each side, first antennal joint near apex, and prothorax on posterior angles each with a long cilia; head indistinctly, finely, and remotely punctate; inside of orbital furrow with a foveola; prothorax hardly rugulose on disk, the flattened margin smooth; abdomen very sparsely and minutely punctate, the last sternite on each side with a submarginal row of three setigerous punctures.

Callida discoidalis sp. nov.

C. splendidula Fabr. affinis, sed maior, capite latiore, clipeo margine antico subsinuato, postico subrotundato; fronte utrinque ante oculos plicato, intra plicam utrinque rugulis obliquis postror-

[6] Trans. Ent. Soc. London (1873) 322.
[7] Chaudoir, Bull. Soc. Nat. Moscow 50 (1876) 28.

sum ad frontis medium angulato-convergentibus; antennarum articulo tertio primo aequilongo ac quarto distincte longiore; prothorace subcordato, longitudine latiore (3.5 : 4.1), impressione basali transversa manifesta; elytris rufo-testaceis, utrinque late viridi-metallico-vittatis, vittis ad basin et ad apicem late confluentibus; corpore subter pedibusque rufo-testaceis unicoloribus.

Long. 11 mm., lat. 4.

MINDANAO, Davao Province, Davao (*7247*).

Allied to *C. splendidula* Fabr., but larger, the metallic green lateral stripes of elytra broadly confluent at base and at apex, including the abbreviated subscutellar stria, the dark red common dorsal patch extending to the fifth stria; elytra proportionately broader than in the related species, *C. permuda* Chaud., which has unicolored metallic green elytra.

Callida splendidula Fabr.

Recorded from Bengal, Java, Hongkong, Shanghai.

LUZON, Tayabas Province, Malinao.

Dendrocellus geniculatus Klug.

Hitherto known from India, Assam, Burma, Malacca, Java, Borneo, and Celebes.

MINDANAO, Davao Province, Davao.

Thlibops intermedius sp. nov.

Thlibops omega Heller[8] affinis, sed multo minor; prothorace angustiore, lateribus parallelis, margine basali emarginatione mediana minuta arcuata; elytris striis, octavo excepto, apice haud punctatis, spatio tertio secundo fere duplo latiore; sternitis per totam latitudinem rude punctato.

Long. 15 mm., lat. 4.

LUZON, Laguna Province, Los Baños (*12051*).

Very near to *T. omega* Heller, but smaller; the seven interior striæ of elytra arranged as in that species and with the apical part impunctate; thorax longer, with parallel sides, with a small semicircular emargination in the middle of the base; abdomen punctate all over, in the middle somewhat more sparsely so.

CLERIDÆ

Genus DIPLOPHERUSA novum

Tillinorum prope Cladiscus

Antennae ab articulo tertio longe biramosae. Labrum recte truncatum. Palpi maxillares articulo ultimo breviter subcy-

[8] Abh. Ber. Mus. Dresden No. 8 (1899) 3.

lindrico, palpi labiales articulo ultimo perlongo, cylindrico, acuminato. Oculi transversi, reniformes. Prothorax latitudine haud longior, globosus, basi fortiter constrictus. Tibiae anticae rectae, posticae tumidae. Unguiculi in dimidia parte basali dentato-dilatati.

Diplophorus Fairm. has similar, but much shorter bipectinate antennæ; nothwithstanding this the new genus is more closely allied to *Cladiscus*. It is distinguished from *Cladiscus* by the long bipectinate antennæ, as well as by the very long apical joint of labial palpi, which is six times longer than thick; the medially subtransversely spheric thorax; the thickened hind tibiæ; and the broadly dentate unguiculi.

Diplopherusa tumidipes sp. nov. Plate 1, fig. 6.

Nigro-cyanea, antennis atris, articulis 3 ad 10 subter longe biramosis, elytris palpisque testaceis; prothorace margine basali sanguineo, creberrime punctato, margine antico leviusculo, parte basali constricto transverse subrugoso; elytris crebre seriato-punctatis, in dimidia parte, minore, apicali, dense punctulatis; tibiis posticis fortiter clavatis.

Long. 11 mm., lat. 2.2.

LUZON, Mount Banahao.

Body dark steel blue, thorax coarsely and densely punctate, in the apical part with fine and scattered punctures, on the contracted basal part transversely wrinkled, the basal margin dark red; elytra pale cinnamon in color, in the basal two-thirds coarsely and subtransversely seriate-punctate, on the posterior third with irregular fine and dense punctures; hind tibiæ strongly clavate.

Cladiscus bacillus sp. nov. Plate 1, fig. 7.

C. strangulato affinis, niger capite prothoraceque parte anteriore subrufescentibus, hoc parte basali longiore; antennis serratis, articulis duobus basalibus testaceis; prothorace fortius punctato; elytris latitudine basali 4.5 partibus longioribus, striis punctatis omnibus spatiis latioribus.

Long. 6.5 mm., lat. 0.7.

LUZON, Mountain Province, Baguio.

A unicolored black, cylindric species similar to *C. strangulatus*, but with serrate antennæ, the two basal joints fulvous, joints 8 to 10 hardly longer than broad, the last elliptic, not quite twice as long as thick; front between eyes distinctly convex, moderately densely but rather strongly punctate; constricted basal part of prothorax less transverse, trapeziform, strongly strigose along sides, nearly as long as broad; elytra four and one-half times longer than broad, the seriate-punctate striæ all broader than the intervals, the punctures becoming distinctly larger toward the smooth apical part; underside shining, indistinctly and remotely punctate, the three last sternites finely fulvous-pubescent, the penultimate with semicircularly sinuate posterior margin.

I have some doubt as to whether the pectinate antenna is a generic character, or only a sexual one. Schenkling[9] mentions *C. sauteri*, male ?, as also having serrate antennæ and a sinuate penultimate ventral sternite.

Callimerus fenestratus Chapin. Plate 1, fig. 4.

Callimeris fenestratus CHAPIN, Proc. Biol. Soc. Washington 32 (1919) 232.

Chalybaeus, capite corporeque subter plus viridescentibus, subtiliter parceque albido-pilosus, labro, antennis pedibusque, tibiis dorso nigricante exceptis, pallide testaceis, lineis albo-squamosis ornatus, nempe: thorace una basali, altera apicali, elytris quatuor transversis, prima basali, per suturam cum secunda, in primo quarto sita et signaturam communem fere x-formem formante, conjuncta, tertia in secundo triente per suturam cum quarta, subapicali et cum secunda per vittam discoidalem conjuncta; corpore subter lateribus etiam albo-squamosis.

Long. 7 mm., lat. 2.

PALAWAN, Puerto Princesa (*4272*).

Allied to *C. albovarius* and *C. dulcis* Westw.; elytra, as in *C. mirandus* Gorh., ornamented with white-scaled bands, but head without a squamose frontal patch; thorax longer, and elytra not pointed at apex; labrum ivory white with a delicate median line; last joint of the yellowish antennæ longer than thick, ovate-acuminate; elytra densely punctate-striate, the intervals hardly as broad as the striæ; legs yellowish, tibiæ brownish on dorsal edge.

Callimerus octopunctatus sp. nov. Plate 1, fig. 5.

Niger, albo-setulosus, prothorace, capite corporeque subter subcoerulescentibus, prothorace margine laterali elytrisque singulis maculis punctiformibus quatuor, longitudinaliter dispositis ac inter se aequidistantibus, albo-tomentosis, palpis, antennis pedibusque testaceis.

Long. 8 mm., lat. 2.

LUZON, Laguna Province, Mount Maquiling.

[9] Ent. Mitteilungen, Berlin-Dahlem 1 (1912) 322.

This species is allied to *C. pictus* Gorh. and is easily recognizable by its four round, squamose, white dots, forming a longitudinal row upon each elytron. The yellowish antennæ extend scarcely beyond hind margin of eye, the last joint is twice as long as broad. Palpi as in *C. albovarius* Westw., thorax one-third longer than broad, with three fine, transverse wrinkles in the constricted basal part; upper side of body dull black, underside somewhat glossy, dark, bluish green, with a squamose, lateral, white stripe; legs yellowish, hind tibiæ slightly dilated in posterior part, the dorsal edge emarginate at apex.

Ommadius aurulentus sp. nov. Plate 1, fig. 10.

Rufo-castaneus, flavo-aurato-tomentosus, prothorace fasciisque tribus in elytris nigris, antennis pedibusque unicoloribus fulvis, femoribus intus in medio macula oblonga fusca; prothorace in dimidia parte posteriore carina mediana, ante haud transverse strigoso; elytris in triente basali distincte, reliquis vix punctato-striatis, striis tribus intrahumeralibus ad basin granulosis, fasciis nigris, valde biarcuatis, praesertim antica, extrorsum latioribus, spatiis inter fasciis quam his latioribus; corpore subter testaceo, abdomine subrufescenti, coxis posticis nigricantibus.

Long. 17 mm., lat. 4.

LUZON, Laguna Province, Mount Maquiling.

Similar to *O. abscissus* Gorh. (= *fasciatus* Kuw.), but the thorax with a median carinula in the basal half, without transverse wrinkles in the apical part; belonging to the first group of Kuwert's key.[10] Body yellowish red-brown; thorax, mesosternum, and three dentate-undulate crossbands on elytra black; front nearly three times as long as broad between the eyes; antennæ and legs fulvous, hind coxæ brown, femora mediad with an oblong brownish patch; thorax one and one-half times longer than broad, in the anterior part without transverse wrinkles, at base with a double submarginal furrow; punctate striæ of elytra granulate-punctate at base, becoming obsolete toward apex.

Ommadius bakeri sp. nov.

O. vespiformi Gorh. simillimus, sed prothorace disco haud tuberculato, fulvo, parte anteriore constricto, inter oculos margineque basali, toto nigris; elytris fasciis tribus rectis, transversis, per suturam anguste interruptis, ultima latitudine partis apicalis fulvi longitudine aequante.

[10] Ann. Soc. Ent. Belg. **38** (1894) 63.

Long. 12 mm., lat. 3.

LUZON, Laguna Province, Mount Maquiling (*1974*).

This handsome species represents a vicarious form of *O. vespiformis* Gorh., from which it is distinguished by the reddish yellow thorax which bears no granules on disk and has the apical margin black between the eyes; the basal margin is of the same color, but is broader; the middle portion is narrower. The three black bands of the elytra are perpendicular to the suture and of equal breadth, the last as broad as the yellow apical part is long.

Tillus quadricolor sp. nov. Plate 1, fig. 9.

Capite, antennarum articulis octo distalibus, prothorace dimidia parte anteriore, elytris fascia utrinque triangulari, antemediana abdomineque, processu intercoxali, rufo, excepto, nigris; labro, prothorace in dimidia, elytris in quarta parte basali proet metasterno ut pedibus, femoribus anticis apice, posticis totis, nigris, exceptis, rufis; elytris fascia postmediana eburnea, triente apicali testaceis, nigro limbatis, apice densius sericeus, usque ad fasciam eburneam seriato-punctatis, punctis ad elytrorum basin spatiis fere aequilatis, postrorsum decrescentibus, in parte apicali vix observandis; abdomine nitido, remote subtilissimeque punctulato, lateribus griseo-pubescentibus ac in sternito secundo et tertio dense punctulatis.

Long. 6.5 mm., lat. 2.

LUZON, Laguna Province, Mount Maquiling.

Nearly allied to *T. semperanus* Gorh. of which I have a specimen from Cuernos Mountains, Negros (leg. *Baker*) before me; but the basal half of the thorax is red; the ivory white, postmedian crossband broader, interrupted by the suture; and the apical third entirely testaceous and finely bordered with black.

CERAMBYCIDÆ

Ceresium (?) geniculatum sp. nov. Plate 1, fig. 11.

Testaceum, subtiliter, elytris apicem versus longius, fulvopubescentibus, genubus basique tibiarum nigricantibus; prothorace latitudine distincte longiore, subconico, haud punctato, disco callositate minuta, oblonga, glabra, elytris latitudine triplo longioribus, distincte, apicem versus evanescente punctatis; femoribus clavatis, posticis sternitum tertium parum superantibus; tarsorum articulo primo duobus segmentibus unitis breviore.

Long. 12 mm., lat. 2.5.

LUZON, Mount Banahao.

Because of the brevity of the description of *Ceresium imite* Newm. this new species might easily be taken for that species, but it shows neither the bare tubercles on the thorax nor the unicolored legs with the knees strikingly black. In common with the genus *Salpinia*, it has a short frons and a long, nearly cylindric thorax, while in the form of antennæ it agrees with *Ceresium*.[11] *Ceresium geniculatum* is light yellowish brown as is *Axinopalpus gracilis;* the elytra toward the apex are longer and finely golden yellow pubescent; the apices of femora and basal third of tibiæ are black. Frons between insertion of antennæ transverse, with a median furrow extending neither cephalad nor caudad of eyes; profile of frons slightly obtuse angulate, posterior part longer than the anterior; thorax uneven, impunctate, finely tomentose, front margin smooth, basal margin finely carinate, disk with an indistinct oblong callosity; base of elytra with an interhumeral, longitudinal impression, scarcely seriate-punctate, obsolete toward the apex; underside nearly smooth; hind femora strongly clavate, apex extending somewhat beyond third sternite; first joint of hind tarsi a little shorter than the two following together.

Zosne cachila [12] sp. nov. Plate 1, fig. 12.

Niger, cretaceo-, vittiis fasciisque umbrino-, antennis articulo primo secundaque, ut quarti basi, lurido-, quarto, reliquo, quintoque nigro-, 6. ad 9. isabellino-, ultimis nigricante-tomentosis; vertice thoraceque utrinque vitta, elytris, crebre fortiterque punctatis, humeris fasciisque duabus, una fere totam partem anteriorem occupante, altera, postmediana, umbrinis, per fasciam arcuatam cretaceam separatis, antica linealis duabus, retro divergentibus ac scutello incipientibus interrupta; corpore subter plus minusve umbrino-, vitta laterali in thorace lateribusque meso- metasternique, sternito ventrali paenultimo toto, ultimo lateribus cretaceo-squamosis.

Long. 14 mm., lat. 5.

MINDANAO, Davao Province, Davao *(7173)*.

The single species of this genus hitherto described, *Z. cincticornis* Pasc., I know only from the description and the figure given by Pascoe.[13] The new Philippine species is broader and more robust, and the first joint of antennæ bears a longitudinal

[11] Gahan, C. J., Fauna of British India, Coleoptera 1: 163.

[12] *Cachila* is used by some of the inhabitants of Mindanao to designate a Spaniard.

[13] Proc. Zool. Soc. London (1866) 264, pl. 28, fig. 11.

carina, which is not mentioned by Pascoe. Frons with a fine median furrow, remotely and deeply punctate, covered with ochraceous tomentum continued as a stripe on to vertex; scutellum semicircular, cretaceous, lateral edges blackish; elytra, especially posteriorly, densely and coarsely punctate with a nut-brown marking (Plate 1, fig. 12) ; underside blackish brown; a lateral stripe on thorax, side of mesosternum and metasternum, middle of abdomen, penultimate sternite entirely, and a lateral spot on last sternite white; tarsi and apical part of tibiæ black.

Doliops humerosus sp. nov. Plate 2, fig. 2

Niger, antennis articulis octo apicalibus cinnamomeis, prothorace opaco, margine basali, puncto mediano-basali, margine oculari, parte posteriore excepto ut scutello albo-tomentosis; elytris, basi virescenti excepta, purpurascentibus, applicate, subtilissime parceque nigricante pilosis, maculis albo-tomentosis adspersis, humeris tuberculo dorsali mammiforme, basi subasperato-, retrorsum subtilius, apicem versus evanescente subseriato-punctatis, apice truncatis angulo externo producto; corpore subter nigro-opaco, sternito primo virescenti, lateribus albo-maculatis.

Long. 13 mm., lat. 5.5.

MINDANAO, Zamboanga Province, Zamboanga (*7172*).

Frons sparsely and deeply punctate; vertex, margin of eyes except the caudal border, basal margin of prothorax, a dot in the middle before this, and scutellum white; base of antennæ gray, thickened apex of the elongate third joint black, the eight remaining joints cinnamon-tomentose; prothorax transverse, moderately densely but deeply (elytra on base sparsely, strongly, and somewhat asperate) punctate, the punctures disappearing toward apex; a mammiform tubercle on shoulders; outer edge of the truncated apex bluntly produced; underside black, abdomen greenish; upper part of meso-episterna, entire epimera, metasternum except the broad margins, meta-episterna on their anterior extremities, and the sternites laterad more or less white tomentose; legs blackish purple, femora without punctures and, like the tarsi and tibiæ, blackish, the latter medially whitish tomentose entad.

Doliops humerosus var. **subfasciatus** var. nov.

Praecedenti differt: elytris viridibus, maculis albidis in fasciis, una mediana, altera in secundo triente, confluentibus, prothorace macula mediano-basali nulla.

MINDANAO, Davao Province, Davao (*7171*).

Because of the greenish elytra which show two white cross-bands, interrupted by the suture, this variety makes so striking an impression that attention may be drawn to it by the above name.

Planodes simplicicornis sp. nov. Plate 1, fig. 13.

Niger, antennis articulis tres basalibus, tertii parte apicali nigro excepto, ut vitta mediana in vertice, carinato, pallide ochraceo-, prothorace vitta lata mediana, altera tenuissima sublaterali signaturisque vermiculosis in elytris cinereo-tomentosis; antennis articulo tertio apice haud spinoso; prothorace subtransverso in parte mediano griseo subconcavo, remote punctato, utrinque transverse rugoso; elytris dorso deplanatis, singulis carinula mediana obsoleta, ad basin seriato-subgranoso-punctata, apice oblique sinuato-truncatis; corpore subter griseo-, linea laterali, sub oculos incipiente ac usque ad abdominis apicem continuata albido-tomentosa, mesosterno inter coxas intermedias tuberculato.

Long. 18 mm., lat. 6.

MINDANAO, Zamboanga Province, Zamboanga.

In spite of the extraordinary resemblance of this species to the known species of the genus, especially to *Planodes tuberculatus* Pasc., it may perhaps later form a new genus distinguished by the absence of a spine on apex of third antennal joint; by the singly and obliquely truncate, lightly convex apical margin of elytra; and by the intercoxal tubercle in front of intermediate coxæ. Tomentum on head, on first and second antennal joints, and on basal half of third light ochraceous, on basal half of fourth whitish, on the remaining joints black; prothorax slightly transverse, gray like the vermiculated marking of elytra, the latter constricted by four subquadrate, black patches to a cruciform dorsal marking; vertex with a fine but sharp median carinula; prothorax slightly concave on disk, on each side transversely wrinkled and remotely punctate; scutellum semicircular, black; each elytron in the posterior part with a remote and finely seriate-punctate carina which in the basal half is only indicated by a row of denser seriate-granulate punctures; underside gray, with a white lateral stripe, and as broad as meta-episterna, beginning under eye and extending to apex of abdomen; caudal margin of sternites shining reddish on each side.

Anancylus [14] vicarius sp. nov. Plate 1, fig. 8.

A. maculoso Auriv.[15] similis, sed aliter signatus, griseo-tomentosus, maculis, elytris praeterea fascia subbasali nudata, fusco nigris; prothorace margine antico simplici, punctis paucis dispersis, seriebus transversis, tribus, antica posticaque e maculis quinque, mediana e maculis quatuor formatae; elytris ut in maculosa ad basin subasperato, retrorsum evanescenti-punctatis, maculis fuscis sat symmetricis, in elytrorum quarte parte, apicali, utrinque duabas oblongis ornatis; tibiis basi et triente apicali fuscis, tarsis articulis duobus basalibus niveis, reliquis nigris. Long. 13 mm., lat. 5.

MINDANAO, Zamboanga Province, Zamboanga.

Specimens before me from Sattelberg, New Guinea, collected by R. v. Bennigsen, in the Deutsche Entomologische Museum, Berlin-Dahlem, and in the Zoölogical Museum, Dresden, I believe to be *A. maculosus* described by Chr. Aurivillius.[15] The new Philippine species is very closely allied to it, but the light gray tomentum on the elytra is more extended and more confluent, forming two longitudinal stripes in the apical quarter of each elytron. Antennæ blackish, as in *A. maculosus*, joints at base beginning with third, and the two basal joints of tarsi, whitish; anterior margin of prothorax simple, in contrast to *A. maculosus*, where it is bicarinate; underside gray with a small spot in the middle of meta-episterna, another on each side of anterior margin of second, third, and fourth sternites, and a larger one in the middle of femora.

Anancylus strix [16] differs from *A. vicarius*, besides being differently marked, in the longer elytra, and in the first antennal joint being deeply furrowed lengthwise.

Heteroclytomorpha [17] davaona sp. nov. Plate 2, fig. 5, ♀.

Niger, ferrugineo-tomentosa, prothorace utrinque in dimidia parte basali linea, in elytrorum basi continuata et hic paulo dilatata, elytris in secundo triente pone suturam et in tertia quarta, ad marginem lateralem, macula, punctiforme, sat magna, disco in primo triente, post tertiam quartam, puncto minutis-

[14] W. Schultze, in his Catalogue of Philippine Coleoptera, Manila (1915) 113, indicates Dejean instead of J. Thomson as the author of this genus; moreover the name of my species is *strix*, not *stix*.

[15] Arkiv f. Zoolog. Stockholm 7 (1911) 16.

[16] Philip. Journ. Sci. § D 10 (1915) 241, pl. 1, fig. 12.

[17] Cf. Aurivillius, Ent. Zeitschr. (1908) 218.

simo, albo-tomentosis, in dimidia parte apicali subtricarinulatis, apice truncatis, extus spinosis; corpore subter tomento ferrugineo, sat crebre denudato-punctato, abdomine parte mediano glabro.

Long. 23 mm., lat. 7.

MINDANAO, Davao Province, Davao (*7162*).

Distinguished from the known species of the genus with white tomentose stripes by the restriction of the latter on the basal half of prothorax and on base of elytra, the outer edge of the apical truncature of which is produced into a distinct point; moreover, the elytron shows a white spot in the second third, on first and second intervals of carinæ, which are feebly marked in the apical half, the inner of which is displaced to the front; and a small white dot on disk, behind the second third and on the third quarter of lateral margin; cinnamoneus tomentum of body interrupted on head, on first three antennal joints, and on underside inclusive of femora and tarsi by rather large, dense, dark brown, naked punctures; frons concave, uneven and dispersed punctate; front margin with a small, smooth callosity on each side; prothorax sparsely punctate, with an indistinct middle line confluent in front with a triangular area, behind with a transverse smooth area; scutellum semilunately finely tomentose on each side.

Micromulciber[18] **ochrosignatus** sp. nov. Plate 2, fig. 1.

Brunneus, subtilissime luteo-tomentosus; prothorace disco utrinque vitta obsoleta elytrisque lineis, nempe: una utrinque antrorsum curvata, in quinta parte basali, altera, laterali, a basi oblique suturae secundum trientem versus directa, dein parum extrorsum curvata et in parte apicali sagittato-dilatata, apice longe distante, altera in triente parte ad suturam, altera mediana ibidem ut corpore subter partim, ochraceo-tomentosis.

Long. 13 mm., lat. 3.8.

MINDANAO, Zamboanga Province, Zamboanga, one specimen.

Dark reddish brown, very finely ochraceous-tomentose, indistinct lines on head and thorax; a design of lines on elytra as shown in Plate 2, fig. 1, and isolated areas on the underside denser, dark golden-yellow tomentose; antennæ bright reddish, scape and two following joints mottled, remaining joints uniformly ochraceous; prothorax with coarse, irregularly dispersed punctures, which leave a rectangular oblong discal area, on

[18] Aurivillius, Arkiv f. Zoolog. Stockholm 8 (1913) 25.

each side of which is an ochraceous stripe; elytra subseriate-punctate, punctures on base of elytra asperate, toward apex finer and more remote; underside with bare brown spots as in *Heteroclytomorpha davoana* sp. nov.

Micromulciber ochrosignatus is closely allied to *M. biguttatus* Pasc.,[19] which occurs also in Borneo, but differs from it in part by the very acutely produced apex of elytra.

Euclea tagala var. **tricolor** var. nov.

A specie typica differt maculis fasciisque omnibus, fascia alba mediana excepta, lateritio-tomentosis.

MINDANAO, Zamboanga Province, Zamboanga (*7196*).

This striking variety differs from typical *E. tagala* Heller[20] by the color of the tomentose markings which is dirty bright red instead of pure white, only the median crossband of elytra being of the latter color.

Agelasta violaceicornis sp. nov.

A. mystica Pasc. affinis, sed antennis articulis, a tertio usque ad septimo, ut in mystica, basi albotomentosis, sed reliquis violaceo-pruinosis; prothorace basi apiceque vitta marginali quaque alteracum supra coxas conjuncta, albis; elytris fasciis tribus angustis, scapo vix latioribus, una subbasali, altera mediana, tertia anteapicali, latera versus interrupta, ut femorum dorso, albo-tomentosis, tibiis anticis obscure sanguineis curvatis.

Long. 18 mm., lat. 8.

LUZON, Laguna Province, Los Baños.

It may be possible that a larger series of specimens of *A. mystica* Pasc.[21] will prove the variability of the white tomentose pattern in this species and that *A. violaceicornis* is only a variety of that species; but the striking violet pruinose antennæ of *violaceicornis* was not mentioned by Pascoe of *mystica;* moreover, the white bands are otherwise placed and the spots between them are wanting. Thorax white only on anterior and posterior margins, elytra close to scutellum at base, with a narrow band in the middle and above the fourth sternite white like the apical border; legs dark reddish brown and violet pruinose; anterior tibiæ curved.

[19] Trans. Ent. Soc. London III 3 (1869) 453.
[20] Abh. u. Ber. Mus. Dresden No. 3 (1899) 6.
[21] Journ. Linn. Soc. London IV 4 (1869) 204.

Glenea caraga[22] sp. nov. Plate 2, fig. 3.

G. anticepunctata J. Thoms. affinis, ferruginea, capite vittaque mediana thoracali ochraceo-, vitta frontali maculaque postoculari nigro-, genae thoracis lateribus angulisque posticis ut scutello cretaceo-tomentosis, elytris in dimidia parte basali vix tomentosis, lineis duabus indistinctis, exteriore plus retrorsum extensa, flavo-sericeis, macula dorso-mediana, transverso-elliptica, altera rhomboidali ante-apicali cretaceo-, spatio inter eas latitudine paulo longiore ut parte apicali nigro-velutinis; corpore subter dense cretaceo-, metasterno lateribus episternisque, apice albo excepto, sternito ultimo, apice ferrugineo-penicillato, puncto subapicali, laterali, albo excepto, nigro-, metasterno medio flavido-tomentosis; pedibus testaceis.

Long. 13 mm., lat. 4.

MINDANAO, Davao Province, Davao (*7175*).

Differs from the closely allied *G. anticepunctata* J. Thoms. chiefly in the following characters: Elytra in basal half hardly tomentose, with two indistinct sericeous stripes, the outer one extending farther behind; shoulders not bordered with black; the ivory, median cross mark not an oblique stripe but an elliptic spot; the following velvety black band on each elytron hardly longer than broad; the apical ivory spot rhomboidal; underside densely white tomentose, only the sides of metasternum and in connection with it the episternum except the white apex, and the last sternite except a white spot on each side, black tomentose; legs fulvous, as in *G. anticepunctata*, but the underside of that species, in contrast to *G. caraga*, is uniformly and delicately grayish pubescent.

Glenea scalaris sp. nov. Plate 2, fig. 4.

Nigra, capite, fronte excepta, prothorace linea mediana basalique, scutello, fasciis tribus, duabus anterioribus, in elytrorum primo et secundo triente, angustis, ultima latiore, sutura usque ad fasciam tertiam et eacum conjuncta ut corpore subter, albo-tomentosis; palpis, antennis pedibusque fulvis.

Long. 13 mm., lat. 4.

LUZON, Laguna Province, Mount Maquiling (*1441*).

A dull black tomentose species with fulvous palpi, antennæ, and legs; easily recognizable by the striking pattern of white lines.

[22] *Caraga* is a name used by some of the inhabitants of Davao, Mindanao.

CURCULIONIDÆ

LEPTOPSIDINÆ

Celebia philippinica sp. nov.

Niger, subrosaceo albido-squamosa, capite, vertice albo-squamoso excepto, badio-pulverulento, prothorace linea mediana, nigra, denudata; fronte inter oculos convexa, antennis funiculi articulo secundo primo distincte, latitudine sua circiter sesqui longiore, rostro latitudine apicali paulo longiore, vitta dorsali antrorsum attenuata, apice subelevata; oculis fortiter convexis; prothorace longitudine mediana latiore, vitta mediana, denudata, ante medium elongato-impressa, squamulis minutis, breviter ovatis, transversim dispositis, utrinque vitta indeterminata denudata; scutello circulari; elytris latitudine sesqui longioribus, sat rude remoteque seriato-punctatis, spatiis convexiusculis.

Long. (rostro haud computato) 11 mm., lat. 4.3.

MINDANAO, Davao Province, Davao.

This species is of much zoögeographical interest as its genus is hitherto known only from Celebes; the species is closely related to *C. modesta* Faust,[23] from which it differs in having less prominently hemispheric eyes; a broader, glabrous dorsal stripe on rostrum, frons, and thorax; less-rounded sides of elytra; coarser and more remotely punctate striæ; and non-setaceous intervals.

PACHYRRHYNCHINÆ

Pachyrrhynchus bakeri sp. nov.

P. glorioso Faust affinis, cupreo-metallicus, capite pedibusque ignitis, fronte macula mediana, capite rostroque vitta infraorbitali, prothorace utrinque in margine antico macula, in dimidia parte basali vitta, pallide aeruginoso-squamosis; elytris subtiliter, subremote, seriato-punctatis, singulis vittis quatuor, secunda in dimidia parte basali abbreviata, maculisque punctiformibus in medio, inter vittas secundas fascia-transversa, interrupta, formantibus, lineola suturali, apicali corporeque subter, vitta inframarginali in prothorace maculaque subapicali in femoribus, pallide aeruginoso-squamosis; femoribus posticis elytrorum apicem haud superantibus.

Long. 18.5 mm., lat. 6.

LUZON, Mountain Province, Baguio (*5538*).

[23] Ann. Soc. Ent. Belg. 37 (1893) 421.

This species is so closely allied to *P. gloriosus* Faust that one may be inclined to consider it only as a variety. The different direction of the verdigris green squamose lines, the smaller and shorter thorax, and the shorter hind femora which do not extend beyond the apex of elytra, mark it as a distinct species.

Pachyrrhynchus pavonius sp. nov.

P. gemmato Waterh. subsimilis, maculis ocellatis aliter dispositis, subcupreo-purpureus, rostro vix perspicue punctato, ut capite haud squamoso-maculato; prothorace in angulis anticis macula ocellata, elytrorum simili sed minor, thoraceis marginem anteriorem tangente, altera trigonali, aurata, mediana ad basin; elytris maculis ocellatis 24, cyaneis, anulo viridi, extrorsum aurato circumcinctis, ornatis ac ut in P. immarginatus Kr. dispositis, partim inter se fere tangentibus; corpore subter haud punctato, sternito ultimo apice transverse rugoso (♂), prosterno utrinque supra coxa macula ocellata oblonga, altera, minore, laterali, utrinque in metasterno, in sternito primo secundoque et una aurata in meso-episternis; tibiis in parte apicali subflexuosis anticis margine interno granulis setuligeris circiter sex remotis.

Long. 15 mm., lat. 6.

LUZON, Nueva Vizcaya Province, Imugan.

One of the most splendid species of this genus. Elytra with twenty-four blue ocellated scale spots, surrounded like those of peacock feathers by a green and a broader golden ring and arranged as in *P. immarginatus;* thorax with three similar spots, of which the roundish spot at the front angle touches the apical margin; in the middle a single triangular and hardly ocellated basal spot.

Pachyrrhynchus psittaculus sp. nov. Plate 2, fig. 6.

P. psittacino Heller affinis, sed sat dissimilis, nigro-nitidus, elytris maculis oblongis vittisque prasino-squamosis ornatus; rostro impressione dorsali transverse elliptica, haud squamosa, prothorace utrinque margine antico, disco utrinque puncto minuto, basi punctis duabus medianis, majoribus, subter vitta supracoxali, viridi-squamosis; elytris maculis duabus suturalibus, una pone medium, altera apicali, dein vitta subsuturali in dimidia parte basali in maculis duabus oblongis dissoluta apice cum vitta marginali conjuncta seria secunda e maculis duabus formata, vitta submarginali basi apiceque abbreviata, meso-epimeris, metasterni et sterniti primi et secundi lateribus maculaque femorali, subapicali, eadem colore squamosis.

Long. 16 mm., lat. 6.

LUZON, Mount Banahao (*8399*).

Elytra with characteristic greenish scale markings as follows: Two spots on suture, one in the middle, the other on apex; a twice-interrupted subsutural stripe connected behind with a similar marginal stripe; disk with two oblong spots, one before, the other behind the middle; submarginal stripe abbreviated on base and at apex. In other respects it is very similar to *P. psittacinus*, from which it differs in having the dorsal impression on rostrum well defined, transverse oval, unscaled, and head and prothorax almost imperceptibly remotely punctate. In my single specimen of *P. psittacinus* the triangular, laterally and posteriorly shallow, dorsal impression on rostrum shows the front margin on both sides slightly emarginate and, therefore, the apical part of rostrum feebly bilobed dorsally.

Pachyrrhynchus modestior Behrens var. **transversatus** var. nov., ♀.

A specie typica differt: vittis pallide chloro-squamosis in thorace fascia antemediana, in elytris fascia submediana, ad suturam vix interrupta, conjunctis.

Long. 16 mm., lat. 7.

LUZON, Nueva Vizcaya Province, Imugan.

Like *P. inclytus* Pasc. this remarkable form, with a crossband before the middle of thorax and another very near the middle of elytra, represents only a variety, hardly a local race, of *P. modestior* Behrens. I have not seen it from any other locality than Imugan.

Pachyrrhynchus rugicollis Waterh. var. **aurinius** var. nov.

A specie typica differt: squamulis rosaceo-margaritaceis in loco malchiticis ornatus.

LUZON, Zambales Province, Iba.

As I have enumerated *P. rugicollis* Waterh. in my key of *Pachyrrhynchus* species [24] as a green-scaled, mountain species, attention may be drawn to this variety with scales of a rose pearl-shell luster.

Macrocyrtus pseudopolitus sp. nov., ♀.

Nigro-nitidissimus, M. negrito Heller subsimilis sed minor, elytris ante apicem, corpore subter macularum viridi-squamosarum rudimentis; rostro impressione sulcoque mediano dorsalibus; prothorace latitudine longiore, lateribus perpaulo rotundatis, subparallelis, vix perspicue vageque punctato; elytris

[24] Philip. Journ. Sci. § D 7 (1912) 310.

breviter ovatis, apice productis, sutura utrinque ante declivitatem subtuberculata, thorace distinctius partem subseriato-punctatis, stria extrema basi margine remota, post coxas posticas marginali ac seriato-punctata; femoribus posticis elytrorum apicem vix attingentibus.

Long. 16 mm., lat. 6.

LUZON.

Because of its glossy black dorsum this species reminds one of *Metapocyrtus politus* Heller,[25] though it is allied to *Macrocyrtus negrito* Heller [26] and perhaps in freshly preserved specimens also shows a sparse, bluish, squamigerous marbling on the elytra like that species, but differs from it by the longer, nearly parallel-sided thorax, the triangular dorsal impression of rostrum, the tubercles upon suture before the declivity in the female, and other characters.

Nothapocyrtus basifasciatus sp. nov.

N. chloromaculato Heller affinis, sed major ac angustior, nitidus, obscure rufo-castaneus, elytris fascia basali, gutta utrinque apicali, vitta postmediana marginali, ut corpore subter vitta supra coxas anticas et macula utrinque in meso- et metasterno, cobaltino-squamosis; prothorace vix perspicue punctato elytris elongato-ovatis tenuissime, in dimidia parte posteriore evanescente, duabus externis distinctius, seriato-punctatis; pedibus rufis, femoribus posticis elytrorum apice superantibus.

Long. 11 mm., lat. 4.5.

LUZON, Nueva Vizcaya Province, Imugan.

Allied to *N. chloromaculatus* Heller but slenderer; elytra elongate elliptic, in basal half with four to six rows of fine punctures, in apical half with two distinct punctate submarginal striæ, a broad crossband at base, a small marginal dot behind middle, and a round patch before apex; a stripe above anterior coxæ and sides of metasternum cobalt-blue scaled.

This and the following species are similar in general facies to *N. luzonicus* Schultze.[27] The first differs from *N. luzonicus* by the obliterated rows of punctures posteriorly, and the crossband instead of a spot of cobalt blue scales on base of elytra; *N. subpilosulus* differs in having a distinctly punctured prothorax, which shows a central furrow in the basal half and wants the scale spots on elytra mentioned by Schultze.

[25] Philip. Journ. Sci. § D 7 (1912) 349.
[26] Op. cit. 333.
[27] Philip. Journ. Sci. § D 12 (1917) 256, pl. 1, fig. 6.

Nothapocyrtus subpilosulus sp. nov.

Praecedenti, basifasciato, minor, rufo-castaneus, subtilissime parceque albido-pilosus, prothorace distincte punctato, in dimidia parte basali sulco mediano; elytris minus nitidis, maxima latitudine post medium, totis seriato-punctatis, basi apiceque, margine laterali ante et post medium macula, prothorace supra coxas vitta, metasterno utrinque, viridi-squamosis; femoribus ut elytris apice nigricantibus, posticis elytrorum apice superantibus.

Long. 9 mm., lat. 4.

LUZON, Mountain Province, Baguio.

I have only one specimen similar to a small *N. chloropunctatus* before me, from which the green scales may be somewhat worn off; but it is easily distinguished by the distinctly punctate prothorax which shows a central furrow in the basal half, the entirely and distinctly punctate-striate elytra which have their greatest breadth nearer the apex than the middle, and by each puncture bearing a fine whitish hair. The legs are similarly marked. The apices of elytra are black and singly acuminate.

Metapocyrtus pseudomandarinus sp. nov.

Niger lineis pallide chloro-squamosis M. mandarino Heller verisimiliter ornatus, antennis, clava nigricante excepta, rufescentibus, rostro latitudine longiore, fortiter punctato, fronte inter oculos oblonga, viridi-squamosa, utrinque carinula supraorbitale determinata; prothorace orbiculari, rude rubruguloso-punctato, linea laterali viridiscenti squamosa, cum anteromarginali conjuncta; elytra breviter ovatis, sat rude irregulariterque, partim subseriato-punctatis, margine basali lateralique viridescenti-squamosis, ad basin et in apice in spatio secundo conducta vitta marginali cum opposita fascia, medio-transversa, conjuncta, hac in disco ramum postrorsum emittente.

Long. 8 mm., lat. 3 ad 3.5.

LUZON, Nueva Vizcaya Province, Imugan (*8396*).

Resembling *M. mandarinus* Heller; a black species with similar pale green, sometimes with somewhat golden scaled stripes and a small transverse band in the middle of elytra; frons oblong between eyes, bounded on each side by a supraorbital carinula; thorax globose and coarsely punctate, with a central furrow; elytra coarsely and irregularly punctate, the second longitudinal green stripe, in the posterior half of elytra, situated at the middle of elytra, whereas in *M. mandarinus* it is nearer the external border.

Metapocyrtus proteus sp. nov., ♂, ♀.

Aterrimus, prothorace ad angulos plagis (aut annulis), elytris plagis (aut annulis) 22 lineolaque marginali, postmediana, viridi-, viridi-aurato-, aut coerulescenti-squamosis, ornatis; rostro latitudine paulo longiore, crebre punctato, dorso impressione longitudinali, fronte ante macula squamosa, sulco mediano distincto; prothorace subtransverso, globoso, nitido, perremote subtiliterque punctato, sulco mediano basi abbreviato, macula, in angulis anterioribus minore, plerumque subtransversa, posteriore, majore, oblonga; elytris disperse punctatis maculorum seriebus transversis quatuor, basali utrinque maculis tres, harum mediana minore ac posteriore, mediana quatuor atque lineola posteriore anteapicali tres, apicali una; corpore subter nigro, nitido, prosterno supra coxas macula, (aut annulo) oblongis, metasterno lateribus maculaque subapicali in femoribus viridi- aut cœruleo-squamosis, his in mare distincte in femina vix elytrorum apice superantibus.

Long. 9 ad 10.5 mm., lat. 4.3 ad 5.5.

LUZON, Nueva Vizcaya Province, Imugan (*8408*, *8401*).

M. proteus var. *annuliger* repraesentant specimina annulis, in loco plagis, ornata (*8409*, *8411*).

A very variable and interesting species which shows how the strange annular scale markings, found also in other genera, for example, in *Alcides semperi*, *Pachyrrhynchus argus*, and *Pseudapocyrtus schadenbergi*, may arise from originally spotted markings by the continual rubbing off of the central part; there are two apparently very different forms: one ornamented with four scale patches on the thorax and twenty-four on the elytra, the other with as many rings of greenish or bluish scales, arranged on the elytra in four cross rows, a basal one with three, the middle ring of which is situated more caudad, the median four externally oblique, the anteapical with three, the apical with two ring markings on each side, but not distinguished from each other by any plastic character. The latter consists in both of rather strong, dense punctures upon rostrum, equally fine and remote on the globular, medially furrowed thorax, and a more distinct, partly striate punctation on the elytra. The hind femora of the female hardly, of the male distinctly, extend beyond the apex of the elytra. One female specimen is abnormal, showing only five funicular joints instead of seven on the right side. This results from the union of the second, third, and fourth joints.

Metapocyrtus pseudoelegans sp. nov., ♂.

Aterrimus, fronte, prothorace margine antico, in parte mediana et utrinque vitta, laterali, elytris maculis similiter ut in M. eleganti Waterh. dispositis, margine laterali haud, argenteo-viridi-squamosis; rostro latitudine distincte longiore, sat fortiter denseque punctato, basi haud transverso-tumido, dorso sulco mediano manifesto, utrinque carinula antrorsum divergente; fronte oblonga, medio sulcata, utrinque carinula supraorbitali determinata; prothorace globoso, latitudine distincte longiore, sat remote ac distincte punctato; elytris oblongo-ellipticis, subseriato-punctatis, utrinque basi et ante medium maculis duabus rotundatis, post medium tribus, ad apicem una, corpore subter prosterno margine antico vittaque supra-coxali, metasterno, ut sternito primo, lateribus, femoribus posticis (in mare elytris superantibus) dorso perparce, argenteo-viridi-squamosos; tibiis utrinque minute remoteque granulosis ac parce fusco-pilosis.

Long. 8 mm., lat. 3.

LUZON, Nueva Vizcaya Province, Imugan.

Resembling *M. elegans* Waterh., but slenderer, and differing from it by the longer and stronger rostrum, not transversely swollen at base; the oblong, slightly concave front; the non-granulate but distinctly punctate, oblong globular thorax, the sublateral greenish lateral stripe of which extends from base to beyond middle; and the much finer, hardly seriate-punctate and less convex elytra, the lateral margin of which is unscaled except for the oblong greenish spot, forming the extremity of the third transverse row.

Metapocyrtus rufotibialis sp. nov.

Fuscescenti-niger, maculis lineolisque chloro-squamosis ornatus, antennarum scapo, femoribus basi tibiisque totis, rufis, rostro elytrorumque apice, sed praesertim corpore subter pedibusque, parce albociliatis, rostro latitudine longiore, dense ruguloso-punctato, fronte oblonga, subconcava, squamosa, sulco mediano usque in vertice continuato; prothorace latitudine distincte longiore, lateribus in duabus trientibus basalibus fere parallelis, perremote punctato, dorso in dimidia parte coriario, ante nitido, hic sulco mediano distincto, vitta sublaterali, interrupta, chloro-squamosa; elytris oblongo-ellipticis apice attenuato-productis, seriebus quatuor longitudinalibus maculis, oblongis, chloro-squamosis ornatis, prima, subsuturali macula oblonga basali, altera antemediana lineolaque in triente posteriore, seria secunda (in spatii quarti loco) maculis tribus, in basi, in primo et secundo quarto longitudinis, tertia, laterali, duabus, deorsum solum anteriore visibile, quarta, marginali, lineola, subbasali, altera, longiore, post medium.

Long. 9 mm., lat. 3.5.

LUZON, Mountain Province, Baguio.

Blackish brown; femora red in basal half, tibiæ entirely so; elytra with four longitudinal rows of greenish scale spots, the subsutural row consisting of two oblong dots and, in the posterior part, of a stripe, the second of three, the fourth and marginal row of two, more or less oblong dots. A peculiarity of this species is that the rostrum, the apex of elytra, the underside of body, and the legs are covered with fine and sparse whitish hairs, and that the prothorax is finely coriaceous in the basal half and shining smooth and furrowed in the middle of its anterior part.

RHYNCHITINÆ

Deporaus nigrifrons sp. nov., ♂.

A. (Deporaus) marginato Faust[28] valde affinis, sed capite longiore, fronte, nigra, prothoraceque margine antico nigro, exceptis, rufescenti-fulvus; rostro, antennis, meso- et metasterno, pedibus, femoribus basi fulva excepta, elytris, singulis plaga, oblonga, in dimidia parte basali excepta, ut pygidio, nigris, his praesertim in dimidia parte apicali griseo-pubescentibus.

Long. 5 mm., lat. 2.

LUZON, Laguna Province, Los Baños.

Very similar to *Deporaus marginatus* Faust from Calcutta, but distinguished by the different coloration, the longer head, the stronger antennæ, and the much more finely punctured rows on elytra. Rostrum of male somewhat obtuse-angularly bent downward, above insertion of antennæ with a slight indication of a divided dorsal nodosity; third joint of funicle rather longer than fourth, sixth and seventh equal, gradually passing over into the club; thorax subconical, somewhat more densely punctured than in *D. marginatus;* elytra nearly twice as long as broad, finely punctate-striate, the diameter of punctures much less than the breadth of intervals; underside finely, meta-episterna more densely, yellowish white pubescent; first tarsal joint as long as the two following together.

[28] Ann. Mus. Genova 34 (1894) 168.

Deporaus galerucoides sp. nov., ♂.

Niger, capite, antennis, prothorace, elytris, sutura nigra margineque laterali exceptis, pedibusque fulvis; rostro leviusculo, in parte basali utrinque seria una punctorum, fronte distincte punctata, capite ad oculos longitudine latiore; prothorace transverso, maxima latitudine in medio, lateribus aequaliter rotundatis, sat crebre punctato, sulco mediano tenui; scutello quadrato, nigro, punctato; elytris sat tenuiter seriato- (vix striato-) punctatis, punctis retrorsum decrescentibus; pygidio apice utrinque subrufomaculato.

Long. 7 mm., lat. 2.2.

LUZON, Isabela Province, San Luis (*C. R. Jones*), Bureau of Science accession No. 15484.

Mesosternum, metasternum, and abdomen black; head, thorax, and legs reddish yellow; elytra, except blackish lateral margin and suture, straw yellow; grizzly pubescent throughout; rostrum distinctly seriate-punctate on each side of base only; antennæ yellow, third joint of funicle as long as the two preceding together, the penultimate shorter than the last; head nearly twice as long as broad at the eyes; prothorax a little broader than long (27 : 25), with a fine median furrow, coarsely and closely punctured; scutellum quadrate, punctate, and black; elytra finely seriate-punctate, the punctures at base and toward apex obsolete, fifth stria impressed at base; pygidium shining, distinctly punctured only at base, in the apical half with an oblong reddish marginal spot; meta-episterna along upper margin with a series of coarse punctures.

Deporaus galerucoides var. **uniformis** var. nov.

Differt a specie typica, abdomine ferrugineo, elytris unicoloribus testaceis (Bureau of Science accession No. 14788).

Several specimens, coming from the same locality as the typical species, differ by a rust-brown abdomen and unicolored testaceous elytra, and these represent the variety *uniformis*.

Deporaus nigricornis sp. nov.

Testaceus, flavo-pubescens, antennis nigris, tibiis tarsisque infuscatis; rostro prothorace aequilongo, dorso in dimidia parte basali seriebus duabus punctatis, antrorsum paulo divergentibus, capite latitudine (ad oculos) longitudine fere aequali; antennis nigris, ante rostri medium insertis; prothorace crebre subruguloso-punctato, latitudine perpaulo longiore; scutello subrectangulari-rotundato transverso; elytris seriato-punctatis, interstitiis vix punctatis; corpore subter subtilissime punctato.

Long. 4.5 mm., lat. 1.8.

LUZON, Laguna Province, Mount Maquiling.

Pale brownish yellow, pubescent, antennæ black, tibiæ and tarsi infuscate; rostrum as long as head, in the basal half with two series of punctures which are convergent in front; antennæ inserted before the middle of rostrum, not quite twice as long as rostrum, third joint longer than second and fourth, eighth shortest, club as long as the basal five joints together, its apical joint a little longer than its first joint; head as long as broad at base, frons finely punctate; prothorax as long as broad, narrower at front margin than at base, rather densely punctate, with a fine middle line; scutellum somewhat transversely rectangular; elytra seriate-punctate, intervals hardly perceptibly punctate; first joint of posterior tarsi as long as the two following together, second triangular in outline, a little longer than broad (7 : 6); propygidium indistinct and remotely transverse-granulate.

Deporaus exophthalmus sp. nov.

D. nigricorni, praecedenti, affinis sed major, colore plus saturate testacea, capite prothoraceque subferrugineis, antennis nigris, tibiis tarsisque haud infuscatis; capite ad oculos longitudine plus sesqui latiore, fronte sat fortiter punctato; prothorace crebre ruguloso-punctato, carinulis duabus baseo-marginalibus, linea mediana, impressa, tenuissima; scutello subtrapezoidali, transverso, margine apicali sinuato; elytris sat crebre fortiterque subruguloso-punctatis; pedibus concoloribus, tarsis posticis articulo primo duobus sequentibus unitis distincte longiore.

Long. 5.5 ad 6 mm., lat. 2.3 ad 2.5.

LUZON, Laguna Province, Los Baños, Mount Maquiling, and Mount Banahao (*4424*, *1382*).

Like the preceding unicolorous testaceous, only the antennæ black, head and prothorax of a more ferruginous tone; head broader, one and one-half times as broad at eyes as the distance between basal constriction and front edge of eyes; prothorax strongly rugulose-punctate, with two marginal carinulæ at base and a very finely impressed median line; intervals of the seriate-punctate elytra finely but distinctly rugulose-punctate; hind tibiæ slightly curved, the intermediate more so, first joint of posterior tarsi distinctly longer than the two following together.

The four preceding species of *Deporaus* are closely related to *D. marginellus* Faust., formerly placed by me under the subgeneric name *Arodepus* Heller in litt.

Deporaus dimidiatus sp. nov.

Ferrugineus, fulvo-, aut praecipue abdomine, griseo-pubescens, antennis, rostro, tibiis elytrorum femorumque praesertim posticorum dimidia parte apicali, nigris, pygidio, propygidio, abdomineque plus minusve nigricantibus, partim obscure sanguineis; capite inter stricturam basalem et marginem anteriorem ocularem longitudine paulo latiore; prothorace sat dense minuteque punctato, linea mediana impressa, tenuissima; scutello rotundato-transverso; elytris latitudine plus sesqui longioribus (1 : 1.6), punctato-substriatis, punctis sat manifestis, in dimidia parte apicali minoribus, spatiis subtiliter punctatis, extrinsecus subcostulato-declivibus, carinula suturali tenui, pone scutellum opposita confluenti; tarsorum posticorum articulo primo duobus sequentibus unitis longiore.

Long. 4, mm., lat. 1.5.

LUZON, Laguna Province, Mount Maquiling.

Similar to *D. nigrifrons*, but smaller and narrower; elytra proportionately longer in basal half, entirely ferruginous; rostrum, tibiæ, and apex of femora, especially the posterior, blackish; antennæ and apical half of elytra black, the latter strongly substriate in basal half, gradually more finely punctate in apical half, the intervals distinctly punctate, chiefly on outer edge subcarinate, sloping, the suture with a fine carinula which is confluent behind scutellum; propygidium rather densely punctate, pygidium more remotely so; underside ferruginous, abdomen blackish, sides of first and penultimate sternites (the last nearly entirely), propygidium, and pygidium dark reddish brown; first joint of posterior tarsi longer than the two following together.

HYLOBIINÆ

Scaphostethus cylindricollis sp. nov. Plate 2, fig. 7.

Scaphostethus tuberculicolli Faust [29] similis, badio tomentosus, tuberculis concolore setosis; prothorace lateribus perfecte cylindricis, ante apicem subconstrictis, disco ante medium utrinque tuberculo rotundato majore; scutello oblongo, postrorsum dilatato, albido setoso-squamoso; elytris prothorace fere duplo latioribus, latitudine sesqui longioribus, remote seriato-punctatis (solum ad locos denudatos observandum), spatio secundo tuberculis quinque majoribus, duobus approximatis, subbasalibus, uno

[29] Hor. Soc. Ent. Ross, 24 (1890) 469. The species is described as a *Niphades*, but belongs to *Scaphostethus* Roel.

mediano, alteris duobus postmedianis spatio quarto tuberculis 5-6 minoribus inter se sat aequaliter distantibus, tuberculis ad declivitatem partim albido setosis; corpore subter vix, metasterno lateribus punctis paucis rudis; tibiis anticis in dimidia parte apicali subdilatatis.

Long. 10 mm., lat. 4.8.

LUZON, Bataan Province, Mount Limay: Tayabas Province, Malinao.

The Chinese species *Scaphostethus tuberculicollis* Faust, from Kau-en, is so similar to this new species that it may be confounded with it, but the elytra of the latter are shorter and broader and the sides of thorax are nearly straight and parallel. Antennæ dark red, second joint of funicle longer than the thickened first, the four apical ones thicker than long, the seventh joined with the subcylindric club; femora and tibiæ hardly (in *tuberculicollis* very coarsely) punctured, the first whitish setaceous, the last slightly dilated toward apex.

ALCIDINÆ

Alcides (Metallalcides) chalcomorphus sp. nov., ♀.

Viridi-metallicus, antennis tarsisque nigris; prothorace pedibusque subaenescenti-micantibus, illo in angulis quatuor et in angulo scutellari, ut elytris singulis ad basin, macula, illis praeterea fascia mediana, lata, ad suturam subproducta lunulaque subapicali subtiliter griseo-piloso-tomentosis.

Long. 11 mm., lat. 4.5.

MINDANAO, Surigao Province, Surigao.

This species belongs to the metallic, shining forms for which I have proposed, for practical reasons, the subgeneric name *Metallalcides*.[30] It shows a bright metallic green color, somewhat coppery on thorax and legs. Antennæ and tarsi black; prothorax with rather scattered, finer punctures, on each side, near the anterior and on the posterior angles, there (only partly visible from above) with a grayish tomentose spot, a fifth smaller one on the scutellar lobe; elytra hardly twice as long as broad (1 : 0.6), with a subtransverse, roundish, slightly impressed spot near base, extending from the middle of second interval as far as fifth stria, a broad median band the front border of which is sinuate on each elytron and coincides externally with the middle of meta-episterna; a subapical bond, in front concave

[30] Stettin. Ent. Zeit. (1917) 215.

lunulate, tomentose like the thoracic spots; hind border of the grayish crossband concave, beginning externally above posterior edge of second sternite; punctures of punctate series remote, much serried on the tomentose parts of elytra; second and ninth series extending nearly to apical margin, approaching each other on apical part, third and eighth series confluent at apex; venter shining, scarcely punctate, middle of first sternite more distinctly and remotely punctate, middle of prosternum, entire mesosternum, medially swollen metasternum, and first, third, fourth, and fifth sternites grayish pubescent on the sides; tooth of intermediate and posterior femora on its distal edge minutely bi- or tridenticulate; anterior tibia with a strong tooth behind the middle of its inner edge.

Alcides aeratus sp. nov., ♂.

Nitido-aeneus, prothorace, similiter ut in praecedenti, maculis punctiformibus, sed densius ac albidotomentosis, elytris 15 similibus atque duabus minimis apicalibus, ornatis, una suturali in primo triente, utrinque duabus subsuturalibus ad declivitatem, una basali, inter striam tertiam et sextam, altera, subtransversa, spatium 3 ad 6 occupante, et tribus marginalibus, in primo, secundo et tertio triente; striis omnino punctis aequaliter dense seriatis; corpore subter ut in chalcomorpho, sed densius ac albido-tomentoso.

Long. 9.5 mm., lat. 4.5.

MINDANAO, Surigao Province, Surigao.

Shining bronze-colored; antennæ and tarsi black; prothorax similar to *Alcides chalcomorphus*, but five tomentose spots white and a little more strongly punctate; elytra with fifteen similar spots and two very minute apical spots, a large one on each side at base between third and sixth striæ, three smaller submarginal spots in the first, second, and third intervals, two subsutural ones on the declivity, one in the disk on third, fourth, and fifth intervals, and a common, somewhat larger one in the first third of suture; punctures of elytral series equidistantly approximate on the tomentose parts only, the same as in *Alcides chalcomorphus*, ninth and tenth stripes much more impressed at base than in this species; on the underside those parts are white tomentose, but the metasternum has a white lateral spot in the posterior half only; femora dentate as in *A. chalcomorphus*, the inner edge of intermediate tibiæ slightly enlarged in the first third.

Megarhinus[31] **validirostris** sp. nov.

Niger, nitidus, oculis planiusculis, rostro sat curvato, latitudine apicali vix duplo longiore, creberrime, basin versus paulo remotius punctato, antennis funiculi articulo secundo crassitudine distincte longiore; prothorace crebre granuloso, in dimidia parte basali carinula mediana, post attenuata; scutello subquadrato-rotundato, margine basali concavo; elytris spatiis subgranulosis, parce subtilissimeque fulvo-pilosis; tibiis anticis in dimidia parte apicali abrupte dilatatis.

Long. 3 mm., lat. 2.

MINDANAO, Agusan Province, Butuan.

The short and thick rostrum, which is more than usually curved and twice as long as broad at apex, and the anterior tibiæ, which are dilated in the apical half, distinguish this black species from the others. Second joint of funicle longer than thick; thorax finely rugose-granulose, one-half broader than long, in the basal half with a median carinula obsolete toward base; pygidium coarsely and densely punctate; venter plumose-squamose; tibiæ with strikingly coarse and dense punctures.

Megarhinus curvipes sp. nov.

M. carinicolli Heller affinis, sed major, oculis minus convexis, rostro longiore, nitido, minus dense punctato; antennis funiculi articulo secundo conico, crassitudine distincte longiore; prothorace carina mediana in dimidia parte basali distincta, granulis, partim transverse confluentibus obsitis, apicem versus evanescentibus; elytris subrufescentibus, spatiis extrinsecus carinato-declivibus, subtilissime granulatis; tibiis anticis intermediisque curvatis, illis in triente basali intus dentatis; corpore subter parce stramineo-plumoso-squamoso.

Long. 5.5 mm., lat. 3.

MINDANAO, Zamboanga Province, Dapitan (*4513*).

Allied to *M. carinicollis* Heller[32] except that the rostrum is less densely punctate, not rugose-punctate, and as long as thorax, and the eyes are flatter. Second joint of antennæ distinctly longer than thick; thorax finely, partially confluently granulated, anterior margin nearly smooth; anterior and intermediate tibiæ curved, the first dentate in the basal third.

[31] Lacordaire remarks that this name, being preoccupied, is unavailable in modern usage since Saint-Fargeau had established, in 1825, a genus of Diptera *Megarhina* which, however, is synonymous with *Rhamphidia*.

[32] Philip. Journ. Sci. § D 10 (1915) 227.

Menechirus[33] **fuscodorsalis** sp. nov.

M. oculato Hartm. paulo major ac convexior, avellano, elytris plaga communi dorsali prothoraceque lateribus brunneo-squamosis; rostro prothorace paulo, latitudine dorsali triplo longiore, dense squamoso, dorso deplanato; antennis funiculo sat crasso brevique funiculi articulo secundo primo breviore, quinque sequentibus distincte transversis; prothorace transverso-subconico, margine antico in medio tuberculis duabus minutis, disco, ante medium, duabus majoribus nigro-velutinis; scutello subelongato-rotundato, ut elytrorum margine basali, inter striam tertiam, pallide ferrugineo-squamoso, elytris latitudine longitudine aequali, spatiis alternatis subconvexioribus, plaga dorsali, acuminato-ovata, inter striam secundam et quartam, ramo, quadrato, basin attingente; corpore subter stramineo-squamoso; femoribus, praesertim anticis fortiter incrassatis.

Long. 7.3 mm., lat. 5.

LUZON, in seeds of *Eugenia suborbicularis* imported from Port Darwin, Australia, Bureau of Science accession No. 2121 (*A. G. Bellis*).

A hazel-colored species with a brown, common, dorsal patch upon the elytra which extends between the second and fourth striæ to the base; sides of the nearly conical thorax brown; alternate intervals of elytra slightly more convex; anterior femora strongly incrassate.

COLOBODES, DERETIOSUS, AND APRIES

Pascoe[34] has given a key of the genera allied to *Chaetotectorus* to which he added later[35] the genus *Apries* Pasc. He thus confused at once Lacordaire's definition of "Cryptorhynchides vrais"[36] which were differentiated from the three other "Sous-Tribus" by the rostral canal being delimited behind by the mesosternum, because in *Apries* it is delimited by the metasternum, which is moreover produced between the coxæ into a nodose process. A. M. Lea also neglects Lacordaire's definition to the extent of arranging *Deretiosus*, which is without a mesosternal

[33] This genus was established by Hartmann on a Papuan species. The new species imported into the Philippine Islands from Australia agrees with it, except in the formation of the antennæ, and therefore the characters of the genus must be extended; moreover the anterior coxæ are remote in both species and so it seems better to place it in the Haplonicidæ. *Menechirus* represents a *Haplonyx* with two unguiculi.

[34] Trans. Ent. Soc. London (1870) 478.

[35] Journ. Linn. Soc. 11 (1871) 196.

[36] Genera Coléop. 7 (1866) 50.

receptacle, among the "Cryptorhynchides vrais." [37] Pascoe [38] himself placed this genus at first in the Ithyporides, later [39] in the "Genera incertae sedis." Finally, J. Faust [40] has described a new species of *Apries, histrio*, from Burma, but without mentioning the aberrant formation of its rostral canal, limited behind (similar to *Mecistocerus*) by the metasternum which forms a sinuate edge between the intermediate coxæ and, therefore, this species could be classified by others with more right as of the Sophrorhinides; but in the latter tribe the rostral canal is limited laterally by two lamellæ on each side, one on the prosternum behind the coxæ, and the other on the mesosternum.

All these facts, and a series of Philippine genera, partly related to *Deretiosus* and partly to *Colobodes* and *Apries*, have brought me to the opinion that departure from Lacordaire's arrangement, without resynopsizing the genera, is not to be recommended, as it would only augment the confusion in this difficult chapter of taxonomy; it is impossible to treat the genera mentioned without considering their relation to others. Therefore, I give here a preliminary key of the genera which belong partly to the Ithyporides and partly to the Sophrorhinides, Lacordaire's two "Sous tribus," which are hardly to be separated even in the sense in which that meritorious author separates them.

Key of genera allied to Colobodes, Deretiosus, and Apries.

Neither the postcoxal part of prosternum nor the sides of metasternum with a lamella limiting the rostral canal laterally as is the case in *Mecistocerus*.

a^1. Ocular lobes distinct (indistinct only in *Thisus* Pascoe).
- b^1. Anterior coxæ remote.
  - c^1. Intercoxal process of metasternum between the intermediate coxæ slightly declivous, passing off into a plane with the mesosternum. Funicle of antennæ 7-jointed.
    - d^1. Intercoxal process of mesosternum narrower than the diameter of intermediate coxæ.
      - e^1. Femora strongly clavate and dentate, almost extending beyond the fourth sternite.
        - f^1. Scutellum bare.
          - g^1. Rostrum more than four times longer than thick, apex of scrobes not visible from above and nearer to the middle than to the apex .... Colobodes Boh.
          - g^2. Rostrum shorter, apex of scrobes visible from above. Eucolobodes g. nov.
        - f^2. Scutellum tomentose .... Deretiosomimus g. nov.

[37] Journ. Linn. Soc. New South Wales 34 (1909) 593.
[38] Journ. Linn. Soc. 11 (1871) 184.
[39] Journ. Linn. Soc. 12 (1873) 192.
[40] Ann. Mus. Geneva 34 (1894) 286.

e^2. Femora linear or hardly clavate, minutely dentate.
h^1. Tibiæ not dilated toward apex .... Solobrachius Desbr.
h^2. Tibiæ dilated toward apex, outer margin angulate near base. Perrhaebius Pasc.
d^2. Intercoxal process of mesosternum at least as broad as the diameter of coxæ.
i^1. Exterior angle of posterior coxæ distant from lateral margin of elytra.
j^1. Scutellum bare, tarsi slender .... Brachycolobodes g. nov.
j^2. Scutellum tomentose; second and third joint of tarsi trapezoidal, transverse .... Colobodellus g. nov.
i^2. Exterior angle of posterior coxæ touching the lateral margin of elytra; scutellum very minute .... Systaltopezus Faust.
c^2. Intercoxal process of metasternum steeply declivous between the intermediate coxæ, but neither forming a sharp transverse margin nor a nodose process between the intermediate coxæ; scutellum always tomentose.
k^1. Funicle 7-jointed.
l^1. Thorax more or less conical, broadest at base, lateral margin not edged.
m^1. Posterior femora not extending beyond second sternite; tibiæ compressed and slightly enlarged toward apex. Lobocodes g. nov.
m^2. Posterior femora extending beyond second sternite; tibiæ not distinctly compressed, mostly attenuate toward apex. Ocoblodes g. nov.
l^2. Thorax not conical, sides rounded or more or less parallel in basal half, contracted anteriorly.
l^3. Lateral margin of thorax edged, thorax and elytra strongly nodose or cristate .... Deretiosus Pasc.
l^4. Lateral margin of thorax not edged.
k^2. Funicle 6-jointed .... Eprias subg. nov.
c^3. Intercoxal process of metasternum forming an acute transverse, slightly sinuate edge between the intermediate coxæ.
k^3. Funicle 6-jointed .... Micrapries g. nov.
k^4. Funicle 7-jointed .... Parapries g. nov.
b^2. Anterior coxæ closely approximate or contiguous.
n^1. Antennæ inserted nearly at apex of rostrum; posterior femora clavate, extending beyond apex of elytra; scutellum very minute, transverse .... Amphialus Pasc.
n^2. Antennæ inserted nearly at middle of rostrum.
o^1. Femora dentate, ocular lobes indistinct but ciliate .... Thisus Pasc.
o^2. Femora not dentate .... Byrsia Pasc.
a^2. Ocular lobes absent.
p^1. Anterior coxæ distant; metasternum vertically declivous; rostrum robust, slightly curved, cylindrical .... Dinapries g. nov.
p^2. Anterior coxæ approximate; antennæ inserted near apex of rostrum, the latter squamose to apex .... Nannocolobodes g. nov.
(Here belong also the genera *Lybaeba* and *Emide* Pasc.)
c^4. Intercoxal process of metasternum forming an anteriorly produced nodose process between the intermediate coxæ .... Apries Pasc.

TYPICAL SPECIES OF THE PRECEDING GENERA

Colobodes billbergi Boh. Schh. Gen. Curc. 4 (1837) 466; described from Java, occurring also in Cambodia, Borneo (Sarawak), and Mindanao, there collected by W. Micholitz at Davao (Dresden Museum).
Eucolobodes horribilis sp. nov.; Borneo.
Deretiosomimus angulicollis sp. nov.
Solobrachius acalloides Desbr., Compt. Rend. Soc. Ent. Belg. **35** (1891) ccclx; Benguet, Luzon.
Perrhaebius ephippiger Pasc., Journ. Linn. Soc. **12** (1873) 34; New Guinea (Dorcy) Aru, Macassar, and Morotai.
Brachycolobodes undulatus sp. nov.; Sumatra.
Colobodellus alboscutellatus sp. nov.; Mindanao.
Systaltopezus nodosus Faust, Deutsche ent. Zeit. **31** (1887) 174; Amur.
Lobocodes turbatus Faust, Ent. Zeit. Stettin **53** (1892) 210; New Guinea (described as a *Colobodes*).
Ocoblodes lineola sp. nov.; Luzon and Mindanao.
Deretiosus aridus Pasc., Journ. Linn. Soc. **11** (1871) 185; New Guinea and Ceram.
Eprias vana sp. nov.; Mindanao.
Micrapries nanna sp. nov.; Luzon.
Parapries histrio Faust, Ann. Mus. Genova **34** (1894) 286; Burma (described under *Apries*).
Amphialus turgidus Pasc., Ann. & Mag. Nat. Hist. V **11** (1883) 127; Ceylon.
Thisus biguttatus Pasc., Ann. Mus. Genova II **11** (1885) 250; Sumatra.
Byrsia cerata Pasc., Ann. & Mag. Nat. Hist. V **12** (1883) 96; Queensland.
Dinapries salebrosa sp. nov.; Sumatra.
Nannocolobodes mus sp. nov.; Basilan and New Guinea.
Apries eremita Pasc., Journ. Linn. Soc. **11** (1871) 196; Batjan.

CRYPTORHYNCHINÆ

Genus **EUCOLOBODES** novum

Corpus latiusculum tomentosum. Rostrum validum, prothorace brevius, cylindricum, apicem versus subincrassatum, scrobibus apice deorsum visibilibus, basi ad oculum sulco glabro separatum. Antennae apicales, funiculo 7-articulato. Prothorax latitudine longior, lateribus in fronte subrotundato-convergentibus, lobis ocularibus obsoletis. Mesosternum processu intercoxali declivi metasternali aequo. Scutellum distinctum, glabrum. Elytra prothorace multo latiora, basi utrinque subproducta, angulis humeralibus rectangulariter rotundatis. Femora subclavata dentata. Tibiae subcompressae, basi flexuosae. Sternitum secundum duobus sequentibus (in linea mediana) aequilongum.

Typus, Eucolobodes horribilis sp. nov.

Eucolobodes horribilis sp. nov.

Robustus, niger, antennis sanguineis, corpore supra lurido-, elytris in dimidia parte apicali isabellina-, vertice linea mediana pallida excepta prothorace apice, bi-penicillato, fasciculis duabus discalibus, elytris fascia submediana, intra striam secundam usque ad basin producta, margine postico concavo; anguste velutino ut femoribus in parte mediano tibiisque in parte basali plus minusve nigricante-tomentosis; spatio secundo in quinta parte basali elevato ac pallidiore, intra linea nigro-velutina determinata, areum baseo-suturalem, subrotundatam circumcingente, linea altera nigro-velutina, transversa, plus minusve interrupta, fere suturae medio incipiente et meta-epimera versus currente; scutello obscure sanguineo, subbituberculoso, nitido-glabro; abdomine ochraceo-tomentoso, squamulis separatis transverse remote seriatis, majoribus..

Long. 8.5 mm., lat. 4.5.

BORNEO SEPTENTRIONALIS, C. Wahnes leg. ex coll. W. Müller; Kinabalu, altitudine 1,500 meter (H. Rolle, Berlin vend.) in Mus. Dresden (olim borneonensis Heller in litt.).

A robust, dorsally isabelline, tomentose species of very distinctive appearance, with a broad, blackish crossband near the middle of elytra, which is bordered on its posterior margin by a fine, velvet black line and produced in front to the scutellum, where it is enlarged to a roundish area, encircled by a velvet black line which is limited on each side by the elevated and pale tomentose base of the second interval. Rostrum stout, densely and finely punctured; prothorax a little longer than broad, sides in the basal half nearly parallel, the apex blackish and like the disk bearing two black tufts; elytra much broader than prothorax, its base truncate, slighty produced inward, one and one-third times longer than broad, hardly perceptibly striate on the anterior part, and at the sides more distinctly so, the black crossband large, its posterior margin concave, velvet black bordered and crossing the middle of the suture, a similar black, but often interrupted, velvet line before the anterior margin of crossband, this line diverging to posterior margin of the latter, which is concave behind; femora more or less nebulous black on the middle part, but the tooth always pale tomentose; tibiæ on the basal half blackish and there subsinuate on inner edge.

In consequence of the velvet black lines, of which those on the base of elytra encircle a roundish sutural area, *E. horribilis* recalls *Colobodes ornatus* Roelofs [41] from Japan, but in the latter species the antennal furrow is not visible from above and the antennæ are inserted nearer to the middle than to the apex of rostrum.

[41] Ann Soc. Ent. Belg. 18 (1875) 155.

Genus DERETIOSOMIMUS novum

Corpus squamosum supra tuberculosum. Rostrum thorace fere aequilongum, apice glabro, subdepressiusculo, basi utrinque ad oculum foveola glabra transversa. Antennae funiculo 7-articulato. Prothorax transversus, abrupte constricto, penicillato-tuberculato, lobis ocularibus explicatis. Coxae anticae remotae. Mesosternum processu intercoxali parum declivi, processu metasternali aequo ac coxarum diametro angustiore. Scutellum tomentosum. Elytra basi truncata, prothorace latiora, penicillato-tuberculata. Femora clavata. Sternitum secundum duobus sequentibus unitis longius.

Typus, Deretiosomimus angulicollis sp. nov.

Deretiosomimus angulicollis sp. nov.

D. arido Pasc.[42] multo minor ac plus elongato, fusco-variegatim lurido-squamosus, elytris tuberculis lutescenti-penicillatis obsitis, ante declivitatem linea transversa albo-squamosa litera M-simili; antennis ferrugineis, funiculi articulo primo incrassato, secundo, tenuiore, aequilongo, tertio quarto haud longiore, crassitudine fere aequilongo; prothorace transverso (5 : 7) crebre punctato, lateribus in duabus trientibus basalibus rectis, parallelis, in fronte fere rectangulariter abrupte constrictis, angulis submedianis ut disco utrinque penicillatis; scutello convexo, suborbiculari, fusco-tomentoso; elytris tenuiter sed distincte punctato-striatis, spatio secundo ante medium et in medio, spatio quarto in prima secunda, tertia et quarta parte, sed hic minus, penicillato-tuberculatis, femoribus gracilioribus ac plus clavatis quam in arido, ut tibiis in medio infuscatis.

Long. 5 mm., lat. 2.8.

LUZON, Laguna Province, Los Baños.

Easily distinguishable from *D. aridus* Pasc.[43] by the angulate sides of the densely punctate prothorax, which are straight and parallel in the basal half, and abruptly constricted in front. Color of scaling luteous, blackish variegate, lateral margin at the base, the penultimate interval in the middle with a single black dot, the seventh in the apical half with a row of blackish dots, before the declivity with an M-shaped white scale line, similar to *aridus;* prothorax on the disk and on the front margin with two tufts of erect brownish scale bristles, on the lateral angles with a less developed one; elytra finely but distinctly

[42] Journ. Linn. Soc. 11 (1871) 185.
[43] Loc. cit.

punctate-striate, intervals as in *aridus*, penicillate-tuberculate, the femora slender and more clavate and, like the tibiæ, infuscate in the middle.

Deretiosomimus angulicollis subsp. **lactifrons** subsp. nov.

Praecedenti habitu simillimo, sed fronte eburneo-, elytris vix nigricante-variegatis, unicoloribus, luteo-squamosis, spatiis lateralibus totis, sutura spatiisque dorsalibus praecipue in parte apicali squamulis setiformibus erectis sat dense seriatis.

Long. 5.2 mm., lat. 2.5.

LUZON, Nueva Vizcaya Province, Imugan.

Nearly identical in size, general facies, and color with *D. angulicollis*, but the front strikingly milk-white squamose; elytra proportionately narrower, not quite parallel-sided, but slightly enlarged in the second third; suture and lateral intervals along the whole length, the dorsal intervals, especially in the apical third, set with erect, strong scale bristles which are only a little shorter than on the callosities.

Further material may perhaps prove that this form merits the status of a distinct species, since the single specimen before me is dirty, and not nearly so well preserved as the fine specimen of *D. angusticollis*, which shows no rows of erect and rather densely seriate scale bristles on suture and on intervals.

Solobrachius modestus sp. nov.

Ferrugineus, omnino isabellino-,[44] prothorace disco macula trapeziforme elytrorumque apice nigricanti-squamosis, parce erecteque infuscato-setoso-squamosus, rostro in dimidia parte basali substriatim ruguloso, apice sat crebre subtiliterque punctato; antennis fulvis, scapo oculum haud attingente, funiculi articulo primo incrassato, secundo fere aequilongo, 3. ad 7. submoniliformibus, clavam versus crassioribus; prothorace transverso, maxima latitudine ad basin, lateribus antrorsum subrotundato-convergentibus, ante medium subconstrictis, disco margineque apicali utrinque setulis nigricantibus, subpenicillatim acervatis; scutello oblongo-ovato, ferrugineo, glabro; elytris latitudine sesqui longioribus, subtiliter punctato-striatis, spatiis alternatis ad basin convexioribus hic, spatio secundo etiam in medio, setis nigricantibus seriato-acervatis; corpore subter minus dense ac squamulis majoribus obtecto.

Long. 5.3 mm., lat. 2.8.

LUZON, Mount Banahao.

[44] Saccardo, Chromotaxie, Patavii (1894) pl. 1, No. 8.

Nearly allied to *Colobodes fallax* Faust, but besides the different color, distinguished by the oblong (in *fallax* quadrate) scutellum and the elytra which show in the intervals, except in the middle of the second interval, where there is a row of dense blackish bristles, a sparser accumulation of black, remote, seriate, perpendicularly erect (not flat as in *fallax*) bristles, which form at the base of the second and fourth intervals a simple crestlike row, instead of a scaled pustule as in *fallax* Faust. Hind femora hardly reaching beyond the third sternite; claw-joint smooth as in *fallax*.

Perrhaebius[45] **x-album** sp. nov. Plate 2, fig. 9.

Elongatus, nigro-opacus, prothorace maculis tribus basalibus, elytris in quarta basali signatura, communi, X-forme, fasciaque in secundo triente, partim in punctis dissoluta, ut corpore subter, femoribus tibiisque praesertim nigris, exceptis, cinereo-squamosis; rostro parte apicali nudo, sat fortiter punctato, parte basali griseo-squamoso, carinulis dorsalibus quinque; antennis subrufescentibus, funiculi articulo primo longitudine crassitudine aequali, secundo elongato-conico, reliquis transverso-moniliformibus, singulis clavam versus crassitudine crescentibus; prothorace fasciculis nigro-squamosis sex (duabus apicalibus quatuorque seria mediana transversa formantibus; scutello oblongo, nigro-glabro; elytris spatio, secundo quartoque pone basin et in medio, priori praeterea in triente apicali, posteriori in apice subcalloso, nigro-fasciculatis, sutura in triente mediano punctis nigro-velutinis remotis; femoribus basi tibiisque apice macula, tarsis totis, ut corpore subter, cinereo-squamosis.

Long. 10.5 mm., lat. 5.

LUZON, Mountain Province, Baguio.

Dull black; three basal patches on prothorax, an X-shaped mark in the first fourth of elytra, extending on each side to seventh stria, and a transverse row of partly confluent spots before the declivity, the underside for the most part ashy scaled, except for the black femora and tibiæ, scape of antennæ not reaching eye, first joint of funicle as long, second hardly twice as long as thick, the following spheric; club short oval, slightly longer than thick (17 : 14) ; prothorax coarsely punctate, with a shallow longitudinal impression in the middle and six black fascicles, two in front, the others forming a medial transverse row; scutellum black and smooth, somewhat longer than broad,

[45] Pascoe, Journ. Linn. Soc. 12 (1873) 34.

with parallel sides, basal margin notched; elytra with three or four black brush spots on the second and fourth intervals, the suture in the posterior half with velvet black spots.

Perrhaebius delicatus sp. nov. Plate 2, fig. 10.

Oblongus, niger albido-squamosus, elytris basi margineque laterali, linea frontali maculisque supra-orbitalibus, ut femoribus, macula fuscescenti mediana excepta, rosaceo-, capite, elytris, fascia mediana utrinque attenuata trienteque apicali, praecipue fusco-squamulosis, sutura spatioque secundo et quarto, in fasciae medianae vestigio, penicillis 2 vel 3 nigro-, in parte basali singulis uno albido-, in elytrorum parte declivi 1 vel 2 nigro-squamosis; prothorace transverso, semielliptico, margine antico utrinque squamulis nigricantibus setiformibus acervatis, dorso seria transversa e tuberculis quatuor obsoletis, internis nigro-, externis albido-, basi utrinque macula subquadrata fusco-squamosis; corpore subter albido-, metasterni lateribus subrosaceo-, sternitis tres ultimis lurido-squamosis.

Long. 8.5 mm., lat. 4.

LUZON, Laguna Province, Mount Maquiling.

The brown crossband of the elytra recalls *P. histrio* Faust, but it is narrower, the rostrum only two and a half times longer than broad; antennæ shorter and more robust, dark reddish brown, club blackish, a little longer than thick (9 : 7); prothorax half elliptic, somewhat shorter than broad (23 : 26), feebly tuberculate on each side of base with a subquadrate brownish spot, the inner two tubercles of the median crossrow blackish, the outer two white-scaled; elytra hardly twice as long as broad (7 : 4), second, fourth, and sixth intervals with moderately protuberant fasciculate callosities, a larger white one on the hind border of pink basal scaling, two or three on each side of the brown median band, and one in the beginning of the brown apical part; base without a striking basal tubercle, upper side predominantly white; head with a dilated median band on suture, this band white spotted here and there; apical third and an indistinct crossband in the middle of femora dark brown; a frontal stripe, a spot above the eye, the lateral margin and base of elytra as well as femora and sides of metasternum and of abdomen pinkish, last three sternites dirty white, tibiæ brownish spotted.

Perrhaebius elegans sp. nov. Plate 2, fig. 8.

Oblongus, niger, isabellino-squamosus, prothorace utrinque vitta, lata, marginali, ante convergentibus, apicem versus attenuata, elytris basi, spatii primi basi excepta, ut plaga communi ultra medium ac utrinque ad striam septimam anguloso-extensa fasciaque ante-apicali, fuliginoso-squamosis, spatiis alternatis convexioribus, lineolis obscurioribus ac raro subtuberculato-nigro-squamosis; corpore subter paulo pallidius, femoribus fusco-maculosis.

Long. 8.5 mm., lat. 3.7.

MINDANAO, Surigao Province, Surigao.

This isabelline-scaled species with a nut-brown pattern, as shown in the figure, has a rostrum four times longer than broad, which is closely rugulose-punctate on the basal half and there bears a dorsal carinula. Antennæ robust, the third joint of funicle as long as thick, the following becoming gradually thicker, the last spheric, club a little longer than thick (4 : 3.5); prothorax hardly broader than long (3 : 2.8), with a transverse row of four obsolete, black, bristly tubercles just before the middle, on each side of the anterior margin, with an accumulation of black bristles; scutellum parallel, nearly twice as long as broad, smooth, blackish; elytra one and three-fourth times longer than broad, second, fourth, sixth, and eighth intervals convex, especially the second at base and the eighth in apical part; hind femora extending hardly beyond second sternite.

Perrhaebius directus sp. nov.

Ferrugineus, parce breviterque erecto-setosus, prothorace, macula basali fuliginosa excepta, ut corpore subter elytrisque (his sordide) albido-, capite elytrorumque spatiis alternatis ad basin plus minusve lutescenti-, macula subcallosa ad spatii secundi basin, fusco-nigro-, plaga transversa, post-mediana, communi, semilunari, fumoso-squamosis; femoribus maculis dorsalibus duabus, obsoletis fuscescentibus, posticis sternitum quartum haud superantibus.

Long. 6 mm., lat. 2.8.

BATAN, Batanes Province, between Luzon and Formosa (*R. C. McGregor*), Bureau of Science accession No. 7753.

Ferruginous, isabelline-colored or white-scaled, a roundish median spot at base of prothorax extending to middle of disk; another, oblong, at base of second interval; and a common, semilunar, transverse, dark brownish spot behind the middle, the latter dark grayish tomentose; rostrum in basal half closely whitish scaled with an indistinct dorsal carinula, in the apical part densely punctate and erect seriate-setose; antennæ reddish, apical half of funicle black, second joint of the latter longer than the thickened first, third and fourth hardly longer than thick, fifth and sixth spheric, seventh the largest, club nearly twice as long as thick; head pale ferruginous; prothorax for the most part covered with coarse punctures, its semicircular, apical part feebly tuberculate on each side, and the middle of the sides with erect brownish clavate bristles; scutellum oblong, scaled; elytra finely seriate-punctate, the alternate intervals (second, fourth, and sixth), especially at base, broader than the others, and there all are pale ferruginous-scaled and irregularly remotely granulate, only the fourth interval at base with a row of denser ferruginous-ringed granules all of which bear a thick and short, apparently broken-off bristle; second interval at base with an oblong, black, tomentose callosity, the dark gray dorsal spot extending to third stria; prosternum with larger white scales than the remainder of underside; femora with two indistinct brownish dorsal spots, the hind femora not extending beyond fourth sternite.

Genus **BRACHYCOLOBODES** novum

Corpus squamosum, habitu Conotracheli simili, supra tuberculoso-squamosum. Rostrum prothorace parum brevius, apice depressiusculum, basi utrinque haud foveola glabra transversa ab oculo separatum. Antennae medianae, funiculo 7-articulato. Prothorax tuberculatus, lobis ocularibus subproductis. Mesosternum inter coxas intermedias diametro earum latius. Scutellum nitido-glabrum. Elytra prothorace latiora, basi truncata. Femora clavata, dentata postica sternitum quartum haud superantia. Tibiae in parte basali curvatae. Tarsi graciles.

Typus, Brachycolobodes undulatus sp. nov.

Brachycolobodes undulatus sp. nov.

Subfuscescenti-niger, luteo-squamosus ac parce breviterque setosus, antennis tarsisque obscure sanguineis; rostro prothorace breviori, in dimidia parte apicali glabriusculo, in dimidia parte basali punctis rudis, seriatis, squamositate obtectis; fronte nigro-bimaculata, in fronte late impressa; antennis funiculi articulo primo secundo paulo longiore, incrassato, articulis 3 ad 7 moniliformibus, clavam versus gradadim increscentibus; prothorace subconico, transverso, disco apiceque, hoc minus, nigro-bipenicillato; scutello nitido-glabro, rotundato-quadrato; elytris prothorace multo latioribus, vix $1\frac{1}{3}$ partibus latitudine longioribus, subtiliter punctato-striatis, spatiis asperis, lineis nigro-velutinis pererratis, spatio secundo prope ante ac post medium callositate, majore, nigro-penicillata, basi, ut humeris, ochraceo-squamosis;

corpore subter remote fortiterque, sternitis, duabus paenultimis, uniseriatim punctatis; femoribus clavatis, ante medium alboanulatis.

Long. 5.7 mm., lat. 3.2.

SUMATRA, from the Faust collection *Staudinger* and *Bang-Haas*.

Of the form of a stout *Conotrachelus;* blackish, sparsely and shortly setose, covered with a dirty luteous squamosity, elytra with velvet black undulate crosslines; antennæ and tarsi dark red; front with two large spots, broadly impressed in front; first joint of funicle thickened and a little longer than second, the following joints moniliform, gradually increasing toward club; thorax subconical, transverse, front margin with two smaller, disk with two larger, tufts of black scales; scutellum bare; elytra hardly one and one-third times longer than broad, much broader than thorax, punctate-striate, the intervals rugose by reason of accumulated scales; shoulders and base of second interval pale ochraceous, the latter moreover just before and behind the middle with a larger black squamose callosity; femora clavate, with a white scaled ring before the middle; abdomen remotely punctate, the third and fourth sternites with a single crossrow of punctures.

Genus **COLOBODELLUS** novum

Ithyporidarum prope Systaltopezus Faust [46]

Rostrum arcuatum, subcylindricum, scrobibus lateralibus; oculi rude granulati. Antennae funiculo 7-articulato, scapo oculum haud attingente. Prothorax lobis ocularibus distinctis. Prosternum excavatum. Mesosternum planum, latum, inter coxas intermedias latitudine coxarum diametro aequante. Scutellum distinctum, tomentosum. Elytra prothorace latiora, subelongata, striata. Femora linearia, dente minuto armata. Coxae posticae elytrorum marginem lateralem haud attingentes. Tarsi articulo tertio lato, subbilobo, ultimo nudo.

Distinguished from the similar and allied genus *Systaltopezus* Faust [46] by the distinct tomentose scutellum and the flat and broad mesosternum, the posterior margin of which is equal to the diameter of intermediate coxæ. Hind coxæ neither extend to the meta-episterna nor touch the margin of elytra. Femora rather linear, minutely toothed, claw joint bare.

[46] Deutsche ent. Zeitschr. Berlin 32 (1887) 54. According to Faust the meta-episterna are invisible and the scutellum absent in this genus, but cleaning the type specimen revealed both, the latter being very minute.

Colobodellus alboscutellatus sp. nov. Plate 2, fig. 11.

Niger, tarsis ferrugineis, tomento atro obtectus, elytris callositatibus nigro-velutinis, scutello fasciaque obliqua, anteapicali, laterali, albido-, intus dissoluta ac ochraceo-tomentosis; rostro crassitudine circiter triplo longiore, in dimidia parte apicali vix, in parte basali sat crebre punctato ac squamoso, dorso utrinque carinula laterali; antennis fulvis, funiculi articulo secundo primo, incrassato, paulo, ipso crassitudine fere triplo longiore, reliquis sensim brevioribus ac crassioribus; prothorace transverso, lateribus antrorsum rotundato-convergentibus, crebre fortiterque punctato, linea mediana levi, seria transversa mediana e pustulis quatuor nigro-velutinis; scutello elliptico; elytris prothorace latioribus, latitudine vix sesqui longioribus, subtiliter punctato-striatis, spatiis pustulis nigro-velutinis videlicet: una utrinque oblonga ad basin in spatio secundo et quarto, altera subrotundata in sutura, spatio secundo, quarto sextoque, seriebus tribus transversis una basali, una mediana alteraque postmediana formantibus, sutura basin versus sensim angustata, striis spatiisque atomis albidis remote seriatis, apice copiosis; corpore subter albido-, femoribus in dimidia parte basali ut abdomine nigricantibus.

Long. 4.2 mm., lat. 2.2.

MINDANAO, Agusan Province, Butuan.

In size and habitus rather similar to *Systaltopezus nodosus* Faust; dull black; antennæ fulvous, tarsi reddish brown, scutellum pure white, an oblique and slightly curved band, beginning on elytra above hind margin of first sternite and running backward to suture, white, inwardly diffuse and ochraceous, apical margin of elytra, except the black apex of suture, grayish tomentose; rostrum nearly as long as thorax, scaled in basal half and densely punctured, in apical half hardly punctured; second joint of funicle three times longer than the much incrassate first, third hardly one and a half times as long as thick, the following becoming gradually thicker and shorter; club three times longer than thick; prothorax in the middle with a transverse row of four velvet black pustules; elytra with three transverse rows of such pustules, two oblong callosities on each side at base of second and fourth intervals, and four roundish callosities on each side in and behind the middle, on the suture, and on the second, fourth, and sixth intervals, forming a backwardly, convexly curved row; each puncture of striæ and intervals with a minute white scale bristle, more densely set toward apex; underside whitish, abdomen, apical half of femora and basal half of tibiæ blackish; hind femora hardly extending beyond third sternite; apex of tibiæ with a large hook.

Genus **LOBOCODES** novum

Corpus robustum, latiusculum, tomentosum. Rostrum fere usque ad apicem dilatatum ac subdepressum, tomentosum, prothorace brevius, basi sulco glabro, anteoculari, transverso. Antennae antemedianae, funiculo 7-articulato. Frons foveolata. Prothorax subconicus, transversus, apice bipenicillatus, lobis ocularibus distinctis. Scutellum tomentosum. Elytra prothorace latiora, basi truncata, lateribus parallelis. Metasternum inter coxas intermedias fortiter declive. Sternitum secundum duobus sequentibus unitis longius. Femora clavata, dentata, postica sternitum secundum vix superantia. Tibiæ subcompressae. Tarsi articulo secundo latitudine parum longiore cum tertio, transverso, unito primo aequilongo.

Typus, Colobodes turbatus Faust [47] ex New Guinea et Ferguson Islands.

Genus **OCOBLODES** novum

Corpus squamosum ac setosum. Rostrum cylindricum arcuatum, thorace fere aequilongum, dimidia parte basali squamosum, basi foveola glabra ab oculo separatum. Antennae medianae, funiculo 7 articulato. Prothorax lobis ocularibus sat distinctis. Scutellum tomentosum. Elytra oblonga, prothorace modice latiora, lateribus parallelis. Metasternum inter coxas intermedias fere perpendiculariter declive. Sternitum secundum, duobus sequentibus unitis longius. Femora sublinearia, dentata. Tarsi breviusculi, articuli secundo tertioque transversis.

Typus, Ocoblodes lineola sp. nov.

Ocoblodes lineola sp. nov.

Oblongus, pallide saturateque ochraceo-variegatus, parce breviterque setoso-squamosus, elytris interdum praeterea albidopunctatis, spatiis remote fuscescenti-seriato-tuberculatis, spatio secundo lineola, postmediana, brunnea, cum opposita figuram suturalem fere V-formam formantibus; rostro prothorace quarta parte breviore; antennis rufis, prope ante rostri medium insertae, funiculi articulo secundo primo, incrassato, longiore, tertio quartoque crassitudine vix sesqui longioribus, reliquis subtransversis, clavam versus crescentibus; prothorace transverso, parte ante-

[47] Stettin. Ent. Zeit. 53 (1892) 210.

riore semicirculari, lateribus in dimidia parte basali vix rotundatis, utrinque intra angulos posticos lineola, interdum etiam linea mediana, albicanti-squamosis; scutello rotundato, fusco-squamoso; elytris latitudine fere sesqui longioribus, striato-punctatis, spatiis planiusculis, spatio secundo pone basin callositate oblonga densius fusco-setosa; corpore subter albido-squamoso, femoribus fusco-maculatis, dente spiniformi armatis, tibiis subflexuosis.

Long. 4.2 mm., lat. 2.2.

MINDANAO, Agusan Province, Butuan (*4449*, *4452*): Zamboanga Province, Zamboanga. LUZON, Mountain Province, Baguio.

Closely dirty whitish or brownish scaled; an indistinct median line on prothorax and a short streak within each of its posterior angles; a more or less transverse streak in the first third of elytron, sometimes also some punctures on striæ and nebulose dots on the intervals (as all of the underside) pure white, second interval in the second third with a brown line meeting the corresponding line of the other elytron, forming a common V- or lyre-shaped pattern more or less filled with fawn-colored scales, apex brown; thorax one-third broader than its median length, upper side covered with scattered brown bristle scales forming a transverse row of four fascicules in the middle; elytra more than twice as long as broad (2.5 : 1), finely punctate-striate, the intervals with remotely seriate, short cylindric bristle scales, second interval broader than third and fourth together, like fifth and sixth approximate at base; underside whitish, rarely, as a spot on femora, brownish scaled. This species is in other respects such a variable one that no two specimens are identical in color of scaling.

Ocoblodes conspersus sp. nov.

Oblongus, fusco-niger, dense pallideque luteo-squamosus, elytris punctis dispersis, minutis, albidis spatio quarto ante declivitatem puncto albido paulo majore; rostro subrufescenti, subtiliter remoteque punctato, antennis fulvis, funiculi articulo secundo primo, crassiore, parum longiore, tertio quartoque elongatis, crassitudine duplo longioribus, clava fulvo-pubescenti; prothorace transverso (2 : 3), dense squamoso ac punctato, squamulis paucis (circa 3 ad 5) erectis utrinque in disco et in lateribus acervatis; scutello obovato, squamoso; elytris latitudine plus sesqui longioribus (4 : 6.5), subtiliter punctato-striatis, sutura basin versus angustata, spatio secundo ad basin dilatato ac callositate oblonga, corpore subter albido-squamoso.

Long. 4.5 mm., lat. 2.

LUZON, Laguna Province, Mount Maquiling (*5903*).

Body oblong, covered with luteous scaling, elytra showing very scattered and minute white punctures along the finely punctate striæ, the third interval before the declivity with a larger subquadrate one, first interval (the following two alternates also but in lesser degree) enlarged at base and there with an oblong callosity which is set about by six erect scale bristles; scales of front, intervals, metasternum, and legs more or less concave or patelliform, intervals set with remotely seriate, erect, strong but short, cylindric bristles, which are isolated at base from the squamosity of the intervals; elytra a little more than one and a half times longer than broad; underside more densely whitish scaled, the anterior margin of the third, fourth, and fifth sternites more sparsely scaled; posterior femora extending but a little beyond hind margin of second sternite.

Ocoblodes (?) cionoides sp. nov.

Ciono thapsi Fabr. paulo minor ac angustior, cinereo- et ochraceo-variegatus, elytris in striis remote albido-punctatis, sutura spatiisque alternatis remote minuteque seriatim pustulosis, pustulis singulis seta brevi, valida, cylindrica, munitis, spatio secundo prope basin callositate oblonga, quarto eodem loco, altera, rotundata, fuscescenti-, sexto callo humerali albido-squamosis; rostro prothorace aequilongo; capite vertice albido-squamoso; antennis prope ante rostri medium insertis, rufescentibus, funiculi articulo secundo primo, incrassato, breviore, tres sequentibus crassitudine fere aequilongis, sexto conico, majore, crassitudine paulo longiore; prothorace transverso, margine antico tuberculis duabus, disco seria transversa e tuberculis quatuor, horum internis fuliginoso-, externis luteo-, linea mediana thoracali, interdum albido-squamosis; corpore subter albido-, lateribus plus minusve nebulose, femoribus bimaculatim fuliginoso-squamosis.

Long. 3.5 mm., lat. 2.

LUZON, Mount Banahao (*5906*); Mount Maquiling: Tayabas Province, Malinao. MINDANAO, Agusan Province, Butuan.

This species, recalling a European *Cionus*, is ashy-colored, whitish on shoulders, and shows the punctate whitish striæ on elytra; thorax, suture, and alternate intervals minutely and remotely brown, partly whitish pustulated, each of the pustules bearing a short cylindric bristle, which is free around the insertion; base of rostrum with broader, roundish, patelliform scales, which cover three fine dorsal carinulæ; antennæ fulvous, club hardly twice as long as thick; white scales of vertex tridentate in front, with two brownish median spots behind; prothorax transverse (2 : 2.5) in front, here with two tubercles, with a transverse row of tubercles in the middle of disk, the first two and the inner two of the latter nut brown; scutellum oblong, half elliptic; elytra broader than prothorax, not quite one and one-half times as long as broad (3 : 2.2) ; underside whitish, as are also the sides of mesosternum, metasternum, and first sternite; a band before and behind the middle on femora dark gray-scaled; legs with sparse, erect, whitish bristles. After the conclusion of this paper I found that the intermediate coxæ of this species were so widely distant, that it must be transferred to near *Colobodellus*.

Ocoblodes (Eprias [48] subg. nov.) **vana** sp. nov.

Oblonga, albida-squamosa parce breviterque setosa; rostro rufescenti fusco, longitudinaliter rugoso, antrorsum sensim dilatato, parte basali dorso tri-carinulato; antennis fulvis, articulo primo funiculi incrassato, crassitudine paulo longiore, articulis tres sequentibus transversis, sexto conico, crassitudine longiore; prothorace subtransverso, lateribus in dimidia parte basali fere parallelis, in parte apicali semicirculariter convenientibus, disco seria transversa e tuberculis quatuor fusco-fasciculatis; elytris remote punctato-striatis, interstitiis alternatis convexioribus, squamulis remote seriatis spatuliformibus, squamorum convoluto infundibuliformi insertis; corpore subter squamulis sat magnis concavis dense recto; femoribus posticis sterniti tertii marginem posticum attingentibus.

Long. 2.5 mm., lat. 1.

MINDANAO, Agusan Province, Butuan (*4435*).

A pretty, white-scaled species, sparsely set with short, thick, cylindric setæ, with two indistinct brownish medial and one lateral stripe in basal half of thorax, a black-scaled scutellum, a large, arcuate, middle band, and apical third of elytra blackish. Rostrum dark reddish brown, rugulose, slightly enlarged toward apex, with three dorsal carinulæ in basal half, the median ab-

[48] This new subgenus differs from *Ocoblodes* chiefly by the six-jointed funicle of the antennæ.

breviated behind; antennæ fulvous, scape not reaching eye, funicle gradually thickened toward club, first joint incrassate, like second slightly longer than thick, the following transverse, sixth the largest, a little longer, club one-third longer than thick; prothorax a little broader than long, sides in basal half parallel, apex semicircularly rounded, set with remote fusiform scale bristles, forming a transverse row of four tufts on disk; elytra broader than prothorax, finely and remotely punctate-striate, alternate intervals more convex with remotely seriately spatulate bristle scales, each inserted in a funnel-shaped dimple formed by smaller scales; underside densely covered with large, concave, white scales; femora with an acute tooth at middle, posterior femora extending to posterior margin of third sternite; tarsi fuscous, first and second joints sparsely covered with setiform, adpressed, white scales.

Ocoblodes (Eprias) binotata sp. nov.

Praecedenti (vanae Heller) similis, sed prothorace nigro, linea mediana lutescenti, elytris nigro-luteoque variegatis, fascia arcuata, in secundo triente, albido-, macula humerali transversa obsolete, luteo squamosis, setis longiusculis erectis remote dispersis interstitio secundo pone basin lineola nigro-cristata; corpore subter griseo, metasterno lateribus imbricato-, femoribus, nigricantibus, basi albo-anulatis, reliquis, ut tibiis, parce albosetosis.

Long. 2.1 mm., lat. 1.1.

LUZON, Mountain Province, Baguio.

Similar to *O. vana* Heller, but the blackish prothorax with an indistinct pale middle line; elytra piebald blackish and dirty luteous scaled, an arcuate band in second third white, second interval near base with an oblong crest formed by erect dark brown bristle scales; rostrum densely blackish scaled, apex bare, reddish brown, punctate; prothorax as in the former species, but the scales distinctly concave; alternate intervals of elytra hardly more convex than the others, the remote bristle scales much longer, fuscous, not inserted in a funnel-shaped dimple; femora and tibiæ black with scattered white setæ, and with a whitish ring on base; tarsi fulvous, whitish haired; underside gray, the sides of metasternum blackish.

Deretiosus venustus sp. nov. Plate 3, figs. 1 and 2.

Niger, albo-, elytris maculis punctiformibus paucis, prothorace maculis duabus basalibus fuscescenti-nigro-squamosis, hoc tuberculis duabus medianis et apicalibus fuscescenti-altero, laterali, in medio-, albido-, elytris in spatio secundo ad basin et in medio callositate fuscescenti-penicillatis; corpore omnino setis, erectis, albidis, remote obsito; femoribus macula mediana, altera subapicali, tibiis anulo mediano fuscescentibus, femoribus posticis sterniti anali apicem fere attingentibus.

Long. 5 mm., lat. 2.2.

LUZON, Laguna Province, Los Baños (*610*). MINDANAO, Zamboanga Province, Dapitan.

Black, covered with whitish scales and scattered, erect, white setulæ, base of prothorax in the middle with two oblong rectangular, brown or blackish spots, elytra with irregularly dispersed small dots of the same color; antennæ reddish, first joint of funicle only one and one-half times longer than thick, second shorter than first but more than twice as long as thick, the following moniliform, gradually becoming larger toward club; rostrum nearly as long as prothorax, its basal part coarsely and densely punctate and closely scaled like head; prothorax broader than long (3.3 : 3), sides in basal half slightly convex, nearly parallel, with a white setose callosity in the middle, set in one transverse row, with two similar but brownish setose callosities on disk, two such also on the semicircularly produced apical part; scales of prothorax proportionately large and concave, only partly touching one another; scutellum minute, very convex; elytra more than twice as long as broad (2.5 : 1), broader than thorax, basal margin hardly produced on each side of scutellum, the punctures of striæ oblong, distant by their length one from another, with a roundish white, penicillate callosity in the middle and on the apex of the subconvex fourth interval; underside densely white; femora in the middle and before the apex, tibiæ only in the middle, brownish annulate.

One of the two specimens from Los Baños is much paler in color, but agrees in all other respects with the others.

Genus MICRAPRIES novum

Rostrum subarcuatum, subcylindricum, prothorace fere aequilongum. Antennae rostri basin quam medio paulo propius insertae, funiculo sex-articulato. Prothorax lobis ocularibus distinctis, supra caput productus. Scutellum punctiforme tomentosum. Elytra parallela, prothorace latiora, basi utrinque parum productis, intra humeros subsinuatis. Coxae anticae remotae. Prosternum excavatum. Mesosternum post perpendiculare, concavum. Metasternum inter coxas subsinuatum ac acute marginatum, coxarum diametro paulo angustius. Sternitis duabus basalibus ampliatis, sutura arcuata divisis, sternito secundo duobus sequentibus unitis longiore. Femora linearia, subter spinoso-uni-denticulatis, posticis abdominis apicem haud attingentia. Tibiae subcompressae, rectae. Tarsi breviusculi, articulo tertio transverso. Unguiculi basi approximati.

Typus, Micrapries nanna sp. nov.

Micrapries nanna sp. nov.

Oblonga, lutescenti-squamosa, elytris nebulose fuscescenti-, in spatiis alternatis lineolatim obscurius, basi fasciaque communi curvata, obsoleta, submediana alteraque postmediana, laterali, pallidiore, corpore subter dense albido-squamosis; antennis testaceis, funiculo articulo primo incrassato, secundo tenui, primo aequilonge, tertio crassitudine duplo longiore, tres sequentibus eodem aequilongis, clava maxima, latitudine ante medium; prothorace longitudine latitudine fere aequali, (2.8 : 3) lateribus in dimidia parte basali retrorsum covergentibus, ante semicirculariter productis, margine apicali setis validis seriatis, disco seria transversa e tuberculis sex, minutis, unisetosis formata; elytris latitudine fere sesqui longioribus, punctato-striatis, spatiis alternatis subconvexioribus, remote seriato-setosis; femoribus minute dentatis, subter in dimidia parte apicali subsinuatis.

Long. 2.5 mm., lat. 1.3.

LUZON, Mount Banahao.

Similar in outline to *Apries eremita* Pasc., but only a fifth of its size; scales fawn-color, base of elytra, a backwardly convexly curved transverse band before the middle, an oblique lateral band behind the middle, and apical margin dirty white, pure white scales on underside, surface all over with scattered proportionately thick bristles; antennæ yellowish brown, second joint of funicle equal in length to the thickened first, third twice, the following ones as long as thick, club somewhat shorter than the five preceding joints together, broadest before the middle; thorax slightly longer than broad (8 : 7), closely and coarsely punctate, with a transverse row of six small tubercules in the middle, each bearing a short thick seta, anterior margin with a row of strong setæ; scutellum punctiform, scaled; elytra one and one-half times longer than broad (7 : 4.5), the alternate intervals slightly convex, and like the suture set with remotely seriate, thick bristle scales; underside dense felty white.

Micrapries echinus sp. nov.

Oblongus, albido, scutello suturaque ad basin fusco-squamosis, remote erecteque setosus; rostro prothorace breviore, fere usque ad apicem squamoso, antennis prope ante rostri medium insertis, clava, nigra excepta, fulvis, funiculi articuli secundo primo, incrassato, longiore ac tenuiore, tertio crassitudine duplo longiore, tres sequentibus crassitudine haud longioribus, clavam versus crescentibus; prothorace longitudine latitudine aequali, in dimidia parte apicali semicirculari, in dimidia parte basali rectis, basin versus subconvergentibus ac trituberculatis, disco seria transversa, e tuberculis quatuor, fuscescenti bi- aut trisetosis formata; elytris spatiis alternatis convexioribus ac remote seriato-tuberculatis, spatio secundo ad basin callositate, oblonga, pluri-, tuberculis reliquis uni-setoso-squamosis.

Long. 4 mm., lat. 2.

LUZON, Mount Banahao (*2645*).

Dirty white, elytra brownish white, the oblong scutellum and the basal part of suture nut brown; rostrum, except the smooth apex, densely squamose, set with very scattered bristles; antennæ yellowish brown, the club black, second joint of funicle nearly three times longer than the thickened first joint; thorax in anterior part semicircular, the sides in posterior part nearly parallel, with small tubercles; disk with a tranverse row of four tubercles, each bearing 3 or 4 brownish scale bristles; elytra punctate-striate, the alternate intervals convex, set with very remotely seriate granules, each bearing a spatuliform scale bristle, second interval with an oblong callosity bearing several bristles, shoulders slightly prominent; underside whitish scaled.

Genus **PARAPRIES** novum

Corpus oblongum, squamosum ac setosum. Rostrum cylindricum, prothorace brevius usque ad apicem, subdilatatum, squamosum, basi utrinque sulco glabro, transverso, ab aculo separatum. Antennae antemedianae, funiculo 7-articulato. Prothorax lobis ocularibus distinctis. Scutellum tomentosum. Elytra prothorace latiora, lateribus parallelis, basi parum producta. Metasternum inter coxas intermedias perpendiculariter declive, subconcavo ac marginem elevatum concavum formante. Femora sublinearia, dentata, sternitum quartum vix superantia. Tarsi breviusculi.

Typus, Apries histrio Faust, ex Birma.

Genus **DINAPRIES** novum

Corpus oblongum, squamosum. Rostrum cylindricum, prothorace aequilongo, usque ad apicem, subdilatatum, squamosum, basi utrinque sulco glabro ab oculo separatum. Antennae medianae, funiculo 7-articulato. Prothorax lobis ocularibus nullis. Scutellum partim glabrum, partim parce squamosum. Elytra prothorace modice latiora, lateribus parallelis. Metasternum inter coxas fortiter (fere perpendiculariter) declive. Femora sublinearia minute dentata, postica segmentum ventrale secundum parum superantia. Tarsi validi, squamosi.

Typus, Dinapries salebrosa sp. nov.

Dinapries salebrosa sp. nov.

Oblonga, fuliginoso-, prothorace lateribus, prosterno toto, mesosterno, metasterno sternitoque primo, lateribus exceptis, ut femoribus anterioribus in dimidia parte basali, albido-squamosis; rostro squamoso, apicem versus paulo dilatato carinulaque dorsali tenui; antennis robustis, funiculi articulis duabus basalibus longitudine aequalibus, primo crassiore, reliquis moniliformibus, clavam versus majoribus; prothorace longitudine latiore, lateribus in dimidia parte basali parallelis, dein rotundato-attenuatis, parte mediana, fusca, subtrapezoidali, lateribus concavis, antrorsum convergentibus, tuberculis duobus apicalibus ut duobus discalibus fusco-, tuberculo laterali albo-penicillato-squamosis; scutello obovato, utrinque parce albo-squamoso; elytris obsolete punctato-striatis, squamoso-salebrosis, spatio primo ad basin, quarto ad apicem callosis; femoribus sternitum tertium haud superantibus.

Long. 8 mm., lat. 4.

SUMATRA (unicum a Staudinger et Bang-Haas comparatum) in Mus. Dresdense.

Upper side unicolorous, dark nut brown, only the lateral margin of prothorax broadly white-scaled; elytra densely covered with longer scaled callosities which are as broad as the intervals and each of which bears a short, erect seta; rostrum as long as thorax, densely scaled with a fine dorsal carina; antennæ robust, first and second joints of funicle of equal length, the following spheric, increasing gradually in size toward club, the last only as long as the three preceding joints of funicle together and one and one-half times longer than thick; prothorax a little longer than broad (3.3 : 3), its sides in basal half parallel, its anterior margin with a row of four small tubercles, of which the outer two are white, the others black setose; scutellum oviform, with scattered, minute, white scales on each side on posterior part; elytra more than one and one-half times longer than broad, broader than prothorax, the basal margin on each side hardly produced, the striæ formed by oblong punctures, mostly covered by scales; second interval at base, fourth on apex, convex, there with denser and more divergent bristle scales; prosternum entirely, mesosternum and metasternum white as is the first sternite, except its sides, remainder of abdomen dark brown, with much-dispersed white scales; legs prevailingly dark-scaled and erect-setose; femora with an indistinct tooth, the posterior extending hardly beyond second sternite, the anterior whitish on basal half, as are also the anterior tibiæ on apex.

Genus NANNOCOLOBODES novum

Ithyporidarum olim

Corpus squamosum ac erecte squamoso-setosum. Rostrum sat robustum, scrobibus lateralibus, apice deorsum visibili. Antennae prope rostri apicem insertae. Prothorax antice productus, in dimidia parte apicali attenuato, lobis ocularibus obsoletis. Scutellum distinctum, glabrum. Elytra oblonga, prothorace latiora, basi truncata. Femora linearia, minute dentata, tibiae rectae, margine interno in medio subdilatato. Coxae anticae contiguae, intus planatis, intermediae distantes, posticae metaepisternis tangentes. Metasternum inter coxas intermedias vix declive. Prosternum excavatum.

This genus may be placed to the best advantage in the Ithyporidæ and belongs to the few exceptions of "Curculionides phanerognathes apostasimérides" [49] that have the anterior coxæ contiguous and that share the other characters, even the apically inserted antennæ, with *Amphialus* Pasc., [50] the eyes being small, the ocular lobes wanting, the scutellum distinct, and the first joint of hind tarsi shorter than the claw joint.

Nannocolobodes mus sp. nov.

Niger, antennis rufescentibus, cinereo-, elytris parte basali, semicirculari (post convexo) maculaque minuta, apicali, ochraceo-, rostro capiteque albido-squamosis, setis erectis, nigricantibus, parce obsitis; rostro latitudine plus duplo longiore, dorso subcarinulato; prothorace longitudine paulo latiore, lateribus in

[49] Lacordaire, Gen. Col. 7: 1.
[50] Ann. & Mag. Nat. Hist. V 11 (1883) 127.

dimidia parte basali fere parallelis, squamulis clavatis, setiformibus, in medio longioribus ac validioribus obsitis; scutello subquadrato, deplanato, nitido-castaneo; elytris subtiliter striatis, spatio secundo ad basin callositate oblonga, ante medium altera, subrotundata, nigro-penicillatis; corpore subter griseo-squamoso, abdomine praeterea setulis, incurvatis, albidis, remotis; metaepisternis ut femoribus tibiisque partim infuscatis, femoribus posticis sternitum quartum haud superantibus.

Long. 4 mm., lat. 1.7.

BASILAN.

Upper side dark, disk of thorax lighter ashy; rostrum, head, and semicircular patch at base of elytra which is as broad as elytra, as well as a small spot on each side of apical margin of the latter, ochraceous scaled; remotely beset throughout with erect setiform scales, of the same color as the surface upon which they are inserted; rostrum shorter than prothorax; antennæ fulvous; first joint of funicle short conical, one-fourth longer than thick, second equal to first but only half as thick, the following joints as long as thick, increasing in size toward club, this being oval and twice as long as thick; eyes coarsely granulate, surrounded behind by a furrow; prothorax broader than long (6 : 5), parallel-sided in basal half, anterior half semicircular, sparingly beset with anteriorly directed, club-shaped bristles; scutellum smooth, roundish, castaneous; elytra truncate at base and there broader than thorax, sides in anterior three-quarters parallel, second interval at base with an oblong, in the middle with a round, black, setose callosity; underside dirty whitish scaled, abdomen with whitish, curved bristles; femora nebulous brownish and with blackish, straight, sparse bristles; claw joint sparingly white setose.

Therebus (?) bifasciatus sp. nov.

Oblongus, niger, thorace parte apicali, elytris basi, fascia postmediana, apice corpore subter pedibusque (femorum apice nigro tibiisque nigris exceptis) cinereo-squamosis; rostro capite longiore, basi excepto, nigro-nudo, sat dense punctato; antennis funiculi articulis 3. ad 7. transversis, clava breviter ovata; prothorace transverso, crebre punctato ac squamoso, dorso utrinque impressione magna levissima; scutello oblongo-elliptico, squamoso; elytris prothorace paulo latioribus, latitudine fere duplo longioribus, parallelis, distincte striato-punctatis, striis basin versus extrorsum subcurvatis, femoribus, linearibus, compressis, abdominis apicem vix attingentibus.

Long. 10 mm., lat. 3.6.

LUZON, Laguna Province, Mount Maquiling (*5878*).

I place this Philippine species in this Australian genus with some hesitation, though it agrees sufficiently with Pascoe's short characterization.[51]

Body more than twice as long as broad; elytra with parallel sides, dull black; prothorax on anterior part, elytra on base and on apex, and a crossband in the second third yellowish gray; underside more whitish and less closely scaled, except apical half of femora and tibiæ, which are black; rostrum one-third longer than head, glossy black, tolerably densely punctate, scaled on base; antennæ robust, the two basal joints of funicle hardly twice as long as thick, together as long as the five following combined, scape only one-third longer than thick; prothorax about as long as broad at base (3.5 : 3.7), moderately densely, coarsely punctate, with a large, flat, roundish impression on each side of disk; scutellum elliptic, scaled; elytra coarsely punctate-striate, the punctures oblong but hardly longer than the distance between them; hind femora linear, scarcely reaching apex of abdomen, the anterior unarmed; hind tibiæ compressed, curved, and black; tarsi pure white scaled.

Dyspeithes seriatopunctatus sp. nov.

D. dentipedi Kirsch. longiore, squamulis minoribus ac plus adpressis parcius vestitus, rostro, basi parce squamosa excepta, nitido, parce punctulato; elytris in dimidia parte apicali subpunctato-striatis, reliquis fere seriato-punctatis, punctis oblongis, spatiis minute remoteque granulosis, spatio secundo quartoque pone basin et post medium nigro-fasciculato-squamosis, macula humerali pallida minore quam in dentipedi.

Long. 8 mm., lat. 4.

LUZON, Mount Banahao.

Very near to the preceding species but readily distinguished from it by the glossy rostrum, the bases of third and fifth intervals of elytra, which are not black setulose-squamose, and the striæ which are hardly striate, nearly seriate-punctate in the anterior half and there rectangular-oblong, separated from each other by only a narrow bar; suture with a single row of granules, intervals with adpressed scales and therefore flat, sparsely, minutely granulate, the second and fourth intervals at base and behind the middle with black setose callosities, the posterior two of which are more or less distinctly joined by an arcuate

[51] Journ. Linn. Soc. London 11 (1872) 480.

black crossband, the pale humeral spot small, as in typical *D. dentipes;* suture with a single row of granules; femora and tarsi white, tibiæ prevailingly black setose-squamose.

Dyspeithes dentipes Kirsch. subsp. punctatostriatus subsp. nov.

A specie typica differt prothorace in dimidia parte anteriore vitta marginali fuliginosa, elytris macula humerali, oculo duplo majore, rotundata, ochracea excepta, transverse ochraceo- et fuliginoso-marmoratis, striis distincte punctatis, spatio secundo quartoque reliquis convexioribus.

Long. 7 mm., lat. 4.

LUZON, Laguna Province, Mount Maquiling.

In the key given by Faust,[52] *D. dentipes* Kirsch. may be differentiated by having only two black scale tufts on the anterior margin of prothorax, whereas in the other species there is also a transverse discal row of such tufts; but the type specimen is much worn, and the remnants of scale tufts can be discerned placed as in *D. dentipes* Kirsch. The Philippine subspecies agrees in this respect with both, but differs by the striæ being distinctly (in *dentipes* hardly) punctate within, the second and fourth intervals being more convex than the others, and by a yellowish patch on the shoulder, twice as broad as the eye.

In both forms, *dentipes* and subsp. *punctatostriatus*, a narrow, black basal fascia occurs on the base of the third to the seventh intervals, which borders the pale humeral patch behind, this patch in the typical species being much smaller.

GENUS MECISTOCERUS FAUVEL AND ALLIED GENERA

The description of new Philippine species of *Mecistocerus* makes necessary some general remarks upon the genus which, in consequence of an incorrect transcription, was erected as *Mechistocerus* (instead of *Mecistocerus*) by Fauvel for *Coelosternus impressus* Montr., and declared by J. Faust[53] as synonymous with *Berosiris* Pasc., the type of which is *Cyamobolus marci* Boh.; further, for *Mecistocerus mastersi* Pasc., with linear femora, he has created the genus *Rhadinomerus,* extensively characterized by him in the same publication.[54] In connection

[52] Ann. Mus. Genova 40 (1899) 55. On this occasion the same author mentions a *D. nycteroides* Faust—a misspelling, as *nechyroides* Faust is the correct name.

[53] Stettin. Ent. Zeit. 53 (1892) 46.

[54] Stettin. Ent. Zeit. 53 (1892) 215.

with the descriptions of sixteen new species of *Mecistocerus*[55] the same author adds two supplementary notes, and finally proposes a new genus,[56] *Isotocerus*, for *I. petax* Faust, a new Papuan species, the rostral canal of which extends toward the middle of the intermediate coxæ.

Nevertheless, M. A. Lea, the highly esteemed connoisseur of the Australian fauna, in his key of Australian Cryptorhynchidæ, has cited the two genera *Mecistocerus* and *Berosiris* as different, differentiating them by a lamella on the metasternum which limits the rostral canal on each side in *Mecistocerus*, but which is wanting (according to Lea) in *Berosiris*. As a matter of fact, the type species of the latter, *marci* Boh., shows this lamella quite as well developed as in *impressus* Fauvel and therefore the genus *Berosiris* of Lea is different from *Berosiris* of Pascoe. I propose for the first the name *Riboseris*, the type of which is *mixtus* Lea.

On this occasion may be mentioned a series of *Mecistocerus* species described by Lea, which he says he received from J. Faust. As all these are now wanting in Faust's collection I suppose they were single specimens.

Also, I must correct an error of Faust in creating the genus *Isotocerus*, of which he says that the rostral canal, extending distinctly beyond the intermediate coxæ in *Mecistocerus*, reaches only to the middle in *Isotocerus*. In examining this character I found that in twenty-eight Indo-Malayan species the rostral canal reaches the hind margin of intermediate coxæ and in only eight species (*marci* Boh., *subundatus* Schönh., *nigrostriatus* Chevr., *corticeus* Faust, *offensus* Faust, *subcylindricus* Faust, *caliginosus* Faust, and *devotus* Pasc.) it extends distinctly to or beyond the hind margin. Also, the other characters of *Isotocerus*, indicated by Faust, agree only partly. I see no difference between *Mecistocerus* and *Isotocerus*, either in the antennal furrow or in the base of the hind femora which is said to be not naked above in *Isotocerus*, for *I. petax* Faust shows a greater extension of naked area than does *Mecistocerus impressus* Fauv.

The similar Papuan species of *Isotocerus* have for the most part an impressed profile at the base of the rostrum, but *Mecistocerus incertus* Pasc. represents a transition to this, so that this character is also untenable.

[55] Ann. Mus. Genova **34** (1895) 265, 279.
[56] Stettin. Ent. Zeit. **59** (1898) 145.

In judging the sculpture of *Mecistocerus*, the state of preservation of the squamosity must be considered. If it is in perfect condition, then the punctures of the elytral striæ seem to be round, small, and remote; but when it is scraped off, they appear to be quadrate or rectangular-oblong, separated only by a narrow cross-bridge.

Key to the Philippine species of the genus Mecistocerus including Rhadinomerus.

a^1. Rostral canal extending backward at least to hind border of intermediate coxæ.......... M. marci Boh.

a^2. Rostral canal not extending backward as far as hind border of intermediate coxæ.

- b^1. Sides of prothorax set with a series of longer diverging bristles. M. sollicitus Faust.
- b^2. Sides of prothorax without such bristles.
  - c^1. Prothorax with a distinct smooth central carina.
    - d^1. Posterior femora not strikingly compressed at base; prothorax without a pale lateral stripe.
      - e^1. Elytra with a more or less extended pale humeral spot.
        - f^1. Elytra depressed[57] along suture, shoulders obliquely truncate and distinctly broader there than base of thorax; posterior femora extending beyond apex of elytra; third and fourth sternites blackish scaled except for a subquadrate pale lateral spot.......... M. ingenuus Faust.
        - f^2. Elytra not depressed along suture, moderately broader at shoulders than base of thorax.
          - g^1. The coarse punctures of first and second sternites bearing a fine seta, those on femora a strong bristle; posterior femora pale with a dark median band. M. nigrostriatus Chevr.
          - g^2. The coarse punctures of first and second sternites, like those of femora, set with similar setiform scales, posterior femora chiefly blackish scaled with a subapical white spot.......... M. montanus sp. nov.
      - e^2. Elytra without a pale humeral spot.
        - h^1. Striæ of elytra narrower than the intervals.
          - i^1. Thorax globose, subtransverse, slightly constricted toward base, densely and deeply, moderately coarsely punctate; intervals of elytra flat. M. setosipes sp. nov. (Rhadinomerus).
          - i^2. Thorax not globose, transverse (6.6 : 9), coarsely punctate; intervals of elytra subconvex, partly subgranulose. M. modestus sp. nov.
        - h^2. Striæ of elytra as broad as intervals; thorax somewhat flattened, very coarsely punctate.......... M. latiusculus sp. nov.

[57] Easy to decide by a view from behind toward the front along the suture.

d^2. Posterior femora strikingly compressed at base; prothorax with a whitish submarginal stripe; elytra black, finely ochraceous-mottled.. **M. compressipes** sp. nov.

c^2. Prothorax without a central carina.

k^1. Prothorax punctate, neither rugose nor granulate.

l^1. Distance between the oblong punctures of elytral striæ nearly equal to their longitudinal diameter.

m^1. Upperside blackish with a large whitish humeral spot extending from the third to the eighth stria. **M. albohumeralis** sp. nov.

m^2. Upperside with a brownish and ochraceous marbling, femora with an indistinct pale dorsal spot......... **M. incertus** Pasc.

m^3. Upperside black with small white spots; femora with a large white subapical dorsal spot.... **M. maculipes** sp. nov.

l^2. Distance between the roundish punctures of elytral striæ much greater than their diameter; upperside brownish, a lateral stripe on thorax; a subapical, flexuous crossband; apex and the rest of elytra with a fine isabelline marbling. **M. pictithorax** sp. nov.

k^2. Prothorax coarsely granulate........................ **M. granulicollis** Faust.

k^3. Prothorax concentrically rugose-punctate; elytra only one-fifth longer than broad, in the basal half strongly, in the apical half finely, seriate, somewhat granulose, punctate. **M. laesipes** sp. nov.

Mecistocerus marci Boh.

As is known, this species was at first described as *Cyamobolus marci* Boh., from Java. In the Dresden Museum it is represented by specimens from Batjan, Halmahera, Mysol, Australia, Luzon, and Mindanao. Those from the Philippine Islands were collected by C. F. Baker on Mount Maquiling, Luzon, and at Dapitan and Surigao, Mindanao.

Mecistocerus (Rhadinomerus) granulicollis Faust?

The typical specimen from Burma (Carin Cheba) agrees fairly well in plastic characters with a smaller female from Basilan Island which I hardly believe is identical with it, as the dirty brick-red color forms a short basal stripe on the second interval of the elytra, and the pale ring on the reddish squamose femora is wanting.

Mecistocerus incertus Pasc.

This species was described as a *Berosiris*, from Aru,[58] and I have before me some specimens from southern Celebes and Bangkai collected by C. Ribbe in 1882, others from Sumatra, and also from Mount Banahao, Luzon (*4818 Baker*).

[58] Ann. Mus. Genova 22 (1885) 268.

Mecistocerus sollicitus Faust.

This species is easily distinguishable by the divergent bristles on the edged and rounded lateral margin of the thorax. It was described from Celebes, but occurs also in the Philippines. Its color is somewhat variable, a male from Mount Banahao, Luzon (*4516 Baker*), showing the dark brown discal patch on the elytra divided by a fawn-colored interval. A male from Malinao, Tayabas Province, Luzon, and a female from Los Baños, Luzon, show this patch dissolved into rows of remote dark dots, three situated on the second interval and one or two on the fourth. The length of this species varies between 7 and 11.5 millimeters.

Mecistocerus nigrostriatus Chevr. [59]

This species, described from the Andaman Islands, occurs also in Java, Borneo, and the Philippine Islands; from the last-named I have a female specimen from Zamboanga, Mindanao, before me.

Mecistocerus indigenus Faust.

Mecistocerus indigenus Faust,[60] from Java, occurs also in the Philippine Islands.

LUZON, Mount Banahao. MINDANAO, Dapitan (*13187, 13198*).

Mecistocerus montanus sp. nov.

Niger, antennis articulisque duabus tarsalibus ultimis obscure sanguineis, corpore supra squamositate nigra, albido-variegata, subter cana tecto; rostro in dimidia parte basali carinulis dorsalibus tribus in parte apicale dorso glabro; antennis funiculi articulo primo valde incrassato, septimo sphaerico; prothorace transverso (3 : 3.5) rude crebreque punctato, carinula mediana, utrinque vitta sublaterali ante medium late interrupta cano-squamosa; scutellum punctiforme sphaerico; elytris latitudine plus sesqui longioribus (23 : 37), fortiter punctato-substriatis, punctis apicem versus decrescentibus, singulo fundo squamula, spatiis squamulis remote uniseriatis breviter setiformibus luteis, macula humerali oblonga, altera subrotundata in callo subapicali, reliquis irregulariter marmoratis, femoribus macula subapicali dorsali, tibiis basi dimidiaque parte apicali albido-squamosis; sternito primo, medio, punctis paucis quam metasterni punctis minoribus, sternito secundo praecedenti subtilius punctato.

[59] Naturalist (1882) 143.
[60] Stettin. Ent. Zeit. 57 (1896) 153.

Long. 9 mm., lat. 4.

LUZON, Mount Banahao (*4517*).

Allied to *M. nigrostriatus* Chevr. and *ingenuus* Faust but easily distinguished by the white markings of the chiefly blackish-scaled upper side, consisting of a sublateral stripe on thorax, interrupted before the middle, and a spot on each shoulder and on apical callus of elytra and on dorsum of femora, before apex. The thorax shows a central carinula and a very coarse and dense punctation, the elytra a row of remote luteous scale bristles on the intervals, the femora at base are strongly compressed, the tibiæ at base and apical half white scaled; punctures of first sternite much sparser and finer than those of metasternum.

Mecistocerus (Rhadinomerus) setosipes sp. nov., ♀.

Niger, antennis tarsisque subrufis, corpore parce minuteque, elytris spatio secundo ad basin densius albido-setoso-squamosis, prothorace sat convexo, transverso, maxima latitudine in medio, fortiter crebreque punctato, carinula mediana levi; elytris latitudine sesqui longioribus, punctato-substriatis, striis solum in parte apicali, tribus extremis totis distinctius impressis, punctis ipsorum diametro distantibus, spatiis striis latioribus planiusculis (spatio secundo ad basin subconvexo) ut sutura remote seriato-subgranulatis, fuliginoso et albido-variegato-squamosis; femoribus sat fortiter punctatis ut corpore subter parce minuteque posticorum dente densius, albo-squamosis, tibiis setis erectis, remote seriatis.

Long. 6 mm., lat. 2.8.

LUZON, Mountain Province, Baguio (*5904*).

Because of the slightly thickened femora and the basally impressed profile line of rostrum, this species might be placed in *Rhadinomerus* Faust, which I believe to be only a subgenus.[61] Body black, very sparsely whitish, the elytra nut brown and white squamose marbled; antennæ and tarsi dark reddish brown, second joint of funicle somewhat longer than the thickened first, the four following longer than thick, seventh spheric, club cylindric, twice as long as thick; rostrum on each side of base carinated and, like the head, coarsely punctate; thorax one and one-sixth times broader than long, broadest in the middle, longitudinally rather convex, coarsely and densely punctate, anterior margin finely so, the punctures with a small white scale within;

[61] Ent. Tidskr. Stockholm 35 (1904) 186.

sides with a spotlike, condensed, yellowish squamosity, the central carina abbreviated in front and at base; scutellum punctiform and bare; hind femora extending a little beyond apex of elytra; tibiæ with a series of remote, erect bristles; second joint of hind tarsi pyriform, longer than thick.

Mecistocerus modestus sp. nov.

Niger, supra squamositate subtili aequaliter lurido ac albido-variegata; antennis sanguineis, funiculi articulis quatuor distalibus sphaericis; rostro apice rufescenti, basi carinulis tribus, dorsalibus; prothorace crebre fortiterque punctato, carinula mediana tenui; scutello punctiformi, transverso, glabro; elytris latitudine fere sesqui longioribus (3.4 : 5), punctato-striatis, spatiis duabus, subsuturalibus, striis vix latioribus, ut reliquis remote seriato-subgranulatis, squamulis seriatis, vix eminentibus, luteis; corpore subter aequaliter lurido-squamoso, femora macula dorsali, subapicali, albida; sternito primo, quasi ut metasterno, rude punctato.

Long. 7.5 mm., lat. 3.

LUZON, Laguna Province, Mount Maquiling.

An inconspicuous, dirty-looking species with fine uniformly luteous and whitish varied scaling; thorax with a fine central carina; antennal funicle having the last four joints spheric, becoming gradually larger toward the club; the latter one and one-half times longer than thick, subtruncate at base; elytra seriate-punctate, hardly striate, each puncture bearing a minute whitish scale within; intervals slightly elevated at base, remotely and minutely subtransversely granulate; first sternite as coarsely punctate as the metasternum; femora with a white subapical dorsal patch.

Mecistocerus latiusculus sp. nov.

Niger, antennis sanguineis, parce ochraceo-squamosus ac setosus, prothorace fere semicirculari rude crebreque apice haud punctato, carinula mediana distincta; scutello rotundato convexo, nigro-glabro; elytris punctato-striatis, punctis rectangularibus aut quadratis, approximatis, spatiis aequilatis, in elytrorum triente apicali decrescentibus hic rotundatis ac spatiis multo angustioribus, his solum in dimidia parte basali subconvexiusculis, ut sutura remote seriato-granulosis, corpore subter sat dense ochraceo-tomentoso ac setoso; femoribus posticis elytrorum apicem attingentibus, vix punctatis, tibiis parum punctatis, remote breviterque erecti setosis.

Long. 8 mm., lat. 3.9.

LUZON, Laguna Province, Mount Maquiling.

The single specimen before me is unfortunately worn and therefore appears dull black; it is covered with sparse, dirty clay-colored tomentum and bristles, but in other respects is so different from the known species that it is easily distinguished. Antennæ dark red, first and second joints of funicle of equal length, the first thicker, the third one-third shorter than second, somewhat shorter than fourth, the following gradually decreasing in length; club twice as long as thick, subcylindrical; rostrum with three strong dorsal carinæ on basal half; front with a deep linear impression; thorax transverse (5 : 6.8) and traversed by a median carina; the punctures like those on metasternum, very coarsely and moderately dense; elytra with rows of coarse, rectangular-oblong foveolate punctures, which are as broad as the intervals, these with remotely seriate rough granules; hind femora hardly extending beyond apex of elytra, their basal half dorsally shining, smooth; hind tibiæ slightly compressed and curved, attenuate toward apex.

Mecistocerus compressipes sp. nov., ♂. Plate 3, fig. 4.

Niger, antennis tarsisque rufis, prothorace utrinque vitta, apice abbreviata submarginali dense, elytris variegatim parceque sulfureo-, corpore subter parce albido-squamosis, elytrorum spatiis apicem versus squamulis erectis setiformibus, pedibus adpressis albidis; prothorace crebre apicem versus parcius punctato, carinula mediana tenui, scutello punctiforme, nigro; elytris punctato-striatis, punctis latitudine paulo longioribus, subquadratis, spatiis ut sutura minute remoteque seriato-granulosis, striis paulo latioribus; femoribus posticis in primo triente aequilatis fortiterque compressis margine dorsali nitido-glabro; tibiis posticis compressis, in dimidia parte apicali fortiter attenuatis.

Long. 7 mm., lat. 3.

LUZON, Mount Banahao.

Black, antennæ and tarsi red, thorax on anterior half with a lateral, abbreviated stripe and a speckled, sulphurous squamosity on elytra; rostrum coarsely striate-punctate, with three dorsal carinæ, the middle limited between the eyes by an oblong foveola; antennæ robust, the last four joints of funicle spheric, club more than twice as long as thick; thorax longer than broad (9 : 7), sides nearly parallel in basal half, densely punctate, in front more sparingly so, each puncture with an erect whitish bristle; elytra more than one and one-half times longer than broad (11 : 7), coarsely punctate-striate, second interval more convex at base than the others, and all, like the suture, remotely seriate-granulate; underside minutely whitish squamose, sides of metasternum with coarse foveolate punctures, each of which bears a small squamula; hind femora strongly compressed and bare at base, hind tibiæ scythe-shaped; first joint of hind tarsi one and one-half times as long as the two following together.

Mecistocerus albohumeralis sp. nov., ♀. Plate 3, fig. 3.

Niger, ubique nigricanti-tomentosus, antennis tarsisque rufis, elytris plaga magna humerali, intus striam tertiam tangente, punctis subapicalis atomisque dispersis parce cremeo-squamosis, corpore subter minute parceque albido-squamoso; antennis funiculo robusto, articulo secundo primo vix longiore, rostro in dimidia parte apicali vix perspicue remoteque punctato; prothorace transverso, fortiter crebreque punctato, apice utrinque, ut vertice, ochraceo-squamosis; scutello punctiforme glabro; elytris spatiis striis punctatis latioribus, remote seriato-setosis; femoribus posticis elytrorum apicem distincte superantibus.

Long. 6 mm., lat. 2.7.

LUZON, Mount Banahao.

Black, entirely clothed with a black tomentum; antennæ and tarsi red; elytra with a creamy humeral patch extending within as far as third stria, an apical spot on fourth interval and some dispersed specks of the same color; head and a patch on each side of front margin of thorax fawn-colored; rostrum at base between the three dorsal carinæ with a series of coarse punctures; frons with an oblong impression between eyes; prothorax one-fourth broader than long, coarsely and densely reticulate-punctate, the front part nearly impunctate, each puncture with a setiform scale; scutellum shining black, convex; elytra one and two-thirds times as long as broad (5 : 3), punctate-striate, the punctures rectangular-oblong, as long as intervening distance; hind femora broadly bare on basal half.

Mecistocerus maculipes sp. nov., ♂.

Niger, antennis tarsisque rufis, supra minute parceque ferrugineo-squamosus, maculis punctiformibus, una utrinque thoracis in disco et subter marginem lateralem, altera majore ad spatii primi basin, duabus antemedianis lateralibus, in spatio quinto et octavo, hac posteriore, atomisque dispersis plagaque dorsali, subapicali, in femoribus, albo-squamosis.

Long. 8 mm., lat. 3.8.

LUZON, Laguna Province, Mount Maquiling.

Allied to *M. albohumeralis* sp. nov. and distinguishable by the white-scaled white dots. Rostrum at base with three indistinct dorsal carinæ and there rather densely punctate; the remainder very finely and remotely punctate; first joint of funicle thicker and longer than second, third and fifth cask-shaped, slightly longer than thick, the last spheric, club two and one-half times longer than thick; thorax coarsely but not so densely punctate as in *albohumeralis*, each puncture bearing, behind, a setiform scale; on each side, nearer the sides than the middle line, a small whitish scale dot of the size of scutellum, a similar one occurring below the lateral margin; scutellum rounded quadrate, convex, shining dark brown; elytra one and one-half times as long as broad, coarsely punctate-striate, the punctures nearly as long as the intervals between them, sixth series with smaller punctures at base, seventh and eighth abbreviated near shoulder, first interval with a white basal dot, similar ones at apex of fourth interval, which is more convex, in the first quarter of fifth, and in the first third of seventh and eighth intervals, moreover with dispersed white specks of color and some granules; underside nut brown, the sides of metasternum with a white setiform scale in each of the coarsely cicatrized punctures; femora before apex with a large white dorsal patch, with, at most, a small white dorsal stripe behind the middle; hind femora strongly clavate, the front edge of femoral tooth whitish.

Mecistocerus pictithorax sp. nov., ♂.

M. picticolli Pasc. similis, sed prothorace breviore, lateribus rotundatis, medio haud carinulato, isabellino-squamosus, prothorace dorso, margine laterali lato excepto, nigricante; elytris fuscescenti variegatis, fascia subapicali undulosa, obsoleta, apice, spatio primo secundoque ad basin pallidioribus, fere isabellinis; scutello transverso-rotundato, glabro; elytris utrinque ad saturae basin subtumidis, sutura spatiisque granulis minutis, remote seriatis, setuligeris, plerumque squamositate occultis; tibiis posticis in triente apicali marginis antici longe albido-barbatis.

Long. 7.5 mm., lat. 3.

MINDANAO, Davao Province, Davao.

Very similar to *M. picticollis* Pacs.[61] of which I have before me specimens from Java and Borneo, but the funicle is more robust, and the last two joints moniliform and thicker than long. Prothorax one and one-fourth times as broad as long, the dark dorsal patch trapeziform, without a central carina; scutellum

[61] Journ. Linn. Soc. London 13 (1873) 43, pl. 1, fig. 43, subg. *Berosiris*.

rounded, transverse, bare, dark brown; elytra swollen at base, the first stria in the first quarter coarsely, the others finely, seriate-punctate, the brown spotted intervals with partly naked, remotely seriate granules, which bear a setula, the base of the second and third intervals, a wavy crossband in the second third of length, apex of elytra, and several small dots, as well as underside, isabelline-colored; hind tibiæ in apical third yellowish fasciculate on front edge.

Mecistocerus laesipes sp. nov., ♀.

Niger, latiusculus, antennis tarsisque subrufescentibus, parce, spatio secundo sextoque basi vittatim stramineo-setoso-squamosis; prothorace longitudine sesqui latiore, crebre rudeque punctato, spatiis rugosis, discum circumcurrentibus; scutello punctiforme, glabro; elytris latitudine vix sesqui longioribus, punctato substriatis, punctis in élytrorum tertia parte basali rudis, dein decrescentibus in tertia parte apicali fere evanescentibus, spatiis planis, striis multo latioribus, ut sutura remote minutissimeque seriato-granulosis; corpore subter parce lurido-setoso, femoribus rude ruguloso-punctatis, posticis elytrorum apicem superantibus, tibiis carinula externa, in tertia parte basali arcuatis ac impressione levi ad receptionem dentis femoralis idonea.

Long. 6.5 mm., lat. 3.7.

LUZON, Tayabas Province, Malinao (*5880*).

A comparatively broad species with a sparse squamosity, prevailingly setose and dirty ochraceous, on the elytra speckled and condensed into a stripe on base of second and sixth intervals. Rostrum with three dorsal carinæ at base; antennæ dark red, second joint of funicle as long as the thickened first, third short conical, last three spheric, club hardly twice as long as thick (9 : 5) ; thorax with coarse punctures, arcuate wrinkles between these partly arranged concentrically around an antemedian center, each puncture with a clavate bristle; elytra in first third coarsely, posteriorly finely striate-punctate, punctures rectangular-oblong, intervals remotely granulate; hind tibiæ in first third arcuate, with an impression interrupting the longitudinal carina and arranged for the reception of the point of the femoral tooth.

Tragopus albicans sp. nov.

Oblongo-ovatus, niger albido-squamosus, antennis subrufescentibus, funiculi articulo secundo tribus sequentibus unitis aequilongo, clava crassitudine duplo longiore; prothorace longitudine perpaulo latiore, sulco mediano obsoleto, in secundo triente depresso, margine apicali subcristato, seria transversa e plagis rotundatis, subimpressis, pone medium excepta ubique granulis inaequalibus parce dispersis; elytris oblongo-ovatis, spatiis seriato-granulosis, granulis inaequalibus, praesertim spatii secundi in medio majoribus, raro rugulis transversis confluentibus, spatio primo ad basin callositate oblongo-elliptica, crebre granulosa.

Long. 8.2 mm., lat. 4.

LUZON, Mount Banahao.

Smaller than *T. sablanicus*, the elytra shorter and more convex, broader at base than base of thorax, but differing chiefly by the following: Club of antennæ shorter and thicker, only twice as long as thick; thorax longer than median breadth (3.7 : 3.3), flattened in apical part, apical border slightly elevated and more densely setose, the granules of different sizes, especially those on the disk before the middle, which are larger; elytra broadest in the middle, moderately longer than broad (63 : 48), first interval on base with an oblong granulate callosity, outside of it with a small longitudinal impression; granules of intervals of unequal size, here and there, especially in the middle of the suture and first interval, confluent to form transverse wrinkles.

Tragopus sablanicus sp. nov.

Oblongo-ovatus, niger, dense cinereo-squamosus, thorace elytrisque granulis minutis, glabris, dispersis, in elytris raro rugulis transversis confluentibus; antennis funiculi articulo secundo tribus sequentibus unitis aequilongo; clava crassitudine fere triplo longiore; fronte sulco mediano, prothorace subconico, longitudine latitudine aequali, linea mediana, ut seria transversa e plagis rotundatis, obsoletis, formata, haud granulosis; elytris ovatis, ad basin prothorace haud latioribus, granulis squamulam minutam gerentibus; pedibus albido-squamosis, femoribus posticis plus triente apicali elytra superantibus.

Long. 9 mm., lat. 4.4.

LUZON, Mountain Province, Baguio (*Baker*), Sablan, Bureau of Science accession No. 10321 (*W. Schultze*).

Oblong-ovate, black, closely whitish-scaled, the legs sparsely yellowish gray-scaled; rostrum with erect, setiform scales; antennæ reddish brown, second joint of funicle as long as the two following together, club three times as long as thick; thorax as long as broad at base, fairly densely covered with minute, glossy, black granules, except on the median line and a transverse row of four slightly impressed, roundish spots, close behind the middle; sides very slightly rounded, converging anteriorly; elytra at base not broader than base of prothorax, in the first sixth somewhat broader, from there to apex attenuate; intervals hardly convex, the suture slightly so, beset with granules as on thorax, but each bearing one posteriorly inserted bristle and placed here and there upon irregular transverse wrinkles; legs sparsely, the anterior more densely, covered with white scale bristles, which on the femora arise from coarse, flat punctures, these being seriate on the tibiæ; hind femora exceeding, by their apical third, apex of the elytra.

One of the Baguio specimens differs only by a sharp median carina on the posterior portion of that part of the mesosternum which forms the end of the rostral canal. This may be a secondary sexual character.

Tragopus ornaticollis sp. nov. Plate 3, fig. 5.

Niger, opacus, prothorace vitta mediana elytrisque parce saturate ferrugineo-, vitta prothoracali submarginali, utrinque in medio subcruciforme dilata cremea-, plaga in dimidia parte basali intra vittam nigro-tomentosis; prothorace linea mediana tenui, nigro-denudata, ad basin longitudine perpaulo latiore, lateribus in dimidia parte basali fere parallelis, antrorsum fortiter convergentibus; elytris similiter, ut in praecedenti, sed minus convexe granuloso tuberculatis, apice minus declivi, sutura in medio tuberculo circulari granuloso, altero minore, in declivitatis initio, subconvexo.

Long. 8 mm., lat. 4.3.

LUZON, Cagayan Province, Cape Engaño (*J. Whitehead*), one specimen in the Dresden Museum.

Dull black; antennæ dark ferruginous; a broad median and two sublateral stripes on prothorax, the latter feebly cross-shaped for half its length, dilated, creamy white with a quadrate spot inside of it, basal half of prothorax velvet black; elytra covered with scattered, fine, ferruginous tomentum, denser on the granulate callosities; second joint of funicle as long as the three following together, club not quite twice as long as thick (10 : 6); thorax a little broader than long (3.8 : 3.5), median line smooth, with a furrow on each side before the middle, disk with a few shining granules; elytra with similar callosities but less convex and ferruginous-setose-granulate than in *T. vitticollis*, the apical declivity less sloping; suture before the declivity with a larger, round granule, a smaller one in connection with and behind it.

Tragopus vitticollis sp. nov.

Niger, opacus, rostro a fronte sulco anguloso separata; antennis funiculi articulo secundo primo longiore, fere quatuor articulis sequentibus, moniliformibus, unitis, aequante, clava ovata, crassitudine sesqui longiore; prothorace ad basin longitudine perpaulo latiore, subconico, vitta sublaterali usque in humeris continuata, ochraceo-squamosa, parce nigro-setoso-squamoso, in dimidia parte apicali utrinque impressione longitudinali; elytris latitudine vix tertia parte longioribus, seriato-foveolatis, foveolis setuligeris, spatiis callositatibus granosis, una communi fere circulari in suturae primo quarto, duabus utrinque in spatio secundo et quarto, ante medium et ad declivitatem, his validioribus, sutura declivitatis initio fortiter granoso-cristata, crista ante apicem, rotundato-dilatatum, constricta; corpore subter pedibusque parce ochraceo-setosis, femoribus posticis elytra vix superantibus, apice subincrassatis ac subcurvatis.

Long. 9.7 mm., lat. 5.

MINDANAO, Surigao Province, Surigao.

This and the following species, remarkable for the close, creamy-white, tomentose vitta on each side of prothorax, have the rostrum separated from the frons by an obtuse, angular furrow which coincides with the median furrow of the former. The present species is prevailingly dull black, the anterior and posterior margins of prothorax finely bordered with ferruginous tomentum. Rostrum rugulose, punctate on the apical part; second joint of funicle about as long as the four following joints together, the last three spheric and feebly transverse, club ovate, one and one-half times longer than broad; thorax hardly broader than long (4.6 : 4.4), nearly conical, sparsely and finely punctate, toward the sides more coarsely so; in the apical half, on each side of the median line, with a linear, anteriorly converging impression, elytra lacunose-seriate-punctate, the punctures at least as large as the breadth of intervals, bearing a testaceous scale bristle within; suture in first quarter with a circular, granulose callosity which surrounds scutellum, and another before the declivity which is carinate and constricted at the middle; other more or less elliptic callosities before and behind the middle of second and fourth intervals, larger on the latter; moreover, the anterior half of the intervals bears some minute, agglomerated granules; below, especially the abdomen, closely testaceous setose, legs more sparsely so.

Cydostethus [62] **obliquesignatus** sp. nov. Plate 3, fig. 6.

Ellipticus, niger, supra fuliginoso-, secundum suturam, ut spatiis raro, brunneo-, lineis tribus thoracalibus, elytris fascia obliqua utrinque postmediana, a stria secunda usque ad marginem lateralem, hic dilatata, extensa lituraque, oblonga, apicali, ut corpore subter, pallide ochraceo-squamosis; rostro rufescenti, fortiter crebreque punctato, dorso in medio vitta levi; prothorace minute remoteque granuloso, lateribus in dimidia parte basali fere parallelis, dein rotundato-convergentibus, in quinta parte apicali fortiter attenuatis; elytris sutura spatiisque alternatis, convexioribus, latioribus ac crebrius granulosis; femoribus anticis reliquis longioribus, dente majore armatis.

Long. 5.7 ad 7.6 mm., lat. 2.4 ad 3.2.

LUZON, Laguna Province, Mount Maquiling.

Cydostethus lineolatus Pascoe [63] also has three ochraceous vittæ on the prothorax; the remaining whitish pattern is said to be variable. The sculptural characters presented by the Philippine species were not mentioned for *lineolatus*.

Rostrum coarsely and densely punctate, except a broad, short, smooth, dorsal stripe in the middle; antennæ dark red, second joint of funicle hardly longer than first, the following gradually decreasing in size, fifth as long as thick and spheric like the remaining ones, the last transverse, club more than four times longer than thick; prothorax very minutely, scatteredly granulate; elytra hardly punctate in the striæ, the suture and alternate intervals broader, more convex, and densely granulate; sides of metasternum and its episterna remotely punctate; anterior tibiæ brownish, compressed in basal half.

Pascoe has placed the genus *Cydostethus* near *Cyamobolus* and *Euthyrhinus;* but because of the absence of ocular lobes one could be misled into placing it near *Moemactes*, following Lacordaire's key.[64] Supplementary to Pascoe's diagnosis may be mentioned the fact that in *Cydostethus* the eyes are very finely granulate and separated in front by nearly half the breadth of the tibiæ. The scape does not reach the eye, the two basal joints of funicle are elongate, the femora beneath are without a furrow fitted to receive the tibiæ. The base of elytra is lobately produced, the end of rostral canal is excavated as in *Gasterocerus* and dissimilar in the scaled excavation shown by *Euthyrhinus.*

[62] Journ. Linn. Soc. London 12 (1873) 37.
[63] Loc. cit.
[64] Gen. Insect. 7: 105.

Cyamobolus definitus sp. nov. (non var.).

C. sturmi affinis, sed paulo augustior, prothorace minus transverso, parcius punctato; elytris striarum punctis plus elongatis, spatio primo callositate subbasali oblonga, ut reliquis (linea laterali- et baso-marginali, circumscutellari alteraque transversa, in secundo triente et longitudinali in spatii secundi dimidia parte apicali, albidis, exceptis) nigro-squamosis.

MINDANAO, Davao Province, Davao (*7317 Baker*). SAMAR, altitude 500 feet, about 150 meters (*J. Whitehead*).

Since the publication of the name *C. sturmi* var. *definitus* Heller [65] I have received further specimens which induce me to erect this form into a distinct species. It is distinguished by the basal band surrounding the scutellum, the oblong, black-scaled callosity at base of first interval, and the broad first punctate row which is at least as broad as the suture, the punctures of which are one and one-half times longer than broad.

Zeugenia rosacea sp. nov.

Z. histrio Pasc.[66] valde affinis, differt; antennis funiculi articulo tertio quartoque subcylindricis, crassitudine duplo longioribus, tribus ultimis, subconicis, crassitudine vix sesqui longioribus, clava crassitudine duplo longiore, ovata; prothorace transverso, lurido- et rosaceo-, in dimidia parte basali macula mediana, ovata, albo-squamosis ac similiter ut in histrio fasciculis nigris notato; scutello circulari, albido-squamoso; elytris plaga humerali obliqua, in spatio secundo ultra medium ducta, rosaceo-, macula minuta, oblonga in primo et secundo triente spatii quarti et in secundo triente spatii secundo albido-, hoc praeterea fasciculis tribus remotis nigro-fuscis, uno postmediano rosaceo-, illo, uno subbasali, altero postmediano, nigro-fuscis, reliquis cervino-squamis, punctis, nigris, dispersis; corpore subter pedibusque rosaceo-, femoribus basi maculaque antemediana albido-squamosis.

Long. 5.8 mm., lat. 3.

MINDANAO, Zamboanga Province, Zamboanga.

Pascoe has described three very closely allied species of this genus. The Philippine species before me stands next to *Z. histrio* Pasc., as figured by him, and differs by the antennæ having the third and fourth joints of funicle subcylindric, twice as long as thick, the three apical joints hardly one and one-half times longer than thick, the club twice as long as thick. More striking is

[65] Philip. Journ. Sci. § D 10 (1915) 233.
[66] Journ. Linn. Soc. London 11 (1871) 197, pl. 8, fig. 11.

the pinkish color of all parts, which are ochraceous in *Z. histrio,* the darker parts of the elytra being fawn spotted with black, the basal patch of prothorax ovate, not extending in front beyond the two blackish discal fascicules, the pinkish humeral stripe reaching beyond the middle on the second interval, the latter in the basal half with two brown fascicles; in the apical half with three, one brown, pinkish and white, a white one in the third interval before the middle, and a brown and white one behind the middle. These fascicles form three transverse rows, one at the base, another behind the middle, and the third in the third quarter. Below, except the whitish abdomen, moderately densely pinkish scaled, a spot on apex of femora white scaled.

Rhadinopus pseudofrigidus sp. nov.

Rh. centiniformi Faust [67] affinis, sed minor, elytris aliter Cryptorhyncho frigido F. similiter, pallide signatis, niger, ochraceo-squamosus, antennis rufis, fasciculi articulo primo crassitudine triplo (in centriniformi vix duplo) longiore, secundo primo aequilongo, 3. ad 5. crassitudine paulo longiore, duabus ultimis sphaericis; rostro in dimidia parte basali carinula dorsali acuta; prothorace transverso, rude crebreque punctato, longitudinaliter rugoso-carinulato, carinula mediana distincta; scutello elliptico; elytris litura straminea humerali ad suturae medium currente, spatiis, praesertim 2. et 5. acute carinatis; corpore subter similiter ut in centriniformi squamoso, sed squamulis apice nunquam bilobatis, femoribus vix dentatis, posticis dorso fere rectis.

Long. 6 mm., lat. 3.3.

LUZON, Bataan Province, Lamao (*H. E. Stevens*), Bureau of Science accession No. 9802.

Allied to *R. centriniformis* Faust, but smaller and distinguished by the following characters: Antennæ red, first joint of funicle nearly three times longer than thick at apex; thorax transverse, subconical, broadest at base, upper side besides the central carina with abbreviated, parallel, longitudinal wrinkles, between these coarsely punctate, each puncture bearing a brownish scale (not bilobate as in *centriniformis*) ; scutellum somewhat immersed, elliptic and squamose; elytra clothed with sparse ochraceous scales, a straw-yellow stripe running obliquely from shoulders to middle of suture, intervals, especially the second and fifth, carinate; femora indistinctly toothed, the posterior with slightly wavy lower edge.

[67] Ann. Mus. Genova 34 (1894) 289.

Rhadinopus borneonis sp. nov.

Niger, ochraceo-, elytris basi anguste nigro-squamosis, antennis rufescentibus, funiculi articulo primo incrassato, crassitudine duplo longiore, articulo secundo angustiore, primo aequilongo, duobus sequentibus crassitudine paulo longioribus, tres ultimis sphaericis, clava crassitudine duplo longiore; prothorace carinula mediana solum ad basin manifesta; scutello circulari, squamoso, carinula mediana levi; elytris spatiis subcostatis, solum penultimo carinulato; corpore subter parce, femoribus densius squamosis, his distincte dentatis.

Long. 8 mm., lat. 4.8.

BORNEO, Sarawak, Kuching, March 5, 1900, from the Sarawak Museum.

Distinguished by the comparatively strong tooth on the underside of femora and the narrow black base of elytra. Antennæ reddish brown, the first joint of funicle twice as long as thick and as long as the second.

Rhadinopus javanicus sp. nov.

Niger, nigrofusco-, elytris in triente basali, macula basali, intrahumerali, nigro-denudata, excepta, pallide ochraceo-, corpore subter parce ochraceo-squamosis; antennis rufis, funiculi articulo secundo primo, crassiore, distincte longiore, 3. ad 5. crassitudine fere sesqui, ultimo perpaulo longioribus; prothorace rude crebreque punctato, spatiis tenuiter longitudinaliterque undulato-rugosis, punctis plerumque setulis fuscis, rare squamis ochraceis gerentibus; scutello rotundato-rhomboidali, elytris spatiis acute carinatis; femoribus minute dentatis.

Long. 6.5 mm., lat. 3.8.

JAVA, from the collection of J. Faust, in the Dresden Museum.

This species differs from the closely allied *R. pseudofrigidus* by the longer second joint, the very elongate penultimate joints of the funicle, and the longitudinally undulate rugosities between the punctures of prothorax. Each puncture bears a bristle which is mostly blackish, seldom a fawn-colored, not very pointed, simple scale. The squamation of elytra is blackish brown in most of the posterior part; in the outwardly narrower basal third pale ochraceous, except a blackish, transverse, basal patch on shoulders and the partly naked suture. The striæ are coarsely punctate, much broader than the finely carinate intervals, the punctures only in the pale basal part of elytra occupied by an ochraceous scale. Femora minutely dentate, the anterior ones more distinctly so; posterior femora hardly reaching apex of elytra.

Key to the species of Rhadinopus.

a^1. Prothorax broadest at base.
  b^1. Elytra with a round or oblong basal emargination of suture for the reception of scutellum.
    c^1. Elytra in anterior half partly paler squamose.
      d^1. Elytra in anterior half predominantly paler squamose.
        e^1. Scales of prothorax cordiform or two-pointed. **R. centriniformis** Faust.
        e^2. Scales of prothorax neither cordiform nor two-pointed, the interstices between punctures without wrinkles, parallel to the central carina; basal emargination of suture nearly circular .... **R. javanicus** sp. nov.
      d^2. Elytra in basal half with a pale stripe, running from shoulder to middle of suture, basal emargination of which is oblong; prothorax with wrinkles running parallel to the central carina. **R. pseudofrigidus** sp. nov.
    c^2. Elytra with a narrow black basal band, otherwise equally ochraceous-squamose .... **R. borneonis** sp. nov.
  b^2. Elytra with transverse basal emargination of suture for the reception of the transverse scutellum .... **R. consputus** Faust.
a^2. Prothorax broadest in the middle .... **R. pascus** Faust.

Coelosternus philippinensis sp. nov. Plate 3, fig. 7.

Niger, saturate ferrugineo-, prothorace maculis duabus nebulosis, elytris utrinque maculis lineoliformibus circiter sex (tribus ad basin in medio, post medium et ante apicem in spatio primo, duabus in spatio quarto, praeterea 2 ad 3 lateralibus) nigro-, macula humerali ochraceo-squamosis, spatiis squamulis setiformibus, remote seriatis, pallidioribus; antennis rufescentibus, funiculi articulo secundo primo sesqui longiore, reliquis decrescentibus, septimo sphaerico, clava crassitudine duplo longiore; prothorace transverso, lateribus antrorsum rotundato convergentibus; scutello rotundato, minute squamoso, basi puncto glabro; elytris rude striato-punctatis, spatiis subcristato-elevatis, lateralibus seriato-subcrenulatis; corpore subter sat remote grosseque punctato, punctis squamula albida, in meta-episternis-uniseriatis, squamula ochracea repletis; femoribus inter dentem medianum et apicem dente secundo minutissimo, tibiis longitudinaliter carinulatis.

Long. 8 mm., lat. 4.

LUZON, Mount Banahao.

Black; above predominantly dark reddish brown, a few black spots, shoulders ochraceous squamose; rostrum on basal half with three dorsal carinæ and bristle-bearing punctures; frons foveolate; antennæ dark reddish brown, second joint of funicle one and one-half times longer than first, the last two spheric, club elliptic, somewhat longer than the three preceding joints of funicle together; prothorax one and one-half times as broad as long, broadest at base, with a smooth median line and clothed with larger brown or black scales, the latter condensed on each side of disk into a black dot, and moreover with some smaller hornlike transparent scales which form a double median line in the anterior half; scutellum roundish, sparingly setose-squamose, the base smooth in the middle; elytra broadest at base, there broader than prothorax, proportionately shorter, as in *C. loripes* and *C. dentipes*, the alternate intervals more convex, the punctures of striæ very coarse, as broad as the intervals, and each filled by a scale; along the suture and on shoulders covered with long, adpressed scales; intervals with series of erect, remote setiform scales, the second with four, the fourth with three, the sides with two or three lineolate black spots; moreover here and there with aggregated bluish white hyaline and vesiculous scales; below very coarsely punctate, each puncture filled by a white scale, meta-episterna with only a single row of quadrate punctures; hind legs with a second, minute tooth, hind tibiæ with fine carinulæ.

Roelofs [68] has described four non-American species of *Coelosternus* as questionably of this genus, from Japan, while the other species, enumerated by Gemminger and Harold,[69] for the Oriental Region, belong mostly to the genus *Lobotrachelus*. I have before me only *Coelosternus* (?) *electus* Roelofs, determined by D. Sharp, which is distinguished from Schönherr's first section by the shorter oblong-ovate instead of cylindric club; but, notwithstanding this, it is best placed in this genus. Lacordaire [70] mentions as particularly characteristic for *Cryptorhynchus* and *Coelosternus* a band of mostly golden-yellow bristles on the outside of the apical part of hind tibiæ, such band being absent in *C. philippinensis* but present in the following, very closely allied species from Java:

Coelosternus javanus sp. nov.

C. philippinensi sp. nov. valde affinis, sed differt: squamositate pallidiore fere numquam maculis nigris intermixta, ad humeros albicante, elytris apicem versus minus attenuatis, sutura in dimi-

[68] Ann. Soc. Ent. Belg. 18 (1875) 168–172.
[69] Cat. Col. 8 (1871) 2574.
[70] Gen. Col. 7: 123.

dia parte basali inter marginem et striam primam granulis nitidis, manifestis, remote seriatis, metasterno utrinque ad rostri receptaculum praeter squamositatem longe pallide setoso.

Long. 8 mm., lat. 4.

JAVA (*Staudinger*), from the collection of J. Faust.

Faust has labeled this species in his collection as *Cryptorhynchus aversandus* Faust in litt. It differs from *Coelosternus philippinensis* sp. nov. by the posteriorly less attenuate elytra, the paler rust-red and whitish squamation, the lack of black spots, the remote and minute but acute granules on the anterior half of suture, the carinate lateral intervals, and the whitish erect bristles on mesosternum on each side of rostral canal. The hind femur shows, as in *philippinensis*, a minute granule-like second tooth between its tooth and its apex.

Sybulus calidus sp. nov.

Sat late ovatus, ferrugineus, subter subrosaceo-albido-, supra cervino-, parce seriatim erecteque albido-, thorace utrinque vitta discoidali, antrorsum attenuata, elytris lineolis, una utrinque in spatio primo, ante et post medium illa tenui, interdum indistincta, hac latiore, maculiforme, altera in spatio quarto ad basin, fusco-nigro-, linea mediana, thorocali, cruciforme, altera latiore, interdum obsoleta, a humeris ad suturae medium currente spatioque primo, post maculam obscuram, post medianam, plus minusve albido-squamosis; antennis ferrugineis, funiculi articulo secundo primo, crassiore, aequilongo, tertio praecedenti dimidia parte breviore, tres ultimis fere moniliformibus, clava fusiforme, funiculi articulis sex praecedentibus aequilonga, crassitudine plus duplo longiore; femoribus omnibus bidentatis, posticis inter-mediisque macula obsoleta fuscescenti.

Long. 5 mm., lat. 3.

LUZON, Laguna Province, Mount Maquiling.

As Pascoe himself mentioned, the characters relating to the antennæ cannot stand. Lea [72] also describes a *Sybulus* from Cape York with different antennæ and sees the principal characters of this genus in the coarsely granulate eyes, the proportionately longer rostrum, the cylindrical club, the slightly excavate rostral canal, and the bidentate femora, which are furrowed beneath.

I have before me a species from New Guinea that, in spite of Pascoe's different drawing of the antennæ, I take for *peccua-*

[72] Proc. Linn. Soc. New South Wales 32 (1907) 429.

rius Pasc., from Batjan. From this and from another species from Borneo, the Philippine species differs chiefly by the squamation. Its ground color is dark reddish brown, the upper side covered with fawn-colored scales, the underside with sparse, reddish white scales; prothorax with a whitish cross-shaped or sagittate marking on the disk, limited along each side by a brown stripe; elytra with a whitish band, running from shoulder to middle of suture, first interval before and behind the middle, and fourth interval at base, with a short blackish brown streak, and like the others with erect, oblong, white scales, condensed on first interval, behind the postmedian dark streak, to a white stripe; antennæ reddish yellow, scape hardly reaching anterior margin of eye, second joint of funicle as long as the thickened first and half as long as the third; frons coarsely and densely punctured with a small brown dot between the eyes; prothorax transverse (5 : 8), the base somewhat the broadest, coarsely and very closely punctured, and with large scales; scutellum rhomboidal, sparingly and minutely scaled; elytra broader and more densely squamose than thorax, punctate, striate, fifth and sixth striæ impressed at base, the punctures of striæ rather closely seriate and each filled by an oblong, adpressed, whitish scale; the fawn-colored and whitish scales of intervals roundish, the erect brown and seriate white scales oblong-triangular; fourth and sixth intervals convex on base; hind femora not extending beyond fourth sternite, tibiæ broadest at base, gradually attenuate toward apex, the fine longitudinal carinæ mostly covered by the scales.

Nechyrus bifasciculatus sp. nov.

Niger, opacus, prothorace sat dense grosseque, elytris parce minutissimeque, cano-squamosis, his spatio primo pone basin tuberculo, in suturae parte mediano lineola, altera in spatio secundo, ante declivitatem, subcristatis, nigro-velutinis; antennis funiculi articulo secundo primo tertia parte longiore, reliquis moniliformibus, septimo transverso-globosi, clavae adpresso; rostro in dimidia parte basali carinula dorsali ac crebre fortiterque, in parte apicali minute punctato; prothorace lateribus rotundatis, carinula mediana tenui; scutello minuto hemisphaerico, ochraceo-tomentoso; elytris foveolato-striatis, foveolis dorsalibus ellipticis, earum longitudine inter se vix distantibus, spatiis punctis perpaulo latioribus, ut sutura in triente basali, granulis nitidis remotis, solum ad humeros acervatis; corpore subter parce, femoribus sat dense albido-, tarsis dense cano-, tibiis nigricanti-squamosis.

Long. 9 mm., lat. 4.5.

MINDANAO, Zamboanga Province, Zamboanga.

Somewhat similar to *N. cristatus* Faust, but the white-scaled thorax without black-scaled, longitudinal stripes, moderately densely punctate, not all punctures filled by a white scale, disk with a smooth median carina; antennæ black, second joint of funicle more than one and one-half times longer than first, the following spheric, seventh slightly thicker than long, club one and one-half times longer than thick; thorax hardly broader than long (3.7 : 3), the sides feebly rounded; scutellum minute, hemispheric, yellowish-scaled; elytra not quite one and one-half times longer than broad (7 : 5), sides parallel in basal half, dull black, more sparsely covered with much smaller scales than prothorax, apparently unscaled if seen with the naked eye, foveolate-punctate-striate, the inner striæ hardly impressed, the punctures elliptic, each distant from the other by its length, on anterior border of cavity a black seta, inserted from behind; intervals a little broader than striæ, second and fourth more distinctly convex than the others, second in the middle fifth slightly convex and near the base with an oblong callosity, both black, like the second third of suture and some lateral spots; intervals throughout, suture in anterior half, with a row of remote smooth granules; below coarsely punctate, covered with pale, scattered, roundish scales; femora coarsely rugose-punctate, with similar but longer and denser scales, and interspersed with black setæ; tibiæ black setose, tarsi densely white-scaled, posterior femora extending distinctly beyond apex of elytra.

Nechyrus humerosus sp. nov.

Praecedenti similis ac affinis, sed supra parce unicolor ochraceo-squamosus; prothorace apice et utrinque in disco squamulis nigris maculatim fasciculatis, lateribus in dimidia parte basali postrorsum subdivergentibus, angulis posticis subacutis; elytris ad humeros productis ac oblique truncatis, ad truncaturae angulum externum (ut in humeralis Faust) maxima latitudine, foveolato-striatis, foveolis plus minusve rotundatis, spatiis punctis paulo latioribus, ut in bifasciculato alternatis convexioribus ac partim nigro-costato-fasciculatis, praesertim spatio secundo, pone basin, tuberculo oblongo, nigro-fasciculato, distincto.

Long. 10 mm., lat. humeralis 5.

SAMAR, altitude 500 feet, about 150 meters (*J. Whitehead*), received from Staudinger.

Elytra as in *N. humeralis* Faust,[73] produced and obliquely truncate at shoulders, otherwise similar to the preceding (*N. bifasciculatus*) but distinguished as follows: Rostrum at base only a little more coarsely punctate, without dorsal carina; thorax broadest at base, there one-seventh broader than long, lateral margin in posterior half hardly converging toward base, sides with a few smooth granules, hind angles acute, disk carinulate in the middle and with a transverse row of four black, fasciculated spots, the anterior margin with two such spots, scales like those of elytra, minute, remote, ochraceous; scutellum hemispheric, yellowish-scaled; elytra with rows of more or less roundish or quadrate punctures, which are never distinctly oblong; an elevated stripe on declivity of suture, a tubercle at base, and an elevated stripe in the middle of second interval black-scaled; femora covered prevailingly with ovate and sparser lanceolate scales.

Nechyrus lineicollis sp. nov.

Aterrimus, prothorace in dimidia parte basali linea mediana elytrisque, his perminute remoteque, luteo-squamosis, spatio primo ante declivitatem, secundo pone basin et ad declivitatem, 3. et 4. solum ad declivitatem, macula oblonga, nigro-fasciculata, posterioribus fasciam obliquam formantibus, prothorace longitudine paulo latiore, rude crebreque, apicem versus subtilius punctato; scutello minuto, subacuminato-rotundato; elytris prothorace latioribus, punctato-substriatis, spatiis convexiusculis, striarum punctis oblongis confertis; corpore subter parce minuteque luteo-squamoso, metasterno sternitoque primo nitidioribus, femoribus rude crebreque punctatis, tibiis, praesertim posticis, nigro-fimbriato-squamosis.

Long. 7.2 mm., lat. 3.7.

LUZON, Mount Banahao (*4515*).

Dull black all over, covered with scattered, minute, luteous scales, a median stripe on posterior half of prothorax with larger and denser scales, metasternum and first sternite glossy, remainder minutely and remotely luteous-scaled; rostrum on basal half coarsely, somewhat seriately, finely punctate; antennæ

[73] Ann. Mus. Genova 40 (1900) 77. This species is chiefly distinguishable by a transverse row of four tubercles on the declivity, the inner two of which are much larger than the outer.

dark red, inserted in the middle of rostrum, first and second joints of funicle elongate and equal in length, third and fourth short, conic, fifth to seventh spheric, the last transverse, club ovate, not quite twice as long as broad; thorax hardly broader than long, subconical, sparsely blackish setose, irregularly coarsely and closely punctate, in front more sparsely so, punctures varying in size, in the apical half with a fine, smooth median line; scutellum roundish, finely, sparsely, and yellowish-haired; elytra punctate-striate, dorsal stripes less impressed, coarse punctures oblong, the distance between them less than the length of a puncture, second interval near base, first to fourth intervals on the declivity, with a short, bristly stripe, followed behind by a smooth spot; femora coarsely and densely punctate; tibiæ, especially the posterior, black fimbriate.

Odosyllis albolinea sp. nov.

O. intricatae Faust[74] affinis, sed differt: prothorace minus transverso (4.2 : 3.5), subconico, multo subtilius dense punctato, elytris in dimidia parte basali, spatiis planiusculis, tertio in dimidia parte apicali, minori dense albido-squamoso.

Long. 10 mm., lat. 4.5.

LUZON, Nueva Vizcaya Province, Imugan.

Closely allied to *O. intricata* Faust, but more shining; antennæ with much slenderer funicle; prothorax less transverse, less constricted in front, with much finer punctures, each filled by a circular white scale. Intervals in basal half nearly flat, broader than the striæ, in apical half, especially on sides, distinctly costate and there hardly broader than the striæ, third interval in apical half densely white-scaled; abdomen with large, white, dispersed scales; femora and tibiæ with scattered salmon-blue scales, the latter much more compressed, as in *O. intricata*, and fringed with black, spatuliform scales on outer edge.

Odosyllis subsulfurea sp. nov.

Fusco-niger, antennis subrufescentibus, corpore omnino, mesosterno, metasterno, sternito primo, inter coxas, pedibusque albido-squamosis exceptis, sulfureo-squamoso; rostro, basi excepto, glabro; prothorace transverso, in triente apicali fortiter attenuato, perparce irregulariterque granuloso; scutello rotundato, nigro-glabro, in dimidia parte basali utrinque puncto niveo-squamoso; elytris punctato-striatis, spatiis planis, ut sutura granulis perpaucis remotis, sutura apice spinosa; femoribus posticis elytra vix

[74] Stettin. Ent. Zeit. (1890) 75.

superantibus, tibiis posticis ut anticis fortiter compressis, latis margine exteriore curvatis, secundum marginem maxima parte nigro-squamosis.

Long. 4.5 ad 7 mm., lat. 2.5 ad 3.2.

LUZON, Mount Banahao (*8444*), Mount Maquiling.

Blackish brown, except mesosternum, metasternum, intercoxal process of first sternite, and legs, which are whitish; elytra somewhat densely and unequally yellowish-scaled; scutellum round, smooth, with a characteristic snow-white scale spot on each side of basal half; rostrum finely and dispersedly subseriate-punctate, at base more coarsely punctate; antennæ red, first and second joints of funicle of equal length, each longer than third and fourth together, fourth longer than the two succeeding joints, sixth slightly transverse, seventh strongly so (5 : 7), the last pubescent and adpressed to the elliptic club, which is twice as long as broad; frons between eyes with an indistinct, longitudinal impression and scattered black scale spots; prothorax transverse, with a median furrow at base and scattered, black, shining granules except on a transverse area on basal half. Base of elytra less produced on inner half, and less emarginate on outer half, as in *Euthyrhinus meditabundus*, the striæ finely and densely seriate-punctate, intervals even and, like the acutely produced suture, with many distantly seriate granules, forming about the middle of the suture a loose group extending on each side nearly to the fourth stria; hind femora extending slightly beyond apex of elytra, on the outside carinate, covered with scales as large as, but less dense than, those of the metasternum; fore and hind tibiæ broad, strongly compressed, outer edge curved and broadly black, here and there white-scaled.

Odosyllis chlorizans sp. nov.

O. subsulfurea affinis, sed supra variegatim pallide aeruginoso-squamosa, rostro validiore, basi rude subseriato-punctato, prothorace multo crebrius minuteque granuloso; scutello oblongo-elliptico, nudo; elytris paulo inaequalibus spatiis, praecipue secundo, convexioribus, in dimidia parte basali sat crebre, in parte apicali confertim uniseriato-granulosis, meso-, metasterno abdomineque ut pedibus minute minus dense albo-squamosis.

Long. 8 mm., lat. 3.9.

LUZON, Laguna Province, Mount Maquiling.

Black, upper side covered with fine, pale verdigris-colored scales, partly black-cloudily denuded; rostrum stouter than in *O. subsulfurea*, strongly and densely punctate at base and there with a fine, median carina; antennæ reddish brown, club black, second joint of funicle as long as first, equal in length to the two and one-half following joints together, seventh a little broader than long, conical; prothorax unequally, densely and finely granulate, each granule bearing a short, anteriorly directed, black bristle; scutellum elongate, elliptic, bare; elytra produced at apex of suture into a point; intervals, especially the second, convex and rather densely uniseriate-granulate only in the apical half, but the granules much closer together than in *O. subsulfurea;* below moderately densely covered with whitish scales, only those on prosternum verdigris-colored; hind femora without a lateral carinula; tibiæ very similar to those of *subsulfurea,* strongly compressed, the posterior cultrate; tarsi white setose on the back.

Odosyllis sellata sp. nov.

Isabellino-squamosa, elytris macula basali, inter striam secundam et quartam plagaque communi discoidali, postmediana, transverso-ovali usque ad striam quartam extensa, fuscis; prothorace transverso, lateribus fortiter rotundatis dorso ubique sat remote granuloso; scutello convexo, squamoso, subtransverso; elytris spatiis aequiminute ac remote, in spatio 7. et 8. artius seriato-granulosis, sutura apice spina communi.

Long. 12 mm., lat. 5.5.

MINDANAO, Zamboanga Province, Zamboanga.

Of the same size as *O. crucigera,* but sides of thorax more rounded; upper side all over, except outer third of basal margin, equidistantly granulate, the seriate granules of the intervals equally minute and rather remote; scales isabelline-colored, a small roundish spot at base of elytra between second and fourth striæ and a larger, blackish brown one, common to the two elytra, transverse ovate, behind middle of suture, extending to fourth stria; a short black streak on shoulder bare; second joint of funicle as long as the two following together, these and the fifth of the same length, a little longer than thick, the last as long as thick; prothorax broader than long (11 : 8.6) with an indistinct median impression in basal half; elytra produced at apex into a point, the seventh and eighth intervals somewhat more densely striate-granulate than the others; hind femora on the outside with an indication of a longitudinal carina.

Odosyllis bilineola sp. nov.

O. pauxilla affinis, sed plus aequaliter ac pallidius griseo-squamosa, antennis funiculi articulis 3. ad 7. fortiter transversis;

prothorace plus transverso, elytris apice mucronatis, spatiis alternatis, praesertim septimo, convexioribus, macula suturali quadrata ad scutellum, lineola in spatii tertii primo triente fuliginoso-, vitta, vix observanda a humeris usque ad suturae secundum trientem currente, ut spatio septimo corporeque subter, pallidius squamosis.

Long. 6 mm., lat. 3.

LUZON, Mountain Province, Baguio.

Closely allied to *O. pauxilla*, but distinguished by the shorter and more robust antennæ, the last three funicular joints of which are strongly transverse; by the broader thorax (3.4 : 4.9), the sides of which diverge posteriorly in the basal two-thirds; by the sparser granulation; and by the remotely granulate intervals, the second of which bears four approximate granules behind the basal impression. A quadrate sutural spot behind scutellum and first third of third interval nut brown, an indistinct oblique vitta, passing from shoulder to second third of suture, whitish; sides of prosternum pure white scaled.

Odosyllis octopunctata sp. nov.

Fusco-niger, prothorace subrufescenti, antennis fulvis; prothorace confertim subgranuloso-punctato, sat dense luteo-squamoso, basi utrinque macula nivea, elytris simplice profundeque striatis, spatiis seriebus 2 vel 3, e squamulis luteis formatis, spatio tertio ante medium puncto, ad declivitatem, ut septimo in medio, lineola, prosterno dense, abdomine minus dense, niveosquamosis.

Long. 2.8 ad 3.1 mm., lat. 1.5 ad 1.8.

LUZON, Laguna Province, Los Baños and Mount Maquiling.

This species, easily recognizable by the white-scaled spot markings, is of a blackish brown ground color, the depressed apex of rostrum and thorax more reddish, only the antennæ yellowish, stout, the scape hardly three times longer than thick, funicle scarcely twice as long as scape, its last four joints transverse, gradually increasing toward the ovate club which is hardly twice as long as thick; prothorax densely, somewhat granulate-punctate, its base forming a slight convex curve, like vertex and elytra sparsely covered with luteous scales; scutellum bare; elytra simply and strongly striate, third interval before the middle with a quadrate white spot; second third, seventh interval in the middle, and prothorax on each side at base with a short white-scaled stripe; prosternum and middle of metasternum very densely, the abdomen and the legs more sparsely, covered with white scales; femora minutely dentate, without a longitudinal carina; tibiæ carinulate.

Odosyllis octopunctata var. cervina var. nov.

Praecedenti valde affinis sed paulo major, elytris dense cervino-squamosis, spatio tertio ante medium macula minuta subquadrata, spatio septimo, octavo margineque laterali in secundo triente macula communi multo majori albo-squamosis; prothorace utrinque macula basali nulla.

Long. 4 mm., lat. 2.

LUZON, Laguna Province, Paete.

Differs from the typical species by its larger size; absence of basal spots on each side of thorax; the denser fawn-scaled elytra which show only on the third interval before the middle a small, subquadrate patch and a larger, lateral one common to the seventh and eighth intervals; and the white-scaled lateral margin.

Perhaps later more specimens will necessitate the specific separation of this form.

Odosyllis eubuloides[75] sp. nov.

Niger, ochraceo-squamosa, elytris plaga dorso-basali, triangulare, suturae medium attingente, nigra; antennis subrufescentibus, funiculi articulo secundo primo sesqui longiore, 3. ad 7. crassitudine perpaulo longioribus, octavo aequante; prothorace fortiter transverso, utrinque ad marginem lateralem et ad basin granulis paucis acervatis; scutello subrotundato, nigro-glabro; elytris latitudine minus sesqui longioribus, spatiis alternatis subconvexioribus, per totam longitudinem, reliquis in triente basali ac manifeste, sutura ut margine apicali minute, seriato-granulosis; corpore subter pedibusque dense squamosis, his praeterea remote minuteque setoso-granulosis.

Long. 7.2 mm., lat. 4.

LUZON, Tayabas Province, Malinao.

Black, luteous; a large basal patch on elytra, acuminate behind and reaching middle of suture, black, brownish-scaled toward base; rostrum reddish on apex, rugulose along basal part, the rest hardly perceptibly punctate; antennæ dark brown, second joint of funicle one and one-half times longer than first, the following scarcely, eighth not longer than thick, club not quite twice as long as thick (9 : 5) ; an indistinct medial spot on vertex, and another above eye, paler-scaled than remainder of head;

[75] This name is given because of the resemblance to *Eubulus triangularis* Boh., a Brazilian weevil.

thorax transverse, broadest at base, on each basal angle with an accumulation of 6 to 8, and below the lateral margin with numerous, shining, brown granules, on the attenuate apical part with dissociated yellowish brown bristles; scutellum roundish, convex, smooth, dark brown; elytra not quite one and one-half times longer than broad (3 : 2.2), not broader at base than base of prothorax, broadest in the first third, apex not produced into a point, striæ fine, the alternate intervals slightly convex, extending as far as basal patch; sides in the first third like the suture, but this more minutely, remotely seriate-granulate; underside covered with large circular scales, these longer in forepart of body, femora with longer, scattered, scaled bristles; anterior femur with a strong tooth, the others unarmed, the posterior reaching nearly to apex of elytra.

Odosyllis albifrons sp. nov.

Niger, pallide isabellino-squamosa, fronte macula rotundata, prothorace macula nebulosa in angulis posticis, elytris fascia obliqua indistincta, posthumerali, puncto subapicali maculisque punctiformibus paucis, albido-, macula oblongo in spatii tertii et quarti basi, nigro-squamosis; prothorace transverso (4 : 6), lateribus rotundatis, in quarta parte anteriore fortiter angustatis, sat crebre, maculis basalibus pallidis exceptis, nitido-granuloso, in dimidia parte basali linea mediana tenui, nuda; scutello rotundato-quadrato, nigro-glabro; elytris spatiis alternatis vix convexioribus, ut sutura minute remoteque seriato-granulatis, femoribus posticis elytrorum apicem haud attingentibus.

Long. 7 mm., lat. 3.8.

LUZON, Laguna Province, Mount Maquiling.

Black; pale isabelline-colored varying to fawn, an elliptic frontal spot, a transverse one above eye, posterior angles of prothorax, an indistinct oblique band between third and eighth striæ behind shoulder, a common spot on preapical callus of fourth to eighth intervals, and some scattered umbilicate punctures on elytra whitish; a rectangular-oblong spot at base of third and fourth intervals velvet black-scaled; rostrum similar to that of the preceding species, *O. eubuloides;* antennæ reddish brown, second joint of funicle as long as first, third as thick as long, the following increasing in thickness, eighth transverse, club short ovate (12 : 19); thorax more than twice as broad as long, fairly densely granulate, the whitish scale spot on posterior angles hardly so; scutellum oblong rounded-rectangular, convex, smooth, dark brown; elytra ovate-acuminate, broadest behind shoulders, the alternate intervals hardly more convex, and like suture seriate-granulate to apex; underside rather densely scaled, intercoxal process of first sternite more sparsely scaled; femora infuscate on apex with scattered granules, each bearing a pale scale.

Odosyllis leucometopus sp. nov.

O. albifronti simillima, sed differt supra squamositate praecipue albida tecta; antennarum funiculo tenuiore, articulo secundo primo distincte longiore; prothorace longitudine tantum sesqui latiore, plaga oblonga utrinque basali, oblonga, densius albo-squamosa, excepta, sat confertim minuteque granulatis, granula quaque squamulam, reliquis angustiorem, gerente; elytris spatiis plus convexiusculis, macula nigro-fusca, subrhomboidali a margine basali plus distante; spatio secundo tertioque ante declivitatem macula communi, subrotundata, nigro-fusca, septimo octavaque (ut in albifronti) altera, apicali, dense albido-squamosis.

Long. 7.5 ad 9 mm., lat. 3.8 ad 4.8.

LUZON, Laguna Province, Mount Maquiling. MINDANAO, Zamboanga Province, Zamboanga.

This species resembles *O. albifrons* so closely that one might believe it to be the other sex of that species; but the very differently shaped thorax, which is only one and a half times broader than long, gives evidence of a different species; moreover the thorax of *albifrons* shows a faint central carinula in the basal half, which is wanting in *leucometopus;* also each granule in the latter species bears a squamula of smaller size than those between them, whereas in *albifrons* they are equal.

Odosyllis pauxilla sp. nov.

Niger, fusco- atque cinereo-, subter albido-squamosa, prothorace basi maculis duabus medianis, obsoletis, elytris macula quadrata suturali, pone scutellum, lineola subbasali in spatio tertio, altera, antemediana, in spatio primo, cum fascia postmediana, spatio 1 ad 3 communi, confluenti, fuliginoso-, fascia lata subapicali albido-squamosis; prothorace irregulariter, parce minuteque granuloso, granulo singulo setam fuscescentem gerente; scutello convexo, obovato, squamoso; elytris ad basin depressis, spatiis in dimidia parte basali fortius, reliquis minute, perremote granulosis, sutura apice subproducta; tibiis anticis rectis subcompressis.

Long. 5 mm., lat. 2.3.

LUZON, Laguna Province, Los Baños.

Excepting *O. vitiosa* Pasc., which is 4.2 millimeters long, this is one of the smallest species of *Odosyllis* and is readily recognizable by the dark brown scale pattern of the elytra. Black; below reddish white, above ashy with brownish shades and patches of blackish scales; rostrum reddish, finely seriate-punctate, isabelline-scaled at base, with a bare dorsal stripe; the two elongated basal joints of funicle of equal length, the following as long as thick; head fawn colored, an indistinct median stripe on vertex and some scales on inner border of eye paler; thorax transverse (3 : 4.1), sides in basal third feebly rounded, in apical part strongly constricted, the latter and some patches on posterior angles paler cloudy; two approximate basal spots in the middle nut-brown scaled, the granules sparse and minute, irregularly scattered, and with an anteriorly inserted scale bristle; posterior half, except the hind angles and an area on each side of disk, free from granules; scutellum convex, ovate, ochraceous; elytra produced on apex of suture into a short point, at base transversely impressed, the intervals in basal half coarsely, in apical half much more finely and remotely granulate; a quadrate sutural spot behind scutellum, a short basal stripe on third interval, a transverse, postmedian, outwardly dilated band, common to the first to third intervals, and produced anteriorly in such a manner on first interval that it forms on the right an L-shaped (reversed on the left) pattern of dark nut brown, limited behind by a large whitish band; below closely whitish squamose, the scales of prosternum more or less isabelline-colored in the center; hind femora hardly reaching hind margin of fourth sternite and with a feeble trace of a longitudinal carina.

Odosyllis similis sp. nov.

Niger, supra unicolore cinereo (vix fumato-nebuloso-) subter isabellino-squamosus, rostro in dimidia parte apicali vix perspicue punctulato, antennis obscure sanguineis, funiculi articulo primo secundo perpaulo breviore, septimo, tomentoso crassitudine paulo longiore; prothorace fortiter, in parte apicali minute, vitta indistincta intra marginem lateralem vix granulata; scutello elytris concolore, his subtiliter striatis, spatiis uniseriatim nigro-nitido-granulatis, spatii primi dimidia parte basâli granulis partim vix diametro eorum inter se distantibus; sutura apice obtuse subproducta.

Long. 7 ad 9 mm., lat. 3 ad 4.4.

LUZON, Mount Banahao.

Unicolored ashy gray with a distinctly shining, black, granulate thorax, a stripe on each side of disk nearly without granules; antennæ dark reddish brown, first and second joints of funicle nearly equal in length, seventh subconical, as long as broad; scutellum like elytra, gray scaled; elytra on suture and intervals uniseriate granulate, the granules on first interval in groups, each distant from the other by scarcely its diameter; below isabelline-colored scales; intermediate and posterior tibiæ with a black setose dot on outside of apex, front femora inside with a fairly distinct carinula. This species is similar to the following one, but is distinguished by the different granulation and the scutellum, which is not pure white scaled.

Odosyllis alboscutellaris sp. nov.

Unicolor ochraceo-, subter plus isabellino-, scutello, rotundato, niveo-squamosis; rostro nigro, subtiliter, basi fortius punctato ac hic squamoso, antennis funiculi articulo tres ultimis longitudine latitudine fere aequalibus; elytris apice haud mucronatis, spatiis seriato-granulatis, granulis in spatii 6. et 7. dimidia parte posteriore oblongis, in spatii septimi, tertia quarta granulis approximatis, distantia inter haec longitudine aequalibus.

Long. 6 mm., lat. 3.

LUZON, Laguna Province, Mount Maquiling.

Unicolored pale ochraceous, below isabelline colored, the roundish scutellum snow-white scaled; rostrum black, finely and remotely punctate, toward base more coarsely so, and there scaled, with a bare dorsal carina, reaching upward to anterior border of eye; antennæ fulvous, club blackish, first joint of funicle hardly longer than second, the last three joints nearly as long as thick; prothorax transverse, the basal two-thirds of sides rounded, above remotely black granulate; elytra not produced at apex, the intervals remotely seriate granulate, first to third intervals at base with larger, roundish, marginal granules; seventh to ninth in posterior half with oblong granules, which in the third quarter of the seventh interval are so close together that the space between them is hardly as long as a single granule; scaling of underside mixed with remote, longer, and paler scale bristles.

Key to the species of Odosyllis.[76]

a^1. Striæ of elytra, at least in apical half, as broad as the carinate intervals.

[76] The species *atomaria*, *vitiosa*, *granulicollis*, *terrena*, *irrorata*, *ingeus*, and *gemmato* of Pascoe I know only from the descriptions.

b^1. Suture granulose-punctate; intervals even in basal half costulate; third interval without a white scale stripe. Philippine Islands.
O. intricata Faust.

b^2. Suture minutely and remotely seriate-punctate; intervals in basal half flattened, the third, in apical half, densely white scaled. Philippine Islands .... **O. albolinea** sp. nov.

a^2. Striæ of elytra much narrower than intervals.

c^1. Prothorax deeply impressed at base before scutellum. New Guinea.
O. crucigera Pasc.

c^2. Prothorax without a deep impression before scutellum.

d^1. Sides of prothorax with a group of acute, spinelike granules before the constricted apical part.

e^1. Elytra dark brown, scaled with scattered black dots. New Guinea .... **O. maior** Heller.

e^2. Elytra with a large semicircular lateral patch, which occupies nearly the whole lateral margin and touches inside the second stria. New Guinea .... **O. lateralis** Heller.

d^2. Sides of prothorax without spinelike granules.

f^1. Elytra distinctly produced at apex of suture into an acute point; when not produced, then the size of body is less than 5 millimeters.

g^1. Front tibiæ strongly compressed, cultrately curved.

h^1. Prothorax equidistantly granulate, elytra short-ovate. Celebes .... **O. congesta** Pasc.

h^2. Prothorax irregularly dispersed granulate, elytra oblong ovate.

i^1. Scutellum circular, intervals of elytra with a single row of very remote granules. Philippine Islands.
O. subsulfurea sp. nov.

i^2. Scutellum elongate-elliptic, elytra on the intervals irregularly, partly densely granulate. Philippine Islands.
O. chlorizans sp. nov.

g^2. Front tibiæ neither compressed nor curved.

j^1. Elytra with a large, common, dark sutural spot; length of body more than 10 millimeters.

k^1. Sutural patch roundish, situated at base and extending backward to middle of suture. Philippine Islands.
O. mindanaoensis Heller.

k^2. Sutural patch transverse, roundish, situated behind middle of suture. Philippine Islands ... **O. sellata** sp. nov.

j^2. Elytra without a common dark sutural patch; length of body usually less than 10 millimeters.

l^1. Elytra without pure white spots, chiefly gray scaled, except a brownish stripe at base of the inwardly curved third interval. Philippine Islands.
O. bilineola sp. nov.

l^2. Elytra with eight pure white spots. Philippine Islands.
O. octopunctata sp. nov.

f^2. Elytra not produced into a point at apex of suture.

m^1. Elytra with bicolored scaling.

n^1. Apical part of elytra entirely or, at least, partly dark.

o[1]. Elytra in apical part dark, in basal half pale scaled. New Guinea.. O. opposita Pasc.

o[2]. Elytra in apical part only with a roundish black sutural patch. New Guinea.......................... O. apicalis Heller.

n[2]. Apical part of elytra pale.

p[1]. Basal part of elytra with a large, common, triangular basal patch, extending to middle of suture. Philippine Islands..................................... O. eubuloides sp. nov.

p[2]. Basal part of each elytron with a dark brown streak or subquadrate spot.

q[1]. Frons whitish scaled. (Besides the two Philippine species, others from Java, Borneo, Sumatra, and Key belong here.)

r[1]. Prothorax twice as broad as long; scales of granules equal to the others. Philippine Islands.
O. albifrons sp. nov.

r[2]. Prothorax one and a half times broader than long; scales of granules narrower and longer. Philippine Islands........................ O. leucometopus sp. nov.

q[2]. Frons dark brown scaled, prothorax one and one-third times broader than long. Philippine Islands.
O. pauxilla sp. nov.

m[2]. Elytra unicolored, more or less pale luteous or isabelline scaled. (Here must also be placed *granulicollis* from Celebes, which shows the intervals of elytra "subseriatum granulatis.")

s[1]. Prothorax distinctly and rather densely granulate; scutellum concolorous with elytra; front femora along inside with a fairly distinct carinula. Philippine Islands.
O. similis sp. nov.

s[2]. Prothorax minutely and remotely granulate; scutellum pure white scaled; front femora without longitudinal carinula. Philippine Islands.... O. alboscutellaris sp. nov.

Blepiarda apicalis Heller.

The species described by me as *Endymia apicalis*[77] is a *Blepiarda,* of which genus only Australian and Papuan species have been hitherto known. I was misled in this case by the formation of the antennæ. *Endymia philippinica,* however, is a true *Endymia. Blepiarda apicalis* is closely allied to *B. simulator* Pasc., but differs by the longer club, which is one and one-half times longer than all the other joints of the funicle together, by the narrower elytra, the striæ of which are not incurvate at base; by the suture, which is smaller than the first interval and not elevated before the declivity; and by the light convex second to fourth intervals, each of which bears about four pustules, the

[77] Philip. Journ. Sci. § D 10 (1915) 29.

basal ones of which are ashy, the others smaller, and blackish scaled behind the middle.

ZYGOPINÆ

Agametis proba sp. nov.

Nigra, supra cervino-, subter ochroleuco-squamosa, rostro, antennis tibiisque ferrugineis; funiculi articulo secundo articulis sequentibus dimidiaque clavae unitis aequante; prothorace, vitta utrinque dense squamosa excepta, grosse parceque punctato; scutello trapezoidali, cervino-squamoso; elytris dorso in primo triente depressiusculo, subseriato-punctatis, punctis squamula minuta pallidiore imperfecte expletis, sutura in dimidia parte basali denudato-rugulosa, post medium plaga communi rotundato-trigona, usque ad striam secundam extensa, albido-squamosa, post fascia nigricante, in spatio tertio antrorsum ducta, determinata, macula humerali oblonga spatiisque duobus extremis, apice exceptis, fuscescentibus.

Long. 6 mm., lat. 2.7.

LUZON, Mount Banahao.

Similar to *A. segnis* Faust; above fawn-colored, below yellowish-white scaled; rostrum and antennæ yellowish red, the former remotely and finely (in *segnis* in the whole basal part closely and coarsely) punctate in anterior half of basal part; second joint of funicle as long as all the following and the club together; prothorax nearly twice as broad as long on the median line (19 : 11), broadest in the middle, the sides before the acute posterior angles slightly sinuate, except a longitudinal scale stripe on each side, coarsely and especially on the disk, remotely callose-punctate; scutellum trapeziform, densely, transversely ochraceous scaled; elytra more than one and one-half times as long as broad (8 : 5), intervals slightly convex, only on the declivity with some seriate granules which, mostly, bear a longer whitish bristle; striæ with paler scales which do not entirely fill the punctures; scaling of underside very dense, on sides of mesosternum composed of large ovate scales; hind femora extending to apex of elytra, in apical half with brownish dorsal shading.

Agametis festiva Pascoe.

Agametis festiva Pasc. (=*pulchra* Kirsch.),[78] an elegant species, distributed from Malacca through Borneo, Ceram, Batjan, and Amboina to New Guinea, occurs also in the Philippine Islands, where it was found by Baker (*13194*) at Dapitan, Mindanao.

[78] Heller, Abh. Ber. Mus. Dresden No. 2 (1894) 5.

Emexaure suturalis sp. nov. Plate 3, fig. 9.

Niger, elytris rostroque obscure rufis, antennis fulvis, prothorace margine basali in parte mediano, scutello, sutura in triente parte apicali et ante medium niveo-, reliqua nigro-, spatiis 2., 3., et 5. ad basin corporeque subter niveo-squamosis; prothorace transverso, varioloso-punctato, linea mediana in dimidia parte basali margineque apicale ut lateribus in dimidia parte posteriori, levibus; elytris prothorace multo latioribus, basi truncatis, deciens fere simpliciter striatis, spatiis dorsalibus in parte anteriori sat dense granulosis, reliquis levibus; pedibus parce albido-piloso-squamosis.

Long. 2.8 mm., lat. 1.5.

LUZON, Laguna Province, Mount Maquiling.

Black; rostrum and elytra dark reddish brown with white-scaled, lineolate spots on suture; antennæ fulvous; thorax transverse and, except basal half of median line, covered with large but flat shagreened punctures, its sides slightly divergent posteriorly, broadest before base; base on each side with a semilunar, transverse white band nearly connected with the opposite white band; scutellum with scales of same color; elytra strongly (from the fifth stria finely) striate; only the three exterior striæ more distinctly but very remotely punctate, the others hardly punctate, eighth abbreviated on shoulder; base sparsely whitish haired, fifth dorsal interval with fine granulation which extends to first interval beyond the middle and becomes gradually shorter on the others, so that on shoulder there is only a remnant of it; femora denticulate, first joint of hind tarsi as long as the three following together.

Emexaure septempunctata sp. nov. Plate 3, fig. 8.

Rufa, prothorace utrinque macula punctiforme in angulis posticis, scutello quadrato, lineola suturali, antemediana, brevi, altera apicali longiori, macula transversa, post-mediana in spatio 5. ad 7. albido-, spatiis convexis setis albidis remote seriatis exceptis, parce nigro-setosis; prothorace crebre punctato; corpore subter albido-squamoso, pedibus rufis, parce albido-piloso-squamosis.

Long. 2.8 mm., lat. 1.2.

LUZON, Laguna Province, Mount Maquiling.

Ferruginous; posterior angles of prothorax with a white scale spot equal in size to the white quadrate scutellum; elytra before the middle with a white-scaled spot on suture twice as long as broad, at apex with a longer, and behind the middle of fifth to seventh intervals with a transverse white scale spot; rostrum at base fairly closely and indistinctly punctate; prothorax transverse, very densely punctate, with remote and transversely placed yellowish white bristle scales; elytra more than one and one-half times as long as broad, intervals somewhat convex and sparsely black setose, with a longitudinal row of remote white bristles; first joint of hind tarsi as long as the three following together.

Metialma nigritana sp. nov.

Aterrima, rostro apice antennisque sanguineis, illo utrinque basi oculorumque margine inferiore, prothorace ad angulos anticos, posticos et in angulo mediano, basali, elytris ad marginem basalem et in suturae dimidia parte basali tenuissime, partim vix perspicue, in suturae apice macula punctiforme, elongata, ut abdomine, densius albo-tomentosis; rostro in parte basali carinulis quinque; prothorace creberrime punctato, margine apicali levi; elytris latitudine humerali vix decima parte longioribus (4.5 : 5), sat fortiter striatis, striis punctis oblongis, plus eorum longitudine inter se distantibus, seriatis, spatiis subtiliter crebreque granulosis, parce subtilissimeque nigro-, corpore subter, meso-epimeris meta-episternisque fuscescenti-nigro-, pygidio nigro piloso-squamosis; corpore reliquo subter albo-piloso; femoribus posticis anulo mediano, lato, denudato; tibiis anticis fortiter curvatis.

Long. 5 mm., lat. 2.5.

MINDANAO, Davao Province, Davao (*7321*).

A dark species with an oblong white spot on apex of suture, somewhat similar to the South African *M. moestificans* Fahrs. Sides of rostrum and in continuation with it lower border of eye, an indistinct spot on anterior and posterior angles and on scutellar lobe of thorax, basal half of suture, and base of intervals, very finely and scarcely adpressed-pilose, the remainder dark brown setaceous; rostrum in basal half with five fine carinulæ, the inner two of which are somewhat irregular and interrupted here and there; apical part nearly smooth; prothorax closely and strongly umbilicate-punctate, the hairs of whitish spots transversely placed, apical margin bare; elytra deeply striate, the striæ indistinctly and remotely punctate, the intervals closely and finely granulate-punctate; underside, except the blackish meso-epimera and meta-episterna, covered with whitish scales, which are hairlike on legs; hind femora in the thickest part with a large, blackish crossband; first joint of hind tarsi as long as the three following together.

Nauphaeus carbonarius sp. nov.

Niger, minute fusco-nigro- ac parcius ochraceo-squamosus, prothorace utrinque vitta, elytris plaga basali triangulari, angulo apicali in scutello sito squamulis fusco-nigris praevalentibus; rostro creberrime ruguloso punctato, in secundo triente longitudinis vitta dorsali levi; antennis obscure rufis, funiculi articulo secundo primo paulo breviore, clava articulis quinque praecedentibus aequilonga; scutello rotundato, glabro, convexo; elytris basi fortius quam in nebuloso Heller lobato-productis, sutura basi granulis 3 vel 4 majoribus confertis, reliqua uniseriatim perremote, apicem versus vix granulata; corpore subter pedibusque albido-squamosis.

Long. 9 mm., lat. 4.2.

LUZON, Tayabas Province, Malinao.

This species is greatly at variance with Pascoe's characterization of the genus, as the second joint of the funicle is shorter than the first; in other respects it agrees very well with the other species of this genus. It is black, covered with minute, equally mixed brown and ochraceous scales; only a stripe on each side of thorax and a triangular patch in first third of suture, the summit of which converges into the scutellum, nearly entirely black; rostrum densely rugulose punctate, in the middle third with a bare dorsal stripe; second joint of funicle shorter than first (8 : 11), club as long as the five preceding joints together; prothorax broader than median length, its anterior margin more produced and the scales larger and more erect than in *N. nebulosus;* elytra rather finely punctate-striate, none of the striæ incurved toward the other on base; inside of shoulder with a large, flat, basal impression, suture near base with a row of three or four approximate granules which are larger; these become more distant in the remaining part and inconspicuous toward apex; similar granules are to be found in the first third of second and third intervals where they are sometimes set in double rows and grouped beside the dark basal impression; underside of body whitish scaled, femora toothed, as in *nebulosus,* the anterior more swollen.

Nauphaeus manobo [79] sp. nov.

N. simio Faust [80] similis, fusco-niger, ochraceo-squamosus, rostro funiculoque rufescentibus; prothorace sat dense granoso-punctato, linea mediana lituraque basali antrorsum attenuata ac medium vix attingente, albido-squamosis; scutello convexiusculo, ochraceo-squamoso; elytris, triente apicali excepto, fuliginoso-marmoratis, lateribus supra coxas posticas macula, interdum declivitatis initio fascia transversa, pallidioribus; sutura usque ad trientem apicalem (in simio usque ad medium) granulosa.

Long. 7.5 ad 10 mm., lat. 3.2 ad 4.5.

MINDANAO, Zamboanga Province, Zamboanga (*7318*, *7319*).

This species is so nearly allied to *N. simius* Faust [80] that it will be sufficient to indicate the differences between the two species. Both are ochraceous, on the underside paler squamose; but, while in *simius* the prothorax shows three pale, longitudinal lines, *manobo* shows only one pale median line; on each side in basal half an anteriorly attenuate streak, and instead of a nut-brown crossband on the declivity of elytra, there is in this species a marmorate pattern, ordinarily limited on the declivity by a pale transverse line. Essentially different is the scutellum, which in *simius* is flat and squamose only in the middle, while in *manobo* it is convex and entirely squamose; also in *manobo* the granulation of the suture is denser and extends backward to the apical third.

Mecopus niveoscutellaris sp. nov. Plate 3, fig. 12.

Niger, antennis rostroque apice rufescenti exceptis, albo-squamosis, prothorace utrinque fascia discoidali, post diffusa obsoletaque; scutello oblongo, parallelo, apice bilobo, niveo; elytris ad basin thoracis basi latioribus, spatiis alternatis, iis sunt 2., 4., et 6., remote asperate-granulosis, post medium subcristato-elevatis ac macula transversa umbrina conjunctis, spatio secundo quartoque inter basin et hanc maculam linea tenui umbrina; corpore subter pedibusque cretaceo-squamosis, femoribus posticis elytrorum apicem perpaulo superantibus.

Long. 4.5 mm., lat. 2.

MINDANAO, Zamboanga Province, Zamboanga.

With regard to the short femora one may perhaps be tempted to take this species for a *Daedania*, but its femoral tooth is small as in some of the species of *Mecopus*. The color of *M. niveo-*

[79] Manobo, a member of a group of tribes of Mindanao.
[80] Stettin. Ent. Zeit. (1892) 222.

scutellaris is similar to that of *M. kuhni* from Key Island,[81] in which the hind femora extend beyond the singly spined apex of elytra. Apical part of rostrum and antennæ dark red, the remainder of body densely white scaled except the following parts: A distinct, posteriorly dilated, gradually obsolescent stripe on each side of thorax; a small spot on shoulders and two fine stripes on second and fourth intervals, extending from base beyond middle and there joined by a transverse streak, dark brown. Rostrum one-fifth longer than thorax, rather coarsely and very densely punctate, the sides in basal half as also apex of scape sparsely white scaled; first joint of funicle a little longer than second, this as long as the two following together. Prothorax broader than median length (3.2 : 2), greatest breadth of the rounded sides in the middle; elytra not quite one and one-half times as long as broad (11 : 7.1), second, fourth, and sixth intervals with remote, rough, seriate granules; scutellum oblong, parallel-sided, snow-white, bilobed on apex; hind femora with a fifth of their length extending beyond apex of elytra and like the others with a spinelike tooth; anterior tibiæ linear.

Mecopus nigroplagiatus sp. nov., ♂.

Niger, femoribus subrufescentibus, cinereo-squamosus, elytris singulis plagis tribus, una subbasali, altera postmediana suturali, transversa, tertia anteapicali minore, nigro-tomentosis; rostro apice sanguineo, sat crebre subtiliterque, in parte basali creberrime ac fortius punctato, carinulis dorsalibus quinque; antennis sanguineis; prothorace crebre reticulato-punctato, parce albido-squamoso, squamulis in linea mediana basique condensis; elytris punctato-striatis, punctis sat remotis, oblongis, striis duabus extremis in dimidia parte basali profunde insculptis, punctis connectantibus, sutura in dimidia parte apicali seriato-spinulosa; femoribus posticis, dente triangulari, prosterno maris spinis duabus armatis.

Long. 5.5 mm., lat. 2.2.

LUZON, Laguna Province, Los Baños.

Allied to *M. ceylanensis* Heller[82] but only the apical half of suture with a row of granules, scaling white instead of yellowish; rostrum proportionately short, a third longer than thorax in the male; apex dark red, moderately densely and finely punctate, in the basal half more coarsely punctate and with five fine

[81] Abh. Ber. Mus. Dresden 12 (1908) 22.

[82] Abh. Ber. Mus. Dresden (1892, 1893) 16, 26.

dorsal carinæ; antennæ yellowish red, third to sixth joints equal in length, conical, hardly one and one-half times as long as thick; thorax transverse (6 : 9), its scaling apparently worn off in the unique specimen, exposing to view a dense reticulate punctuation; only the median line and the basal and apical margins whitish-scaled; scutellum oblong, white; elytra with three dark brown spots, the anterior one on each side near base triangular and extending inward to first stria; the second, common spot placed diagonally on suture and subquadrate; the third between apical commissure of fourth and seventh striæ; lateral margin of elytra, and in connection with it the basal third of the two exterior intervals, and the apical half of the penultimate interval are likewise dark brown scaled; scales on elytra small, triangular, on underside of body much larger and elliptic; legs adpressed whitish-haired, femora armed with a large, angular tooth near base, and this, like the straight prosternal spines, dark red; hind tibiæ slightly thickened in the middle.

Othippia impexa sp. nov.

O. urbana Faust [83] (species africana) statura aequante, fuscescenti-nigra, antennis ferrugineis, rostro, in dimidia parte basali, lateribus margineque oculari (inferiori) dense ochraleuco-squamosis, prothorace, praesertim lateribus, dense varioloso- ac umbilicato-punctatis, area circulari, discoidali, utrinque altera majore subconjuncta, exceptis, sparsim ochraceo-pilosa, pilis adpressis ac transversim dispositis; elytris profunde striatis, spatiis sat remote minuteque granulosis, callo humerali levi, ochraceo-villosis, fascia nebuloso-, denudata, ante-mediana, humeros versus curvata, inter striam primam et quartam fuscescenti-setoso-squamosa, corpore subter, praesertim metasterno, ochroleuco-squamoso, pedibus parce ochraceo-villosis, tarsorum articulo ultimo sanguineo.

Long. 3 mm., lat. 1.6.

LUZON, Mount Banahao.

Of the size and form of the African *O. urbana* Faust, but the thorax without a median carina and the upper side unicolorous ochraceous tomentose; rostrum on each side of the dark red, apical half striate-punctate, smooth on back, basal half yellowish hair-scaled, with a fine dorsal carina; antennæ red, scape somewhat yellowish, first joint of funicle thickened and equal in length to second, third to eighth joints gradually smaller,

[83] Deutsche Ent. Zeitschr. (1898) 41.

eighth spheric, club twice as long as thick; prothorax conical, hardly twice as broad at base as median length, sparsely covered with fine, long, transversely directed hairs, a roundish spot on disk and a larger one on each side of it bare, exposing to view umbilicate punctures; elytra deeply striate, seventh and eighth striæ abbreviated on base, the intervals, except the lateral, rather densely and finely granulate, covered moderately densely with curled hairlike, yellowish scales, which are nearly as long as the intervals are broad; before the middle with an indistinct crossband which is interrupted by the more densely haired suture; this crossband is produced on each side toward shoulder, brownish, and more sparsely haired; a similar spot, which is twice as long as broad, occurs between the middle and the apex on second, fourth, and sixth intervals; mesosternum and metasternum densely squamose, but each of the ovate scales is isolated from the other; prothorax with sparse, adpressed, bristlelike scales, which stand transversely on the basal margin; femora sparsely whitish haired, and with a small spine; outer surface of hind femora with a longitudinal carina.

CALANDRINÆ

Otidognathus pictus sp. nov. Plate 3, fig. 10, ♀.

Supra, capite nigro excepto, testaceus, maculis nigris ornatus, subter niger mesosterni epimeris episternisque, metasterni epimeris totis, episternis apice testaceis; rostro feminae, in dimidia parte basali late subsulcato ac indistincte, in dimidia parte apicali carinula mediana; prothorace vittis duabus, nec marginem anticum nec posticum attingentibus, postrorsum dilatatis, maculam discoidalem oblongo-rhomboidalem, nigram, includentibus; scutello nigro, perlongo; elytris angulo suturali angulato-producto, spatio primo in dimidia parte posteriore sutura distincte angustiore, litura humerali, fascia posthumerali, a stria quarta usque ad marginem lateralem extensa, fascia mediana suturam spatiisque tribus internis occupante fascia apicali in spatio quinto angulatim antrorsum producta, pygidio linea mediana, nigris; corpore subter lateribus parce breviterque aureo-piloso.

Long. (rostro haud computato) 12 mm., lat. 5.3.

LUZON, Laguna Province, Mount Maquiling (*7346*).

Smaller than *O. elegans* Fairm. and distinctly narrower, the punctures of prothorax and of the five inner striæ of elytra much more conspicuous, the suture in posterior half broader than the first interval and at apex acute-angularly produced; rostrum shorter than the median line of prothorax and very slightly curved, in the apical half with a fine median carina and an indistinctly granulate lateral carina, in the basal half with a broad, flat, longitudinal impression; scutellar lobe of prothorax before the broad smooth apical margin with a simple transverse row of coarse punctures; upper side, except head, yellowish with black markings, as shown in Plate 3, fig. 10; underside and legs black, sides of body sparsely covered with short golden-yellow hairs.

Sphenophorus (?) basilanus sp. nov. Plate 3, fig. 11.

Sanguineus, griseo pruinosus, Sph. alfuro Heller [84] peraffinis, ab eo praesertim differt thorace parcius ocellato-punctato, disco utrinque macula nigro-velutina, rotundata; elytris, loco macula discoidali, macula suturali oblongo-rhomboidali, nigra.

Long. 8.5 mm., lat. 3.

BASILAN.

What I have stated concerning the genus *Sphenophorus*, in connection with the description of *S. alfurus*,[84] applies also to *basilanus*, which is nearly allied to it; but the body of the latter is smaller, the thorax is more constricted in front, the ocellate punctures are sparser, and the two black discal spots are slightly impressed and but half the size of an eye. Elytra with a characteristic, large, rhomboidal, black, sutural patch which extends on each side to the fourth stria; hind femora extending hardly beyond apex of abdomen.

BRENTHIDÆ

Schizoeupsalis [85] **kleinei** sp. nov., ♂. Plate 3, figs. 13 and 14.

Sch. promissa Pasc.[86] affinis ac simillima, sed capite plus sphaerico, rostro multo angustiore ac longiore, inter antennarum insertionem callositatibus duabus oblongis, sulco mediano distincto divisis, impressione basali profunda, utrinque carina determinata, ante oculos tuberculo conico instructo, apophysis majoribus, plus transversis; prothorace breviore; elytris, stria subsuturali manifesta excepta, glabriusculis, muculis flavis simliter ut in promissa Pasc. dispositis, sed minoribus, spatio secundo solum in primo triente macula punctiformi.

Long. 9 mm., long. rostr. 1.5, lat. elytror. 1.8.

MINDANAO, Davao Province, Davao.

[84] Ent. Mitteil. 3 (1914) 313, pl. 5, fig. 7, 7*a*.

[85] Arch. f. Naturg. Berlin 82 (1917) 77.

[86] Ann. & Mag. Nat. Hist. IV 10 (1872) 323, pl. 5, fig. 8.

Red-brown, elytra ornamented with yellow spots, anterior and posterior margins of prothorax and base of femora blackish; head subtransverse spheric, eye large, occupying nearly the whole side of head, on anterior margin with an outwardly directed, subconical, lateral projection which is limited anteriorly by a large excavation, covered in front by large auriculate apophyses; rostrum more than twice as long as head, but much narrower, its basal impression roundish, transverse and deep, limited on each side by a longitudinal ridge, between the insertion of antennæ, with two oblong dorsal callosities, separated by a distinct medial furrow; apex of rostrum narrower than its base; mandibles straight, subbidentate; antennal tubercles moderately explicate; antennæ longer than head and prothorax together, second joint shortest, third longer and like the following thicker; prothorax one-third longer than broad, attenuated anteriorly; elytra more than twice as long as broad (5 : 2), as broad as prothorax, with a single distinct subsutural furrow, otherwise smooth, with hardly recognizable, finely seriate punctures; second interval at base with a longer spot, in the second third and before apex with a smaller spot; third, seventh, and eighth intervals in the first third with a common, yellow spot.

This species is nearly allied to *Schizoeupsalis promissa* Pasc., from which it differs chiefly by the large and deep basal impression on rostrum and the smaller spots. It is named for Herr R. Kleine, of Stettin, an excellent connoisseur of Brenthidæ, to whom I am much indebted for the revision of the Brenthidæ of the Dresden Museum.

ILLUSTRATIONS

Plate 1

Plate 2

Plate 3

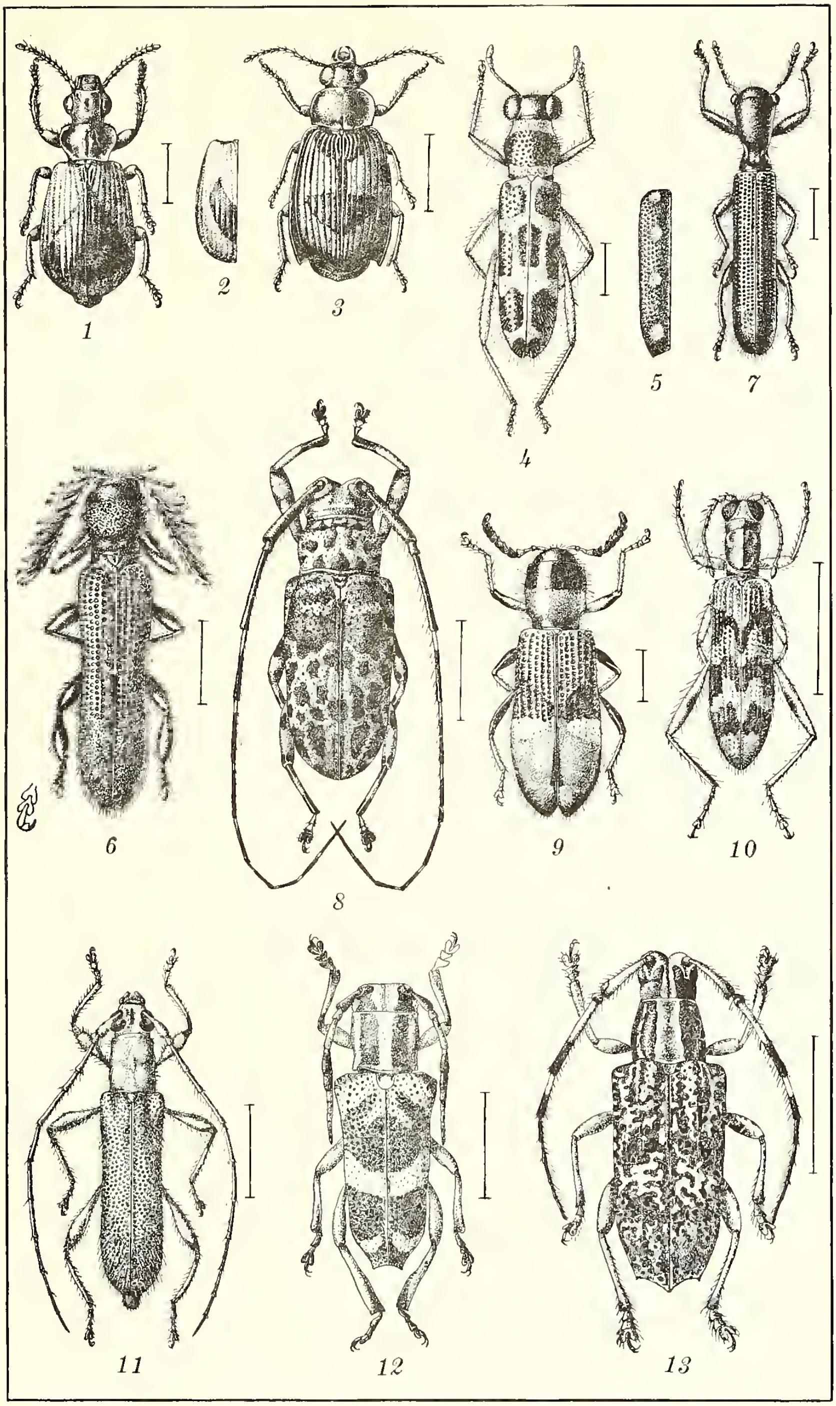


PLATE 1. PHILIPPINE COLEOPTERA.

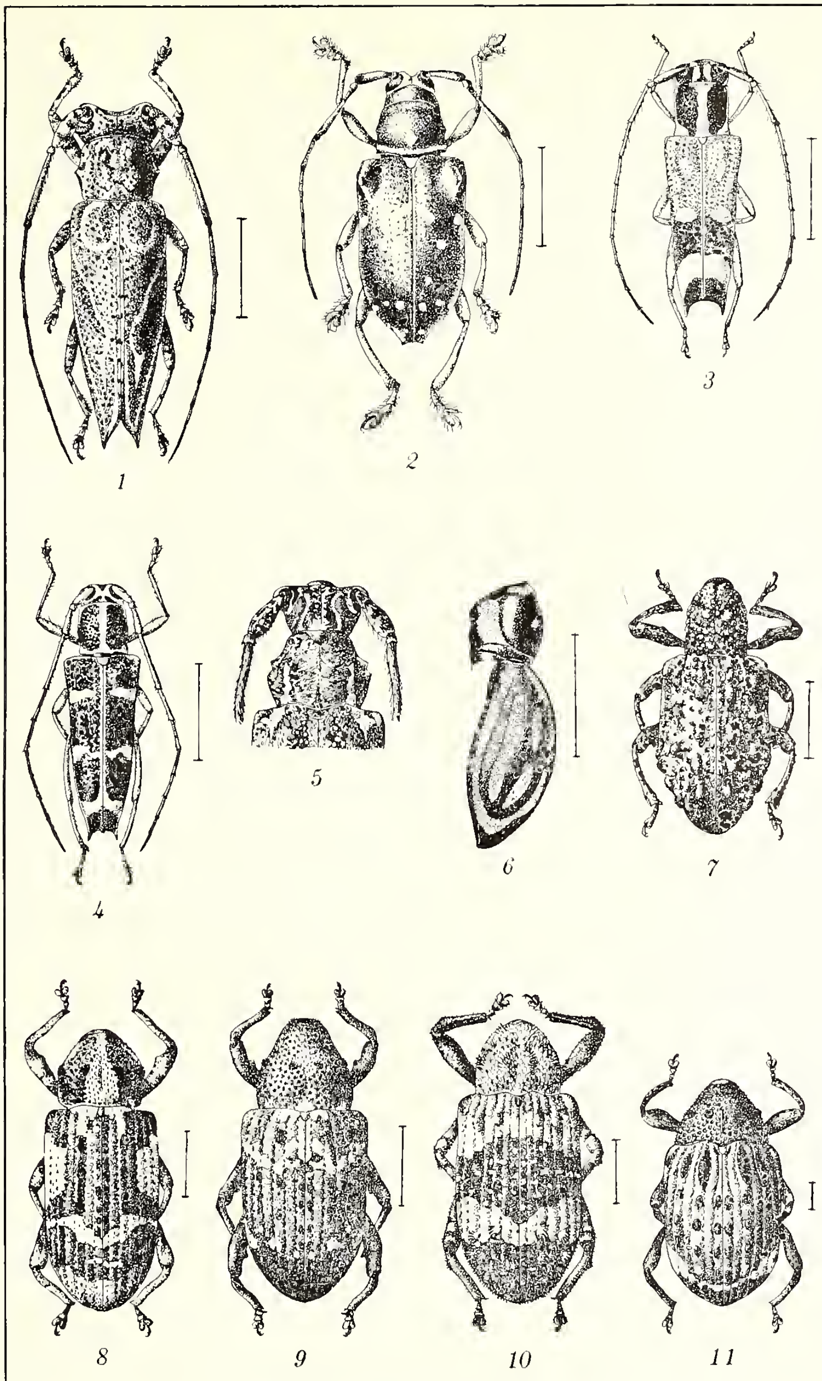


PLATE 2. PHILIPPINE COLEOPTERA.

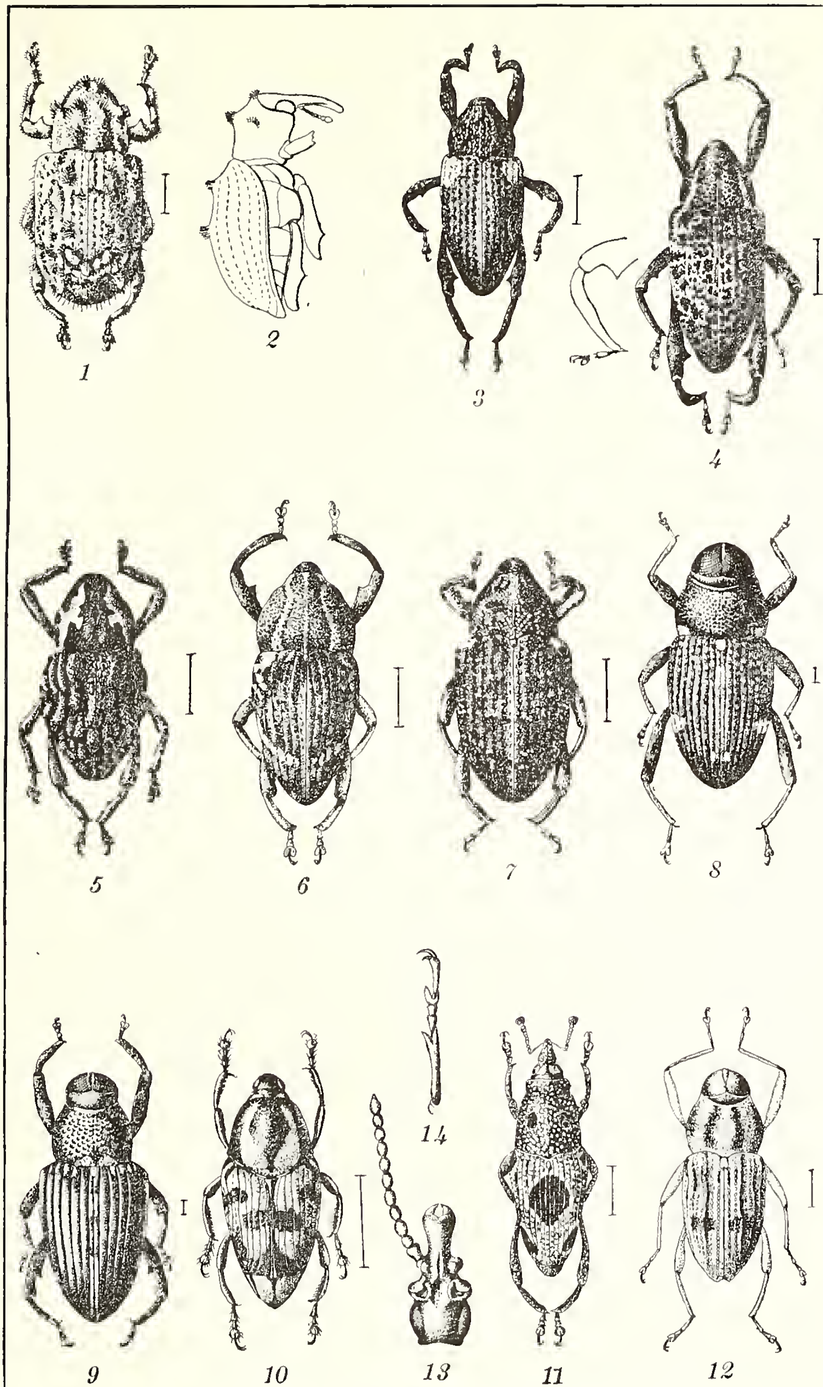


PLATE 3. PHILIPPINE COLEOPTERA.

THE PHILIPPINE BUREAU OF SCIENCE

RECENT PUBLICATIONS

AN INTERPRETATION OF RUMPHIUS'S HERBARIUM AMBOINENSE

By E. D. MERRILL

Based on the collections made in Amboina by the late Charles Budd Robinson

Order No. 450. Bureau of Science Publication No. 9. Paper, 595 pages and 2 maps.

Price, $3 United States currency, postpaid.

SPECIES BLANCOANAE: A CRITICAL REVISION OF THE PHILIPPINE SPECIES OF PLANTS DESCRIBED BY BLANCO AND BY LLANOS

By E. D. MERRILL

Order No. 461. Bureau of Science Publication No. 12. Paper, 423 pages and 1 map.

Price, $2.25 United States currency, postpaid.

PHILIPPINE WATER SUPPLIES

By George W. Heise and A. S. Behrman

Order No 460. Bureau of Science Publication No. 11. Paper, 218 pages, 19 plates, and 4 text figures.

Price, $1.75 United States currency, postpaid.

VEGETATION OF PHILIPPINE MOUNTAINS

The relation between the environment and physical types at different altitudes

By WILLIAM H. BROWN

Order No. 473. Bureau of Science Publication No. 13. Paper, 434 pages, 41 plates, 30 text figures.

Price, $2.50 United States currency, postpaid.

PLEASE GIVE ORDER NUMBER

Orders for these publications may be sent to the Business Manager, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the following agents:

AGENTS

THE MACMILLAN COMPANY, 64-66 Fifth Avenue, New York, U. S. A.
WHELDON & WESLEY, Limited, 28 Essex Street, Strand, London, W. C., England.
MARTINUS NIJHOFF, Lange Voorhout 9, The Hague, Holland.
KELLY & WALSH, Limited, 32 Raffles Place, Singapore, Straits Settlements.
THACKER, SPINK & CO., P. O. Box 54, Calcutta, India.
THE MARUZEN CO., Limited, 11-16 Nihonbashi, Tori-Sanchome, Tokyo, Japan.

CONTENTS

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.

VOL. 19, NO. 6 DECEMBER, 1921

THE PHILIPPINE JOURNAL OF SCIENCE

BUREAU OF SCIENCE
MANILA

MANILA
BUREAU OF PRINTING
1921

183013

THE PHILIPPINE JOURNAL OF SCIENCE

Published by the Bureau of Science of the Government of the Philippine Islands

---

Manuscript intended for publication and books for review should be sent to the editor. One hundred separates of papers published in the Journal are furnished to authors without charge. Additional copies may be had at authors' expense.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

The Journal is issued twelve times a year. The subscription price is 5 dollars, United States currency, per year. Single numbers, 50 cents each.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

THE PHILIPPINE JOURNAL OF SCIENCE

VOL. 19 DECEMBER, 1921 No. 6

VARIOUS METHODS OF SERUM APPLICATION IN BACILLARY DYSENTERY[1]

By PEDRO T. LANTIN

Of the Department of Medicine, College of Medicine and Surgery, University of the Philippines, and Resident Physician of the Philippine General Hospital, Manila

SIX TEXT FIGURES

In my preliminary paper, published in 1918,(5) I reported upon the employment of serum by various methods in a limited number of cases of bacillary dysentery. Fortunately, I have been able to continue my observations on a larger number of cases.

During the twelve months of 1918, there were admitted to the medical wards one hundred sixty-four cases of bacillary dysentery. With the exception of two cases all were Filipino patients. One of the two was a Japanese, and the other was an American who had been in the Philippine Islands a long time. Both sexes were represented in these studies; the sex incidence was as follows:

TABLE 1.—*Sex incidence.*

Sex.	Cases.
Male	114
Female	50
Total	164

AGE INCIDENCE

It is common experience that no age is exempt from the disease. It appears from my series that young adults are most subject to attack. The age incidence is shown in Table 2.

[1] Read before the Manila Medical Society, March 3, 1919.

TABLE 2.—*Age incidence.*

Years.	Cases.
14 to 20	40
20 to 30	80
30 to 40	19
40 to 50	9
50 to 60	8
60 to 70	8
70 to 80	0
Total	164

Table 2 shows that the greatest number of cases occurred in young adults from 20 to 30 years of age. This observation is similar to Shiga's (9) findings, in Japan, who also observed a great number of cases between the ages of 20 and 30 years. A graphic representation of age incidence is shown in fig. 1.

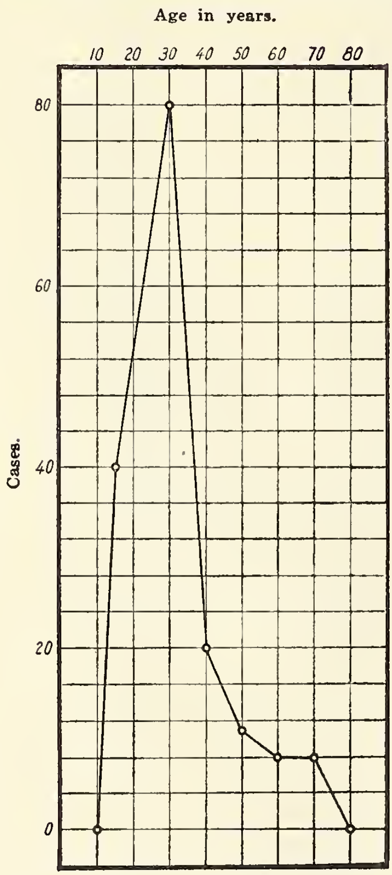


FIG. 1. Illustrating the age incidence by decades.

SEASONAL INCIDENCE

The disease occurs throughout the year. In my series it prevailed in greatest number in July, August, and September. The incidence is shown in Table 3 and graphically presented in fig. 2.

TABLE 3.—*Seasonal incidence.*

Month.	Cases.
January	3
February	2
March	1
April	8
May	7
June	9
July	39
August	42
September	40
October	8
November	2
December	3

A study of Table 3 indicates that there was a gradual increase in the number of cases admitted to the hospital from April to September, the largest number having occurred during

July, August, and September, after which the number of cases decreased.

It is interesting to learn why there are so many cases of bacillary dysentery in Manila from July to September.

There seems to be a good deal of evidence to show that it is due to the seasonal conditions prevailing in those months. In the Philippines the wet season usually begins in May, following the hot season, and from July to September a great deal of rain falls, as a rule. The rainy season, then, is favorable to the spread of the virus, by water and especially by flies, because the fallen rain affords them many breeding places. Flies are more abundant during the wet season.

Flies are carriers of pathogenic organisms, on account of their mode of life; they alight and feed on fæcal matter and then, their bodies infected, again alight on food. Bahr,(1) in Fiji Islands, observed many cases of bacillary dysentery during the wet season.

Furthermore, other diseases, such as typhoid fever, amœbic dysentery, etc., the epidemiology of which points to flies as the carriers of the infecting microorganisms, are also prevalent in Manila during the rainy season.

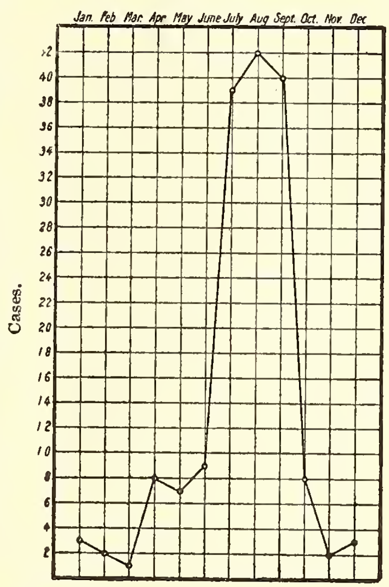


FIG. 2. Showing seasonal incidence.

BACTERIOLOGY

It was established many years ago that the etiologic factors of the disease are the various strains of *Bacillus dysenteriæ*. In the epidemic of 1918 Shiga infection was prevalent. Out of 66 cases in which cultures were made from stools 30 cases were Shiga; 7, Flexner; types undetermined, 14; negatives, 15, or 22.72 per cent. The percentage, then, of positive cases is 77.28, while Cowan's and Miller's(2) Alexandria cases gave 41.2 per cent positive.

MORBIDITY AND MORTALITY

It is an established fact that of all the types of *Bacillus dysenteriæ*, the Shiga-Kruse type is the most toxic. It is the deciding factor in influencing the mortality, especially if the disease is allowed to run many days without adequate treatment. Among patients belonging to the laboring class, who disregard their ailments during the first days of disease and who have low resistance because of their unhygienic mode of living and deficient diet, morbidity is naturally high and mortality correspondingly so. The patients that I have handled were mostly of the laboring class.

Let me state, however, that it was impossible to obtain an adequate supply of serum; consequently it became necessary to select the most serious cases for the administration of serum and to deny the benefits of such treatment to those who did not seem to be very ill. Even in some of the serious cases we were compelled to discontinue the treatment owing to lack of serum.

In addition to the handicap just mentioned, it should be stated that, on admission to the hospital, most of these charity patients were in bad condition. Many of them remained in their homes from three to seven days without any treatment and applied for admission only when the disease had already made much progress, and thus were suffering from severe toxæmia and marked involvements of the larger gut. In many cases they collapsed on admission. In such exceptional cases the use of serum is not efficacious.

With the application of the serum the mortality rate is from 9 to 12 per cent, according to Shiga;(9) Rosenthal, in Russia, has obtained 5.1 per cent; Bahr,(1) in Fiji Islands, obtained 1.8. Of the one hundred sixty-four patients suffering from dysentery who were admitted during 1918 to the medical wards of the Philippine General Hospital fourteen died, giving a mortality rate of 8.53 per cent. Of the one hundred five who received antidysenteric serum twelve died, giving a mortality rate of 10.47 per cent.

Without the use of the serum, there is distinct increase in the mortality rate, as was observed in the Philippine General Hospital in the fiscal year 1912–1913. During this period the death rate among one hundred ninety-one males and seventy-five females amounted to 17.8 and 20 per cent, respectively.

According to Musgrave and Sison,(8) the mortality rates in hospitals in other countries, where treatment with drugs is practiced, are as follows:

	Per cent.
Japan	16.5 to 30.2
Singapore (1902)	25.4
Ceylon (1903)	28.4
Hongkong (1902)	37.3

VARIOUS METHODS OF TREATMENT

In my series various methods of administering the serum were used; namely, (1) per rectum alone, (2) intramuscular injection and per rectum (enema), (3) intramuscular injection alone, (4) intramuscular and intravenous injection, (5) intravenous injection alone.

CLASSIFICATION

To classify the disease exactly under each type, as to whether a case is severe or mild, is not an easy task. The custom of using the number of stools for the basis of classification as to severity is in my opinion oftentimes very misleading. For instance, a case with few bowel movements will be classified naturally as mild; but such cases are not always mild. It has been frequently observed by me that patients are admitted to the department who have few bowel movements but are in very weak general condition, in a stuporous state, and who show subnormal temperature and weak pulse. To place such cases in the same category with mild ones is not justifiable. I emphasize this because many of my deaths were from this type. The worst kind of dysentery is that in which there are few bowel movements, low temperature, and weak pulse. It may be that the toxin acted as antiperistaltic on the digestive tract, as pointed out by Fisher.(4) The severity of toxæmia and the general condition of the patient should, in my opinion, be the basis for classifying the disease as of the severe or of the mild type.

FIRST SERIES

Serum per rectum alone.—This method consists of introducing the serum through a long rubber tube, one end of which is provided with a funnel. The patient is in the knee-chest position. The serum is to be given high, and to be retained a long time—the longer the better. Before the serum is given, preliminary preparation of the patient should be observed. A cleansing enema of sodium bicarbonate (1.5 per cent) is given, to be followed by another enema of 60 to 100 cubic centimeters of starch solution with 15 drops of laudanum, so as to diminish the irritability of the intestines. The high serum enema can then be given half an hour after the starch enema.

Under this method I was able to treat nine cases who were not very sick, whose general condition was good. The fever was not high, and the bowel movements were from 10 to 25 in twenty-four hours. My dosage varied from 30 to 80 cubic centimeters of serum daily, although it can be given in greater amount and more frequently without any danger. In many instances the serum could not be retained long; in such event another serum enema should be given. These nine cases all recovered.

SECOND SERIES

Serum per rectum and intramuscular injection.—In this series I was able to apply the combined method (per rectum and intramuscular) in ten cases, all severe; there were two deaths giving a mortality rate of 20 per cent. All these cases were very severe on admission.

THIRD SERIES

Intramuscular injection alone.—This series comprised sixty-four patients who were all classified as of the severe type. There were five deaths, giving a mortality rate of 7.81 per cent. The usual site of injection is the buttock. The dosage employed was from 20 to 60 cubic centimeters daily, depending upon the severity of the case and the supply of serum. Later, however, I employed the dosage of 20 cubic centimeters every four hours for the first three days after admission, and 20 cubic centimeters twice a day thereafter. I found this method very efficacious.

FOURTH SERIES

Intramuscular and intravenous injection.—In the fourth series I was able to try this combination (intramuscular and intravenous) on thirteen cases, all very severe, some collapsed; five cases died, giving a mortality rate of 38.46 per cent. One case died twelve hours after the intravenous injection. This particular case was in a state of collapse before the serum was given. The other four cases died from two to four days after the administration of serum intravenously.

FIFTH SERIES

Intravenous injection alone.—This method was tried on nine cases, all severe and two collapsed. All these cases recovered. The dosage employed was 10 to 20 cubic centimeters daily, 1 cubic centimeter being injected four to six hours previously so as to avoid anaphylaxis.

The intravenous method should be done under rigid asepsis. The place of injection is usually the anterior cubital fossa where the veins are commonly prominent. It is done in closed method. There is great difficulty, however, in performing the closed method on collapsed patients, as the veins are also collapsed. In my collapsed cases the open method was resorted to. The reaction following intravenous injection was mild; usually there was a chilly sensation lasting from thirty to sixty minutes, accompanied by rise in temperature, with slight acceleration of pulse and respiration. The reaction may last from ten to fifteen minutes, followed by thirst and general weakness. The temperature may fall by crisis or by lysis after the next twelve hours.

DISCUSSION

The main point that I would like to emphasize in the treatment of bacillary dysentery is the early and broad application of the biological products whenever possible. In an acute disease like this one, early application of specific therapy is imperative on account of the definite pathological lesions taking place progressively in the large intestines, and because of the severe toxæmia that arises after absorption of the toxins. It should be given even to cases in which there is suspicion of bacillary dysentery, without waiting for the results of the bacteriological examination. This is highly advisable in cases of infection in children, for they have lower powers of resistance, and they die comparatively sooner than adults. The earlier the serum is given the better, as frequently very good results follow early treatment.

It has been observed by those who have studied the disease carefully that the toxins of the organisms act selectively on the mucosa of the large intestine. Injections of dysenteric toxins into susceptible animals produce similar symptoms, as well as the specific pathological changes in the large intestine, that are observed in human beings. This agrees with the observations of Shiga, Flexner, and Sweet and Doerr. Doerr(3) was able to save the life of an animal, after administering a lethal dose of the dysenteric toxin, by a previous injection of serum. Similar observations by Todd, Vaillard, and Dopter confirm their findings. Shiga,(9) the pioneer in this field, states that dysenteric serum is bactericidal as well as antitoxic.

In view of the established facts, set forth by qualified observers, the local use of the serum seems to my mind not to be unscientific. Considering well the morbid changes in the large intestine, where acute inflammation and ulceration are taking place, and recalling that that is the site where the virus flourishes best, continuously elaborating the toxins, we can see at once the working basis for the use of the local application of serum. As it has been found that the serum is both antitoxic and bactericidal, its administration would mean, then, the neutralization, locally, of the unobserved toxins and the decreased vitality of the virus, if not its actual death.

Clinical observations seem to support this view. Twenty-four hours after the administration of serum per rectum, the patient feels a marked alleviation of the subjective symptoms;

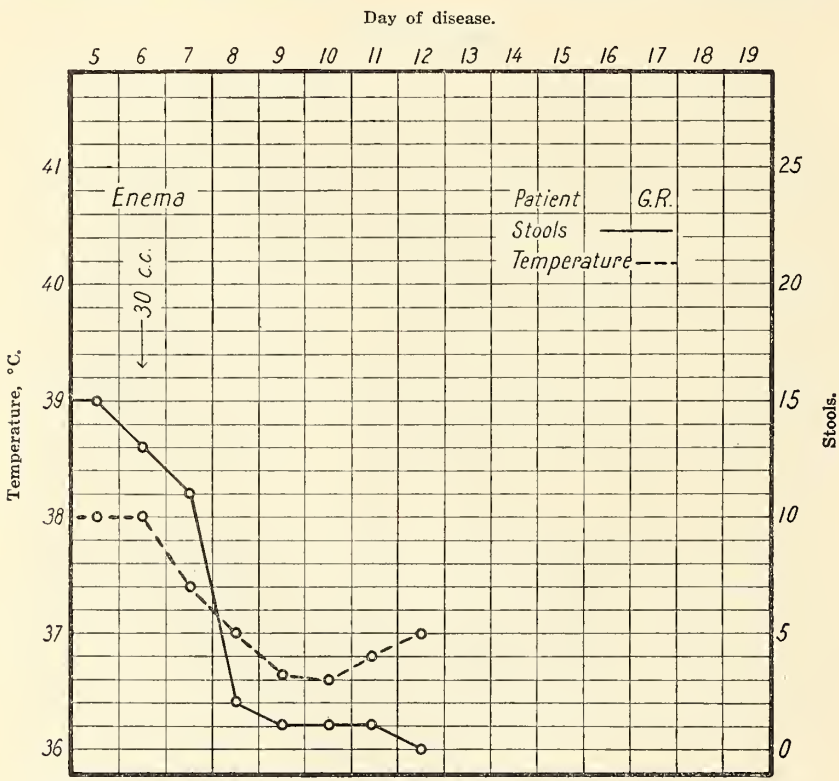


FIG. 3. Showing the response of the patient to the administration of the serum per rectum (enema). Patient G. R.

the colicky pain is diminished, as well as the tenesmus; stools decrease in number; and the temperature is lower. During succeeding days the stools become less bloody and mucoid, then feculent, and then of soft consistence (see fig. 3).

I am fully aware of the drawbacks to this method. The serum may not reach the whole area of tissue involved; it may fail to neutralize the toxins already absorbed in the system; or it may not be retained properly by patients whose intestines are very irritable.

This method is of great advantage only when the patient is able to retain the serum for a long period. I know specific cases in which patients could retain it for from two to four hours, if previously given a high enema of starch solution with laudanum. In case of intramuscular injection in patients whose bowel movements have already diminished, the serum per rectum works well because the serum, being retained for a longer

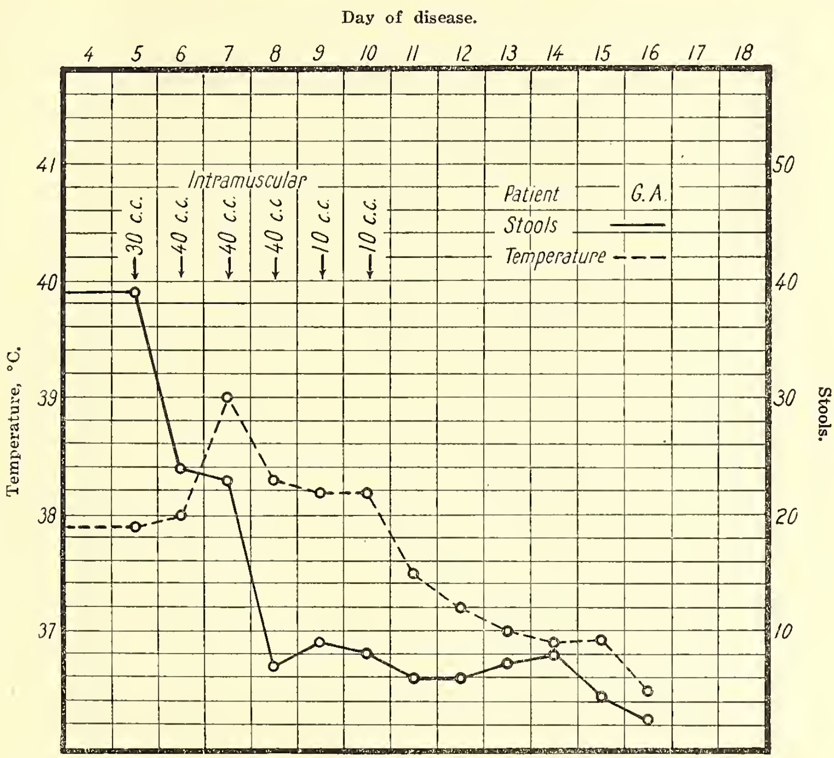


FIG. 4. Showing the effect of serum administered intramuscularly and per rectum (enema). Patient G. A.

period in the lumen of the gut, is absorbed in greater amount. Many patients prefer this method because it is not painful.

The rationale of the administration of serum by intramuscular injection can readily be seen. The main purpose is to neutralize the toxin as much as possible by specific antibodies which are present in the serum. The results are gratifying. If the serum is given, the patient, formerly restless, becomes quiet, the temperature gradually falls, the colicky pain and tenesmus are less severe, and the stools decrease in number. These results may be observed in the twenty-four to forty-eight hours following injection. Where there has been collapse the pulse becomes fuller and stronger a few hours after the injection. There is marked abatement of the subjective symptoms on succeeding days. In my experience it seems that the combination of intramuscular injection and serum enema in acute cases is advisable because we combat the disease from two sides; namely, by direct neutralization of toxin in the blood, and by

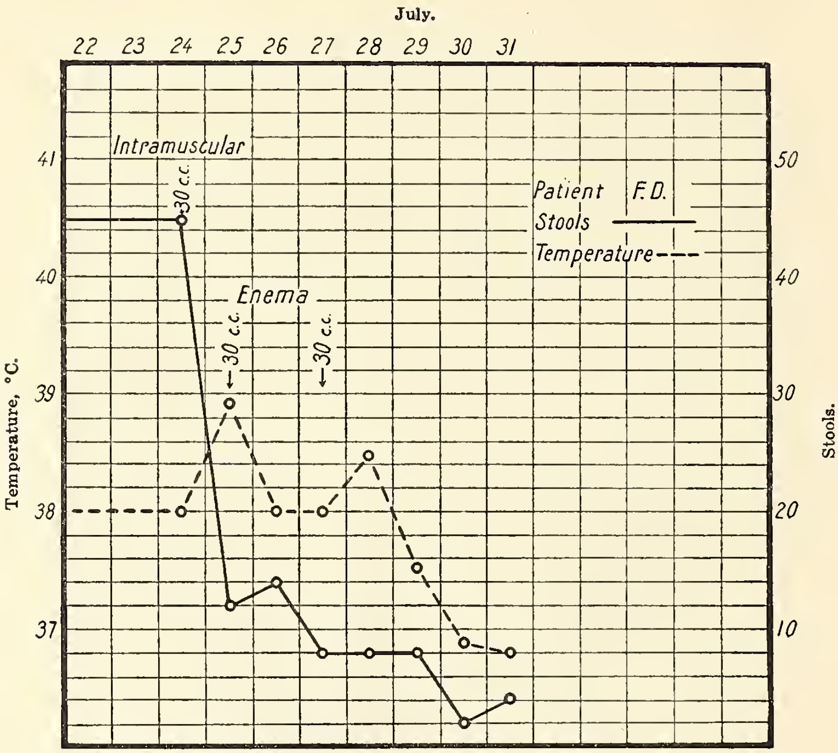


FIG. 5. Showing the effect of serum administered intramuscularly and per rectum (enema). Patient F. D.

direct action of the serum on the bacteria and their poisonous products in the large intestines (see figs. 4 and 5).

The action of the serum introduced intravenously is similar to that of the intramuscular injection except that the effects are more rapid. The special indication of this method is in very severe cases, where injection is followed by marked alleviation of the subjective symptoms; the pulse becomes fuller and stronger a few hours after the injection; restlessness diminishes and the general appearance becomes brighter in the next twenty-four hours. Marked improvement of the objective symptoms follows after the next day. The intravenous injection is usually followed by a chilly sensation which may last thirty minutes, and is accompanied by rise of temperature.

Although I have observed no accident so far, such as sudden death following just after the intravenous injection, or symptoms of embolic formations, the possibility that such may occur under certain conditions should not be overlooked. The treatment should therefore be given with great prudence and caution.

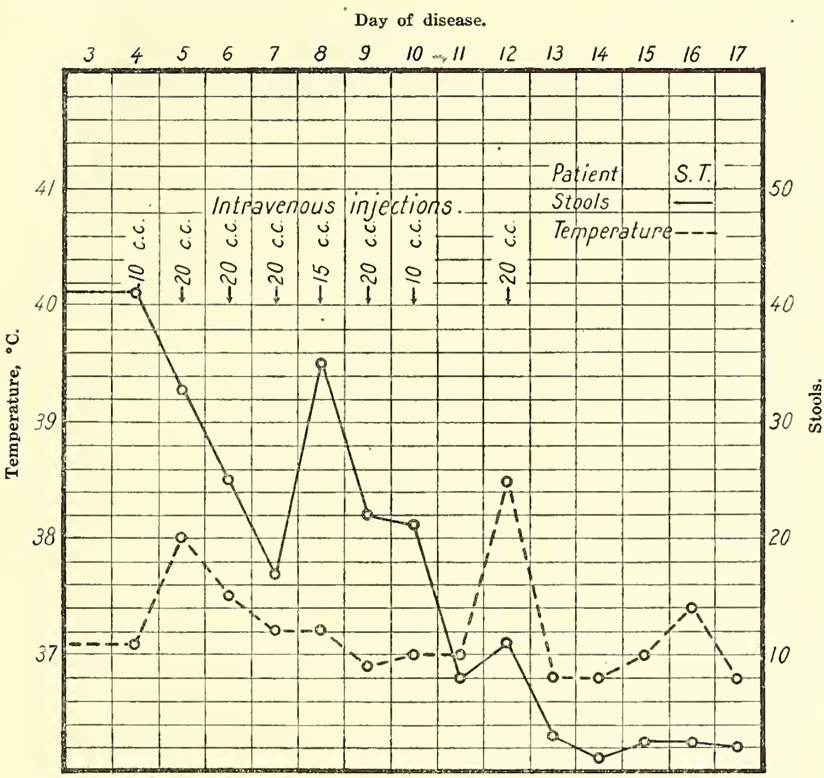


FIG. 6. Showing the effect of serum administered intravenously. Patient S. T.

An example of the results of intravenous injection is seen in fig. 6.

Aside from the specific action of the serum in the treatment of this disease, its nonspecific action should also be considered. When the serum is introduced into the body it may act as a foreign protein, stimulating the body to produce nonspecific substances. The production of nonspecific substances as the result of the use of foreign protein has been considered seriously in the treatment of typhoid fever(6) and of arthritis.(7) In the case of bacillary dysentery these nonspecific substances might be produced, especially when the serum is given intravenously, and some of the beneficial effects that were obtained might be due to them.

COMPLICATIONS

In this series of one hundred five cases treated with serum, no symptoms have been observed referable to serum sickness. Lately, however, I have observed in three cases certain bad symptoms of which the serum might have been the cause.

The first case was an adult, a healthy and robust man. He received two intramuscular injections of 20 cubic centimeters of serum with an interval of twenty hours between injections. One hour after the second injection, the patient felt very weak, became restless, had subnormal temperature, cold perspiration, and small, rapid pulse. Breathing increased in rate. He died twenty-four hours after the onset of these symptoms.

The second case was a female nurse. She is a fairly developed, healthy woman. She developed urticarial rash all over her body, accompanied by sudden rise of temperature, and pain in the joints, more marked in the extremities and the jaws; so much so that she could hardly open her mouth or move her extremities. She was receiving the serum intramuscularly, 20 cubic centimeters daily, and the symptoms were observed on the eighth day. She recovered.

The third case was also a female nurse. She is a very well-developed, very stout woman. For four days she was receiving 20 cubic centimeters of serum intramuscularly daily. Two and a half hours after the last injection, she felt very weak, became restless, moaned continuously, and had subnormal temperature, cold extremities, cold perspiration, and weak and rapid pulse. She remained in this condition for twelve hours, after which time she gradually recovered.

CONCLUSIONS

The serum can be employed in a variety of ways; namely, per rectum alone (enema); intramuscularly; intravenously; in combined form, as per rectum and intramuscularly, etc.

The use of the serum per rectum (enema) is as yet limited; it produces beneficial effects in certain cases when the intestines become less irritable after starch enema with laudanum. The intravenous method produces immediate effects (better than the intramuscular injection), but should be used with great caution, for there is danger of subsequent embolic formations under certain conditions. The combined method (serum per rectum and intramuscular injection) has given just as good results as any method of administering the serum, and is safer than the intravenous method.

Finally, the serum acts in a specific manner, but at the same time it may act as a foreign protein, producing nonspecific antibodies. Above all it must be given early, even in cases where bacillary dysentery is only suspected, in order to produce good results.

ACKNOWLEDGMENTS

To Prof. Ariston Bautista, chief of the department of medicine, University of the Philippines, I acknowledge sincerely my high obligations for placing at my disposal all the material available in the department; also to Dr. Otto Schöbl and Dr. C. S. Pañganiban, of the Bureau of Science, who prepared the serum and made the bacteriological examinations of the stools for me.

REFERENCES

1. BAHR, P. H. Manson Brit. Med. Journ. **1** (1914) 249–296.
2. COWAN, J. M., and MILLER, H. Journ. Roy. Army Med. Corps **31** (1918) 228.
3. DOERR, R. In Kraus und Levaditi, Handbuch der Technik und Methodik der Immunitäts-Forschung. Gustav Fisher, Jena (1909) 2, 164.
4. FISHER, J. B. Brit. Med. Journ. (January 13, 1917) 43.
5. LANTIN, P. T. Philip. Journ. Sci. § B **13** (1918) 261–268.
6. IDEM. Philip. Journ. Sci. **14** (1919) 19–50.
7. MILLER, J. L. Journ. Am. Med. Assoc. **66** (1916) 1765.
8. MUSGRAVE, W. E., and SISON, A. G. Philip. Journ. Sci. § B **9** (1914) 241–251.
9. SHIGA, K. Modern Medicine, by Osler, W., and McCrae, T., ed. 2, Philadelphia and New York, Lea and Febiger **1** (1913) 766–782.

ILLUSTRATIONS

TEXT FIGURES

UNSYMMETRICAL ADDITION TO THE DOUBLE BOND, I: A THEORY OF THE REACTION MECHANISM OF THE DIRECT UNION[1]

By GRANVILLE A. PERKINS

Chemist, Bureau of Science, Manila

SIX TEXT FIGURES

Certain difficult problems in organic chemistry, such as those of the chemical changes in living organisms, cannot be solved without much more definite knowledge of the mechanism of chemical reactions than is available at present. Remarkable advances have been made recently in the theory of valence and the nature of the binding forces between atoms, but it does not appear that any organic chemist has applied these new conceptions toward revising the older theories of the mechanism of reactions.

The theories of Thiele,[2] Vorländer,[3] Michael,[4] and Nef,[5] were founded on Kekulé's hypothesis of "affinity units." According to this hypothesis in its simple form, a reaction involving the main uniting forces between atoms can take place only when preceded or accompanied by a rupture of the bonds of the original compounds. This was supposed to take place symmetrically, as follow:

$$A—B \quad \text{gives} \quad A— + —B.$$

Observing, however, that A—B in general reacts quite unsymmetrically, these investigators merely amended the hypothesis, the favorite amended form being:

$$A^-—B^+ \quad \text{gives} \quad A^-— + —B^+.$$

Even with all possible amendments, the hypothesis proved entirely inadequate[6] for the formation of any definite and con-

[1] Received for publication March 15, 1921.

[2] Thiele, J., Ann. d. Chem. **306** (1899) 87 et al.

[3] Vorländer, D., Ann. d. Chem. **341** (1905) 1 et al.

[4] Michael, A., Ber. deut. chem. Ges. **39** (1906) 2138 et al.

[5] Nef, J. U. Ann. d. Chem. **298** (1897) 202 et al.

[6] Cf. Vorländer, D., Ber. deut. chem. Ges. **36** (1903) 3529, "Der Körper *x* hat an und für sich weder eine bestimmte Wertigkeit noch eigne Valenzen."

sistent theory of the mechanism of reactions. The difficulty was the ancient one of putting "new wine in old bottles."

There has been a strong tendency in the last two decades to refer everything unexplainable to "tautomerism," which has been used as a convenient hypothesis allowing one to manufacture as many structures as he desires for a compound. The result has naturally been a mass of confusion, from which there was only one way of escape, namely, the one clearly indicated half a century ago by Kekulé [7] himself, when he emphasized the fact that his formulas were nothing but *rational* formulas, and that true *constitutional* formulas could be obtained only through physical research. Although physicists cannot yet tell us the exact proportions or the exact forces in atoms, they can tell us much. It seems that the time is now at hand when the Kekulé affinity units may be, with due respect for what they have accomplished, laid on the shelf and replaced by more definite conceptions.

RECENT CONCEPTIONS OF CHEMICAL AFFINITY

Ever since the discovery of electrons it has been apparent that they are connected intimately with atomic union. A certain form of union between atoms (the salt-forming union) was easily explained as due to the transfer of an electron from one atom to another. While such an interpretation proved very valuable to inorganic chemists in dealing with this type of union, it was found to be no advance over the older form, $A^-—B^+$, in dealing with the type of union predominant in organic chemistry, which may be called the direct union. No satisfactory electronic conception of the direct union had been proposed until Lewis [8] advanced his hypothesis of the "cubical atom," which was later developed and made more definite by Langmuir [9] as the "octet theory of valence."

THEORY OF REACTION MECHANISM OF THE DIRECT BOND

On the basis of Langmuir's octet theory of valence it seems possible to revise the older theories of reaction mechanism into a much more tangible and consistent form. For the sake of definiteness, and because physicists disagree concerning force laws at small distances, it is necessary to put in the form of definitions

[7] Kekulé, F. A., Ann. d. Chem. 106 (1858) 147.

[8] Lewis, G. N., Journ. Am. Chem. Soc. 38 (1916) 762.

[9] Langmuir, I., Journ. Am. Chem. Soc. 41 (1919) 868, 1543; 42 (1820) 274. For the notation and nomenclature used cf. Perkins, G. A., Philip. Journ. Sci. 19 (1921) 1.

certain assumptions which Langmuir and others[10] have made concerning the force acting on shell electrons. To these will be added several suppositions which seem to the writer reasonable from a physical standpoint and necessary from a chemical standpoint.

DEFINITIONS

Elastic constraints.—When an external influence acts on an unshared electron in shell C of a compound, A—B—C, moving it from its position of equilibrium, an elastic constraint, or force of restitution, is developed, opposing the motion. This force

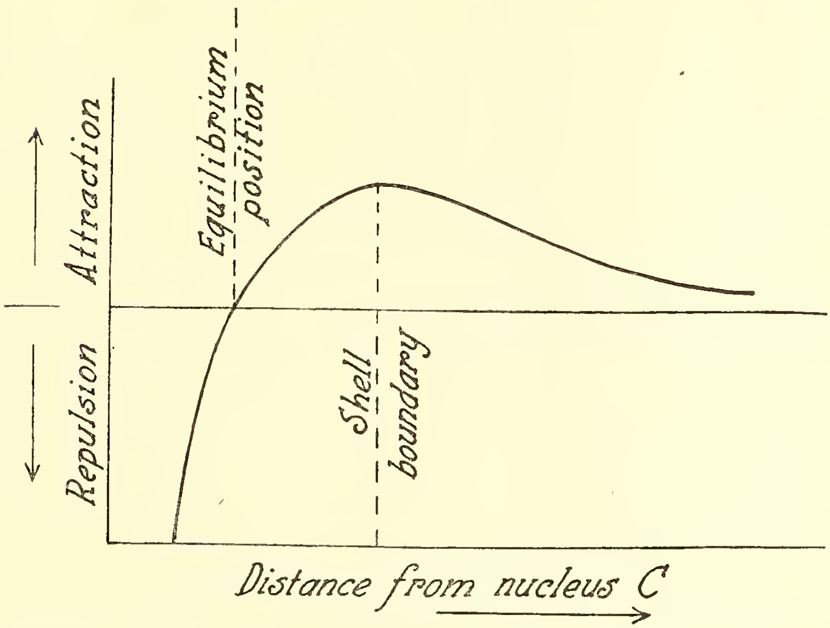


FIG. 1. Forces of restitution acting on an unshared shell electron, upon radial displacement.

does not vary in accordance with Hooke's law; in fact, it may be somewhat discontinuous, but it shows *approximately* the variation shown in fig. 1.

At the present time we cannot accurately resolve this total constraint into its components. It is sufficient for the present purpose to note that this constraint is made up of forces attribut-

[10] Concepts similar to some of these definitions can probably be found in J. Stark's "Electrizität im chemischem Atom," Leipzig, 1915, a book not available to the author at present. Stark was the first to propose any approximately satisfactory electronic conception of the direct bond, but his theory fails to take account of the very important unshared electrons.

able to each nucleus and electron in the compound A—B—C, and therefore any shift of any of the electrons in the compound, or of nucleus A or B, will cause a slight displacement of the position of equilibrium of the electron in question. For calculating the direction and relative amount of such displacement we may tentatively apply the ordinary laws of electrostatics, but *only to the mutual repulsion of electrons.*

When an electron is shared by two shells, as an electron shared by C and D in the compound A—B—C—D—E—F, it is con-

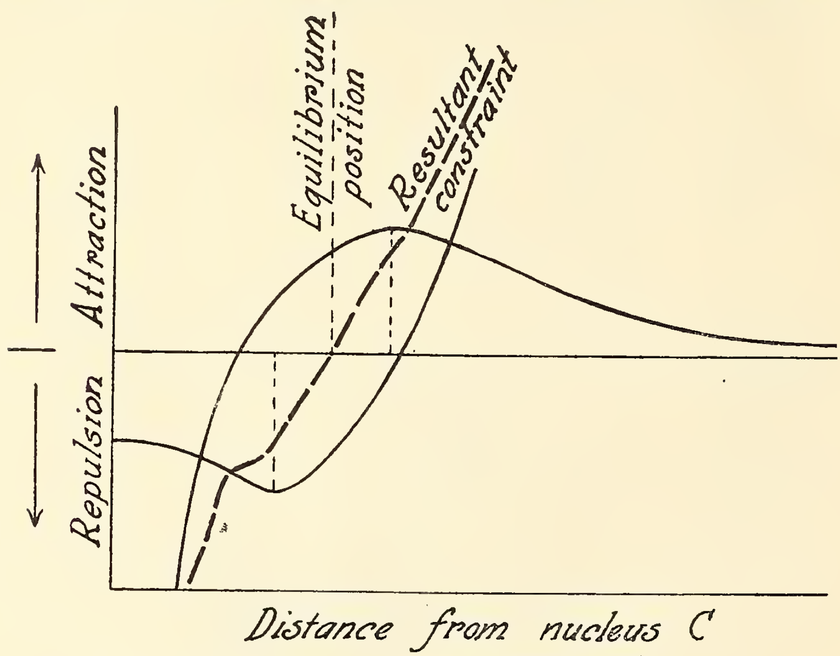


FIG. 2. Composition of forces of restitution acting on a shared electron.

venient to consider its constraint to be the resultant of two *single* constraints of the nature just described. One of these originates in A—B—C—, and the other in —D—E—F. The composition of two single constraints is shown in fig. 2.

Shell boundary.—It is convenient to consider that, when an electron is moved beyond the point where its constraint toward the nucleus reaches a maximum, it is *dissociated* and no longer inside the shell. Accordingly the points of maximum radial single constraint constitute a *dissociation boundary.* This boundary obviously has meaning only in reference to a certain specified electron or pair of electrons. For certain purposes there seems to be an advantage in extending the idea to a *shell* *boundary*, composed of sections, each section being defined in reference to the pair of electrons which it contains. The exact shape of such a shell boundary cannot be determined without more knowledge of the forces involved than is available at present, but the boundary of an ordinary four-pair shell is probably roughly tetrahedral with very rounded corners.

Loosely or firmly held electrons.—An electron whose position of equilibrium is well within a shell boundary requires a relatively large external force to move it even a small distance, and

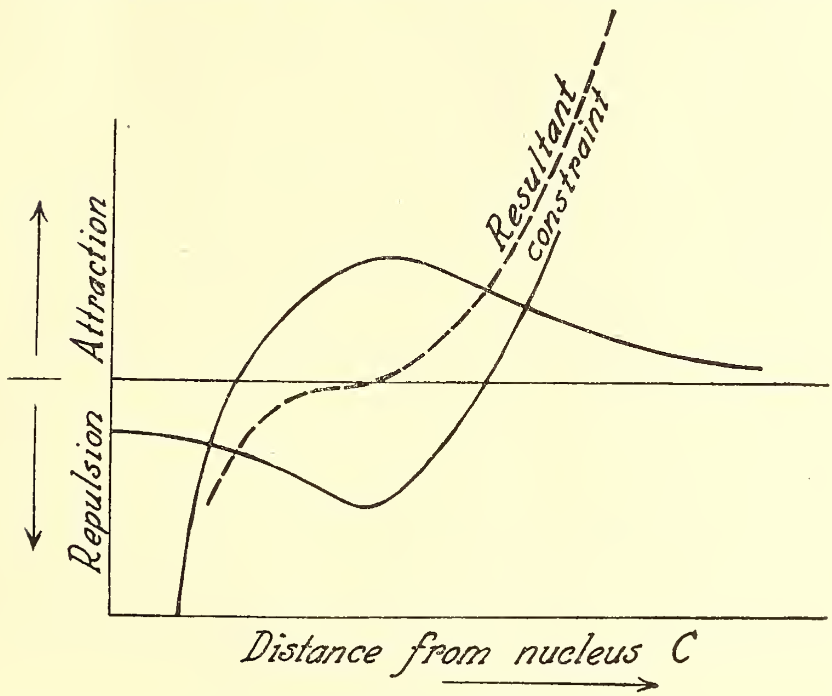


FIG. 3. Symmetrically weak union; loose electron.

will be spoken of as firmly held. A shared electron near the boundaries of both shells requires a much smaller force to move it the same distance, and will be spoken of as loosely held (see fig. 3). Such an electron is easily removed from either shell, both because it is near the boundary and because its constraint is slight.

The distribution of electrons in a shell.—The final solution of this problem has not yet been reached by physicists. As a convenient working hypothesis shell electrons will be considered to be ring-shaped magnetons,[11] which have sufficient magnetic at-

[11] Parson, A. L., Smithsonian Misc. Coll. 65 (1915) No. 11.

traction so that in the shells of the inert atoms they are in direct contact with each other.[12] In the shells of the other atoms, however, it seems that the nuclear attraction is insufficient for such close union, and they separate, forming a larger, looser shell, but still have a strong tendency to form pairs. In the case of unshared electrons this tendency may not be effective, but when external influences concentrate electrons toward certain portions of the shell, pairs are formed.

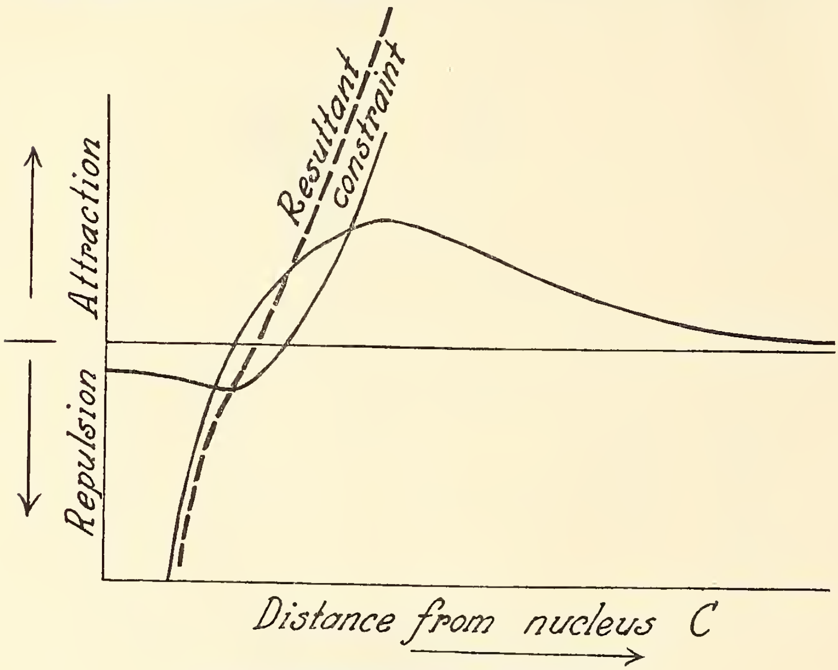


FIG. 4. Unsymmetrical weak union; firm electron.

Forces uniting atoms.—If we consider the forces represented in figs. 2, 3, and 4 to be only the components of constraint in a direction parallel to the line joining nuclei D and C, then the intercept on the "equilibrium position" line of either "single constraint" line is the force with which the electron in question unites the two atoms. Considering the atoms to be at equilibrium distance, the binding forces of this and any other electrons which C and D may be sharing are exactly neutralized by other forces, which may be considered as one force; namely, the mutual repulsion of the two atoms. Therefore the strength of union is measured, not by the *amount* of this binding force, but

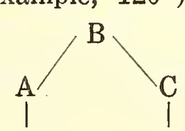
[12] Cf. Perkins, G. A., Philip. Journ. Sci. 18 (1921) 325, 19 (1921) 21.

by the rapidity with which it increases when the atoms are pulled apart. If, in the equilibrium position, the binding electrons are far within the shell boundaries of both C and D, the union is a strong one. If the binding electrons are close to the boundary of *either* C or D, the union is weak, and easily broken. This may be easily verified by noting that if the shells in figs. 3 and 4 are pulled apart the binding force increases only very little and then rapidly decreases.

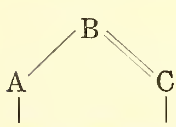
The single bond.—When two shell boundaries intersect, each of the shell electrons near the intersection is drawn, by the foreign nucleus, toward the line joining the two nuclei. That is, there is an effective concentration of electrons toward the portion common to both shells. Any number of electrons from one to six may be thus drawn into the common portion and serve as binding electrons between the two atoms. When electrons are thus concentrated, however, the magnetic tendency to form pairs becomes strong, so that the union with two shared electrons is very stable as compared to the union with one shared electron. Therefore, the latter has not been recognized as a chemical union, and the former has been called a single bond.

According to the above hypothesis as to the distribution of electrons, in the single bond the electrons are in contact (probably in "figure-eight" formation) and in a plane perpendicular to the line joining the two atoms.

The benzene bond.—According to the writer's view of the structure of benzene and similar compounds, the bond composed of three binding electrons is stable under certain conditions. The principal condition is that three atoms should be held rigidly with the lines joining their nuclei at an angle (in the case of carbon, for example, 120°); that is, between those favoring the formation



(109°), and the formation,



(125°). The special cases in which this bond is very stable will be discussed in a later paper. Ordinarily it has an instability comparable with that of the one-electron bond and the five-electron bond.

The double bond.—When the concentrating forces mentioned above bring four electrons into the common portion of two shells, it seems that magnetic forces are strong enough to form two pairs (probably figure-eights) but not enough to bring these pairs together.

The pairs have strong constraints toward their normal positions in each shell, so that independent rotation of the atoms is difficult, and probably impossible without dissociation.

The lateral displacement of the electrons causes large electron-free spaces, mentioned below in connection with direct addition. The radial displacement, caused by the increased repulsion of the atomic kernels at the closer approach demanded by the double bond, brings the electrons nearer to the shell boundaries than in the ordinary single bond. Consequently a double bond, or at least one-half of it, is more easily broken than a single bond.

The triple bond.—The triple bond, with three pairs of electrons, is extremely unstable, due to the extensive displacements of the electrons from their normal positions. The formation of acetylene and similar compounds at high temperatures is by no means a contradiction of this statement.

Dissociation.—When two atoms are bound by a pair of electrons whose position of equilibrium is near the boundary of one of the shells, only a slight thermal shock is necessary to cause the electrons to leave this shell entirely and take up a new position in the other shell. It sometimes happens that the electrons are near enough to the boundaries of *both* shells so that one electron goes to each shell. Due to the magnetic stability of a pair of electrons, however, and because bonds weak enough to dissociate are usually quite unsymmetrical, the result in nearly all cases is that both of the electrons go to the shell which attracts them most strongly, leaving two vacancies in the weak shell. The usual result, therefore, of the dissociation of A—B is not A— + —B as assumed in the affinity unit hypothesis, but $\overset{+}{A}< + \overset{-}{B}$. This is the fundamental point on which the writer's theory differs not only from the older theories of reaction mechanism but also from any of the recent ones that have come to his attention. It appears to be a reasonable deduction from Langmuir's octet theory, but the importance of it in organic chemistry seems to have escaped notice. Attempts to apply electronic conceptions to organic reactions have resulted in little advance over the older theories because of the assumption of dissociation in the manner $\overset{+}{A} - + -B^-$, which does not explain the observed facts in the case of the direct bond.

Direct addition.—The shell boundaries above defined have reference only to the removal of electrons from a normal shell, or the reverse, namely, addition of electrons to an *incomplete* shell. The addition of electrons to a complete shell occurs in a certain type of reaction, which may be called the *direct addition* type.

In general, two separated molecules attract each other by a force which is usually called cohesion, but which Langmuir [13] has shown to be so closely related to the forces of primary chemical union that it should be considered a "secondary valence" force (possibly even a primary valence force in the case of salt-like compounds).

As two molecules approach each other this attraction increases to a maximum, and then, becoming neutralized by a repulsion, falls off to zero. In this equilibrium position the two molecules

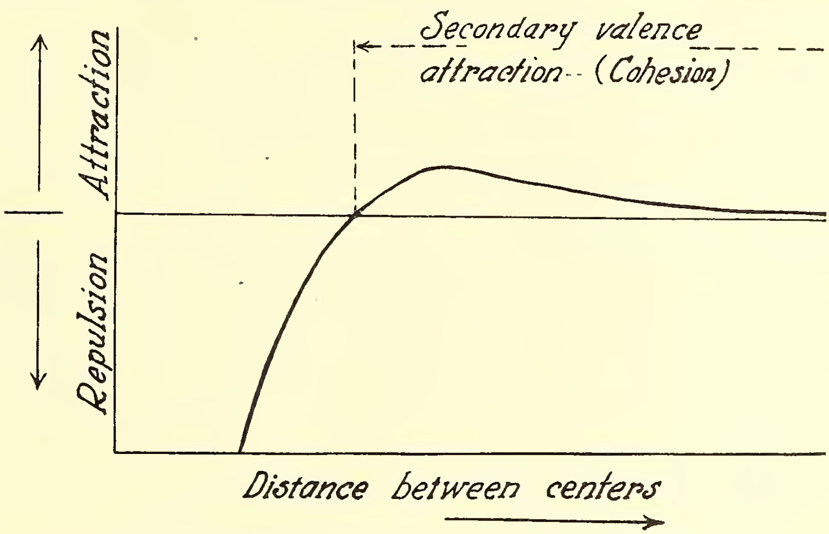


FIG. 5. The attraction between two non-reacting molecules.

are usually not sufficiently close for any interpenetration of shells. Such a union between molecules is identical with Kekulé's *idea* of a "polymolecule," but many of the compounds considered by Kekulé to be of this type are actually direct union compounds. In the case of direct union compounds the secondary valence forces are usually very weak, a typical example being the forces which hold together in a crystal the molecules of a paraffine hydrocarbon. The variation of force with distance in such a case is shown in fig. 5. It is here assumed that each molecule is free to rotate. The attraction, being chiefly elec-

[13] Langmuir, I., Journn. Am. Chem. Soc. 38 (1916) 2221, 39 (1917) 1848.

trostatic and due to the distribution of charges on each molecule, is of course entirely dependent on the orientation of each molecule in reference to the other.

If two molecules are capable of reaction, but only when assisted by thermal impact, the attractive force will be of the nature shown in fig. 6. This figure illustrates well the particular type of reaction under consideration, namely, that of direct addition to an already complete shell. Such reactions are usually dependent on thermal impact, and the molecules show a maximum repulsion at a certain distance (fig. 6, *a*). Direct addition reactions not dependent on thermal impact do not have a repulsion at this distance, but in all probability have a minimum attraction.

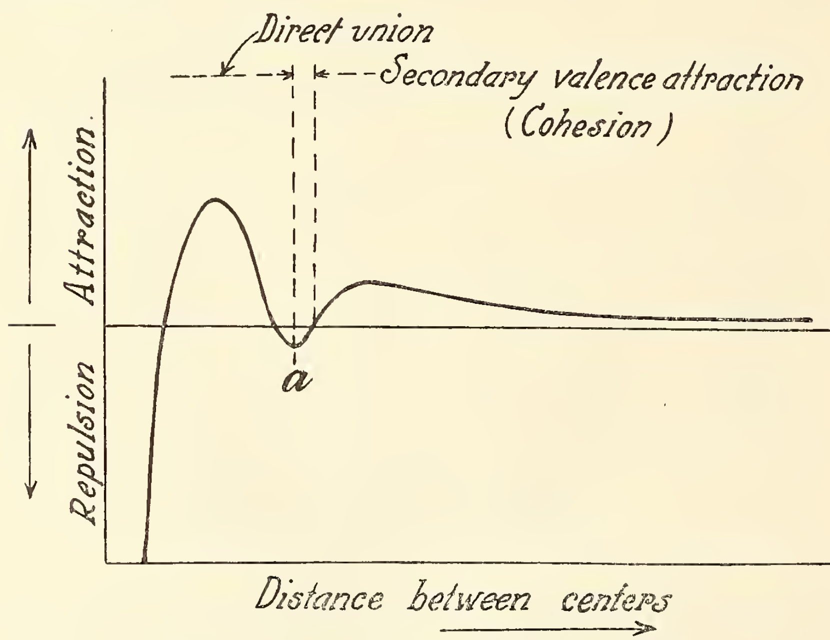


FIG. 6. The attraction between two reacting molecules.

Since the sharp rise to the left of point *a* in fig. 6 is due to the interpenetration of electron shells, we may conveniently consider that just at this distance of maximum repulsion (or minimum attraction) entrance of one or more electrons into a shell of the foreign molecule takes place. This definition makes possible a concept of shell boundary from the point of view of direct addition, which varies however according to the molecule added. The extension of this definition of shell boundary to the process of addition to an incomplete shell is unnecessary, because an adequate concept has already been provided, and impossible, because usually no minimum attraction point a exists.

Addition to an already complete shell is possible only when the electrons are so displaced from their normal positions as to leave *large electron-free spaces* in the shell. When such direct addition occurs, the resulting molecule is unstable, and usually[14] immediately rearranges so as to reduce the number of electrons in the shell to the normal value.

TWO TYPES OF DIRECT BOND REACTION

Most of the reactions of organic chemistry involve both addition and dissociation. These are divided into two types:

Type 1.—Direct addition reaction.

Type 2.—Dissociation-addition reaction.

In type 1 there is evidence that addition of electrons to a shell, as above defined, takes place before dissociation. In type 2 there is evidence that dissociation occurs before addition. The dissociation is usually, but not always, of the unsymmetrical type.

REACTIONS OF THE DOUBLE BOND

As has been intimated, it seems to the writer that the primary cause of double bond reactivity is no more or less than was suggested by Baeyer,[15] namely, that a double union between two atoms cannot exist without a distortion of the binding mechanism (the electron shell) of each atom. In fact, some so-called "double bonds" exist only in the half dissociated condition, $\overset{\diagdown\,\diagup}{A}{}^{+} - B^{-}$ (better $\overset{\diagdown\,\diagup}{A} \propto B$). An illustrative case of each of the two types of double-bond reaction will be briefly considered.

TYPE 1. DIRECT ADDITION REACTION

In the case of the addition of bromine to ethylene and similar reactions it seems to the writer that various assumptions which have been made as to directed valence, tautomerism, opened up force fields, or ionization, are unnecessary to explain the observed facts. It seems more probable that thermal impacts, aided by the slight attraction between the positive and negative areas of the respective molecules, occasionally send a bromine molecule

[14] Sometimes conditions prevent this rearrangement. Cf. Langmuir's discussion of liquid PCl_5. Langmuir, I., Journ. Am. Chem. 41 (1919) 919.

[15] Baeyer, A., Ber. deut. chem. Ges. 23 (1890) 1275.

against an ethylene molecule with sufficient force so that some of the bromine shell electrons momentarily penetrate into one of the large empty spaces in the shell of one of the carbon atoms, *a*. Such an addition loosens (by repulsion) the restraints on shell *a* electrons sufficiently so that the other carbon atom, *b*, immediately pulls a pair of the shared electrons beyond the boundary of shell *a*. The result is:

$$\begin{array}{llllllll} & & & & & \mathrm{H} & & \mathrm{H} \\ & (b) & & (a) & & |\ (a) & & |\ (b) \\ \text{Compound A} & \mathrm{Br} & - & \mathrm{Br} & \propto & \mathrm{C} & \propto & \mathrm{C} \\ & & & & & | & & | \\ & & & & & \mathrm{H} & & \mathrm{H} \end{array}$$

$$\left(\begin{array}{cccccccc} & & & & \mathrm{H} & & \mathrm{H} \\ & & & & | & & | \\ \textit{or} \quad \mathrm{Br} & - & \mathrm{Br}^{+} & - & \mathrm{C} & - & \mathrm{C}^{-} \\ & & & & | & & | \\ & & & & \mathrm{H} & & \mathrm{H} \end{array}\right)$$

This compound has never been isolated, so far as the writer knows. A large number of exactly analogous unstable intermediate products, however, have been isolated. Vorländer,[16] who found it impossible to explain them on the basis of "affinity units," named them class "A" compounds, and the rearranged stable forms, class "B." These designations will be adopted by the writer.

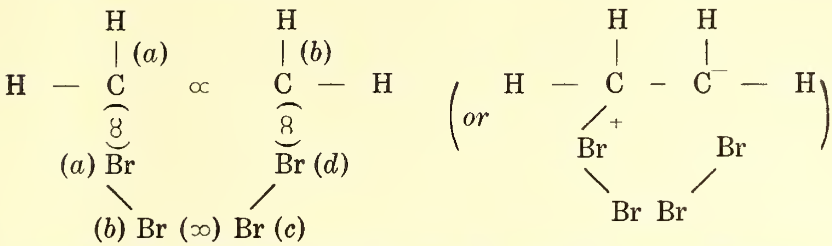
In this case the "class A" compound is very unstable for the reason that when bromine *a* "lends" a pair of electrons to carbon *a*, a general electron shift (toward the right in the formula as shown), away from bromine *b* and toward carbon *b*, takes place notwithstanding the relatively strong attraction which the bromine kernel has for electrons. The strained condition of electron-free spaces originally on carbon *a*, is thus transferred to bromine atom *b*. The next step is probably that another bromine molecule acts on bromine *b*, just as bromine *a* did on carbon *a*; forming a positive bromine ion,

$$\begin{array}{llll} (b) & (c) & (d) & \\ \mathrm{Br}^{+} \propto & \mathrm{Br} & -\mathrm{Br}, & \text{or } [\mathrm{Br} - \mathrm{Br} - \mathrm{Br}]^{+} \end{array}$$

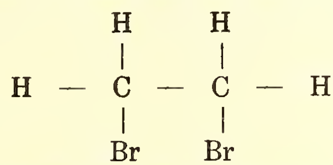
This ion is immediately attracted by the negatively charged carbon *b*, upon which one of its atoms is deposited by a repetition of the same type of reaction. The movements involved at

[16] Ann. d. Chem. 341 (1905) 1.

this stage are more electronic than atomic, as a six-membered ring is easily formed:



When the electrons have moved to their stable positions a molecule of bromine splits off, leaving ethylene bromide:

Compound B 

According to the view just outlined, a double bond is inherently reactive. There are influences, however, which cause this property of reactivity to vary in different compounds.

The formation of addition products of class A is assisted by two factors (1) and (2), and checked by a third (3). The most important of these is (1):

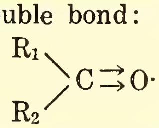
(1). Any influence increasing the size of the electron-free areas in the shell attacked.

(2). Any influence shifting the double bond electrons nearer the boundary of the attacked shell.

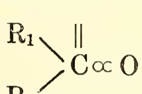
(3). Steric hindrance, limiting effective impact of the intruding molecule.

TYPE 2. DISSOCIATION-ADDITION REACTION

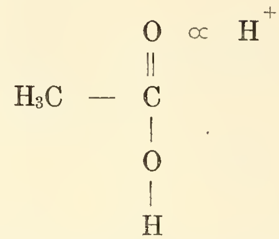
In such cases as the esterification of acetic acid and alcohol, there is a very polar double bond:



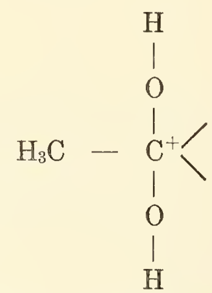
Thermal impacts, even when unassisted by catalysts, are able to cause a small proportion of the molecules to be half dissociated into the form:

 (: C : O :, Lewis's notation.)

When the reaction is catalyzed by $-\overset{+}{H}-$, the acetic acid is directly attacked, forming:

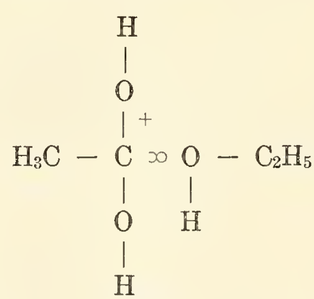


in which the electrons of the double bond are drawn forcibly away from the carbon atom. It is therefore a very reasonable assumption that a large number of these catalyzed molecules take the half-dissociated form:



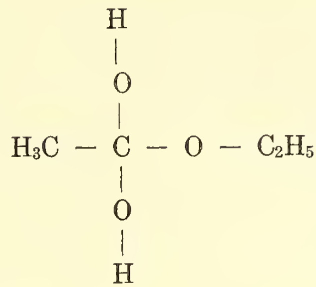
It is to be noted that the carbon atom becomes very unsaturated, having now two vacancies in its shell. It therefore is very reactive, and an addition product with alcohol is formed:

Compound A



Again the first compound is unstable. The accumulation of positive charge near the alcohol oxygen releases the attached hydrogen as $-\overset{+}{H}-$ giving:

Compound B



Further discussion of this reaction, including the subsequent stage of regeneration of the double bond, will be postponed to a later paper. It is sufficient for the present to point out the influences which cause this type of reactivity to vary in different compounds. The reaction does not depend on large spaces in the undissociated shell, but only on dissociation, so that factor (2) mentioned above is primarily important. Factor (3) is relatively unimportant, and factor (1) has no influence.

CONCLUSION

The discussion of the two typical reactions has been very brief, the purpose of this paper being to present a hypothesis, not to justify it. The hypothesis is admittedly in a rough form, and doubtless will require certain additions and modifications of the less-important details. Nevertheless it forms a definite and consistent basis for many of the various "rules" and "principles" that have been applied to organic reactions, in so far as they are consistent with the facts, and is particularly valuable in dealing with the "exceptions" to these rules, among which may be considered the benzene nucleus. The writer expects to take up some detailed applications in a series of papers, but before continuing this series the subject of one-electron and three-electron bonds, not provided for in Langmuir's postulates, will be considered.

SUMMARY

1. A theory of the reaction mechanism of the direct union is proposed, based principally on Langmuir's octet theory of valence.

2. The distinct features of the theory are certain working definitions of the electronic forces and the suppositions (*a*) that dissociation of the direct bond usually takes place in such a

way as to leave one of the atoms saturated and the other with two unsatisfied bonds; and (*b*) that in a certain type of reaction an atomic shell momentarily contains two more electrons than its normal number.

3. The two main types of double bond reactions have been illustrated.

4. The applications of this theory will form the subject of a series of papers.

ILLUSTRATIONS

TEXT FIGURES

CHAROPHYTA FROM ANNAM AND GUAM

By James Groves

Of Yarmouth, England

NITELLA ACUMINATA Braun.

A form with the size and habit of *Nitella flexilis,* but with small, rather dense heads; secondary rays fairly long. It has well-developed, usually geminate, ripe fruit; the oöspore is golden-brown, about 275 μ long, 225 μ broad, 175 μ thick, showing about 8 ridges with flanges and a distinct crest; membrane with minute granular decoration.

Indo-China, Annam, Nhatrang and vicinity, *C. B. Robinson 1342*, March 11 to 26, 1911.

NITELLA DUALIS Nordstedt.

The female plant with well-developed fruit; the oöspore is golden-brown, about 180 to 200 μ long, 150 to 160 μ broad, 100 μ thick, showing 6 or 7 low ridges; membrane with netted decoration, the meshes about 5 μ in diameter. The fruiting whorls are enveloped in dense mucus. Though the dactyls (= ultimate rays) are 2-celled, the allantoid form of the upper cell shows the relationship of the plant with the most extreme members of Braun's section Polyarthrodactylae, rather than with the species placed by him under Diarthrodactylae. The dactyls with their almost mucronate points to the upper cells correspond with Nordstedt's figures of the original plant and, although the oöspore is smaller, its shape and the decoration of the membrane agree with the description. Unfortunately, the specimen is not a satisfactory one owing principally to having been floated out on harsh coarse-fibered paper rendering it well-nigh impossible to detach the slender sterile branchlets intact, but the dactyls of these as well as those of the fertile branchlets appear to be uniformly 2-celled. The original specimens of *Nitella dualis* came from Liberia, West Africa, and so far as I know it had not hitherto been found elsewhere, so that Doctor Robinson's discovery of it in Annam is of great interest.

Indo-China, Annam, Nhatrang and vicinity, *C. B. Robinson 1506*, March 11 to 26, 1911.

CHARA AUSTRALIS R. Brown.

A rather small form with numerous well-developed fruits and antheridia. The characteristic black cylindric-ellipsoid oöspore is about 550 to 650 μ long and 400 μ broad, and shows 7 or 8 strong ridges. This is an important extension of the known range of this species, which has hitherto only been recorded from Australia, Tasmania, New Zealand, New Caledonia, Fiji Islands, and (?) Tahiti.

Indo-China, Annam, Nhatrang and vicinity, *C. B. Robinson 1167*, March 11 to 16, 1911.

CHARA FLACCIDA Braun.

This has the ripe oöspore, when viewed entire, of a transparent golden-brown, the character which serves to distinguish *Chara flaccida* from *C. gymnopitys* Braun. Braun and Nordstedt in "Fragmente Monogr. Charac." record *C. flaccida* from the Marianne Islands and Celebes. Nordstedt, in his account of the Characeae collected by the *Gazelle* expedition, refers to *C. gymnopitys* being found in both localities. If the two species are distinct, they must be very closely related.

Marianne Islands, Guam, *R. C. McGregor 592*, October, 1911. The same locality, December, 1911, *No. 191* (no collector's name).

THE PHILIPPINE WASPS OF THE SUBFAMILY SPHECINÆ

By S. A. Rohwer

Honorary Custodian of Hymenoptera, United States National Museum

The wasps belonging to the subfamily Sphecinæ are often called "thread-waisted," because of the petiolated abdomen. The habits and prey of the group vary considerably. The Chlorionini nest in the ground and provision their nests with Orthoptera. The Sphecini also nest in the ground but use lepidopterous larvæ as food for their young. The Sceliphronini are usually called "mud-daubers," because of their habit of constructing mud nests which are provisioned with spiders.

The group is easily recognized by the three complete cubital cells; petiolate abdomen; long propodeum, in which the spiracles are well removed from the base; the presence of two calcaria on intermediate tibiæ; rather large size; etc.

Key to the Philippine tribes of the subfamily Sphecinæ.

1. Second and third cubital cells each receiving a recurrent vein; propodeum without a U-shaped area on its dorsal surface; robust species with a short petiole .... Chlorionini.
   Second cubital cell receiving both recurrent veins; slender forms with a long petiole .... 2.
2. Propodeum without a U-shaped area on its dorsal surface; female with a tarsal comb .... Sphecini.
   Propodeum with a U-shaped area on its dorsal surface; tarsal claws with an inner tooth; female without a tarsal comb .... Sceliphronini.

Tribe CHLORIONINI

Genus CHLORION Latreille

The species of this genus were monographed by Kohl in 1890 under the generic name *Sphex* and they are still often assigned to that genus, which is however properly applied to species assigned to *Ammophila*.

Key to Philippine species of the genus Chlorion.

1. Tarsal claws with one inner tooth .... 2.
   Tarsal claws with two inner teeth .... 3.

2. Body entirely metallic blue or green........ Chlorion lobatum (Fabricius).
Head and thorax reddish; abdomen metallic purplish.
Chlorion splendidum (Fabricius).
3. Metanotum bituberculate.. 4.
Metanotum not bituberculate or with a longitudinal sulcus................ 8.
4. Wings hyaline or mostly so; head and thorax with silvery pubescence.
Ammobia umbrosa var. plumifera (Costa).
Wings yellowish hyaline, with the apices smoky; pubescence black.
Ammobia umbrosa var. rufipennis (Fabricius).
Wings dark brown or blackish.. 5.
5. Legs black; wings blackish, with a distinct violaceous reflection; pubescence black.. 6.
Legs at least partly reddish; wings brownish, without a distinct violaceous reflection .... 7.
6. Propodeum with a median furrow........ Ammobia (?) maura (Smith).
Propodeum without a median furrow.... Ammobia sulciscuta (Gribodo).
7. Abdomen black; pubescence of head and thorax golden.
Ammobia aurulenta var. lepeletierii (Saussure).
Abdomen partly red; pubescence of head and thorax black.
Ammobia aurulenta var. sericea (Fabricius).
8. Scutellum without a median sulcus; black.. 9.
Scutellum with a distinct median sulcus.. 10.
9. Pubescence black; wings fuscous brown, with a coppery tinge.
Ammobia (?) morosa (Smith).
Pubescence pale, with a faint golden tinge; wings hyaline, with a dark spot apically............ Isodontia severini var. philippensis var. nov.
10. Wings yellowish... Ammobia luteipennis (Mocsáry).
Wings blackish... 11.
11. Legs entirely black........ Ammobia haemorrhoidalis var. mutica (Kohl).
Hind femora red.
Ammobia haemorrhoidalis var. siamensis (Taschenberg).

Subgenus Chlorion Latreille

The two species of this subgenus that have been recorded from the Islands are not represented in the Philippine collections at my disposal. The record of *Chlorion splendidum* is open to question, and it may be well to eliminate this name from the list until specimens have been collected.

Chlorion (Chlorion) lobatum (Fabricius).

This beautiful species can be easily recognized by its metallic body.

Chlorion (Chlorion) splendidum (Fabricius).

This species has been recorded only in the Brown catalogue, and its occurrence in the Islands needs verification.

Subgenus **Ammobia** Billberg

Chlorion (Ammobia) umbrosa var. plumifera (Costa).

Chlorion umbrosus var. *plumiferus* Costa, WILLIAMS, Bull. Hawaiian Sugar Planters' Assoc. 14 (1919) 125.

This variety is included in many of the Philippine lists under the name (*Sphex*) *Chlorion argentata* Dahlbom. *Argentata* is a synonym of *umbrosa* and as there seems to be only one variety in the Islands which might be assigned this name, it is rather certain that references to the species apply to this variety rather than to the typical form.

LUZON, Manila (*W. A. Stanton*), female: Laguna Province, Los Baños (*Baker 369*). Two females and one male, under Bureau of Agriculture accession numbers, as follows: LUZON, Manila (*B. Arce*), accession No. 129: Bataan Province, Lamao, and Nueva Ecija Province, Cabanatuan (*C. R. Jones*), accession Nos. 843 and 1254.

Chlorion (Ammobia) umbrosa var. rufipennis (Fabricius).

Sphex umbrosa var. *rufipennis* Fabricius, KOHL, Ann. Naturh. Hofmus. Wien 5 (1890) 408; ASHMEAD, Proc. U. S. Nat. Mus. 22 (1904) 150.

Ashmead has recorded this variety as occurring in the Islands, but it is not represented in the collection before me. This variety can be recognized by the black pubescence and yellowish hyaline wings with smoky apices.

Chlorion (Ammobia?) maura (Smith).

Sphex maurus Smith, BINGHAM, Ann. & Mag. Nat. Hist. VI 16 (1895) 443; BINGHAM, Fauna Brit. India, Hym. 1 (1897) 247.

This species is recorded from Cape Engaño, Luzon, by Bingham but is not in the collection before me. From the descriptions the species is allied to *Ammobia sulciscuta* (Gribodo) but may be separated from it by the presence of a median furrow on the propodeum. The following characters from Bingham's description should aid in the identification of the species: "Black with black pubescence; the wings dark fuscous, with a rich purple effulgence," scutellum, metanotum, and propodeum furrowed down the middle; propodeum steeply rounded at apex, almost truncate, "the median furrow not reaching the edge of the truncation, but broadening out in spoon-shaped form just before the margin."

Length of male, 25 to 28 millimeters; of female, 28 to 34 millimeters. Tarsal claws with two teeth.

Chlorion (Ammobia) sulciscuta (Gribodo).

Sphex sulciscuta GRIBODO, Miscel. Ent. 2 (1894) 2.

A single male collected at Los Baños, Laguna, Luzon (*E. M. Ledyard 1024*) agrees with Gribodo's description, which is based on the female, except in regard to the clypeus, and it seems likely that this difference is sexual. The species very closely resembles *mutica* (Kohl) but is readily separated by the bilobed metanotum.

Uniformly black, with black pubescence; wings violaceous; face with silvery pile beneath the black hair; clypeus flat, the anterior margin broadly and shallowly emarginate.

Length, 26 millimeters.

Chlorion (Ammobia) aurulenta (Fabricius).

Sphex aurulenta Fabricius, KOHL, Ann. Naturh. Hofmus. Wien 5 (1890) 382; BINGHAM, Fauna Brit. India, Hym. 1 (1897) 250.
Sphex ferruginea LEPELETIER, Hist. Nat. Ins. Hym. 3 (1845) 345.
Sphex lineola LEPELETIER, Hist. Nat. Ins. Hym. 3 (1845) 353.

I have followed the synonymy as published by Kohl in 1890 for this species. Certain of the lists of Philippine Chlorionini have treated *ferruginea* and *lineola* as distinct varieties. Bingham, 1897, uses the name *lineola* for a variety which has the pubescence of the head and thorax silvery white; but he is evidently wrong, as the original description of *lineola* gives the color of the pubescence as golden. It is possible that what Bingham had as *lineola* is the variety *pallidahirta* Kohl and that Kohl's variety should be added to the Philippine list. Only two varieties are represented in the collections before me.

Chlorion (Ammobia) aurulenta var. lepeletierii (Saussure).

Chlorion aurulentus var. *ferrugineus* Lepeletier, WILLIAMS, Bull. Hawaiian Sugar Planters' Assoc. 14 (1919) 124.

LUZON, Laguna Province, Los Baños (*Baker 368*), female.

Chlorion (Ammobia) aurulenta var. sericea (Fabricius).

This variety has been recorded from Manila by Kohl (1890) and is represented in the collection before me by two males received from C. F. Baker.

LUZON, Laguna Province, Los Baños, Mount Maquiling (*Baker 2729*).

Chlorion (Ammobia?) morosa (Smith).

Sphex morosus Smith, BINGHAM, Ann. & Mag. Nat. Hist. VI 16 (1895) 443; BINGHAM, Fauna Brit. India, Hym. 1 (1897) 246.

In 1895 Bingham recorded as doubtfully belonging to this species a female collected at Cape Engaño, Luzon, by Whitehead, but in 1897 he states that the female of this species is unknown. It is possible therefore that the name "*morosus*" should be excluded from the list of Philippine Chlorionini. I do not know the species and have taken the following characters from Bingham's 1897 description of the male:

Claws with two teeth; scutellum and metanotum without a median sulcus; petiole of the abdomen long, slightly curved upwards; propodeum "with a gentle rounded slope posteriorly, except the apex, where it is suddenly steep;" black, with black pubescence, the clypeus and face with dense silvery pile; "wings fuscous brown with a coppery effulgence, the hind wing much lighter and paler." "A variety has the posterior femora below and the inside of the posterior tibiæ red."

Chlorion (Ammobia) luteipennis (Mocsáry).

Sphex luteipennis Mocsáry, KOHL, Ann. Naturh. Hofmus. Wien 5 (1890) 423.

Chlorion luteipennis Mocsáry, WILLIAMS, Bull. Hawaiian Sugar Planters' Assoc. 14 (1919) 127.

LUZON, Laguna Province, Los Baños (*Baker*), female; Mount Maquiling (*Baker 2730*), male, also a female.

Chlorion (Ammobia) haemorrhoidalis (Fabricius).

Sphex nigripes Smith, KOHL, Ann. Naturh. Hofmus. Wien 5 (1890) 421; BINGHAM, Fauna Brit. India, Hym. 1 (1897) 248.

Sphex haemorrhoidalis Fabricius, TURNER, Ann. & Mag. Nat. Hist. VIII 10 (1912) 369.

Turner in 1912 pointed out that the correct name to use for this species is *haemorrhoidalis* rather than *nigripes*. The typical *haemorrhoidalis* is African; the Oriental forms, although they differ greatly in color, are classed as varieties.

Chlorion (Ammobia) haemorrhoidalis var. **mutica** (Kohl).

Ammobia mutica Kohl, WILLIAMS, Bull. Hawaiian Sugar Planters' Assoc. 14 (1919) 128.

LUZON, Laguna Province, Los Baños (*Baker 367, F. X. Williams 5*), females.

Chlorion (Ammobia) haemorrhoidalis var. **siamensis** (Taschenberg).

MINDANAO, Dapitan (*Baker 6842*), one male.

Subgenus Isodontia Patton

Chlorion (Isodontia) severini var. **philippensis** var. nov.

Female.—Length, 17 millimeters; length of anterior wing, 12 millimeters. Differs from Kohl's description of the species in absence of the rufous markings of the abdomen (the narrow testaceous bands on the apical margins of the tergites are not wanting). Fuscous spot in the anterior wing confined to the area anterior of cubitus and beyond end of the radial cell.

Male.—Length, 14 millimeters; length of anterior wing, 10 millimeters. In Kohl's monograph of the species of this group [1] the male runs to *Isodontia diodon* Kohl but differs from that species in the color of the wings. From *Isodontia egens* Kohl, to which it seems allied, it may be distinguished by the longer third antennal joint. In the male the mandibles are slender, acute apically, and with an inner tooth near apex (almost bidentate apically); the outer margin is simple and not as in the female; distance between eyes below but little less than the combined length of the third and fourth antennal joints; eighth sternite with a broad, arcuate emargination medianly; antenna longer than head and thorax. Color and sculpture as in the female.

Type locality.—Puerto Princesa, Palawan.

Allotype locality.—Los Baños, Laguna, Luzon.

Type.—Catalogue No. 23635, United States National Museum.

Both specimens from C. F. Baker, the allotype under his No. 370.

Tribe SPHECINI

Genus SPHEX Linnæus

All of the Philippine species of *Sphex* belong to those subgenera which have the first two abdominal segments forming the petiole. No species of *Psammophila,* which has the petiole formed of the basal part of the first segment, has been recorded. The species now called *Sphex* were formerly assigned to *Ammophila* (a synonym of *Sphex*) and are better known under that name.

Key to Philippine species of Sphex.

1. Tarsal claws with two inner teeth near the base; large, black, with violaceous wings................................ Sphex (Ceratosphex) bakeri sp. nov.
   Tarsal claws simple; wings fuscohyaline.. 2.
2. Frons normal, convex; dorsal part of pronotum with distinct transverse rugæ; scape of female reddish............................ Sphex atripes (Smith).
   Frons deeply concave; dorsal part of pronotum without distinct transverse rugæ (in one specimen there are a few indistinct wrinkles); scape black in both sexes.................................... Sphex coronatus (Costa).

[1] Ann. Naturh. Hofmus. Wien 5 (1890).

Subgenus Sphex Linnæus

Sphex (Sphex) coronatus (Costa).

Ammophila coronata COSTA, Ann. Mus. Zool. Napoli 2 (1862–1864) 111.
Ammophila superciliaris SAUSSURE, Reise d. Novara, Zool. 2[1] Hymenoptera (1867) 24.

There seems no reason to doubt the above synonymy as both descriptions certainly apply to the species treated below. This species, although resembling *atripes* in general appearance, may readily be distinguished by the characters mentioned in the preceding key. The male is without red markings and shows very little variation, but the females vary some in the color of the legs and abdomen. Four females represent a variety in which the first two tergites are largely reddish and the tarsi almost entirely reddish. These color differences are not accompanied by any differences in structure. The structure varies somewhat, as certain specimens have a few rugæ on the side of the pronotum and there is some variation in the rugosity of the mesoscutum.

Typical females from: LUZON, Laguna Province, Los Baños (*Baker 372, 6844*): Bataan Province, Lamao (*C. V. Piper*), (*C. R. Jones*), accession NO. 844, Bureau of Agriculture. Females of the color variety from: MINDANAO, Davao (*Baker 6845*); Dapitan (*Baker 3207*); Iligan (*Baker 3205*). PANAY, Antique Province, Culasi, June, 1918 (*R. C. McGregor*). Males from: LUZON, Laguna Province, Los Baños (*Baker 374*); Mount Maquiling (*Baker*); Bataan Province, Lamao (*C. R. Jones*), accession No. 840, Bureau of Agriculture. MINDANAO, Iligan (*Baker 3206*); Cagayan (*Baker 3820*).

Sphex (Sphex) atripes (Smith).

Ammophila atripes Smith, BINGHAM, Fauna Brit. India, Hym. 1 (1897) 229; ASHMEAD, Proc. U. S. Nat. Mus. 28 (1904) 150.

Ashmead and Brown seem to be the only ones to record this species from the Islands, and I doubt if their records were based on specimens. I have seen no specimens of *atripes* from the Philippines but have included the species in the above key so it can be identified if it occurs there and to point out certain differences between it and *coronata*.

Subgenus Ceratosphex novum

This subgenus can be readily distinguished from true *Sphex* by the presence of two teeth on the tarsal claws at the base beneath. It bears about the same relation to *Sphex* as *Para-*

psammophila does to *Psammophila,* and as a group has long been recognized, but no one seems to have given it a name. To me it seems that there is a distinct use for a name for such a group.

Genotype, *Sphex* (*Ceratosphex*) *bakeri* sp. nov. described below.

Sphex (Ceratosphex) bakeri sp. nov.

Female.—Length, 33 millimeters; length of the anterior wings, 20 millimeters. Robust; head somewhat wider than the thorax, narrowing behind the prominent eyes, mandibles large, with a large inner tooth somewhat before the middle; clypeus convex, with a shallow median impression before apex, the surface with large, well-separated punctures (except around impression), the apical margin truncate; inner margins of the eyes very slightly diverging below; frons shining, convex, parted by a median impressed line, with rather small, separated punctures; ocelli in a low triangle, completely surrounded by an impressed line; postocellar line distinctly shorter than the ocellocular line; vertex convex, with small separated punctures which are closer in the area behind the ocelli; third antennal joint but little shorter than the two following, apical joint truncate, subequal in length to the preceding; pronotum narrow, sloping anteriorly, with only small, widely scattered setigerous punctures; mesoscutum opaque, with close, rather small punctures; tegulæ polished; scutellum and metanotum convex, with irregular, longitudinal, raised lines; propodeum coarsely reticulate, laterally with a tendency to striate reticulations, sharply truncate posteriorly, the lateral dorsal area (behind the spiracle) with distinct transverse rugæ; mesepisternum with distinct, large, rather close punctures; legs strongly spined, the posterior basitarsus subequal in length to the two following joints; cubitella postfurcal; third cubital cell more than twice as long on radius as on cubitus; second abscissa of radius shorter than the first and also shorter than either the second or third abscissa of cubitus; second abscissa of cubitus somewhat shorter than the third; abdomen shining, the first tergite distinctly longer than the second; second tergite distinctly widening beyond the spiracles (that is, beyond middle). Black, with black pubescence; caudal margin of prothoracic tubercule fringed with white hairs; wings black, with a strong violaceous reflection.

Type locality.—Mount Maquiling, Laguna, Luzon.

Type.—Catalogue No. 23636, United States National Museum.

Described from one female received from C. F. Baker, for whom the species is named.

Tribe SCELIPHRONINI

Genus **SCELIPHRON** Klug

Many authors have considered that all the species belonging to this genus should be referred to one superspecific group, but I am inclined to agree with Dahlbom, Patton, and others and recognize two subgenera separated by certain structural characters and easily distinguished by color. Patton [2] was the first to point out the structural characters and at that time he used as genera the names *Pelopaeus* and *Chalybion.* Since then the blue species have usually been referred to *Chalybion.* Hutson [3] expresses the belief that this is wrong and that the name *Sceliphron* will have to be used for the metallic forms. He bases his opinion on recommendations *k* and *n* of the International Commission on Zoological Nomenclature and overlooks the designations of genotypes made by previous students. In 1810 Latreille designates the type of *Pelopaeus* as *spirifex* and in 1897 Bingham cites the same species as the type of *Sceliphron.* The species *spirifex* was included in the original account of both these genera, and both of the above type designations must be accepted as valid even if Bingham did not follow the recommendations (he violated no rules) of the International Code. *Sceliphron* Klug and *Pelopaeus* Latreille are isogenotypic and since *Sceliphron* is the older name Latreille's name will have to be placed in synonymy. This makes it possible to retain the name *Chalybion* for the metallic species.

Key to the subgenera of Sceliphron.

Black and yellow species; petiole usually about twice as long as propodeum; clypeus bilobed or bidentate anteriorly........................ **Sceliphron** Klug.
Metallic blue species; petiole subequal with the propodeum; clypeus with more than two teeth.. **Chalybion** Dahlbom.

Subgenus **Chalybion** Dahlbom

The only species of this genus was originally described under the name *bengalensis* by Dahlbom and considered to be different from the European form, but more recent authors have synonymized the two and I have followed them.

[2] Proc. Boston Soc. Nat. Hist. 20 (1880) 378.
[3] Trans. Am. Ent. Soc. 45 (1919) 218.

Sceliphron (Chalybion) violaceum (Fabricius).

The few specimens of this species may be divided into two groups on the punctation of the frons, but it is probable that this will vary. More specimens should be studied.

LUZON, Manila (*Robert Brown*): Laguna Province, Los Baños (*Baker 379, 1290*), Mount Maquiling (*Baker 1351*): Rizal Province, Alabang (*B. Arce*), accession No. 1853, Bureau of Agriculture.

Subgenus Sceliphron Klug

Three species of this subgenus are represented in the Philippine material before me. One other has been recorded from the Islands, and in the following key I have tabulated it as well as certain other Oriental species. Those not recorded from the Philippines are preceded by an asterisk.

Key to certain Oriental species of Sceliphron.

1. Comparatively large species without yellow marks on thorax and with black pubescence; length about 27 millimeters .... 2.
   Medium-sized species with yellow markings on thorax and with pale pubescence, length under 18 millimeters .... 4.
2. Petiole and hind femora black .... S. luzonensis sp. nov.
   Petiole and at least base of hind femora yellow .... 3.
3. Hind femora and tibiæ marked with black .... * S. intrudens Smith.
   Hind femora and tibiæ all yellow .... * S. spinolae Lepeletier.
4. Petiole but little longer than the propodeum; apex of first tergite marked with yellow; scutellum yellow .... S. deforme (Smith).
   Petiole twice or more than twice as long as the propodeum; postpetiole all black .... 5.
5. Scutellum black .... S. madraspatanum (Fabricius).
   Scutellum yellow .... S. conspicillatum (Costa).

Sceliphron luzonensis sp. nov.

Sceliphron intrudens (Smith), var., WILLIAMS, Bull. Hawaiian Sugar Planters' Assoc. 14 (1919) 120.

This form is closely allied to *intrudens* and may ultimately be treated only as a subspecies. It is however as different as *spinolae*, and until the group can be treated from a study of material I prefer to treat the Philippine form as a species.

Female.—Length, 27 millimeters; length of anterior wing, 17 millimeters. Anterior margin of the clypeus with a deep, narrow, V-shaped median emargination, separating the broad, rounded, depressed lobes; frons with distinct, rather close punctures on a granular surface; a small area adjoining ocelli impunctate; ocelli in an equilateral triangle; postocellar line slightly shorter than the ocellocular line; temples narrow; antennæ long, the third joint somewhat longer than the fourth; pronotum with close punctures, rather long, rounded, a longitudinal, median notch posteriorly; mesoscutum opaque, closely and finely striate-granular, the striations better defined posteriorly; scutellum and metanotum rather finely, longitudinally striate; propodeum with a broad, longitudinal furrow dorsally and with strong curved rugæ; posterior face of propodeum opaque, with strong transverse rugæ below; mesepisternum shining, with small, well-separated punctures; sides of propodeum longitudinally rugate; petiole cylindrical, about twice as long as propodeum; abdomen subglabrous, basally the apical segments subopaque with irregular longitudinal wrinkles. Black; scape and pedicellum rufo-piceous; apices of femora and the rest of the legs yellowish, the four anterior pairs faintly reddish; head and thorax with long black hair; wings yellowish hyaline; venation color of wings.

Type locality.—Mount Maquiling, Laguna, Luzon.

Type.—Catalogue No. 23637, United States National Museum.

Described from two females from C. F. Baker under his Nos. 1350 (type) and 6843.

Sceliphron deforme (Smith).

The name *deforme* has been synonymized with *formosum* by Bingham [4] but the Philippine specimens show so little variation and agree so well with the original description of *deforme*, and differ from the original description of *formosum*, that I have preferred to use the name *deforme* for them.

All the specimens before me are females. LUZON, Laguna Province, Los Baños (*Baker and Williams*); Mount Maquiling (*Baker*).

Sceliphron madraspatanum (Fabricius).

Sceliphron madraspatanum (Fabricius), WILLIAMS, Bull. Hawaiian Sugar Planters' Assoc. 14 (1919) 123.

This species has been recorded from the Islands by a number of authors but is not in any material I have seen from there.

Sceliphron conspicillatum (Costa).

Pelopaeus conspicillatus COSTA, Ann. Mus. Zool. Napoli 2 (1862) 1864, 112.

[4] Fauna Brit. India, Hym. 1 (1897) 239.

This form is readily separated from the preceding by the yellow scutellum. One of the specimens has the petiole entirely yellow but otherwise differs no more than the other specimens do among themselves. The propodeum varies from entirely black to having a yellow apical spot, or with an apical spot and two short lines on the disk.

LUZON, Manila (*Robert Brown*): Laguna Province, Bay (*P. L. Stangl*); Los Baños (*Baker 373*): Bataan Province, Lamao (*C. R. Jones*), one male, accession No. 1725, Bureau of Agriculture. LEYTE, Tacloban (*Baker*). PALAWAN, Puerto Princesa (*Baker 3821*), a variety with black petiole.

TWO NEW SPECIES OF PLANTS FROM HAINAN

By Elmer D. Merrill

Director and Botanist, Bureau of Science, Manila

From time to time in the past few years, botanical material from Hainan has been submitted to me by Miss Margaret M. Moninger, of the American Presbyterian Mission in Hainan, for identification. Much of the material has been collected in the vicinity of Kacheck and represents for the most part species of wide distribution, although with a fair percentage of endemic species. The two forms described below are apparently new.

GESNERIACEAE

TRICHOSPORUM Jack

TRICHOSPORUM MONINGERIAE sp. nov. § *Haplotrichium.*

Frutex glaber, ut videtur epiphyticus, usque ad 2 m altus; foliis oblongo-lanceolatis, in siccitate chartaceis, acuminatis, basi acutis, 7 ad 9 cm longis, usque ad 3 cm latis; inflorescentiis cymosis, terminalibus vel axillaribus, tenuiter longe pedunculatis, 5- ad 7-floris; floribus circiter 3 cm longis, calycis 5-partiti, laciniis elliptico-ovatis, obtusis, circiter 4 mm longis.

A glabrous, slender, apparently epiphytic shrub about 2 m high, the branches slender, terete, pale, the branchlets usually dark-olivaceous. Leaves apparently somewhat fleshy when fresh, when dry chartaceous, olivaceous, oblong-lanceolate, 7 to 9 cm long, 2.5 to 3 cm wide, subequally narrowed to the acuminate apex and to the acute base, the nerves slender, indistinct; petioles about 7 mm long. Cymes axillary and terminal, 5- to 7-flowered, their peduncles slender, 8 to 10 cm long, the branches 2 or 3, about 5 mm long. Bracts elliptic-ovate, about 5 mm long. Flowers orange-red, their pedicels 10 to 18 mm long. Calyx 5-parted, the lobes nearly free, elliptic-ovate, rounded, about 4 mm long. Corolla about 3 cm long, glabrous outside, very sparingly pubescent inside, somewhat curved, 5 to 8 mm wide when flattened, the mouth somewhat oblique, the lobes ovate, obtuse, about 8 mm long. Ovary glabrous, stipitate, including the short style about 2 cm long. Stamens exserted, the filaments slightly pubescent.

HAINAN, Loh-hoe, *Miss M. M. Moninger 188*, January, 1921, in the mountains, altitude about 400 meters.

Although the fruits are unknown, this species apparently belongs in the section *Haplotrichium,* and in this section is one of the very few species with broad obtuse calyx segments. It is further characterized by its slenderly long-peduncled, few-flowered cymes.

RUBIACEAE

GARDENIA Ellis

GARDENIA STENOPHYLLA sp. nov.

Species G. augustae (Linn.) Merr. (G. floridae Linn.) affinis, differt foliis anguste lanceolatis ad lineari-lanceolatis, 4 ad 8 cm longis, 4 ad 10 mm latis.

An erect glabrous shrub about 1 m high, the branchlets slender, grayish. Leaves narrowly lanceolate to linear-lanceolate, 4 to 8 cm long, 4 to 10 mm wide, subcoriaceous, olivaceous, shining, equally narrowed to the cuneate base and the blunt-acuminate apex; lateral nerves 9 to 13 on each side of the midrib; petioles up to 3 mm long, or leaves subsessile. Flowers white, fragrant, solitary. Calyx tube about 1 cm long, 5-ridged, base cuneate, the lobes narrowly lanceolate, in anthesis about 12 mm long. Corolla tube slender, 4 cm long, cylindric, the lobes spreading, oblong-obovate, inequilateral, 2.5 cm long. Fruits narrowly ellipsoid, about 2 cm long, crowned by the persistent erect calyx lobes, which in fruit are about 1.8 cm long and 1.5 mm wide.

HAINAN, Loh-hoe, *Miss M. M. Moninger 152*, May, 1919, in flower: KWANGTUNG PROVINCE, Yamchow, *K. K. Ts'oong 1916 = Canton Christian College 3777*, June 6, 1918, with the local name *muk ak tsz.*

This species grows on river banks and is closely allied to the common *Gardenia augusta* (Linn.) Merr., differing essentially in its very narrow leaves.

Beccari [1] has discussed the stenophyllous plants of Borneo listing species of the genera *Croton, Nauclea, Tetranthera, Antidesma, Pinanga, Osmoxylon, Arundina, Garcinia, Erycibe, Eugenia, Psychotria, Saurauia,* and *Millettia* which occur along the banks of rivers and torrents. In the Philippines, in addition to representatives of some of the genera Beccari lists, we have species of *Randia, Buxus, Atlantia,* and *Excoecaria* growing in similar habitats and presenting similar stenophyllous

[1] Nelle foreste di Borneo (1902) 523.

characters. Our stenophyllous species grow on rocky banks and in the crevices of ledges in places subject to brief and sudden inundations by swiftly running water. In such habitats it is highly probable that the important cause of stenophylly is the fact that the various species, all shrubs and often small in size, have become adapted to the habitat from the effect of periodic brief inundations, as broad-leaved shrubs cannot long persist in such habitats. *Gardenia stenophylla* presents another example of the adaptation of a species to this peculiar habitat. It might better, perhaps, be considered merely as a variety of *Gardenia augusta*, its chief distinguishing character, the very narrow leaves, being due to its habitat.

THE DISSOCIATION OF HEXAPHENYLETHANE FROM THE VIEWPOINT OF THE OCTET THEORY OF VALENCE

By HOWARD IRVING COLE

Chemist, Bureau of Science, Manila

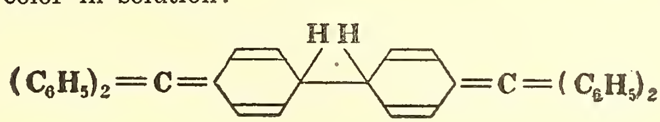
HISTORICAL

Gomberg,[1] in attempting to form hexaphenylethane by subjecting triphenylchlormethane to the action of metals, obtained a hydrocarbon possessing the requisite composition for hexaphenylethane, but its remarkable activity and its unsaturated character presumably precluded it from actually being this compound. He expressed the opinion that this was an instance of a compound with one atom of carbon in the trivalent state; that is, triphenylmethyl $(C_6H_5)_3 \equiv C$, a free radicle.

The original argument against the triphenylmethyl formula was that the determination of the molecular weight gave a dimolecular compound. This fact, however, was partly discounted later by the determination of the molecular weight in naphthalene at elevated temperatures (79° to 80° C.), the values found being lower than those in other solvents.

Markownikoff[2] in 1902 held in favor of the hexaphenylethane formula but assumed that the latter was extremely unstable. He gave no reason for this instability.

Heintschel[3] suggested the following formula as explaining the yellow color in solution:



Vorländer[4] thought that triphenylmethyl, dimolecular, was in some way different from the actual hexaphenylethane, which, if prepared, he believed would turn out to be stable.

[1] Gomberg, M., Journ. Am. Chem. Soc. 22 (1900) 757; Ber. deutsch. chem. Ges. 33 (1900) 3150.

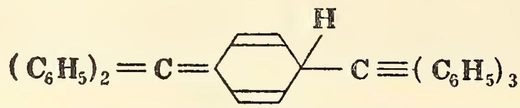
[2] Markownikoff, Journ. Russ. Phys. Chem. Soc. 34 (1902) 140.

[3] Heintschel, E., Ber. deutsch. chem. Ges. 36 (1903) 320.

[4] Vorländer, D., Ann. d. Chem. 341 (1905) 1.

The hexaphenylethane constitution was upheld by Chichibabin.[5] He put forward the instability of trimethylene and its homologues as an analogy for the instability of hexaphenylethane.

Jacobson [6] gave the following constitution to the compound:



Flurscheim [7] was in favor of a hexaphenylethane, unstable, partly broken down into $(C_6H_5)_3 \equiv C$.

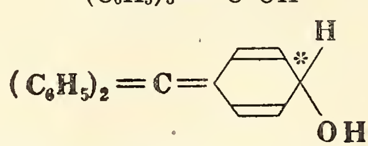
Up to this time one of the chief arguments for an unstable hexaphenylethane was the fact that neither the unsymmetrical tetraphenylethane nor the pentaphenylethane had been prepared. Hence the argument that these compounds were unstable, and from analogy hexaphenylethane was also unstable.

When Gomberg and Cone [8] finally prepared unsymmetrical tetraphenylethane and pentaphenylethane and found them to be fairly stable, the argument of analogy which had previously indicated the instability of hexaphenylethane now indicated its stability.

Gomberg [9] then showed that the color formation of the sulphates and chlorides of triphenylcarbinol is intimately connected with the change of the benzenoid to the quinoid form. He says:

> Furthermore since the manifestation of color and the salt-like properties of these substances are also simultaneous, the conclusion seems warranted that both of these phenomena are results of one and the same cause; i.e., tautomerization to the quinoid state. Consequently these salts were named quinocarbonium salts corresponding to the hypothetical quinocarbonium base:

$$(C_6H_5)_3 \equiv C\text{–}OH$$



> For obvious reasons the basicity was now assumed to lie in the quinone nucleus in the C * and not in the central carbon atom as had been originally supposed.

[5] Chichibabin, A. E., Ber. deutsch. chem. Ges. 37 (1904) 4709; Journ. f. prak. Chem. 74 (1906) 340.

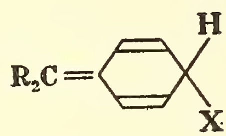
[6] Jacobson, P., Ber. deutsch. chem. Ges. 38 (1905) 196.

[7] Flurscheim, B., Journ. f. prak. Chem. 71 (1905) 505.

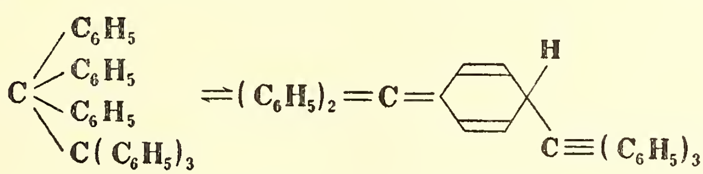
[8] Gomberg, M., and Cone, L. H., Ber. deutsch. chem. Ges. 39 (1906) 1461.

[9] Gomberg, M., and others, Ber. deutsch. Chem. Ges. 40 (1907) 1847, 1860; Journ. Am. Chem. Soc. 33 (1911) 540; Ann. d. Chem. 370 (1909) 190; 376 (1910) 208; Ber. deutsch. chem. Ges. 42 (1909) 406.

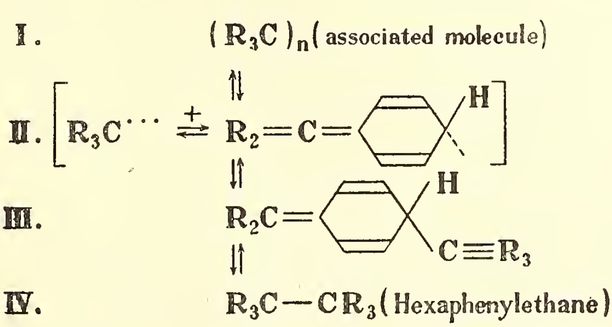
Later a number of the carbinols themselves were found capable of existing in the quinoid state as well as in the benzenoid state.[10] These and other experiments led Gomberg to conclude that (1) triphenylmethyl in solution behaves as if it had the quinol structure, either as a temporary base or as one in equilibrium with some other phase; (2) compounds of the type $R_3C—X$ possess the tendency to tautomerize to the quinoid modification:



(3) since the nature of the group X may apparently vary within wide limits then, as a corollary to the second conclusion, it follows that hexaphenylethane, considered as a triphenylmethane derivative, may also possess the tendency to tautomerize and give rise to a compound of quinol composition:



Gomberg now suggested an explanation which embraces all of the factors concerned: (1) the unsaturated character of triphenylmethyl; (2) the existence of the two, colorless and colored, modifications; (3) the dimolecular state in solution; (4) the probability of the quinollike structure; (5) the possible existence of an unstable hexaphenylethane:



[10] Journ. Am. Chem. Soc. 35 (1913) 1035.

Schmidlin [11] in 1908 observed that solutions of the colorless solid are at first colorless but that they acquire color after standing a few seconds. He was able to show that the colorless triphenlymethyl is only partially converted into the colored modification and that even in solution the two modifications exist in equilibrium with each other. He also showed that the colored form was more reactive.

Schlenck [12] in 1910 gave a new impetus to the trivalent carbon theory by preparing analogues of triphenylmethyl containing diphenyl groups. The determination of the molecular weights of these compounds showed some of them to exist largely in the monomolecular form. The colored modifications of triarylmethyls are monomolecular, some even in the solid state, as, for instance, tribiphenylmethyl.

Piccard,[13] Schmidlin,[14] and Schlenk and Mair,[15] using different methods, came to the conclusion that all solutions of hexaphenylethane contain monomolecular triphenylmethyl, the amount of this in benzol at 80° C. reaching 25 to 30 per cent of the whole amount of the hydrocarbon dissolved.

PRESENT THEORY

The various theories as to the structure of the triarylmethyls cited above tend in the right direction but have been befogged by our old affinity unit conception of valence. The epoch-making articles by Langmuir [16] on the arrangement of electrons and atoms in the molecule have made possible an entirely new conception of the mechanism of organic reactions which leads to a consistent explanation of the constitution and the chemical and physical properties of the triarylmethyls. The coexistence of two or more modifications of a triarylmethyl as shown, for example, by molecular weight determinations, can now be explained more clearly than by the indefinite term tautomerism.

In the following discussion the Lewis-Langmuir theory of valence will be applied to this problem along the lines suggested by Perkins,[17] whose nomenclature will, in general, be followed.

[11] Schmidlin, J., Ber. deutsch. chem. Ges. 41 (1908) 2471.

[12] Schlenck, N.; Weickel, T. U.; Herzenstein, A., Ann. d. Chem. 372 (1910) 1; Ber. deutsch. chem. Ges. 43 (1910) 1753.

[13] Piccard, J., Ann. d. Chem. 381 (1911) 347.

[14] Schmidlin, J., Ber. deutsch. chem. Ges. 45 (1912) 3180.

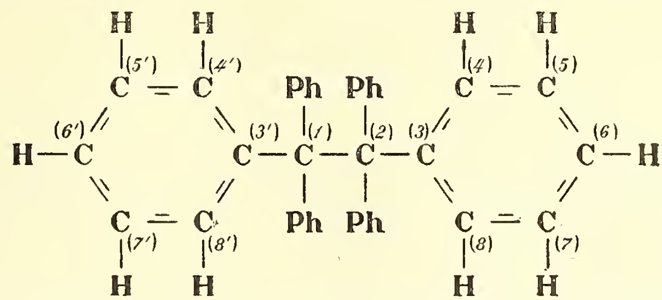
[15] Schlenk, W. u. Mair, L., Ann. d. Chem. 394 (1912) 179.

[16] Langmuir, I., Journ. Am. Chem. Soc. 41 (1919) 868, 1543; 42 (1920) 274.

[17] Perkins, G. A., Philip. Journ. Sci. 19 (1921) 325.

Lewis's nomenclature will be used in a few cases where it is desired to emphasize the supposed electron positions.

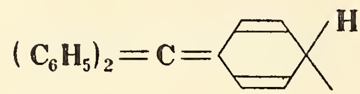
The normal structure of hexaphenylethane is accordingly the following:

A. 

(All the phenyl groups have the same structure as those given in detail.)

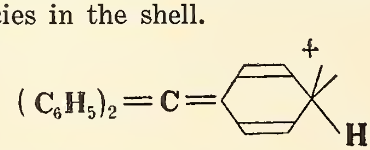
The three strongly negative phenyl groups attached to carbon atom (*1*) draw six of its shell electrons away from the kernel. Consequently the remaining two electrons, namely those shared by carbon atoms (*1*) and (*2*), are held very firmly by the kernel of (*1*). Similarly these two electrons are held very firmly by the kernel of carbon atom (*2*). It therefore follows from the Lewis-Langmuir theory of valence that hexaphenylethane cannot possibly dissociate without a rearrangement of one or more of the phenyl groups. This conclusion is thoroughly substantiated by the experimental evidence that dissociation of this and similar compounds does not occur without color. The chromophoric nature of the quinoid form of the benzene ring has long been established. The reason for the formation of a quinoid ring is generally that electrons are pulled toward two atoms connected to para or ortho carbon atoms. In the case under discussion it is evident that the strong pull of electrons toward one atom attached to each ring [carbon atoms (*1*) and (*2*)] is sufficient under certain conditions to cause rearrangement and consequent dissociation.

In nonionizing solvents such as benzene, rearrangement and dissociation occur symmetrically. One electron between C (*3*) and C (*4*) is pulled to a position between C (*2*) and C (*3*), resulting in a quinoid ring in which C (*6*) lacks one electron. The electrons shared between C (*1*) and C (*2*) are now no longer held firmly by C (*2*), which momentarily has nine electrons in its shell. Therefore C (*1*) and C (*2*) separate symmetrically, each retaining one electron of the shared pair. A double bond of four electrons is immediately established between C (*2*) and C (*3*). The structure of the resulting nonionic dissociation product is shown in formula **B**, which is identical with the quinoid modification in Gomberg's formula **II**.

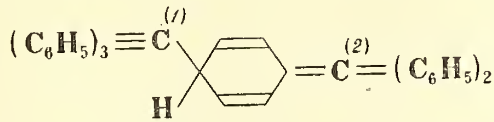
B. 

When carbon atoms (*1*) and (*2*) separate it is not to be supposed that C (*1*) continues to exist with only seven electrons in its shell, six of which are drawn away from the kernel by the chemically negative phenyl groups. The eighth electron is undoubtedly supplied by a quinoid rearrangement in the left-hand part of the molecule (formula **A**) identical with the one described for the right-hand part and taking place practically at the same time as the dissociation or before it. That is, the dissociation of hexaphenylethane in nonionizing solvents is symmetrical, giving two neutral molecules which cannot strictly be called triphenylmethyl and which have the structure shown in formula **B**.

When hexaphenylethane is dissolved in a solvent, such as sulphur dioxide, which contains unshared electrons (that is, an ionizing solvent) the dissociation occurs unsymmetrically. This is caused by an unstable union with a solvent molecule which supplies two additional electrons to the shell of carbon atom (*6*). A quinoid rearrangement takes place as before described except that *two* electrons are supplied by the ring to the union between C (*2*) and C (*3*). Carbon atom (*2*) now has momentarily ten electrons, so that C (*1*) separates, carrying with it *both* of the shared electrons. The left-hand part of the molecule (formula **A**) thus forms a colorless negative ion (**C**) and the right hand part forms a colored positive ion (**D**). The formula below shows only the ion proper without the solvent molecule, which undoubtedly remains loosely attached to the para carbon atom, which otherwise would have two vacancies in the shell.

C. $(C_6H_5)_3 \equiv C^-$ **D.** 

Since C (*1*) has completed its octet and hence has a negative charge while C (*6*) has lost two electrons and therefore has a positive charge, it is quite conceivable that the two ions can reunite in such a manner that C (*6*) is attached to C (*1*), forming the compound:

E. 

Two neutral molecules of B can probably also unite and rearrange to give E.

The above explanation leads us to the conclusion that hexaphenylethane can exist in the modifications A, B, C, D, and E. This is essentially the same conclusion that Gomberg arrived at, except that colorless triphenylmethyl can exist, according to the present theory, only in the form of a negative ion, and that, in the positive ion, one of the para carbon atoms has two unsatisfied affinity units. As for trivalent carbon, the form B contains a para carbon atom in a truly trivalent condition, namely, with one unsatisfied affinity unit. The positive ion exists only in combination with a solvent molecule. The negative ion contains a carbon atom (the central atom) in the satisfied but tricovalent condition which is found in many organo-metallic compounds, and is particularly stable when three pairs of electrons are strongly drawn away from a carbon kernel (as in the case of metallic acetylene derivatives).

Having explained the existence of the various types of hexaphenylethane let us examine their chemical and physical properties in the light of the octet theory.

PHYSICAL PROPERTIES

Color.—Hexaphenylethane is colorless in the solid state; it has colored and colorless modifications in solution. We would expect the compound B, the positive ion D and the compound E to be colored, owing to the presence of the quinoid group. On the other hand, the negative ion C and hexaphenylethane A should be colorless. It should be possible to demonstrate experimentally that the positive ion is the colored ion and the negative ion colorless by electrolysis of a solution of hexaphenylethane in a dissociating solvent.

Piccard [18] by applying Beer's colored solution law shows that a solution of hexaphenylethane in ether undergoes dissociation from R_6C_2 to R_3C as dilution increases. If the solution is caused to crystallize, only the polymer R_6C_2 is deposited be-

[18] Piccard, J., Ann. d. Chem. 381 (1911) 347.

cause the equilibrium is disturbed. Schmidlin [19] states that the equilibrium between the colored and the colorless modifications is affected by the nature of the solvent, temperature, etc. At $-63°$ C. in ether solution there is no color.

Conductivity.—Hexaphenylethane dissolved in liquid sulphur dioxide behaves like an electrolyte. It conducts the electric current, and its molecular conductivity increases with dilution of the solution.[20] This is exactly what we would expect of the positive and negative ions of hexaphenylethane.

CHEMICAL PROPERTIES

Oxidation.—Gomberg lays great stress on the remarkable avidity with which "triphenylmethyl" takes up oxygen to form a peroxide. This is one of the main reasons why the dimolecular form (hexaphenylethane) is not regarded favorably, for one is led to look, rather, for an unsaturated compound. But let us examine the interatomic conditions in the molecule of hexaphenylethane. We have, it is true, a strong union between carbon atoms C(*1*) and C(*2*) (compound A, page 685), due to the strong elastic constraints of the six negative phenyl groups. But these six negative groups tend to pull the electrons away from the nuclei of carbon atoms C(*1*) and C(*2*), leaving large open spaces which become strong positive poles. Under these conditions an oxygen molecule is attracted and enters one of the large open spaces in the shell, say, of carbon atom C(*2*). This atom then has, momentarily, two more than its normal number of electrons.[21] The carbon atom C(*1*) still has a strong attraction for the pair shared between itself and carbon atom C(*2*), but this pair is no longer held firmly by C(*2*), so that the bond is broken and two ions are formed:

$$(C_6H_5)_3 \equiv C^{-} \text{ and } \begin{array}{c} C^{+} \equiv (C_6H_5)_3 \\ 8 \\ O = O \end{array}$$

Due to the attraction of the positive carbon kernel, C(*2*), all of the electrons in the oxygen molecule shift toward the carbon, leaving a positive area on the outer oxygen atom, which then joins to the negative ion, forming the peroxide molecule:

$$(C_6H_5)_3 \equiv C-O-O-C \equiv (C_6H_5)_3.$$

[19] Loc. cit.

[20] Walden, Zeitschr. phys. f. Chem. 43 (1903) 443; Gomberg and Cone, Ber. deutsch. chem. Ges. 37 (1904) 2043.

[21] Perkins, G. A., loc. cit.

Here we have, then, a satisfactory explanation of the oxidation of hexaphenylethane without the supposition of the compound existing in the form of the radicle triphenylmethyl. That is, the reaction is to a large extent of the direct-addition rather than the dissociation-addition type.

The oxidation of the colored compound E proceeds in a somewhat analogous manner, the chemically negative oxygen molecule attaching itself to either carbon atom C(*1*) or C(*2*); the break occurs and the peroxide is formed.

Similarly oxygen adds to the central carbon of compound B. The product contains an uneven number of electrons, which probably causes a three-electron bond to be formed between the oxygen atoms. In this case the shift of electrons in the oxygen molecule is toward the outer atom, which thus becomes very active in attacking the positive open spaces in the shell of the central carbon atom of another molecule of B, thus forming the same peroxide as above-mentioned.

Addition of hydrogen.—Molecular hydrogen does not react with hexaphenylethane. Zinc dust and acetic acid, however, cause the addition of hydrogen, which probably occurs as follows: Zinc like any positive metal furnishes free electrons, which cause the formation of negative ions (formula C) at its surface. These negative ions rapidly combine with hydrogen ions furnished by the acid, and triphenylmethane is formed.

Addition of halogen.—Chlorine and bromine form both substitution and addition products; iodine forms only addition products with hexaphenylethane. The halogen molecule contains a number of unshared electrons, one or more of which during a thermal impact enter an exposed positive space in the distorted shell of the central carbon atom in compound B. By rearrangement to the benzoid form one of these electrons is accommodated in the shell. Any others that may enter are repulsed and one unshared electron in the carbon atom shell joins the newly arrived halogen electron to form a shared pair between the carbon and halogen atoms. The excess of one electron causes the outer halogen atom to dissociate as a neutral atom, which is very active in substituting or adding to a second molecule of compound B.

Addition of xylene.—Wieland and Müller [22] found that, on boiling hexaphenylethane with *o*- or *p*-xylene, dimethyltetraphenylmethane is formed:

$$(C_6H_5)_6C_2 + C_6H_4(CH_3)_2 = (C_6H_5)_3C.C_6H_3(CH_3)_2 + (C_6H_5)_3CH.$$

[22] Wieland, H. u. Müller, C., Ann. d. Chem. 401 (1913) 238.

The reactivity in this case is much less than in the cases previously described, necessitating as it does a high temperature. The heat may activate the xylene as well as the hexaphenylethane, so that the problem of the reaction mechanism is more complicated. The general course of the reaction is analogous to the substitution of chlorine in the xylene ring.

SUMMARY

(1) An explanation of the constitution of hexaphenylethane based on the octet theory of valence has been proposed.

(2) The physical and chemical properties of hexaphenylethane have been shown to be more satisfactorily explained by this theory than by the old affinity unit theory of valence.

NEW OR NOTEWORTHY PHILIPPINE BIRDS, IV

By RICHARD C. MCGREGOR
Ornithologist, Bureau of Science, Manila

FOUR PLATES AND THREE TEXT FIGURES

This paper consists of notes on several species of Philippine birds that are rare or otherwise of unusual interest. The genus *Erythrura* is added to the Philippine list, but unfortunately the species cannot be determined at present. *Chætura picina* was collected in two islands in 1920, although nothing had been seen of it for fifteen years. These captures confirm the long-held opinion that much more ornithological field work is necessary in the Philippine Islands. Only a few of the smaller islands have been thoroughly explored for birds, and the work on the larger islands has been far from complete. From no locality or island have we a record of observations made throughout an entire year. Merrill [1] has shown how incomplete and fragmentary botanical exploration has been, and zoölogical exploration has been equally inadequate.

Megapodius cumingi Dillwyn.

On August 1, 1921, Mr. L. H. Taft brought to the Bureau of Science a chick and two eggs of the tabon. Efforts were made to rear the young bird, but it died in a few days. These specimens were secured near Calabgan, Casiguran, Tayabas Province, Luzon, through the interest of Capt. M. G. Martling. The matter is worthy of notice, because the tabon has been rarely recorded from Luzon. However, Captain Martling says that tabons are common near Casiguran.

Francolinus pintadeanus (Scopoli). Plate 1, fig. 1; text fig. 1.

Tetrao pintadeanus SCOPOLI, Del. Flor. et Faun. pt. 2 (1786) 93.
Francolinus chinensis GRANT, Cat. Bds. Brit. Mus. 22 (1893) 136 (*Tetrao chinensis* Osbeck, 1771, not of Linnæus, 1766); OATES, Hume's Nests and Eggs of Indian Bds. 3 (1890) 431; Cat. Bds.' Eggs Brit. Mus. 1 (1901) 37, pl. 2, fig. 4.

A pair of francolins was collected by Macario Ligaya, on July 4, 1919, near Balagbag, Rizal Province, Luzon. These speci-

[1] Philip. Journ. Sci. § C 10 (1915) 159–167.

mens are now in the Bureau of Science collection, Nos. 13326 and 13327. The male was only slightly wounded, and a photograph shows the bird in a somewhat unnatural attitude. Other individuals of this species were seen in the same locality. There is also a mounted specimen in the zoölogical laboratory of the College of Liberal Arts, which was collected near Fort William McKinley.

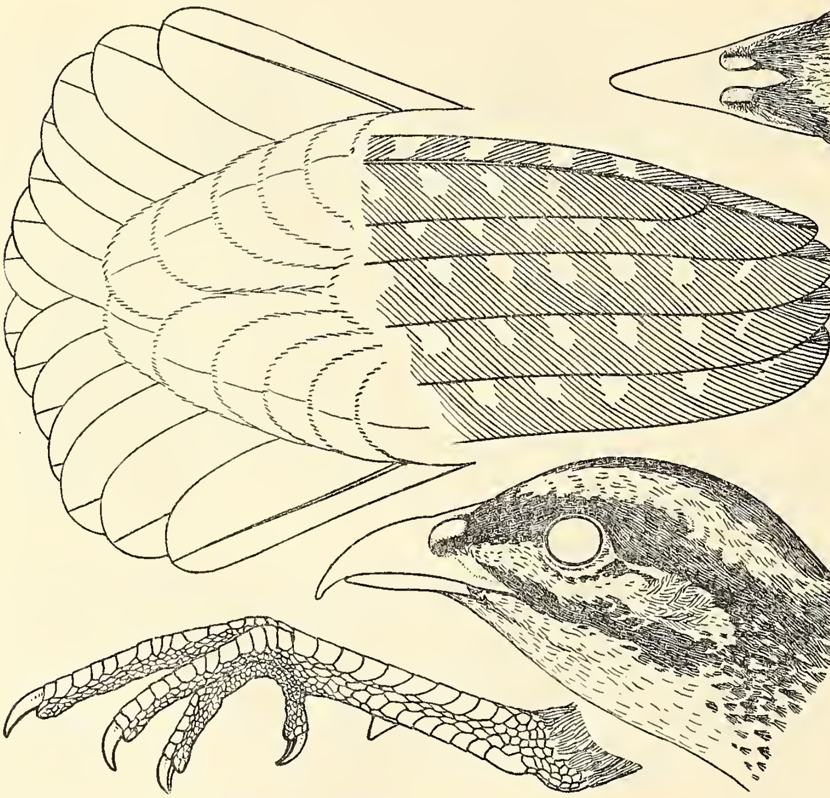


FIG. 1. *Francolinus pintadeanus* (Scopoli); generic details, × 1.

On June 6, 1921, a nest containing five slightly incubated eggs was found near Balagbag. The parent birds were collected with this set. The eggs measure in millimeters: 36.7 by 31.3, 38.4 by 30.7, 37.5 by 30.5, 37.7 by 31.0, 36.6 by 30.0. Three days later another nest, containing three slightly incubated eggs, was found in the same locality. These eggs measure in millimeters: 38.0 by 31.3, 39.6 by 31.1, 39.0 by 30.7. A few days later a third nest was found. The nest in each case was on the ground in a thick bunch of grass about a meter high.

The eggs are the color of good coffee that has plenty of cream in it, somewhat near Ridgway's cinnamon-buff. The shell is compact and somewhat glossy. Under a lens small scattered pits are revealed. Oates says that some of the eggs of the common francolin "exhibit white spots, as if the outer layer of the shell had become disintegrated," but he does not mention white spots in connection with the eggs of the Chinese species. Each of the eight eggs from Balagbag has very evident white markings. These are most numerous near the larger end in each egg. Most of them are very small dots, but a few are spots measuring from 1 to 2 millimeters in diameter. Under the lens these white spots appear to be surface markings and not the result of the disintegration of part of the brown layer. When the eggshell is held toward the light, the opposite side appears light green through the blowhole. The shape of the egg is well represented in the Catalogue of Birds' Eggs, but the coloring of the figure is not very near that of the few eggs I have seen.

I assume that some of these birds had been recently liberated near Manila. I have met a man who told me that he had released five hundred or more in the vicinity of Balagbag. If this species will thrive here, it will probably be a valuable addition to the Philippine fauna, which is very poorly supplied with upland game birds. The following description will serve for the identification of specimens:

Male.—General color dark brown, with many conspicuous white spots; top of head blackish brown, on each side of this a tan stripe from base of bill to occiput, a black stripe from bill through eye to neck, below eye a white stripe from bill to ear, below this a black line; neck and mantle black, each feather with four or six white spots; back, rump, and tail coverts black, barred with narrow wavy white lines; chin and upper throat white, lower throat black, spotted with white similar to mantle but more white, the white spots increase in size on breast and abdomen until the black is reduced to bars; under tail coverts rusty buff, wings dark brown with bold spots of cinnamon-buff; flanks and thighs washed with cinnamon-buff. Bill black; iris dark brown; legs and feet ochraceous orange; nails horn gray. Wing, 147 millimeters; tail, 85; tarsus, 40; middle toe with claw, 37; culmen from base, 28; bill from nostril, 17.

Female.—General color and pattern similar to those of the male, but stripes on side of head obscure. Wing, 139 millimeters; tail, 84; tarsus, 37; middle toe with claw, 34; culmen from base, 24; bill from nostril, 14.5.

The distribution of the Chinese francolin is given as Indo-Chinese countries, Burma, Siam, Cochin China, Hainan, and southern China; it is said to have been introduced in Reunion and Mauritius.

I am indebted to Dr. C. W. Richmond and Mr. J. H. Riley, of the United States National Museum, who kindly identified the specimens and furnished notes on the nomenclature. Osbeck's name for this species is preoccupied by the same combination, which was used by Linnæus to designate what is now called *Excalfactoria chinensis*. Scopoli's name seems to be the next one.

Excalfactoria lineata (Scopoli).

On June 23, 1921, Macario Ligaya gave me a pair of island painted quails that had been snared near Balagbag, Luzon. I took them home, put them in a box, and furnished them with water and such grain as I could find. They were very wild, jumping about and dashing against the cage. One of them called "tic-tico" during the afternoon and again at dusk. The male died during the night. On June 25 I sat near the cage reading most of the afternoon. The female called three times at long intervals. That night I heard her twice at about 1 o'clock. This call had a rich, plaintive quality. There was nothing of the bright happy quality characteristic of the call of the bobwhite or the California valley partridge. On July 2, after 9 o'clock in the evening, the female called three times at half-hour intervals. Each call consisted of four notes.

On July 3 Ligaya and I went to Balagbag, where the station agent gave us another pair of painted quails and a rail, *Hypotænidia striata* (Linnæus). He also gave us an egg that the quail had deposited during the night. The egg measures 24 by 19.4 millimeters; its color is nearly uniform grayish olive. The shell is compact and without pits, but has numerous, minute, dark brown dots, which are clearly raised above the surface. At the larger end a few of these dots can be distinguished without the aid of a lens. One of them is 0.5 millimeter in diameter. Through the blowhole the shell appears dark green.

Sterna hirundo Linnæus.

Mr. W. Cameron Forbes, while visiting Bohol Island, on July 10, 1921, collected a female of the common tern. The specimen is much like the one collected in Calayan Island,[2] but the nape is blacker and is followed by a white space on the neck, while the mantle and upper wing coverts are pearl gray. The bill, the feet, and the claws are black in the dry specimen.

Anous stolidus (Linnæus).

The noddy tern is to be added to the birds known from Luzon on the basis of a male collected in Manila Bay, on May 5, 1908, by B. Barbaza, a local taxidermist. The specimen is in pale brown plumage with slight indications of the gray cap. This record is published through the courtesy of Mr. W. Parsons, who purchased the specimen from the collector.

Canutus tenuirostris (Horsfield).

Among several hundred bird skins obtained by Mr. W. Cameron Forbes, during his visit to the Philippine Islands in 1921, was a male knot collected in Sitanki on August 22. Sitanki is a small island near Sibutu, in the most southern part of the Archipelago.

Lophotriorchis kieneri (Geoffroy St. Hilaire).

A hawk collected near Badajoz, Tablas Island, on September 23, 1905, was recorded by me as *Lophotriorchis kieneri* with an interrogation.[3] I have thought it worth while to send the specimen to the United States National Museum for further examination. Mr. J. H. Riley confirms my determination of it as representing an immature plumage of the above species. The specimen is No. 11220, male, Bureau of Science collection.

Spizaëtus limnæëtus (Horsfield). Plates 2 and 3.

While Col. John R. White was in charge of the penal colony in Palawan he secured a living specimen of a large hawk which he sent to the Bureau of Science. The bird was received on June 17, 1908, in good condition. Through the patience and skill of Mr. Charles Martin, then photographer in the Bureau of Science, several good negatives showing the bird in various positions were secured. Prints from two of these are reproduced. I had considered this bird a specimen of *Lophotriorchis*, but Mr. J. H. Riley has identified it as *Spizaëtus limnæëtus*. I think no previous record of this specimen has been made, so no harm is

[2] Philip. Journ. Sci. § D 13 (1918) 3.
[3] Philip. Journ. Sci. 1 (1906) 772.

done by my error. The specimen is No. 13331, immature male, Bureau of Science collection.

Description.—Head and neck about maize yellow; mantle blackish brown, the feathers edged more or less with pale buff; back and rump light brown, upper tail coverts light brown, nearly white; lower parts white, a patch on the flanks light pinkish cinnamon; faint indications of brown bars on upper thighs; wings blackish brown; median coverts largely white, forming a broad band; tips of secondaries and tertials white, inner webs of primaries white basad of cut in inner web; rectrices with alternating light and dark brown bars, the dark bars about half as wide as the light ones, the latter mottled with white, seven dark bars including the subterminal one, which is scarcely distinguishable from the preceding wide dark brown band; tip of tail white, on the underside the light bars nearly white and the dark bars less distinct than above. Iris brown; bill and nails black; feet light yellow. Length, 650 millimeters; wing, 410; tail, 29; culmen from base, 39; culmen from cere, 31; tarsus, 94; middle toe with claw, about 85.

Pithecophaga jefferyi Grant. Text fig. 2.

The monkey-eating eagle from Imugan, Nueva Vizcaya Province, Luzon, already recorded by me died in the Manila botanic garden early in 1918. The skin is now in the Bureau of Science collection, No. 7748, female. Most of the skeleton, together with the head and a foot of the specimen collected by Mr. H. M. Ickis in Laguna Province, Luzon, was sent to Dr. R. W. Shufeldt for study and is the material used in the description of the osteology of the species.[4]

Since publishing my last notes[5] on the monkey-eating eagle I have handled two more specimens, have seen another mounted, and have heard of two others that I did not see.

1. An eagle of this species, the source of which is unknown, lived for some months in the Manila botanic garden. It died in November, 1918, and was sent to the Bureau of Science. The skin is in the Bureau of Science collection.

2. Mr. Pedro Pulgado, of Manila, while working at Kolambugan, Mindanao, secured a living monkey-eating eagle, which

[4] Philip. Journ. Sci. 15 (1919) 31–58, pls. 1–11.
[5] Ibid. § D 13 (1918) 14.

he brought to Manila where it lived for some months and became fairly tame. It was fed on meat and fish. The bird was sick for two or three weeks before it died, in January, 1920. The owner brought it to the Bureau of Science for mounting. The body was found to be heavily infested with peculiar nodules whose nature has not been ascertained. Some trematodes taken from the intestines and preserved by Prof. Frank G. Haughwout, of the Bureau of Science, have been described as *Phagicola pithecophagicola,* a new genus and new species.[6] Faust considers this new worm so distinct that he erects a new subfamily, Phagicolinæ, for the genus.

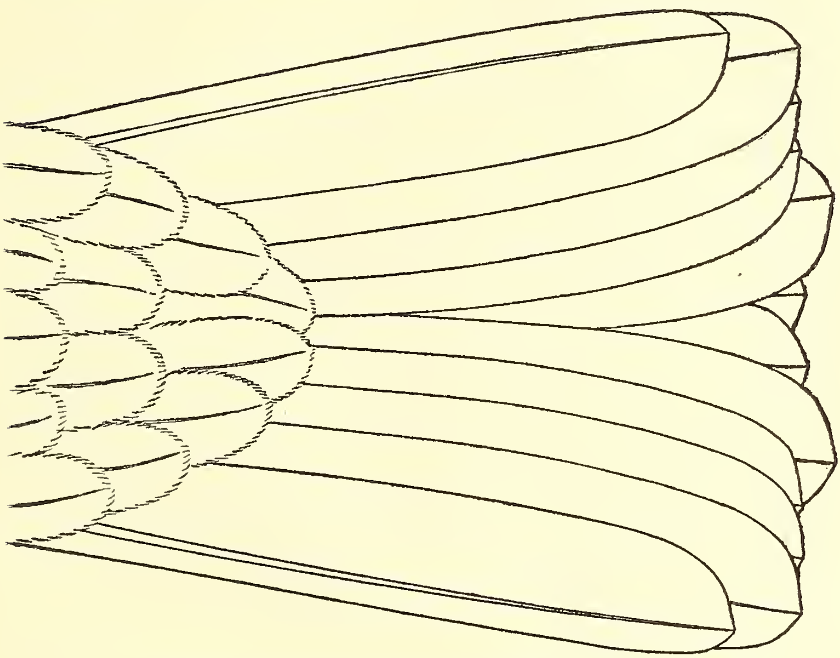


FIG. 2. *Pithecophaga jefferyi* Grant; outline of the tail, × 0.25.

The following data were taken from this specimen: Iris pale blue; cere and face deep plumbeous, base of bill grayer, most of bill blackish slate; tarsus and toes dirty barium yellow; weight, 2.76 kilograms. Fourth, fifth, and sixth primaries nearly equal and longest; first primary 75 millimeters shorter than second; second shorter than third and about equal to seventh.

[6] Faust, E. C., Philip. Journ. Sci. 17 (1920) 627–633, pl. 1.

Measurements of the Kolambugan eagle.

	mm.
Length	960
Extent	1,910
Wing, flat on rule	595
Tail	440
Tarsus	125
Inner toe with claw	98
Middle toe with claw	112
Outer toe with claw	85
Hind toe with claw	84
Depth of bill at nostril	48
Width of bill at cutting edge	19
Chord of culmen from cere	68
Height of nostril opening	12

3. Several individuals reported to me that they noticed a live specimen of the Philippine eagle in one of the exhibits from the Southern Islands at the 1920 Philippine Carnival. Unfortunately, the fire that destroyed nearly all of the exhibits occurred before I visited the Carnival, and I did not see this specimen. However, the eagle is so distinctive that it is unlikely that any other bird could have been mistaken for it.

4. In one of the stores on the Escolta, Manila, I have noticed a mounted specimen of this eagle in 1920. I have no information as to where it came from.

5. Mr. O. W. Pflueger, forester of the Bureau of Forestry and stationed at the Forest School, Los Baños, informs me that he has seen a foot of an eagle which was killed on Mount Maquiling. Although he tried to purchase the specimen, he could not do so. The bird was killed on September 22, 1920, and was destroyed before Mr. Pflueger was able to secure any part of it. The following interesting memorandum was furnished by Ranger Carlos Sulit:

On September 22, 1920, about 7 a. m. Pedro Gibas, a logger and resident of Barrio Anos, Los Baños, Laguna, was riding a carabao on the Tanza trail on Mount Maquiling as he was on his way up the mountain to skid logs. On this trail he met a big bird the like of which he had never seen before. The carabao refused to proceed and so he dismounted in order to procure a pole and capture the bird. However, he did not have time to procure one as the bird followed and attacked him. He drew his bolo and struck it on the wing. This angered the bird and it attacked him again. He then hit it on the head and killed it.

According to Gibas the bird when standing was about 1 meter high and the wings when spread measured about 1.5 meters. The tail of the bird was bought by a student of the College of Agriculture and the meat was eaten by the Gibas family and what was left was given to the dogs.

A cochero by the name of Mamerto Peralta, living in the coconut grove near the College of Agriculture, bought one of the claws which he refused to sell.

No one seems to know the common name of this bird, and they simply call it an eagle. A student of the College of Agriculture who saw this claw says it must be the same species of bird as that which attacked and killed a Negrito in Zambales while protecting her young one. The young of this bird is at present in the possession of a man in San Marcelino, Zambales, who has it for exhibition purposes.

I offer the foregoing account without excessive confidence in either the identity of the species or the accuracy of the statements concerning the struggle of the man with the bird. This species may be expected to occur in the forests near Mount Maquiling as it was definitely recorded by me from the mountains east of Mount Maquiling some years ago, the record being based upon the head, a foot, and a wing of the specimen killed by Mr. Harry M. Ickis. The head and foot of the Ickis specimen are the ones used by Shufeldt in his monograph on the osteology of this eagle.

Baza magnirostris Gray.

The large-billed baza is one of the rare endemic Philippine hawks. The only specimen that I have seen was collected by Andres Celestino on Agusan River, in northern Mindanao, on December 17, 1909.[7] The specimen is a female, No. 12940 of the Bureau of Science collection. Mr. J. H. Riley has confirmed my identification.

Pseudoptynx philippensis Kaup. Plate 1, figs. 2 and 3.

On May 2, 1921, we received a live owl at the Bureau of Science. Under the date April 30 Mr. Dean C. Worcester, of Cebu, wrote that he had received this owl from Catbalogan, Samar. The bird appears to be *Pseudoptynx philippensis,* but in its present condition is rather too lively for a close comparison with our museum specimen from Benguet Province. This bird eats rats, guinea pigs, and beef with gusto, and appears to be perfectly healthy. It was still living in December, 1921. No species of this genus has been recorded from either Samar or Leyte.

Chætura picina Tweeddale. Text fig. 3.

Chætura picina TWEEDDALE, Proc. Zool. Soc. London (1878) 944, pl. 59; GRANT, Ibis VII 3 (1897) 242.
Mearnsia picina RIDGWAY, Bull. U. S. Nat. Mus. 50[6] (1911) 686.

[7] Philip. Journ. Sci. § D 5 (1910) 197.

Chætura picina was described by Tweeddale from a female specimen collected by Everett near Zamboanga, Mindanao, in April, 1878. The next specimens known are two males and a female that were secured by Whitehead in Leyte in 1896. About 1904 Mearns collected one or more specimens of this species in Mindanao. Since then this swift has not been seen, so far as known, until 1920. Mr. E. H. Taylor recently returned from Mindanao and brought a few birds that he collected in the vicinity of Zamboanga. Among these was one specimen of *Chætura picina* collected on September 25, 1920, which Mr. Taylor very generously presented to the Bureau of Science. Andres Celestino, who was collecting in Cebu during December, secured a female of this species at Toledo, Cebu, on December 21, 1920. It is curious that this species had not been seen for years and that these two specimens were collected within three months of each other.

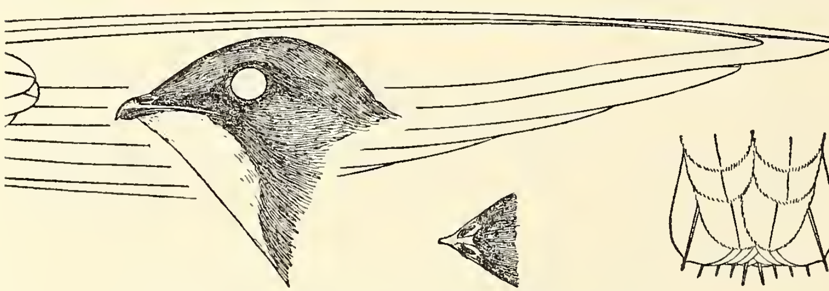


FIG. 3. *Chætura picina* Tweeddale; generic details, × 1.

Ridgway has erected the genus *Mearnsia* for the reception of this species. In the two specimens of *Chætura picina* at hand the first primary is decidedly shorter than the second and longer than the third. The tail is relatively shorter than in *Chætura gigantea,* and the spines of the rectrices are also comparatively short.

Tachornis pallidior McGregor.

Mr. W. Parsons collected a pair of paler palm swifts at Pagsanjan, Laguna Province, Luzon, on January 6, 1921. I have collected this species near Manila and in Tarlac Province, Luzon.

Hirundo striolata (Boie).

On June 18, 1921, Prof. S. F. Light and I noticed from ten to twenty pairs of mosque swallows flying about the quarantine dock at Mariveles, Bataan Province, Luzon. Some nests were plastered to the underside of the cement dock, but we could make no further observations as we were just leaving for Manila. I believe this is the first observation of the nesting of this species in Luzon.

Zanthopygia narcissina (Temminck).

My Philippine record of the narcissus flycatcher was based upon a female specimen from Calayan Island. This was not included in my report on the Calayan collection,[8] but was noted later.[9] As there appear to be only two Philippine records for this species, I thought it worth while to have my determination verified. The specimen, No. 3766, Bureau of Science collection, was accordingly sent to the United States National Museum where Mr. J. H. Riley confirmed my identification.

Malindangia mcgregori Mearns. Plate 4.

The plate of this species published herewith is from a male topotype in the Bureau of Science collection, No. 12907. The only specimens known are those collected by Mearns on Mount Malindang, Mindanao, in 1906.

Turdus chrysolaus Temminck.

Mr. W. Parsons has a male of the Japanese brown thrush that was collected by B. Barbaza at Balintauac, near Manila, on January 16, 1909. Whitehead found a few specimens of this thrush "on the summit of Monte Data [in northern Luzon] mingling with the flocks of *T. obscurus*" in November and December. I found the species fairly abundant in Calayan late in November and during December. I suspect that thorough field work in northwestern Luzon during October, November, and December would yield a lot of interesting information concerning migratory land birds.

Amandava amandava (Linnæus).

> *Sporæginthus amandava* (Linnæus), McGregor, Philip. Journ. Sci. § D 11 (1916) 275. [*Amandava* Blyth, Richmond, Proc. U. S. Nat. Mus. 35 (1908) 588.]

On March 18, 1921, I noticed about fifty small birds in a Manila store. These were of the species reported by me from Manila as *Sporæginthus amandava*. All of them were immature, with gray or clay-colored underparts. A few were in mottled

[8] Bull. Philip. Mus. 4 (1904).
[9] Man. Philip. Birds (1909) 449.

plumage, recalling the corresponding plumage of *Munia jagori.* Later the same day, while crossing Puente Colgante, I met an old man with two bamboo cages containing a hundred or more of these birds, all in young plumage. This man told me that he caught these birds near San Vicente, Ilocos Sur Province, and that they change to the adult plumage in May. On May 9 I again saw this man with a lot of these birds. He was telling a crowd how the birds changed plumage and that they nested in thick grass on the ground. Perhaps he meant to say near the ground. As he was talking to a crowd of Filipinos and not to me, I am inclined to the view that he really gets the young birds from the nests. If he was telling the truth, the species is evidently well established in Luzon, and this is the point that I was interested in.

Erythrura species.

Mr. L. H. Taft, of the Bureau of Forestry, who is stationed at Los Baños, Laguna Province, Luzon, sent four specimens of a green-backed ricebird to Mr. E. H. Taylor and under date of July 7, 1920, wrote:

> The four birds that you received last week were in very bad condition when I found them. A week ago Saturday we started to string a wire for the backstop on our tennis court at the school. We failed to finish, but left the wire standing up. The next Saturday (June 26) we started to finish the job and found that ten of these same birds had evidently flown against the wire and suffered an untimely death during the week. Six of them were too far gone to send at all (the ants had eaten out their throats) but the four I sent in seemed to be O.K. It doesn't seem probable that we caught a flock migrating for eight were on one side of the wire and two were on the other side. Only one of the men seemed to know the bird. He said he had seen many of them in San Carlos, Pangasinan.

These specimens were unfortunately so badly decayed that they could not be skinned, and one was dropped into alcohol. In attempting to identify this specimen I felt fairly safe in the genus *Erythrura* and thought that the species might be *E. trichroa.*[10]

On August 20, 1920, the specimen was sent to the United States National Museum where Dr. C. W. Richmond with characterestic care examined it. As the matter is rather important, I quote Doctor Richmond's comment in full. He said:

> The specimen is in poor condition for determination, and is probaby a female or immature bird, which makes a satisfactory identification more

[10] Sharpe, Cat. Bds. Brit. Mus. **13** (1890) 385.

difficult. It belongs to the genus *Erythrura,* but it has a smaller bill than *E. trichroa,* though the colors agree fairly well with the description of the young of the latter, except for the color of the bill. As the bill is wholly black in the Philippine bird, the specimen is more likely to be an adult than an immature one. In dimensions and size of bill, the specimen is close to an adult of *E. tricolor* from Wetter Island, but it differs greatly in color and is manifestly out of place there. It probably represents a new form, but adult males will be necessary to settle the matter.

This discovery is extremely interesting. If the species of this genus were migratory and if one specimen had been found, it would not be very surprising; however, so far as I can make out the known species are resident in rather restricted areas. The probability is that we are dealing with an unknown resident species. Ten individuals of this species being killed in one day suggests that collectors must do more field work before the species of Philippine birds are all recorded.

ILLUSTRATIONS

Plate 1

Fig. 1. *Francolinus pintadeanus* (Scopoli); a living bird from Balagbag, Luzon. Photograph by E. Cortes.

2. *Pseudoptynx philippensis* Kaup; a living bird from Samar. Photograph by E. Cortes.

3. *Pseudoptynx philippensis* Kaup; showing nictitating membrane of left eye closed. Photograph by E. Cortes.

Plate 2

Spizaëtus limnæëtus (Horsfield); immature male, from Palawan. Photograph of the living specimen by Charles Martin.

Plate 3

Spizaëtus limnæëtus (Horsfield); another view of the specimen shown in Plate 2.

Plate 4

Malindangia mcgregori Mearns; from a male topotype, Bureau of Science collection, No. 12907. Drawn and colored by Macario Ligaya. Reduced about one-fourth.

TEXT FIGURES

Fig. 1. *Francolinus pintadeanus* (Scopoli); generic details, × 1.

2. *Pithecophaga jefferyi* Grant; outline of the tail, × 0.25.

3. *Chætura picina* Tweeddale; generic details, × 1.

Drawings for the three text figures were made by Macario Ligaya.

Fig. 1.

Fig. 2.

Fig. 3.

PLATE 1.

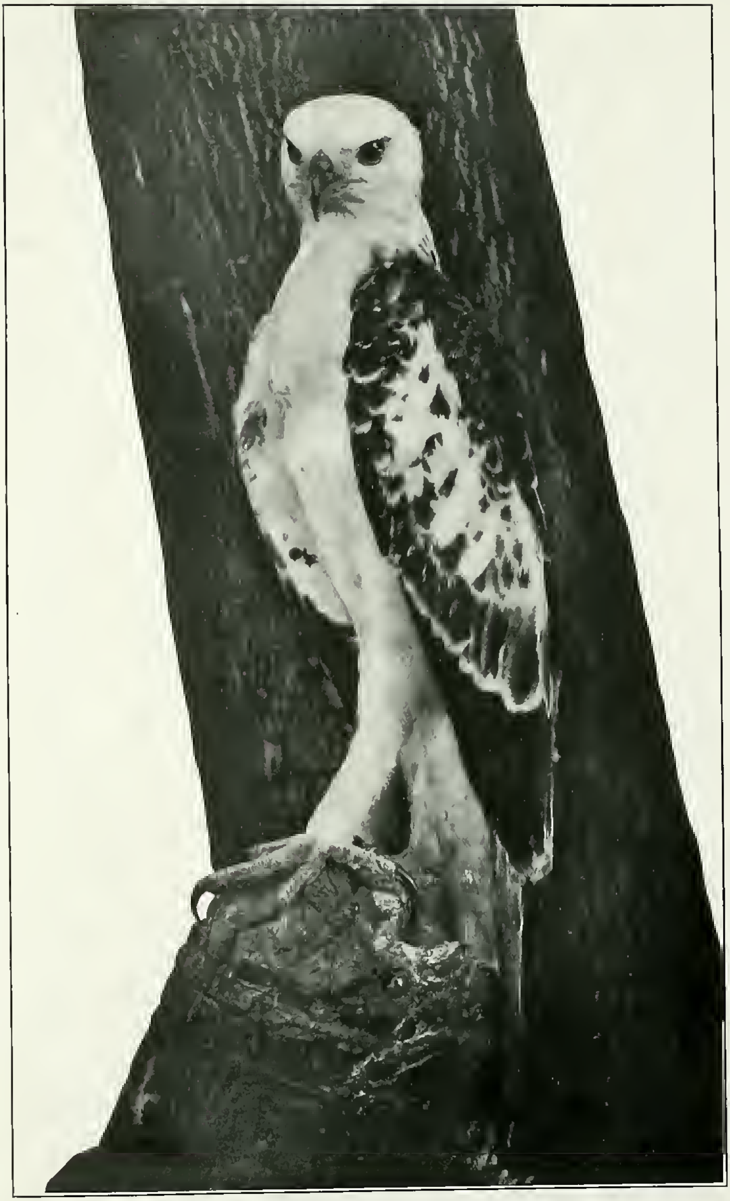


PLATE 2. SPIZAËTUS LIMNÆËTUS (HORSFIELD).

PLATE 3. SPIZAËTUS LIMNÆETUS (HORSFIELD).

PLATE 4. MALINDANGIA MCGREGORI MEARNS.

DIE VIOLEN DER PHILIPPINEN

Von WILHELM BECKER

Rosian (Magdeburg)

In dem letzten Jahrzehnt beschäftigten mich besonders die Violen Asiens und Australiens. Die Ergebnisse meiner intensiven Studien sind zu einem Teile bereits der Oeffentlichkeit übergeben.[1]

Auch das Bureau of Science, Manila, übersandte mir das in seinem Herbar befindliche asiatische Violenmaterial, wofür ich der Direktion auch an dieser Stelle meinen Dank ausspreche. Auf Wunsch veröffentliche ich nun eine Bearbeitung der Violen der Philippinen. Das dieser Arbeit zu Grunde liegende Pflanzenmaterial, etwa 55 Bogen, befindet sich fast ausschliesslich im Herbarium des Bureau of Science, Manila.

Auf den Philippinen sind bisher neun Violaspezies festgestellt: *V. arcuata* Blume, *V. semilunaris* W. Bckr. var. *philippinarum* W. Bckr., *V. merilliana* W. Bckr., *V. diffusa* Ging. und ihre subsp. *tenuis* W. Bckr., *V. rupicola* Elmer, *V. mearnsii* Merr. *V. ramosiana* W. Bckr., *V. betonicifolia* Sm. subsp. *nepalensis* W. Bckr., *V. inconspicua* Blume, und *V. philippica* Cav. subsp. *malesica* W. Bckr. Die Areale dieser Arten liegen in der Hauptsache auf den Inseln Luzon and Mindanao; sonst kommen noch die Inseln Mindoro und Negros mit je einer Spezies in Betracht, die aber auch auf den beiden grossen Inseln vorkommen. Auf der Insel Luzon und zwar im nördlichen Teile, ungefähr im Gebiet der Provincia Mountain, treten sämtliche zehn Arten auf, die *V. betonicifolia* und *inconspicua* ausserdem auch in der Provincia Cagayan, die *V. mearnsii* auch in der Provincia Laguna. Auf Mindanao kommen vor: *V. diffusa, V. mearnsii, V. betonicifolia, V. inconspicua,* und *V. philippica;* auf Mindoro nur *V. betonicifolia;* auf Negros nur *V. mearnsii.* Auf den nördlichen Teil Luzons sind also beschränkt: *V. arcuata, V. semilunaris, V. ramosiana, V. merrilliana,* und *V. rupicola.* Sämtliche Arten kommen nicht unter 2,000 bis 3,000 Fuss Meereshöhe vor; im

[1] Beih. Bot. Centralbl. 34–36 (1916–1918), Abteil. 2, und in Englers Bot. Jahrb. 54, Beibl. 120 (1917); an letzter Stelle sind *Viola Patrinii* und ihr ähnliche Arten besprochen.

nördlichsten Teile der Insel Luzon könnten sie vielleicht tiefer hinabsteigen.

Pflanzengeographische Beziehungen zu den Nachbarländern lassen sich in folgender Weise feststellen:

1. Durch *V. arcuata* zu Westjava, Sumatra und dem südöstlichen Asien; *V. arcuata* ist von Borneo und Celebes ausgeschlossen.
2. Durch *V. semilunaris* zu Japan; diese Art ist bisher nur aus Mittel- und Nordjapan bekannt.
3. Durch *V. diffusa* zu Hinterindien, China, Formosa, und Japan; *V. diffusa* ist von den Sundainseln noch nicht bekannt.
4. Durch *V. mearnsii,* die in Verwandtschaft der *V. selkirkii* Pursh gehört und der *V. boissieuana* Makino nahe steht, zu Japan.
5. Durch *V. betonicifolia* zu Südjapan, Formosa, Ostchina, Celebes, Timor, Java, und weiterhin zu Queensland, Neu-Südwales, Victoria, Tasmania (Australien). Die Art ist von der Insel Neu-Seeland ausgeschlossen; es muss auch erwähnt werden, dass ihr Vorkommen in Südjapan und auf Java noch nicht völlig unzweifelhaft begründet ist.
6. Durch *V. inconspicua* zu Java, Sumatra, und Südchina.
7. Durch *V. philippica* zu Java, China, Formosa, und Japan.

Zu Borneo bestehen keine pflanzengeographischen Beziehungen.

Viola merrilliana, ramosiana, und *rupicola,* sowie *mearnsii* sind für die Philippinen endemisch.

MORPHOLOGIE DER ARTEN

Viola arcuata und *semilunaris* gehören, wie leicht zu erkennen ist, einer Verwandtschaftsgruppe an, den Bilobatae:[2]

Stylus ad basin ± geniculatus, clavatus, ad apicem utrinque lobato-marginatus, antice ad loborum basin rostratus; species acaules, stonoles ± erectos cauliformes rarissime radicantes emittentes.

Diese Gruppe ist von mir ausführlich bearbeitet.[3]

Ebenfalls ausläufertreibende Arten sind V. *merrilliana, diffusa,* und *rupicola.* Ihre Ausläufer liegen an der Erde—bei *V. diffusa* aber auch ± aufrecht—bilden an ihren Enden wurzelnde Rosetten und damit neue Pflanzen. Eine derartige Rosettenbildung habe ich auch bereits in der Gruppe Bilobatae beobachtet. Da nun der Stylus der drei letzten Arten auch eine Aehnlichkeit mit dem Stylus der Bilobatae aufweist, so besteht wahrscheinlich

[2] Becker, W., Beih. Bot. Centralbl. 34[2] (1916) 226.
[3] Loc. cit.

eine gewisse Verwandtschaft mit den Arten dieser Gruppe. Eine endgültige Entscheidung über die systematische Gruppierung dieser Arten verschiebe ich auf spätere Zeit.

Viola rupicola Elmer wurde das erste Mal ohne Ausläufer gesammelt und daher als ausläuferlose Art beschrieben. In Wirklichkeit entwickelt sie lange, sehr dünne Ausläufer, wie sie von *Merrill* unter *Nr. 7765* gesammelt sind. Die Folge des Irrtums war, dass ich *V. rupicola* [4] in die Verwandtschaft der *V. selkirkii* stellte und die *Nr. 7765* [5] als neue Spezies "*V. effusa*" publizierte. *V. rupicola* Elmer und *V. effusa* W. Bckr. sind aber sicher dieselbe Art, und letztere ist also Synonym zur ersteren. *Merrill Nr. 7765* bietet die Art in stat. flor., während Elmers Originale in stat. fruct. gesammelt sind.

Die übrigen vier Arten sind stengellos. Von ihnen gehört *V. mearnsii* zur Verwandtschaft der *V. selkirkii* Pursh, während *V. betonicifolia, inconspicua,* und *philippica* einander näher stehen und in dem weiteren Formenkreis der *V. patrinii* DC. gehören.

Sämtliche Arten gehören zur Violen sektion *Nomimium* Ging.[6] und zwar zur subsect. *Plagiostigma* Godr.[7]

Bestimmungstabelle.

1. Pflanze ausläufer- oder stengeltreibend .... 2.
   Pflanze keine Ausläufer oder Stengel entwickelnd; Ausläufer bei *V. mearnsii* bisweilen vorhanden, vielleicht sich erst später entwickelnd .... 6.
2. Blätter kahl, höchstens mit sehr zerstreuten, kurzen Härchen an den Blattlappen oberseits;
   - a^1. Basalbucht sehr breit offen .... 3.
   - a^2. Basalbucht ± eng, Pflanze zart .... 7. **V. ramosiana** W. Becker.

   Blätter deutlich behaart, mindestens oberseits .... 4.
3. Blätter 2 bis 3 cm lang und breit; Blattrand ziemlich geradlinig zur Spitze verlaufend, Blattrand sehr flach gekerbt, Blattlappen oberseits kahl .... 1. **V. arcuata** Blume.
   Blätter 1 bis 1.5 cm lang und breit, selten etwas grösser; Blattrand schwach gebogen zur Spitze verlaufend, flach gekerbt; Blattlappen oberseits kurz behaart.
   2. **V. semilunaris** W. Bckr. var. **philippinarum** W. Becker.
4. Blätter am Grunde deutlich herzförmig, im Umrisse breit eiförmig bis rundlich, ± zugespitzt, dünn .... 5.
   Blätter am Grunde in den Stiel verschmälert oder schwach herzförmig, breit eiförmig bis länglich, an der Spitze stumpf, ziemlich derb, dicht grau behaart .... 5. **V. diffusa** Ging.

[4] Beih. Bot. Centralbl. 34 [2] (1917) 415.
[5] Op. cit. 424.
[6] Mém. Violac. (1823).
[7] Fl. Lorraine Ed. 2 (1857) 86.

Blätter kürzer, ± rundlich, an der Basis schwach herzförmig.
subsp. tenuis W. Becker.

5. Blätter dünn, häutig, auf der gesamten Oberseite lang weisshaarig; Ausläufer sehr lang, dünn, wurzelnd; Blätter auf der Unterseite an den Nerven deutlich behaart.................................. 4. V. rupicola Elmer.
   Blätter besonders gegen den Rand der Oberseite behaart, auf der Unterseite kahl oder fast kahl; Ausläufer ± aufrecht.
   3. V. merrilliana W. Becker.
6. Pflanze klein, zart; Wurzelstock dünn mit vielen Faserwurzeln; Blätter klein, selten bis 2 und 3 cm lang und breit, aus herzförmiger Basis breit dreieckigeiförmig, kaum länger als breit.
   6. V. mearnsii Merrill.
   Pflanze grösser, 10 bis 15 cm hoch; Wurzelstock meist kräftig, mit wenigen derberen Seitenwurzeln; Blätter deutlich länger als breit, meist mehr als 4 cm lang.. 7.
7. Sporn deutlich länger als die kurzen Kelchanhängsel, 6 bis 7 mm lang.
   10. V. philippica Cavanilles.
   Blätter an der Basis herzförmig..................... subsp. malesica W. Becker.
   Sporn nicht oder kaum länger als die Kelchanhängsel............................ 8.
8. Sporn sehr kurz, die kurzen Kelchanhängsel kaum überragend; Blätter aus ± gestutzer oder verschmälerter, eckiger Basis lang vorgezogen.
   8. V. betonicifolia Sm. subsp. nepalensis W. Becker.
   Sporn ungefähr 3 mm lang, die sehr deutlichen, verlängerten und gezähnten Kelchanhängsel nicht überragend; Blätter aus offen herzförmiger, breiter Basis allmählich geradlinig zur Spitze verschmälert; häufig kleistogam blühend................................. 9. V. inconspicua Blume.

BESPRECHUNG DER ARTEN

1. **VIOLA ARCUATA** Blume Bijdr. 1 (1825) 58; Korth. in Nederl. Kruidk. Arch. 1 (1848) 357; Miq. Fl. Ind. Bat. 1[2] (1859) 114; Oudem. in Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 75; Koorders Excfl. Java 2 (1912) 629, excl. syn. *V. glaucescens* et *japonica* et al. dub. et loc. "Tengger;" W. Bckr. in Beih. Bot. Centralbl. 34[2] (1916) 220–222, 226.

   Viola distans Wall. in Trans. Med. Soc. Calc. 7 (1835) 227; Hook. f. Fl. Brit. Ind. 1 (1875) 183, excl. var. 2 et 3; Trimen Handb. Fl. Ceyl. 1 (1893) 66; Watt in Journ. Linn. Soc. Bot. 18 (1881) 380.
   Viola Wightiana var. *glabra* Thwaites Enum. Pl. Ceyl. (1859) 20.
   Viola Toppingii Elmer Leafl. Philip. Bot. 2 (1908) 504.

Planta glabra; caulibus flagellaceis, decumbentibus vel ascendentibus vel suberectis, 20 ad 40 cm longis; stipulis caulinis lanceolatis, parvis, subintegris, foliis semiorbiculato-reniformibus, acutiusculis, in venis utrinque ciliatis. Rhizoma tenue vel subcrassiusculum, obliquum, articulatum, folia caulesque emittens. Stipulae caulinae virides, 5 ad 7 mm longae, lanceolatae, acutae, remote et indistincte denticulatae. Folia e basi profunde et aperte cordata sinibus rotundatis reniformia vel late ovata, subacuta, indistincte crenata, lobis basilaribus elongatis, rotundatis, glabra, tantum ad nervos basilares interdum subciliata, supra subobscuro-viridia; basilaria longe petiolata. Flores longe pedunculati, parvi; sepala ovato-lanceolata vel lanceolata, acuta vel acuminata, circiter 2.5 mm longa, breviter appendiculata; petala pallide violacea, 8 ad 10 mm longa, lateralia glabra vel verosimiliter plerumque subbarbata, infimum brevissime calcaratum, calcar 2 mm longum et crassum; ovarium glabrum; stylus basi geniculatus, versus apicem clavatus, apice utrinque lobato-marginatus, antice ad loborum basin rostratus; capsula oblonga, glabra, circiter 5 mm longa. Fl. I-III.

LUZON, Benguet Subprovince, Baguio, *Elmer 6042, 8649, Topping 119.* Eine häufige Art, die an feuchten, freien Orten in der Nähe von Bächen und Flüssen wächst und oft dichte, zusammenhängende Matten bildet.

Sonstige Verbreitung: Java (reg. class.), Sumatra, Burma, India (Khasia Hills, Nilagiri Hills) Ceylon, China (Szetschwan, Kwangtung).

In Java sind die Nebenblätter eiförmig bis lanzettlich, ± gezähnt und 1 bis 1.7 cm lang.

2. VIOLA SEMILUNARIS W. Bckr. in Beih. Bot. Centralbl. 34 [2] (1916) 231.

Viola verecunda β semilunaris Maxim. Mél. Biol. 9 (1876) 750; Bull. Acad. Sci. Petersb. (1877) 335; Franch. et Sav. Enum. Pl. Jap. 2 (1879) 648; Matsum. Enum. Pl. Jap. 1 (1912) 381.

Planta gracilis, glabra, caulibus paucis tenuibus flagellaceis erectis usque ad 25 cm altis. Rhizoma crassiusculum, obliquum, articulatum, folia caulesque emittens. Stipulae caulinae parvae, lanceolatae vel lineares, subintegrae, usque ad 7 mm longae, plerumque breviores. Folia basilaria longe petiolata, caulina remote inserta, 2 ad 3 cm longa et 2 ad 2.5 cm lata; inferiora e basi semi-aperte cordata, rotundato-ovata, obtusiuscula; superiora e basi semilunari ± late aperta et profunde cordata, rotundiusculo-ovata vel triangularia, lobis elongatis; omnia supra ad nervos basilares plerumque albido-hispidula, plane crenata. Flores minores, dilute colorati; sepala anguste lanceolata, breviter appendiculata; petala lateralia barbata, infimum brevissime calcaratum; ovarium glabrum; stylus basi geniculatus, versus apicem clavatus, apice deplanatus et utrinque lobato-marginatus et antice ad loborum basin rostratus. (Descr. plantae Japon.)

Exs: Maxim. It. sec. Jap.: Hakodate (a. 1861 et 1866) p. p.; Faurie Pl. Jap. 6988, 2481.

Hab: Japonia media et borealis.

Auf den Philippinen nur die:

Var. PHILIPPINARUM W. Bckr. loc. cit.

Folia parva, circiter 1 ad 1.5 cm longa et lata; caules flagellacei ascendentes, plerumque humiliores. Fl. verosimiliter V-VI.

LUZON, Benguet Subprovince, Pauai, *Bur. Sci. 4363, 4388 Mearns, Merrill 4769, Loher 1646* (herb. Calcutta), in Sümpfen, 2,300 m. s. m.

3. VIOLA MERRILLIANA W. Bckr. in Beih. Bot. Centralbl. 34 [2] (1916) 234.

Planta humilis, acaulis, stolones radicantes tenues emittens. Rhizoma tenue, 2 ad 3 mm crassum, subelongatum, 2 ad 5 cm longum, distincte articulatum, ± obliquum. Stolones elongati, 10 ad 20 cm longi, tenues, foliati, denique radicantes et plantas novellas formantes. Folia longe petiolata, parva e basi ± profunde cordata rotundato-ovata acutiuscula vel triangulariter ovata, subacuminata, supra praecipue ad margines albido-strigosa et in medio subglabra, subtus glabra nervis prominentibus, plane et indistincte crenata; folia ad stolones aequaliter disposita, ad fines radicantes rosulata. Stipulae virides, liberae, e basi ovata lanceolatae, longe acuminatae, remote fimbriatae. Flores parvi, folia superantes, in pedunculis supra medium bracteolatis; sepala ovato-lanceolata, acuta, trinervia, appendicibus brevibus 2.5 ad 3.5 mm longis; petala oblongo-obovata, alba, violaceo-striata, lateralia subbarbata, infimum abbreviatum naviculare brevicalcaratum; calcar saccatum, appendices calycinas paullum superans; ovarium glabrum; stylus basi distincte sigmoideo-curvatus, versus apicem clavatus, apice bilobato-marginatus antice breviter rostratus. Folia 1 ad 2 cm longa, 0.8 ad 1.7 cm lata; petioli 2 ad 4 (ad 6) cm longi; petala 8 ad 12 mm longa. Fl. I-V.

LUZON, Benguet Subprovince, Mount Pulog, *For. Bur. 16219, 16063 bis Curran, Merritt & Zschokke, Merrill 6503, 6493:* Lepanto District, Mount Data, *Merrill 4509, 4565*, alt. 2,000 bis 3,000 m. s. m.

Viola merrilliana ist durch die gegen den Rand hin deutlich behaarten Blätter sehr ausgezeichnet.

4. VIOLA RUPICOLA Elmer Leafl. Philip. Bot. 1 (1908) 324.

Viola effusa W. Bckr. in Beih. Bot. Centralbl. 34 [2] (1917) 424.

Planta acaulis, humilis, longe stolonosa; foliis minoribus, membranaceis, cordato-ovatis, supra in tota pagina albido-strigosis. Rhizoma subcrassiusculum, brevissime articulatum, reliquiis stipularum fuscis obsitum, subperpendiculare vel obliquum. Stipulae lanceolatae, 5 ad 6 mm longae, fuscae vel fusco-viridulae, remote longifimbriatae. Folia ± longe petiolata, e basi anguste et profunde cordata ovata vel rotundiusculo-ovata, subacuminata vel acutiuscula, plane crenata, supra in tota pagina distincte albido-strigosa, subtus tantum ad nervos longe albido-strigosa, 1.5 ad 2 cm longa et 1 ad 1.7 cm lata; petioli tenues, subalati, praecipue in parte suprema dense albido-pilosa. Stolones longi, tenues, procumbentes, plerumque ad nodos non foliati at stipellati et saepe radicellati, ad nodos nonnullos rosulas formantes, e quibus plantae novae oriuntur. Flores folia superantia, inconspicui, ± albi, in pedunculis sublonge bracteolatis; sepala ovato-lanceolata, acutiuscula, subciliata, appendicibus truncatis vel rotundatis et strigosis; petala oblonga, lateralia longe barbata, infimum breviter calcaratum; calcar appendices calycinas vix superans, subtenue; ovarium glabrum, globosum, stylus apice deplanatus, curvatus, antice rostellatus, pone utrinsque lobato-marginatus, rostello distincto horizontali antice subsursum directo. Fl. V.

LUZON, Benguet Subprovince, *Merrill 7765*, in Bergschluchten an den Gebirgspfaden, alt. 2,000 m 45 km nördlich von Baguio; *Elmer 8574*, ungefähr 3 km westlich von Baguio in feuchtem Moose auf Kalkstein in stat. fruct. (loc. class.).

Diese Art ist durch die dünnen, langen Ausläufer und die Rosettenbildung an den Ausläufern ausgezeichnet. Zuerst wurde sie ohne Ausläufer gesammelt und daher in der Diagnose von Elmer als ausläuferlos beschrieben.

5. **VIOLA DIFFUSA** Ging. in DC. Prodr. 1 (1824) 298; Franch. Pl. David. 1 (1884) 43, 2 (1888) 20, Pl. Delavay. (1889) 72; Diels Fl. Centr. China (1901) 477; Benth. Fl. Hongk. (1861) 20; Oudem. in Ann. Mus. Bot. Ludg.-Bat. 3 (1867) 77; de Boissieu in Bull. Herb. Boiss. II 1 (1901) 1077; Matsumura Enum. Pl. Jap. 2 (1912) 372; Makino in Bot. Mag. Tokyo 19 (1905) 73; Hook. f. Fl. Brit. Ind. 1 (1875) 183; Forbes and Hemsl. in Journ. Linn. Soc. Bot. 23 (1886) 52; Maxim. Mél. Biol. 9 (1876) 735; Act. Hort. Petropol. 11 (1890) 61; Matsum. et Hayata Enum. Pl. Formos. (1906) 28; Hayata Ic. Pl. Formos. 1 (1911) 60; Lecomte Fl. Gén. Indo-Chine 1 (1908) 208.

Viola tenuis Benth. in Hook. Lond. Journ. Bot. 1 (1842) 482; Champ. et Benth in Hook. Journ. Bot. Kew Miscel. 3 (1851) 260.

Viola kiusiana Makino in Bot. Mag. Tokyo 16 (1902) 138, 19 (1905) 73.

Planta annua (semper?), acaulis, stonifera, ± pilosa. Radix verticalis, ± tenuis, fibrillosa, albida. Stolones saepe substricte suberecti, ± numerosi, usque ad 15 cm longi, posterius radicantes, in parte inferiore et media stipulis vel foliis muniti, ad finem dense foliati et floriferi. Stipulae lineari-lanceolatae, longe fimbriatae, pallide virides, in parte infima adnatae, 6 ad 12 mm longae. Folia basilaria majora usque ad 8 cm longa, stolonum minora, ± late ovata, obtusiuscula, in petiolum fere aequilongum vel sublongiorem decurrentia vel basi subtruncata, plane crenata; in subspec. rotundiuscula, basi cordata, ± longe petiolata, lamina minore. Flores inodori, longe pedunculati, basilares et in stolonibus, parvi, circiter 7 mm longi vel minores; sepala lanceolata, trinervia, acute, breviter appendiculata; petala oblongo-obovata, pallide violacea vel albido-purpurea, lateralia ebarbata, infimum brevissime calcaratum; calcar appendices calycis non vel vix superans, 1 ad 2 mm longum, subtenue; stylus clavatus, apice bilobus, antice inter lobulos breviter rostellatus; capsula parva, glabra. Fl. XI. et posterius, probabiliter toto anno.

LUZON, Lepanto Subprovince, Balili (Mount Data), *Merrill 4612;* wächst in Felsspalten der Kaffeeplantagen-Terrassen alt. 2,000 m; Bontoc Subprovince, Mount Pukis, *Bur. Sci. 37796 Ramos & Edaño.*

Sonstige Verbreitung: Indien, China, Tonkin, Japan, Formosa; auf Feldern, in Culturen, an Wegrändern, in gemässigtem Klima, 500 bis 2,000 m.

Im östlichsten Teile des Areales, in dem auch der Typus auftritt, kommt eine kleinblättrige Form vor, die durch eine ± rundliche oder eiförmige, an der Basis ± herzfömige Lamina ausgezeichnet ist. Sie tritt bereits in der Flora von Hongkong (Victoria Peak 400 m) auf und entspricht der *V. tenuis* Benth. l. c. Ich habe sie deshalb als subsp. *tenuis* bezeichnet. Vielleicht hat sie nur den Wert einer Varietät. *V. nagasawai* Makino et Hayata [8] dürfte mit ihr völlig identisch sein.

Subsp. **TENUIS** W. Bckr. subsp. nov.

Viola tenuis Benth. l. c., Champ. et Benth. l. c.
Viola diffusa Mats. et Hay. l. c. quoad pl. Formos.; Hay. l. c.

Folia rotundiuscula vel ovata, ± obtusa, basi ± distincte cordata, majora vel minora, ± longe petiolata.

LUZON, Lepanto District, Mount Data, *Merrill 4562.* MINDANAO, Davao Subprovince, Todaya, Mount Apo, *Elmer 11544* in herb. Leyden sub. nom. *Viola apoensis* Elm., folia e basi anguste et profunde cordata rotundata, obtusa, rotundato-paucicrenata, longipetiolata; planta 4 ad 6 cm alta.

[8] Journ. Coll. Sci. Tokyo 22 (1906) 30 [= Matsum. et Hay. Enum. Pl. Formos. (1906) 30].

Merrill gibt auf der Scheda die Beschaffenheit des Standortes genauer an: feuchter Boden, im Regenwalde, Höhenlage 2,300 m. Hier scheint die Pflanze ausdauernd zu sein.

6. VIOLA MEARNSII Merrill in Philip. Journ. Sci. **5** (1910) Bot. 201; W. Bckr. in Beih. Bot. Centralbl. **34**[2] (1917) 411.

Planta nana, in omnibus partibus parva, munda, acaulis. Rhizoma tenue, verticale vel ± obliquum, 1 ad 2 cm longum, breviter articulatum vel sublaeve, probabiliter rarius stolones caulescentes abbreviatos ± erectos potius abnormales emittens. Stipulae lineari-lanceolatae, acuminatae, 3 ad 5 mm longae, infra medium adnatae, breviter glanduloso-fimbriatae. Folia e basi ± profunde et aperte cordata late triangulariter ovata, lobis sinibusque rotundatis, subacuminata, obtusa, glabra, distincte remote crenata, ad crenas pilis, nonnullis munita (interdum tantum sub microscopio visis), longe petiolata. Flores folia ± superantes, parvi, in pedunculis tenuibus plerumque ultra medium bracteolatis; sepala lanceolata, acuminata, trinervia, appendicibus distinctis denticulatis; petala albida, violaceo-striata, oblongo-obovata cum calcari 9 ad 10 mm longa, lateralia papilloso-barbata, infimum abbreviatum breviter calcaratum; calcar appendices calycinas distincte superans, crassiusculum, apice rotundatum, 1.5 ad 2 mm longum, ovarium glabrum; stylus basi sigmoideo-curvatus, clavatus, deplanatus, marginatus, distincte rostratus; capsula globosa. Fl. IV-VI.

LUZON, Benguet Subprovince, Pauai, *Bur. Sci. 4310 Mearns*, *Bur. Sci. 8430 McGregor*, *Merrill 6625*, alt. 2,300 m; Suyoc bis Pauai, *Merrill 4790:* Laguna Province, Mount Banahao, *Bur. Sci. 9781, 9851 Robinson*, alt. 800 und 2,200 m. NEGROS, Canlaon Volcano, *Merrill 9851.* MINDANAO, Misamis Province, Mount Malindang, *For. Bur. 4625 Mearns & Hutchinson* (loc. class.): Davao District, Mount Apo, *Elmer 11543* (herb. Hamburg und Leyden). An schattigen Hängen der Wasserläufe, an Felsen schattiger Schluchten, auf feuchten Wiesen, 800 bis 2,300 m. s. m.

Folia 1 ad (rarius) 3 cm longa, 1 ad (rarius) 2.5 cm lata; petioli 2 ad 6 cm longi; crenae fol. 5 ad 8; stipulae 3 ad 5 mm longae.

Die Art steht der *Viola boissieuana* Makino in Bot. Mag. Tokyo **16** (1902) 127 nahe, gehört daher auch in den Verwandtenkreis der *V. selkirkii* Pursh.

7. VIOLA RAMOSIANA W. Bckr. sp. nov. ex affinitate *V. mearnsii* Merrill.

Planta nana, glaberrima, in omnibus partibus major quam V. Mearnsii, acaulis, stolonifera. Rhizoma tenue, verticale vel ± obliquum, 1 ad 2 cm longum, sublaeve, fibrillosum, stolones tenues foliatos horizontales emittens. Stolones saepe complures, longius articulati, ad nodos folia floresque praebentes, ad finem rosulam foliorum non ostendentes. Stipulae liberae, e basi ovato-lanceolata longe acuminatae, remote glanduloso-fimbriatae, usque ad 1 cm longae, membranaceae, pallide virides, interdum subfuscae. Folia basilaria e basi profunde cordata ovata usque oblongo-ovata, 2 ad 3 cm longa, 1.5 ad 1.8 cm lata, obtusiuscula, glaberrima, lobis sinibusque rotundatis, distincte rotundato-crenata, ad crenas distincte incisas et substipitato-glandulosas sub microscopio interdum pilis nonnullis munita, petiolo subaequilongo. Folia stolonum minora, breviora, basi subaperte cordata, subacutiuscula. Flores folia vix vel non superantes, in pedunculis tenuibus circiter in medio bibracteolatis infra corollam disparse hirsutis; sepala lanceolata, acuminata, trinervia, ad margines ciliata, ad apicem glandula munita, 2.5 mm longa, appendicibus abbreviatis; petala?; capsula ovoidea, glabra, 5 mm longa; stylus?

LUZON, Kalinga Subprovince, Lubuagan, Mount Masingit, *Bur. Sci. 37548 Ramos & Edaño* ad ripas circiter 1,350 m in stat. fruct. II 1920.

A Viola mearnsii stolonibus horizontalibus bene evolutis, foliis glaberrimis ovatis vel oblongo-ovatis obtusiusculis majoribus, pedunculis infra corollam disparse hirsutis, sepalis ad margines ciliatis et appendicibus calycinis abbreviatis diversa est.

Viola mearnsii und *V. ramosiana* sind durch die mit einer Drüse endigenden Sepalen ausgezeichnet. *V. mearnsii* ist einmal mit sehr kurzen Stolonen gesammelt (Benguet Provincia. Pauai, *For Bur. 4310 Mearns*, W. Becker. Herb. Viol.).

8. VIOLA BETONICIFOLIA Sm. in Rees. Cyclop. 37 (1817) No. 7.

Viola Patrinii var. *napaulensis* Ging. in DC. Prodr. 1 (1824) 293.

Viola Patrinii Wight et Arn. Prodr. Fl. Ind. Or. 1 (1834) 32; Hook. f. Fl. Brit. Ind. 1 (1875) 183 p. p.!; Forbes et Hemsl. in Journ. Linn. Soc. Bot. 23 (1886) 53 p. p.!; Trimen Handb. Fl. Ceyl 1 (893) 66; Diels Fl. Centr. Chin. (1901) 476 p. p.; Koorders Excfl. Java 2 (1912) 627 p. p. minima!

Viola Patrinii var. *laotiana* De Boissieu in Bull. Soc. Bot. France 55 (1908) 467.

Viola Patrinii var. *typica* Maxim. in Bull. Acad. Sci. Pétersb. 23 (1877) 315 p. p.!

Viola caespitosa Don Prodr. Fl. Nepal. (1825) 205.

Viola Walkeri Wight Illustr. Ind. Bot. 1 (1840) 42, *t. 18* (tab. falso sub. nom. *V. Patrinii*).

Viola nilagirica Turcz. in Bull. Soc. Nat. Mosc. 36 [1] (1863) 556.

Planta acaulis, estolonosa, glaberrima, plerumque caespitosa; foliis elongato-triangularibus; floribus minoribus, brevissime calcaratis. Rhizoma obscure coloratum, radicibus fere ex uno loco exeuntibus obsitum. Stipulae usque longo ultra medium adnatae, fuscae. Folia plerumque numerosa, ± longe petiolata, glaberrima, e basi truncata vel cuneata in petiolum alatum angustata subhastata elongato-triangularia, indistincte plane crenata, obtusiuscula. Flores circiter 1 cm longi, violacei vel pallide violacei vel albidi, folia non vel non multum superantes; sepala ovato-lanceolata, acuminata, appendicibus subconspicuis; petala obscure lineata, lateralia distincte barbata; calcar brevissimum, subrecurvatum; ovarium glabrum; stylus clavatus, apice deplanatus, praecipue pone marginatus. Fl. VIII-IV.

Die Pflanze der Philippinen gehört zur:

Subsp. NEPALENSIS W. Bckr. in Engl. Bot. Jahrb. 54 (1917) Beibl. 120: 166.

LUZON, Cagayan Province, *For. Bur. 17095 Curran*, alt. 30-50 m: Benguet Subprovince, Baguio, *For. Bur. 5097, 10940 Curran, Bur. Sci. 2767, 2472 Mearns*, alt. 1,400 m: Lepanto Subprovince, Suyoc to Cervantes, *Merrill 4452*, alt. 1,300 m: Mount Data, *Merrill 4499*: Bontoc Subprovince, Bauco, *Vanoverbergh 229*. MINDORO, Mount Sablayan, *For. Bur. 9771 Merritt*, alt. 850 m. MINDANAO, Bukidnon Subprovince, Tankulan, *Bur. Sci. 21464 Escritor, Weber 1502*, verbreitet von Tankulan bis Malaybalay, *Worcester;* Sumilao, *Bur. Sci. 15707 Fénix*. Auf offenen, grasigen Plätzen, Abhängen der Fichtenregion.

Sonstige Verbreitung der subsp. *nepalensis:* China, Formosa, Japan, Celebes, Timor, Java, Burma, Assam, Himalaya, Afghanistan, Vorder-Indien, Ceylon.

Ich habe schon nachgewiesen,[9] dass *V. patrinii* DC. nur in Sibirien (vom oberen Jenissei bis Transbaikalien), im Amurgebiet, bei Wladiwostok und in Japan vorkommt, dass sie eine Pflanze feuchter Standorte ist, die auch von der sonst als *V. patrinii* für gewöhnlich bezeichneten Spezies des südlichen und südöstlichen Asiens wesentlich verschieden ist. Letztere bildet mit der australischen *V. betonicifolia* Sm. entschieden eine

[9] Engl. Bot. Jahrb. 54 (1917) Beibl. 120: 156–166.

morphologische Einheit. Deshalb muss sie als *V. betonicifolia* Sm. bezeichnet werden. Die Gesamtart zerfällt in die subsp. *nepalensis* und *australensis* W. Bckr.[10] Beide Unterarten stehen sich sehr nahe. Bis zum Beginn des Tertiärs müssen sie ein kontinuierliches Areal gehabt haben. Da sich das jetzige Areal nicht auf Neu-Seeland erstreckt, darf man annehmen, dass die Einwanderung nach Australien erst nach der frühzeitigen Abtrennung Neu-Seelands vom australischen Kontinente erfolgte. Nach der heutigen Verbreitung erfolgte die Einwanderung nach Australien über die Philippinen, Celebes, und Timor. Die Gebiete westlich von Celebes (Borneo, Sumatra, mittleres und südliches Hinter-Indien) liegen ausserhalb des heutigen Areales und sind anscheinend nie von der Art bewohnt worden. Auf Java ist sie anscheinend selten und kommt dort vielleicht nur in einem Teile vor (Bromo 2,300 m, leg. *O. Kuntze*).

9. VIOLA INCONSPICUA Blume Cat. Gew. Buitenz. (1823) 57, Bijdr. 1 (1825) 58; Korth. in Nederl. Kruidk. Arch. 1 (1848) 357; Burgersd. in Miq. Pl. Junghuhnianae (1851) 118; Miguel Fl. Ind. Bat. 1[2] (1859) 112 et 686; Oudem. in Ann. Mus. Bot. Lugd.-Bat. 3 (1867) 78; W. Bckr. in Engl. Bot. Jahrb. 54 (1917) Beibl. 120: 167–174.

Viola primulifolia Roxb. Fl. Ind. ed. 2, 1 (1832) 650, ed. 3 (1874) 218.
Viola apetala Roxb. Fl. Ind. 2 (1824) 449, ed. 2, 1 (1832) 650, ed. 3 (1874) 218.
Viola Roxburghiana Voigt Hort. Suburb. Calcutt. (1845) 76.
Viola trinervis Korth. in Ned. Kruidk. Arch. 1 (1848) 357.
Viola Patrinii Hook. f. Fl. Brit. Ind. 1 (1875) 183 p.p.; Baker Fl. Mauritius Seych. (1877) 10, verosimiliter.
Viola Patrinii Ging. var. *typica* De Boiss. et Capit. in Bull. Soc. Bot. France (1910) 340, quoad pl. Assam.; Koorders Excfl. Java 2 (1912) 626, p.p. maxima.
Viola Patrinii Ging. var. *triangularis* Franch. et Savat. Enum. Pl. Jap. 2 (1879) 283, forsitan.
Viola betonicaefolia Boj. Hort. Maurit. (1837) 20, verosimiliter.

Acaulis, perennis (vel etiam annua?), estolonosa. Rhizoma $\pm$ verticale, plerumque simplex et paullum ramosum, tenue vel $\pm$ crassum, elongatum, in parte suprema brevissime articulatum ex eo rugosum et $\pm$ crassatum, ceterum laeve. Stipulae usque ultra medium adnatae, fuscae, distincte abbreviatae, 7 ad 9 mm longae, 1.5 mm latae, laciniis angustis acuminatis extrorsum directis. Folia plerumque numerosa, rosulata, longe petiolata, e basi $\pm$ cordata sinibus rotundatis apertis hastata

[10] Op. cit. 166.

triangularia protracta subacuminata, lobis basalibus ± rotundatis, in medio subattenuata, obtusiuscula, crenato-serrata, plerumque glabra, supra subtilissime dense albido-papillosa, adulteriora nigrescenti-viridia. Flores in pedicellis elongatis, ± tenuibus, plerumque in parte superiore ± longe bracteolatis; sepala lanceolata, acuminata, trinervia, glabra; appendices calycinae angustatae, elongatae, praecipue inferiores saepius sepala aequantes, fine denticulatae, calcar dilute coloratum crassiusculum subrecurvatum distincte superantes; petala violacea, calc. inclus. 10 ad 12 mm longa, sepala non multum superantia, oblongo-obovata, lateralia barbata; ovarium glabrum; stylus basi geniculatus, versus apicem clavatus, apice deplanatus, disco antice oblique-deorsum directo (ex eo "stylo incurvo" apud Blume l. c.) utrinque distinctissime marginato distincte rostrato. Fl. chasmogam. XII-III., cleistogam. probabiliter toto anno.

LUZON, Cagayan Province, Abulug River, *For. Bur. 19622 Curran, Merrill Phil. Pl. 1097 leg. Ramos:* Benguet Subprovince, *Bur. Sci. 5899 Ramos.* MINDANAO, Lanao District, Camp Keithley, *Clemens 21,* alt. 700 m.

Sonstige Verbreitung: Java, Sumatra, Himalaya, Assam, Burma, Yunnan, Szetschwan, Kwangtung, Kiangsu; an Felsen und auch kultivierten Orten.

Ich habe die Art[11] ausführlich besprochen. Sie ist durch die Blattform, die sehr kurzen Nebenblätter, die stark verlängerten Kelchanhängsel und hervortretende Cleistogamität von *V. betonicifolia* Sm. sehr ausgezeichnet.

10. **VIOLA PHILIPPICA** Cav. Icon. 6 (1801) 19, *t. 529, f. 2;* Poir. in Lam. Encycl. 7 (1808) 629; Miq. Fl. Ind. Bat. 1[2] (1859) 113.

Viola confusa Champ. ex Benth. in Hook. Journ. Bot. Kew Miscel. 3 (1851) 260; Benth. Fl. Hongk. (1861) 20.

Planta acaulis, estolonosa; stipulis usque ultra medium adnatis, pallidis; foliis cordato-triangulari-ovatis, subelongatis; floribus longe calcaratis. Rhizoma non crassum, potius tenue, radicibus tenuibus sublaevibus elongatis obsitum. Stipulae usque longe ultra medium adnatae, pallidae. Folia dilute virescentia, numerosa, e basi ± cordata ovata vel triangulariter ovata, subelongata, plane crenata, plerumque glabra vel subpubescentia, in petiolis circiter aequilongis in parte superiore alatis; lamina circiter 1 ad 2 cm lata, 2.5 ad 5 cm longa. Flores mundi, potius parvi, folia superantes, in pedunculis gracilibus 6 ad 10 cm longis; sepala ovato-lanceolata, acuminata, appendicibus

[11] Loc. cit.

subconspicuis; petala angusta, obovata, dilute violacea, basi obscurius colorata, lateralia indistinctissime barbata vel etiam ebarbata (?), infimum longe calcaratum; calcar gracile, 4 ad 5 mm longum; ovarium glabrum; stylus basi geniculatus, apice clavatus deplanatus utrinque distincte marginatus, antice breviter rostellatus. Fl. XI-I.

Die Pflanze der Philippinen gehört zur:

Subsp. MALESICA W. Bckr. in Engl. Bot. Jahrb. 54 (1917) Beibl. 120: 178.

Die Originaldiagnose der *Viola philippica* folgt:

"Viola acaulis foliis ovato-oblongis, obtusis, crenulatis, petiolo longioribus: scapis unifloris bibracteatis. Viola. *Née herbar.*

"Radix fusiformis barbata: caulis nullus. Folia numerosa, petiolis longiora, ovato-oblonga, obtusa, crenulata, subvillosa praesertim inferiore pagina, sesquipollicem longa, quattuor lineas lata: stipulae subulatae petiolo adnatae. Scapi plures, foliis longiores, tenues, uniflori, prope medium bibracteati bracteis lanceolatis. Calix pentaphyllus, foliolis ovato-lanceolatis persistentibus, quorum duo fulciunt petalum longius, duo par petalorum oppositorum huic proximorum, et quintum duo reliqua petala. Corolla pentapetala irregularis violaceo-rubra: petala ovata, apice obtusa, versus basim angusta, quorum unum ceteris longius, basi corniculatum, corniculo obtuso calicis foliolis longiore. Staminum filamenta quinque minima: antherae subconnexae, ovato-compressae, membranis ad apicem auctae. Germen liberum, oblongiusculum: stylus exertus, basi setaceus, postea infundibuliformis, deflexus, ore sistens apiculum brevem. Capsula oblonga, trigona, unilocularis, trivalvis, valvis medio seminiferis. Semina fusco-rubentia subglobosa. Habitat in Insula Luzon tertio a Manila lapide, ibique Oxalis sensitiva; Morinda axillaris; Iusticia nasuta; Mogorium sambac; Scirpus dipsaceus, barbatus, miliaceus et dichotomus. Vidi siccas in eodem herbario."

Die Pflanzen der Philippinen entsprechen nicht dieser Beschreibung; denn ihre Blätter sind Kahl und an der Basis herzförmig. Wohl aber stimmt die nördliche subspezies der *V. philippica*, die subsp. *munda*, mit ihr und der Abbildung gut überein. E. D. Merrill äussert sich [12] dahin, dass *V. philippica* Cav. nicht auf Material von den Philippinen gegründet sein kann; der Originalfundort, wie er bei Cavanilles angegeben ist, sei unmöglich, da er sich auf eine Veilchenart beziehen würde, die in Meereshöhe wachsen müsste; auf den Philippinen

[12] Philip. Journ. Sci. 10 (1915) Bot. 191.

käme aber kein Veilchen unter 600 bis 1000 m Höhe vor, ausser vielleicht am nördlichsten Ende von Luzon. Merrill vermutet dann, dass *V. philippica* Cav. aus Südamerika, Mexico, oder vielleicht sogar aus Californien stammt, da das Material der Malaspina Expedition bezüglich der Ursprungsländer gemischt war.

Er teilte mir auch in einem ausführlichen Bericht über die Malaspina-Expedition [13] (1789–1793), bei der Née und Haenke als Botaniker tätig waren,—in der Publikation der *V. philippica* Cav. ist "Née herbar." angegeben—, mit, dass diese Expedition besonders in Australien und auf Neu-Seeland umfangreiche Sammlungen gemacht hat. Ich muss aber feststellen, dass weder in Australien, auf Neu-Seeland und den Gesellschafts- und Marschallinseln, noch in Südamerika, Mexiko, und Californien eine der *V. philippica* ähnliche und verwandte Form vorkommt. Ich muss annehmen nach Abbildung und Beschreibung, dass *V. philippica* Cav. aus Ostasien stammt, und dass China oder Japan als Ursprungsländer in Betracht kommen. Da das Schiff der Expedition die "Atraveda" im März und April 1792, allerdings ohne die Naturwissenschaftler, Macao in Südchina anlief, so könnte man vielleicht annehmen, dass andere Mitglieder der Expedition die Pflanze von Macao mitgebracht hatten; ich muss aber darauf hinweisen, dass die mir von Macao bekannte *V. philippica* (Herb. Kopenhagen) der subsp. *malesica* angehört, während die Abbildung in Cav. l. c. deutlich auf die subsp. *munda* hinweist. Es ist also bis jetzt noch unklar, wie die Originalpflanzen in das Herb. Née hineingekommen sind. Eine einzige Pflanze von den Philippinen (District Lepanto, Bontoc, Suyoc, *Nr. 14448*) zeigt übrigens inmitten der breiteren Blätter einige schmale Blätter mit cune-

[13] Hauptdaten der Malaspina-Expedition: Abfahrt von Cadiz 30. Juli 1789 - Montevideo - Cap Horn - Westküste von Amerika bis Alaska - zurück bis Acapulco (Mexiko) - westlich durch den Grossen Ozean nach den Mulgrave-Inseln (Marschall-inseln) - Guam (Mariannen) - Philippinen - Fahrtdauer Acapulco bis Manila Januar 1792 bis März 1792 - die "Atraveda" ohne die Naturwissenschaftler am 31. März 1792 nach Macao in Südchina, Rückkehr am 19. Mai 1792 nach Manila - am 6. Nov. 1792 wurde Manila verlassen, Fahrt nach Zamboanga auf Mindanao - Rückkehr über Neu-Seeland, Sidney, Vavao (Tonga-Inseln), Callao (Peru), Cap Horn nach Spanien.- Das meiste von den Sammlungen auf den Philippinen stammt von Luzon; eine Expedition ging von Sorsogon in Süd-Luzon über Land nach Manila; eine andere Expedition von Manila nordwärts an der Westküste entlang zum nordwestlichen Teil der Insel, gelangte nicht sehr weit in des Innere; sonst nur Sammlungen auf Mindanao (Zamboanga) sec. Merrill. Weiterhin umfassende Sammlungen in Australia und Neu-Seeland; ausserdem wurde botanisiert auf den Mariannen, Gesellschafts - und Marschallinseln (Mulgrave-Insel).

ater Basis. Dass sich die Publikation der *V. philippica* Cav. auf die hier in Betracht kommende Gesamtart bezieht, ist nicht anzuzweifeln.

Verbreitung der subsp. *munda* W. Bckr. in Engl. Bot. Jarhb. 54 (1917) Beibl. 120: 175 (folia in summa lanceolata vel oblonga, basi cuneata vel truncata vel subcordata, plane crenata, pubescentia vel glabra): Mandschurei, Korea, Mongolei, nördliches, centrales und südwestliches China, Burma, Japan, Himalaya.

Sonstige Verbreitung der subsp. *malesica:* China (Kiangsu und Tschekiang, formae intermediae ad subsp. mundam vergentes;—*typ:* Fokien, Insel Matson, Canton, Hongkong, Macao), Ostindien (Langson), Formosa, Japan, Java.

Zum Schlusse erkläre ich meine Bereitwilligkeit, auch ferner Violen su bestimmen und zu bearbeiten. Ostasien stellt ein Hauptentwicklungscentrum des Genus *Viola* dar. Deshalb ist das genaue Studium der asiatischen Formen für ihre phylogenetischen Zusammenhänge äusserst wichtig und unerlässlich. Dieses Studium kann aber erst dann wertvolle Resultäte erbringen, wenn es auch stets Bezug nimmt auf das Ganze. Diese Beziehungen kann aber nur der Spezialist herstellen.

NACHTRAG

VIOLA EDAÑOII W. Bckr. sp. nov.

Acaulis, ex affinitate V. mearnsii Merr., major, estolonosa, glaberrima, foliis e basi semi-aperte cordata elongato-ovatis. Rhizoma subdebile, verticale, distincte breviter articulatum, in parte superiore subcauliforme, radicellis elongatis tenuibus obsitum, estolonosum, folia numerosa emittens. Folia circiter 7 ad 10, longe petiolata, cum petiolo 6 ad 8 cm longa, glaberrima; lamina 2 ad 3 cm longa et 1.5 ad 2 cm lata, e basi sinibus rotundatis semi-aperte cordata elongato-ovata vel triangulari-ovata, ± acutiuscula; margines subconvexi vel subdirecti, inciso-crenati, crenis glanduligeris et glandulis exsertis; crenae ad basin laminae saepe binae approximatae. Stipulae liberae, abbreviatae, membranaceae, virides, ovato-lanceolatae, longe acuminatae, versus apicem remote glanduloso-longifimbriatae. Flores in pedicellis gracilibus, circiter in medio breviter bracteolatis, in parte suprema subpilosis; sepala lanceolata, circiter 2 ad 3 mm longa, breviter appendiculata; petala ?; ovarium et stylus ?; capsula circiter 5 mm longa.

MINDANAO, Bukidnon Subprovince, Tankulan and vicinity, ad rupes torrentium in silvis alt. 3,600 m., *Bur. Sci. 39082 Ramos & Edaño,* VII. 8, 1920, in statu fruct.

ART. 12

SECONDARY SEXUAL CHARACTERS IN THE LOACH MISGURNUS ANGUILLICAUDATUS CANTOR

By Kikuo Okamoto

Of the Anatomical Institute of Keio University, Tokyo, Japan

ONE PLATE

Secondary sexual differences are common among mammals, birds, amphibians, and insects, as we know; for instance, in color, in size, and adornment. Among fishes there are scattered instances of such differences, but they are comparatively rare. Since the appearance of Cunningham's (1) work on *Cynolebias*, Regan (3) has published a paper on the sexual differences in *Cynolebias* but not on those of the Ostariophysi. While studying the intestinal respiration of loaches, at the suggestion of Prof. N. Yatsu, I observed the secondary sexual characters in them. According to the descriptions of Cunningham and others, the large size of the body is certainly one of the commonest of the secondary sexual differences in female fishes, while the strong pectoral fins are one of the commonest in the male. In addition to these I observed a remarkable difference; namely, a swelling on the posterior sides of the dorsal fin of the male fish. This swelling is more or less spindling or somewhat cylindrical in shape, tapering at each end and especially so caudad (Plate 1, fig. 1*a*). Its length is about 1 by 10 to 12 centimeters. This specific characteristic of the male distinguishes it markedly from the female.

In some Ostariophysi (for instance, a kind of Cyprinidæ), according to Cunningham's description, the males are distinguished by an enlargement, or swelling, of the anterior ray of the pectoral fins, especially in the spawning season; this swelling disappears soon after breeding has been accomplished. I have not observed this character in the loaches, nor does the swelling on the back disappear even after the breeding season. In what stage does the swelling begin to appear in the male loach? It appears as in other cases in mature fishes, according to my observation, in specimens more than 7 centimeters in length.

The second characteristic of the male consists in the enlargement of the pectoral fins and the elongated second ray of the

265

5-9

12

pectorals (Plate 1, fig. 1*b*). The pectoral fins of the male therefore differ in shape from those of the female. The pectoral fins are, relatively, one to one and a half times the length of the head in the male and half that in the female. The dorsal, the ventral, and the anal fins of the males are also relatively longer than those of the females, but they are not so remarkable as the pectoral fins.

It is well known that among many of the higher animals the sexes differ in size.(2) Thus in fishes the male generally averages smaller than the female. In loaches the males are so markedly smaller that in some cases they are not even half the size of the females. The difference in size of male and female loaches, obtained by measuring 100 specimens of each sex, is shown in Table 1.

TABLE 1.—*Measurements of loaches, one hundred specimens of each sex.*

Length of body.	Male.	Female.
	mm.	*mm.*
Average	101.27	110.02
Maximum	120.00	150.00

The body and fins of the male are, to all appearances, well adapted in size to active motion in the water. It will be interesting to investigate the nature and possible use of the spindly swelling on the back of the male loach.

MICROSCOPICAL OBSERVATION

The preparations were fixed in formalin and stained in hæmatoxylin eosin. Preparations from the corresponding parts of females were also made. According to my observation of the swelling, the male differs from the female in the following points:

The epidermis of the corresponding part of swelling of male preparations is thickened and contains many so-called *Kolbzelle.*

The dermal scale pouch (*Schuppentasche*) is enlarged and contains gelatinous tissue and fat cells.

A more remarkable adipose tissue is found between the dermal and muscle layers. Many melanin pigment cells are found among the fat cells. This adipose tissue has no noticeable capsule of connective tissue.

I paid special attention to the swelling to learn whether or not it is caused by a strong development of muscle layer, by which the ductus deferens might be compressed; my observation led to a negative answer. The true nature of such an adipose tis-

5-10

266

sue under the dermal layer and in the scale pouches is not exactly known. I shall investigate this point some time in the future.

REFERENCES

(1) CUNNINGHAM, J. T. Sexual dimorphism in the animal kingdom. (A theory of the evolution of secondary sexual characters.) London (1900).

(2) GEDDES and THOMSON. The evolution of sex (1901).

(3) REGAN, C. T. Sexual differences in the poeciliid fishes of the genus Cynolebias. Ann. & Mag. Nat. Hist. VIII 10 (1912) 641.

183013——7

5-11

267

268

512

ILLUSTRATION

PLATE 1

FIG. 1. Male and female loaches; the male showing a swelling, *a*, on posterior side of dorsal fin and strong pectoral fins with elongated second ray, *b*; × 0.75.

2. Cross section of the swelling on the male loach; *a*, fat cells in the scale pouch; *b*, fatty tissue; *c*, epidermis; *d*, corium; *e*, muscular layer; × about 40.

269

5-13

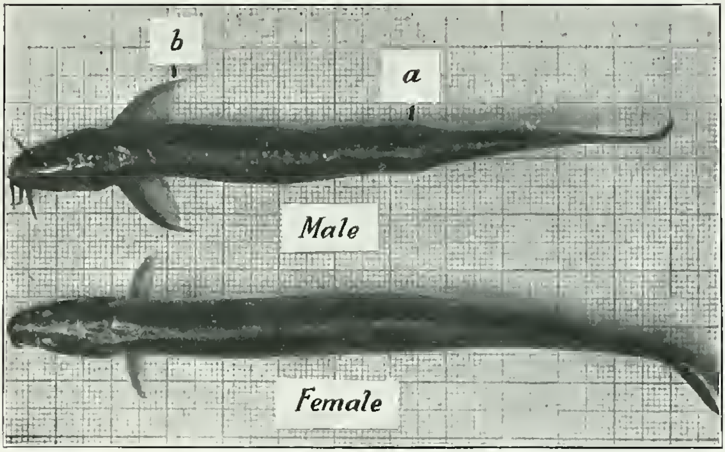


Fig. 1. Male and female loaches; the male showing a swelling, *a*, on posterior side of dorsal fin and strong pectoral fins with elongated second ray, *b*; × 0.75.

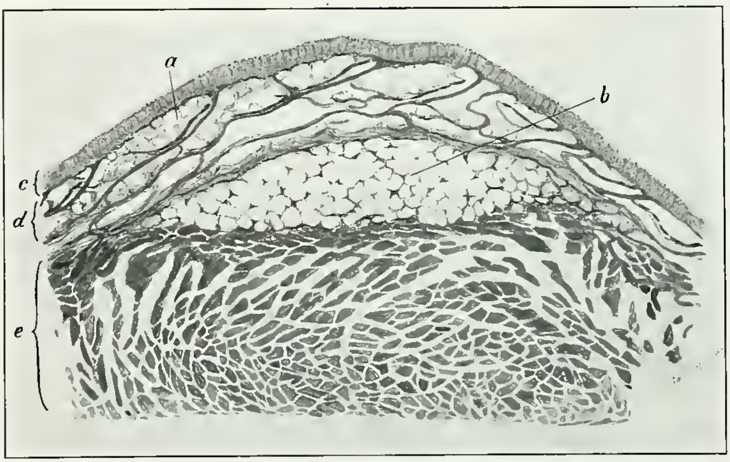


Fig. 2. Cross section of the swelling on the male loach; *a*, fat cells in the scale pouch; *b*, fatty tissue; *c*, epidermis; *d*, corium; *e*, muscular layer; × about 40.

PLATE 1.

278

THE STRUCTURE OF CHLORINE DIOXIDE AND RELATED COMPOUNDS[1]

By GRANVILLE A. PERKINS

Chemist, Bureau of Science, Manila

In a previous paper[2] the writer has discussed the interpretation of some of the older ideas of valence in terms based on the Lewis-Langmuir theory of valence. These interpretations are summarized in Table 1.

TABLE 1.—*Relations between the older "affinity unit" theory and the Lewis-Langmuir theory of valence.*

Affinity unit theory.	Example.	Nomenclature based on Lewis-Langmuir theory.	Example.
Affinity unit; nonmetallic unsatisfied bond.	Cl—	Vacancy for one electron in the shell.	Cl—
Affinity unit; metallic unsatisfied bond.	Na—	One loosely held electron.	Na^{I}
Negative ion	Cl^{-}—	Negative ion	Cl^{-}
Positive ion	Na^{+}—	Positive ion	Na^{+}
Single bond, not ionizable.	Cl—Cl	Single bond; direct union, two electrons in common.	Cl—Cl
Single bond, ionizable	Na—Cl	Salt-forming union	Na^{+}------Cl^{-}
Auxiliary valence, ammonium type.	$(CH_3)_3{\equiv}N{<}^{CH_3}_{Cl}$	Increase of valence by ionization.	$(CH_3)_4{\equiv}N^{+}$----Cl^{-}
Auxiliary valence, amine oxide type.	$(CH_3)_3{\equiv}N{=}O$	Borrowing union (no valence increase).	$(CH_3)_3{\equiv}N{\propto}O$
Double bond	O=O	Double bond, four electrons in common.	O=O
Triple bond	HC≡CH	Triple bond, six electrons in common.	HC≡CH

It may be noted that among the direct (that is, nonionizable) unions the single bond represents two electrons held in common; the double, four electrons; and the triple, six electrons. No place is given in the scheme to bonds consisting of one, three, or five electrons. This is entirely in accord with Langmuir's[3] postulate 11, and certainly in accord with the commonest types of

[1] Received for publication August 8, 1921.
[2] Philip. Journ. Sci. 19 (1921) 1.
[3] Langmuir, I., Journ. Am. Chem. Soc. 41 (1919) 888.

compounds. A discussion of some compounds which may be exceptions to this rule is the subject of the present paper.[4]

ODD MOLECULES

Lewis has called molecules which contain an odd number of electrons odd molecules, pointing out that they constitute an exceptional class. He has further observed[5] that such a molecule "will contain at least one atom with an uneven number of electrons in the shell. This may be called an *odd* atom." Literally construed, this means that only an even number of electrons can be shared, and ClO_2, for example, is $\mathrm{O}{\propto}\underset{|}{\mathrm{Cl}}{\propto}\mathrm{O}$, with a vacancy in the shell of the chlorine atom. There is nothing in Lewis's fundamental postulates, however, against the supposition that an odd number of electrons can be shared, and the writer is inclined to think that, in certain rather exceptional cases, the facts warrant this view rather than Langmuir's postulate 11.

Admitting that there is a strong *tendency* for electrons to be shared in even numbers, we also know that there is a strong tendency for octets to be completed. Why, then, should odd molecules exist? In an odd molecule which of these tendencies is the stronger? Is the sharing of odd numbers of electrons confined to odd molecules? Let us consider a particular case.

CHLORINE DIOXIDE

In this molecule nineteen shell electrons are to be accounted for. The following possibilities present themselves:

1. The total number of shell electrons becomes even by transfer of one or more electrons to or from the kernels.
2. One of the shells in the molecule does not become completed to an octet, but to some odd number of electrons.
3. Two of the shells share, not an even number, but an odd number of electrons.

Explanation 1 is contrary to the strong evidence of the definiteness and stability of the kernel pair in He, Li, Be, Bo,

[4] The three-electron bond is not here presented as in any sense a new idea. It is entirely consistent with Lewis's postulates, but not with the more specific and remarkably successful postulates of Langmuir. Various suggestions are found in recent literature of three-electron bonds in ClO_2, C_6H_6, etc., cf. J. J. Thompson, Phil. Mag. 41 (1921) 535.

[5] Lewis, G. N., Journ. Am. Chem. Soc. 38 (1916) 771.

and of the pair and surrounding octet in F and the heavier atoms.[6]

Explanation 2 is less objectionable than 1 because atoms can exist under certain conditions with incomplete shells. When we consider, however, the high temperatures necessary to prevent such atoms as O and Cl from completing their octets by combination, and the marked reactivity which these atoms show in the nascent condition, it seems that ClO_2, though reactive in some ways, is not in the same class. Nor are there indications that ClO_2 contains an extra electron. Therefore explanation 2, while valid in ordinary dissociation at very high temperatures, does not apply to this case.

Explanation 3, namely, that five electrons are shared in ClO_2 seems to be the most reasonable. This is not inconsistent with the remarkably successful theory of pair sharing if we assume that there is a strong tendency to share in pairs, but that under certain conditions one or three electrons may be shared. To explain ClO_2 on the basis of this assumption it is necessary to show why this substance, containing the inherently unstable three-electron bond, is formed in reactions which would be expected according to the shared-pair theory to give Cl_2O_5 or Cl_2O_4.

The question of the structure of ClO_2 thus resolves itself largely into the reasons for the instability of Cl_2O_4 and Cl_2O_5 which brings us to one of the serious limitations of the octet theory. That is, the octet theory accounts for not only many compounds which exist, but also an enormous number which apparently do not and cannot exist. Langmuir has recently

[6] The only convincing explanation of the properties of N_2, CO, CN, and NO which has come to the writer's attention has been Langmuir's assumption (loc. cit 903) that in these molecules a double kernel is formed surrounded by a single octet. The odd electron in NO is in all probability very close to the center of the line joining the two nuclei, which is practically the central point of the octet. If each kernel even in NO definitely contains two electrons, as Langmuir's theory would indicate, the odd electron is one of three binding electrons situated between the kernels. It is also conceivable, as is pointed out on page 739, that under these conditions a group of four is (by magnetic or unknown forces) stable around each nucleus, only one electron being shared by the two groups. In any case the conditions are entirely different from those in a single kernel surrounded by an octet. The determining forces in ClO_2 must be very similar to those in neon and argon, whose kernels can take up or lose an electron only under the influence of a powerful impact, and then only momentarily.

attacked this difficulty from the physicist's viewpoint of minimum potential energy.[7] The fuller publication of calculations on the stability of various molecules will be interesting and valuable, but in the present state of physical knowledge can hardly be expected to cover completely the point now under discussion. From the chemist's standpoint a few general tendencies may be found which may serve to explain why Cl_2O, ClO_2, and Cl_2O_7 are relatively stable as compared to Cl_2O_3, Cl_2O_4, and Cl_2O_6.

THE TENDENCY TO SHARE ELECTRONS

"Chlorine, like fluorine, tends to form negative ions, but it differs from fluorine in that it can share electrons with oxygen, especially if the molecule takes up electrons from some more strongly electro-positive element. It shows a tendency like phosphorus and sulfur to share all 4 pairs of its electrons, if it has to share any."[8]

It seems to the writer more consistent with the facts to consider the tendency to share electrons as a *mutual tendency* which two atoms may have, rather than a single property of one of them. It seems that electrons can be shared only when an approximate equality exists between what may be called the electron binding strengths of the two atoms. The exact interpretation of this in terms of mathematical physics depends on one's ideas of the structure of the atom; but regardless of such disputed hypotheses, it may be considered as an empirical generalization standing on its own merits. A rough physical interpretation is that a very unsymmetrical union such as $Ne{\propto}O$ $\left(\ :\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Ne}}}:\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{O}}}:\ \right)$ is extremely unstable because, if it should momentarily take place, the shared pair would be held too close to the neon kernel for a strong attraction to exist between the shared pair and the weaker oxygen kernel. Therefore a very slight disturbance would separate the atoms in the form $Ne + \rangle O$ $\left(\ :\overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{Ne}}}: + \overset{\cdot\cdot}{\underset{\cdot\cdot}{\mathbf{O}}}:\ \right)$ and thus lead to the formation of stable oxygen molecules, $O{=}O$ $\left(\ \overset{\cdot\,:\,\cdot}{\underset{\cdot\,:\,\cdot}{\mathbf{O}\ \ \mathbf{O}}}\ \right)$.

In this symmetrical molecule neither kernel pulls the shared electrons beyond the control of the other kernel.

[7] Chemical and Met. Eng. 24 (1921) 554.

[8] Langmuir, I., Journ. Am. Chem. Soc. 41 (1919) 923.

Similarly the fluorine ion, F^- ($:\overset{..}{\underset{..}{\mathbf{F}}}:$), does not form a stable compound with an oxygen atom, $F^- \propto O$ ($:\overset{..}{\underset{..}{\mathbf{F}}}:\overset{..}{\underset{..}{\mathbf{O}}}:$) because the shared pair in such a compound would be drawn too far away from the oxygen kernel. The chlorine kernel, however, has an electron binding strength comparable to that of the oxygen kernel, and the ion, $Cl^- \propto O$ ($:\overset{..}{\underset{..}{\mathbf{Cl}}}:\overset{..}{\underset{..}{\mathbf{O}}}:$), is consequently fairly stable.

Although fluorine does not unite with oxygen it cannot be said to lack a tendency to share pairs, for F—F ($:\overset{..}{\underset{..}{\mathbf{F}}}:\overset{..}{\underset{..}{\mathbf{F}}}:$) is very stable. The second fluorine atom here can unite where the oxygen could not, because its electron binding strength matches that of the first fluorine atom. The present problem is not so much concerned with the differences between the electron binding strengths of the different atoms as it is with the variation of the electron binding strength of a single atom in different compounds. Such a variation is only one of the many observed consequences of the "electron shift.[9]

An obvious way to increase the electron binding strength of an atom is to remove one of the electrons from its shell. The remaining electrons will then be held more tightly than before. Both chemical and physical evidence is quite definite on this point. This is important in connection with the metals, which are not, however, under discussion in the present paper.

In the case of a non-metallic, or chemically negative, atom there is such a tendency toward definite shell (generally octet) formation that the important variation in electron binding strength is not the one just described, but one produced by the

[9] Whatever the forces tending toward a stable configuration of electrons in the shell of an atom, the configuration is altered by the proximity of a foreign charge, and a displacement of one electron tends to shift all the electrons in the shell. Any hypothesis of atomic structure which does not admit of this view, or one very similar to it, is unsatisfactory from the standpoint of chemical evidence.

partial removal of two or more electrons from a shell. If two or more electrons are pulled away from certain other electrons in the same shell, these other electrons are less repelled by them and are consequently bound closer to the nucleus than before. For example, the electrons in the shell of Cl^- $\left(: \overset{..}{\underset{..}{\mathbf{Cl}}} : \right)$ are assumed to be held by a balance of forces near certain equilibrium positions (which perhaps are the corners of a cube). The difficulty [10] which another atom would have in removing simultaneously two of these electrons, may be considered as a measure of the electron binding strength of unicovalent chlorine. Similarly the difficulty of removing two of the unshared chlorine electrons in $Cl^{-}\propto O$ $\left(: \overset{..}{\underset{..}{\mathbf{Cl}}} : \overset{..}{\underset{..}{\mathbf{O}}} : \right)$ is a measure of the electron binding strength of dicovalent chlorine. By elementary physical considerations, and much more convincingly by chemical evidence, we are led to believe that the shared pair in $Cl^{-}\propto O$ $\left(: \overset{..}{\underset{..}{\mathbf{Cl}}} : \overset{..}{\underset{..}{\mathbf{O}}} : \right)$ is farther from the chlorine kernel than the electrons in the shell of Cl^- $\left(: \overset{..}{\underset{..}{\mathbf{Cl}}} : \right)$, and that consequently the remaining (unshared) pairs in $Cl^{-}\propto O$ are held more firmly to the chlorine kernel than are the shell electrons in Cl^-. In general the effect of sharing a pair of electrons which were originally unshared is to draw this pair away from the kernel, and consequently allow all the other electrons to approach more closely to the kernel. That is, excluding double or triple bonds, *the electron binding strength of an atom increases as its covalence is increased.* With multiple bonds the reasoning is the same, but it is evident that the change from a single to a double bond moves a pair of electrons closer to, rather than farther from, the original bond, consequently weakening it.

[10] A physicist would probably prefer to speak of the potential energy of these electrons. This, or some other definition of "difficulty" would be feasible if we knew the mechanism by which another atom removes, or partially removes, the two electrons. At present it seems more satisfactory for a chemist to leave the physical definition somewhat open, and to judge of the "difficulty" directly from chemical data.

Returning now to fluorine, it is easy to see that if its electron binding strength in the unicovalent condition is too great for combination with any but a few atoms, still fewer compounds of dicovalent fluorine are to be expected. There is no reason, however, why certain atoms of very high electron binding strength cannot combine with dicovalent fluorine. The hydrogen atom is to be considered in this class, although occupying a unique position in it. In hydrofluoric acid we have some molecules containing dicovalent fluorine, and also, as has been pointed out by Latimer and Rodebush [11] some atoms of hydrogen in an unstable dicovalent condition.

Aside from hydrogen, the "inert" atoms seem to be the only ones capable of matching the electron binding strength of dicovalent fluorine. This suggests the possibility of an ion, $F - \overset{+}{F} - \overset{+}{Ne}$.

The oxygen atom, in the unicovalent condition has a binding strength which is very weak compared to that of fluorine. In the bicovalent condition its strength of course depends somewhat on the nature of the combined atoms, but it is comparable with that of unicovalent fluorine. Tricovalent nitrogen and quadricovalent carbon also have binding strengths of this same order of magnitude, so unicovalent fluorine combines with quadricovalent carbon in CF_4, and with tricovalent nitrogen in ONF.

THE CHLORINE OXIDES

We are now in a position to return to the chlorine oxides. Unicovalent chlorine, due to the size of its kernel, has a binding strength which is much less than that of unicovalent fluorine or bicovalent oxygen, although somewhat greater than that of unicovalent oxygen.

According to this view Cl—F and Cl—O—Cl would be very unstable molecules. ClF is not known, but Cl_2O is. Although the formula Cl—O—Cl is often ascribed to this substance, the theory here presented indicates that Cl—Cl∝O is the correct formula, because the evidence of chlorine compounds in general indicates that unicovalent chlorine is too weak to share a pair with bicovalent oxygen.

We might expect that bi- or tricovalent chlorine could share electrons stably with bicovalent oxygen, but apparently this is

[11] Latimer, W. M., and Rodebush, W. H., Journ. Am. Chem. Soc. 42 (1920) 1425.

not the case, due to the considerable difference in size between the oxygen and chlorine kernels. Consequently Cl_2O_4 (I) and Cl_2O_5 (III) are not known. Some reactions which we might expect to yield Cl_2O_5 give instead ClO_2 and a perchlorate, while others give O_2 and Cl_2 by an exothermic rearrangement.

$$\begin{array}{ccccccc} O & & & & & & \\ 8 & & & & & & \\ Cl & - & O & - & Cl & \propto & O \\ 8 & & & & & & \\ O & & & & & & \end{array} \qquad\qquad \begin{array}{ccc} O & & O \\ 8 & & 8 \\ Cl & - & Cl \\ 8 & & 8 \\ O & & O \end{array}$$

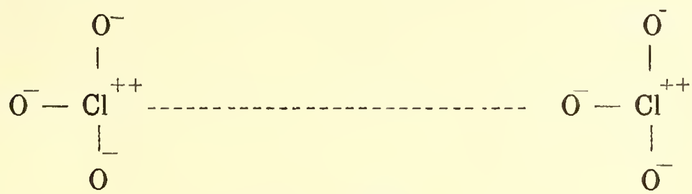
I II

$$\begin{array}{ccccc} O & & & & O \\ 8 & & & & 8 \\ Cl & - & O & - & Cl \\ 8 & & & & 8 \\ O & & & & O \end{array} \qquad \begin{array}{ccccccccc} & & O & & & & O & & \\ & & 8 & & & & 8 & & \\ O & \infty & Cl & - & O & - & Cl & \propto & O \\ & & 8 & & & & 8 & & \\ & & O & & & & O & & \end{array}$$

III IV

It seems that only quadricovalent chlorine (as in Cl_2O_7, formula IV) has sufficient binding strength to unite with dicovalent oxygen. This is the writer's interpretation of the fact that chlorine shows a tendency "to share all 4 pairs of its electrons if it has to share any." Chlorine heptoxide is therefore a relatively stable compound, but it is strongly endothermic as compared to Cl_2 and O_2, because the chlorine shell electrons are all displaced from their normal positions. This quasi-stability ot chlorine heptoxide illustrates the fact that chemical problems deal much more with metastable than with stable equilibrium. Especially in organic chemistry it is well known that the relative potential energy of two sets of possible reaction products has often very little bearing on the question of which will be formed. This applies in a somewhat more limited way also to inorganic chemistry, as will be illustrated in the further discussion of the chlorine oxides.

Cl_2O_4 (formula I) probably exists to some extent in liquid chlorine dioxide. It would seem that formula II represents a much stabler compound, which may be present in certain mixtures of chlorine oxides of disputed composition, but would not be formed readily by the association of ClO_2 or by the decomposition of chlorates. The reason for this is the distinct polarity of ClO_2 and ClO_3^-, caused principally by the fact that the oxygen kernel has a positive charge of six, and the chlorine kernel seven. The unions in ClO_3^- are, therefore, what the writer has called borrowing unions. Usually it is convenient to express such a union with a separate sign $\propto$, as already noted, to avoid confusion and show more graphically the valence relations. The equivalent sign $^+—^-$, however, is used in formula V. This formula shows two chlorate ions in the only position in which they would react smoothly with each other. The case of ClO_2 is practically identical.



V

If the above explanation is correct, Cl_2O_5 and Cl_2O_4 are unstable due to the inability of bi- or tricovalent chlorine to unite with bicovalent oxygen. ClO_2, which contains no bicovalent oxygen, is therefore formed in reactions from which we might expect Cl_2O_4 or Cl_2O_5. We may suppose that ClO_2 contains a three-electron bond without denying the strong general *tendency* toward sharing in *pairs*. In this particular case it seems that the pair-sharing tendency does not have an opportunity to manifest itself. The reasons against any disposition of the odd electron other than in one of the bonds have already been given.

Therefore, it seems highly probable that when an electron is removed from one of the oxygen atoms in the ion $: \ddot{\underset{\cdot\cdot}{O}} : \ddot{\underset{\cdot\cdot}{Cl}} : \ddot{\underset{\cdot\cdot}{O}} :$ ($O \propto Cl \propto O^-$), forming the neutral molecule, $: \ddot{\underset{\cdot\cdot}{O}} : \ddot{\underset{\cdot\cdot}{Cl}} : \ddot{\underset{\cdot\cdot}{O}} \cdot$ ($O \propto Cl—O—$), the vacancy caused in the oxygen shell is immediately filled by a closer approach to the chlorine shell in such a manner that one more electron is shared by the two atoms:

$$: \ddot{\underset{\cdot\cdot}{O}} : \dot{\underset{\cdot\cdot}{Cl}} \vdots \dot{\underset{\cdot\cdot}{O}} : \quad (O \propto Cl \overline{-} O).$$

Lewis's notation is here used, the writer's, which will be further explained in the succeeding section, being given in parenthesis. It is to be noted that the union last mentioned causes no alteration in the number of electrons in the chlorine shell, which is the reason for not extending the new line across to the chlorine symbol.

The formula $:\overset{..}{\underset{..}{O}}:\overset{.}{\underset{..}{Cl}}\vdots\overset{.}{\underset{..}{O}}:$ is in accord with the physical and chemical properties of chlorine dioxide. This substance has a melting point of —76° C., boils at 10° C., and has in the liquid condition a molecular volume of 45. Sulphur dioxide, $:\overset{..}{\underset{..}{O}}:\underset{..}{S}\vdots\underset{..}{O}:$ which is almost isosteric with $:\overset{..}{\underset{..}{O}}:\overset{.}{\underset{..}{Cl}}\vdots\overset{.}{\underset{..}{O}}:$, melts at —76° C., boils at —10° C., and has a molecular volume of 45. Chemically, ClO_2 is characterized by a certain metastability similar to that of a perfectly dry mixture of hydrogen and chlorine.

THE HALF BOND

The three-electron bond might be accorded a special symbol, but it is more convenient to consider it composed of a two-electron and a one-electron bond. Since the bond composed of two electrons has long been called the single bond, and that of four, the double bond, it is convenient to call the one-electron bond a half bond. The three-electron bond may be considered as a single bond plus a half bond.

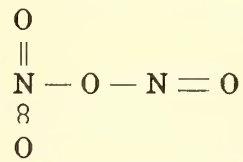
As is shown in Table 1, the customary line for an unsatisfied bond or affinity unit may be used to represent "vacancy in the shell for one electron." Two such lines from different atoms coalesce to form a normal union sign,—, again merely a straight line, joining two atomic symbols. Two affinity unit lines from the same atom may coalesce into the borrowing union sign, ∞. Each of these union signs represents a pair of electrons uniting two atoms, and shows by the ends of the line where the two vacancies are filled. In the case of the half bond only one vacancy is filled, one electron only being shared. It is convenient to represent this by a line considerably shorter than the normal union line, and placed adjacent to the atom in whose shell a vacancy is filled.

Although it is more convenient to consider the three-electron bond as made up of a single and a half bond, the half bond by itself is relatively unimportant. The half bond may explain certain peculiarities such as the combination of sulphuric acid and water now generally considered as secondary valence reactions. The three-electron bond, on the other hand, is undoubtedly found in benzene and all the thousands of benzenoid derivatives.

A consideration of organic compounds being deferred to a later paper,[12] two inorganic odd molecules will now be discussed briefly.

NITROGEN DIOXIDE

This compound (VI) is analogous to chlorine dioxide.

(VI)  (VII) 

It is to be expected that the quadricovalent nitrogen in the associated form (VII) of this compound has a greater electron binding strength than tricovalent chlorine in the analogous compound Cl_2O_4. This is due not only to the smaller size of the nitrogen kernel, but also to the fact that a double bond with oxygen causes more displacement of electrons than two single bonds with unicovalent oxygen atoms. Therefore NO_2 associates to some extent in the gaseous condition, and entirely when in the liquid condition.

NITRIC OXIDE

When ten or more electrons gather around a single nucleus they always form a kernel pair surrounded closely by an octet. The kernel pair not surrounded by an octet is stable when attached to a nucleus of small charge, such as He, Li, Be, and Bo. Langmuir[13] has explained the properties of the nitrogen molecule and some similar compounds by assuming that the two nuclei retain their stable kernel pairs and share between them an extra pair, leaving eight electrons to form an octet around this double kernel. It is hardly more than a restatement of this explanation to say that when a kernel pair is attached to a nucleus carrying a positive charge of six or more, and is not stabilized by a closely surrounding octet, it is no longer the most stable group which can surround the nucleus, but is superseded by a group of four. In the nitrogen molecule, then, the nuclei are

[12] Cole, H. I., Philip. Journ. Sci. 19 (1921) 681, has already discussed in detail the triphenyl aryls, which form odd molecules under certain conditions.

[13] Cf. page 731, footnote 6.

surrounded by groups of four, in which two electrons are shared between the two groups. The reason for expressing the case in these words is that in nitric oxide, $: \cdot\dot{\underset{\circ}{N}}.\overset{\cdot\cdot}{\dot{\underset{\circ}{\underset{\cdot\cdot}{O}}}}\cdot\ :$, the seven kernel electrons can be accounted for as two groups of four in which one electron is shared.

SUMMARY

1. Reasons are given for considering that chlorine dioxide contains a three-electron bond.

2. The electron binding strength of atoms and its variation with the covalence is discussed in connection with the tendency to share electrons.

3. In conformity with older usage the single-electron bond is called the half bond and its importance is indicated.

CERCOSPORA LEAF SPOT OF COFFEE

By Colin G. Welles

Associate Professor of Plant Pathology, College of Agriculture, University of the Philippines

ONE PLATE

INTRODUCTION

The leaf spot of coffee caused by *Cercospora coffeicola* Berkeley and Cooke has not previously been reported from the Philippine Islands. It has not been observed in coffee plantations on the experimental farm of the College of Agriculture, Los Baños, Laguna, but it has caused rather severe spotting and ultimate defoliation of the nursery stock.

The occurrence of the disease at present may be negligible in the Philippine Islands but, unless precautions are taken, it may spread and cause considerable trouble and no little financial loss to the coffee industry.

This paper is a brief description of the disease and causal organism found here, and includes a short summary of related work in other countries.

REVIEW OF LITERATURE

The leaf spot under discussion is commonly known as "brown eye spot,"(1) "brown eyed disease," or berry spot."(2) These names are derived from the type and appearance of the disease in various localities.

The disease has been reported from many of the important coffee-growing regions of the world, including Mexico, Cuba, Trinidad,(3) Porto Rico,(2) Java, Uganda, and India.(1) In India the fungus has been found to parasitize the leaves only, but in Porto Rico(2) and other places(3) the berry spot is very serious, usually destroying all fruits attacked.

It is agreed by all who have worked with the causal organism, that the disease is due to *Cercospora coffeicola* Berkeley and Cooke. As the organism found in the Philippines compares accurately with the organisms previously described, no details will be reviewed here.

The symptoms described by Butler(1) on the leaves, as well as those described by Cooke, are identical with those of the local trouble.

Faucett(2, p. 22) finds that:

On the berries the largest spots, those fastening the fleshy part of the fruit to the parchment, almost always are found on the upper side. Any part of the fruit may be attacked, the spots appearing at first as small brown discolorations. They are especially common on the nearly ripe berries. At the time of picking, the larger spots cover about half of the fruit and are velvety with the spore-bearing outgrowths of the fungus.

He also states that the fruits become infected from the spores formed on leaf lesions.

Butler(1) and Faucett(2) are agreed that the leaf spot may be readily controlled by judicious spraying with Bordeaux mixture. According to Faucett, the fruit lesions may be reduced by controlling the leaf spot.

THE DISEASE IN THE PHILIPPINES

The attack of *Cercospora coffeicola* Berkeley and Cooke in the Philippine Islands is confined to leaves, so far as present observations indicate. The disease has been observed only on nursery stock and has not been found on mature trees. A thorough survey of the coffee plantations of the Islands has not been possible; so the limits and seriousness of the disease are not known at the present time.

SPECIES ATTACKED

Several species of coffee seedlings are grown in the college nursery, and no effort is made to keep them isolated. Because of this any spores from disease lesions may readily be transferred to seedlings of all species.

Under such conditions the leaf spot would be expected to parasitize all susceptible species. However, of the five species grown, *Coffea bukobensis* is the only one affected by the disease.

The following species are unattacked: *Coffea liberica, Coffea robusta, Coffea congensis,* and *Coffea conophora.*

The locality from which the disease came is a matter of speculation for, although the plantations as well as the nursery have been frequently visited by collectors and pathologists for the past five years, no mention has been made of this leaf spot.

No coffee seedlings or seeds have been brought to the college plantation since 1916, when *Coffea liberica* was obtained from Lipa, in Batangas, a neighboring province. It is well to note that this species is not parasitized by *Cercospora coffeicola* Berkeley and Cooke in the college nursery.

Coffea bukobensis, the only diseased species, was obtained from the Kaiserliches Biologisch Landwirtschaftliches Institut, Hafen Taya, in 1914. It is, however, hard to believe that the fungus has been here for so long a period unnoticed.

SYMPTOMS

Up to the present time the fungus has been found to attack only seedlings in the nursery; hence the berry spot, so destructive in Porto Rico,(1) is not known.

The lesions when young are light brown. Later the center portion turns grayish, exhibiting concentric striations and encircled by brown rings. The lesions are found mostly on the upper surface of the leaves. At first they do not penetrate through the leaf, but later a distinct spot is produced on the under surface.

In some instances the spots coalesce and form an irregular lesion. In severe attacks the leaves turn brown and fall off, frequently leaving but a tuft of young leaves on a long stem.

CAUSAL ORGANISM

The organism which causes this leaf spot is *Cercospora coffeicola* Berkeley and Cooke.

The typical *Cercospora* conidiophores and conidia are produced in the grayish central portion of the lesions.

The conidiophores occur in bunches which are formed in stomatal openings. They measure from 60 to 150 μ long and 4 to 6 μ wide and are 5- to 10-septate.

The conidia are from 70 to 130 μ long and 5 to 7 μ wide with from 5 to 12 septa.

Butler(1) reports the formation of secondary conidia on the germination of the primary conidia, but these have not been observed here. The conidia germinate by means of long, slender, germ tubes. Several may arise from one conidium.

CONTROL

Spraying experiments carried on with Bordeaux mixture prove conclusively that the brown eye spot may be easily controlled.

Spraying every two weeks is recommended. If the attack is limited in extent there is no reason why complete eradication may not be effected.

In Porto Rico(1) it was found that shading reduced the berry loss from 10 to 30 per cent. At the present writing this has not become necessary here, however.

SUMMARY

1. Leaf spot of coffee, caused by *Cercospora coffeicola* Berkeley and Cooke has been found on nursery stock of the College of Agriculture, Los Baños, Laguna.

2. This is known as "brown eye spot," "brown eyed disease" or "berry spot," described by Butler, by Faucett, and by Cooke.

3. In the Philippines attack is confined to leaves and therefore it is not very serious. It may spread to berries and become more dangerous.

4. It is found only on *Coffea bukobensis*. The source of the disease is unknown.

5. The causal organism checks with the previously described *Cercospora coffeicola* Berkeley and Cooke.

6. The disease was controlled by spraying every two weeks with Bordeaux mixture.

LITERATURE CITED

1. BUTLER, E. J. Fungi and disease in plants. Thacker, Spink & Co., Calcutta (1918) 485, 486.
2. FAUCETT, G. L. Fungus disease of coffee in Porto Rico. Porto Rico Agr. Exp. Sta. Bull. 17 (1915) 21–24.
3. COOKE, MELVILLE THURSTON. The diseases of tropical plants. Macmillan & Co., London (1931) 163–166.

ILLUSTRATION

PLATE 1. *CERCOSPORA COFFEICOLA* BERKELEY AND COOKE

FIG. 1. Germinating conidia, showing various methods of germ tube production. Drawn with the aid of the camera lucida. × about 500.

2. Conidiophore. Drawn with the aid of the camera lucida. × about 500.

3. Conidia. Drawn with the aid of the camera lucida. × about 500.

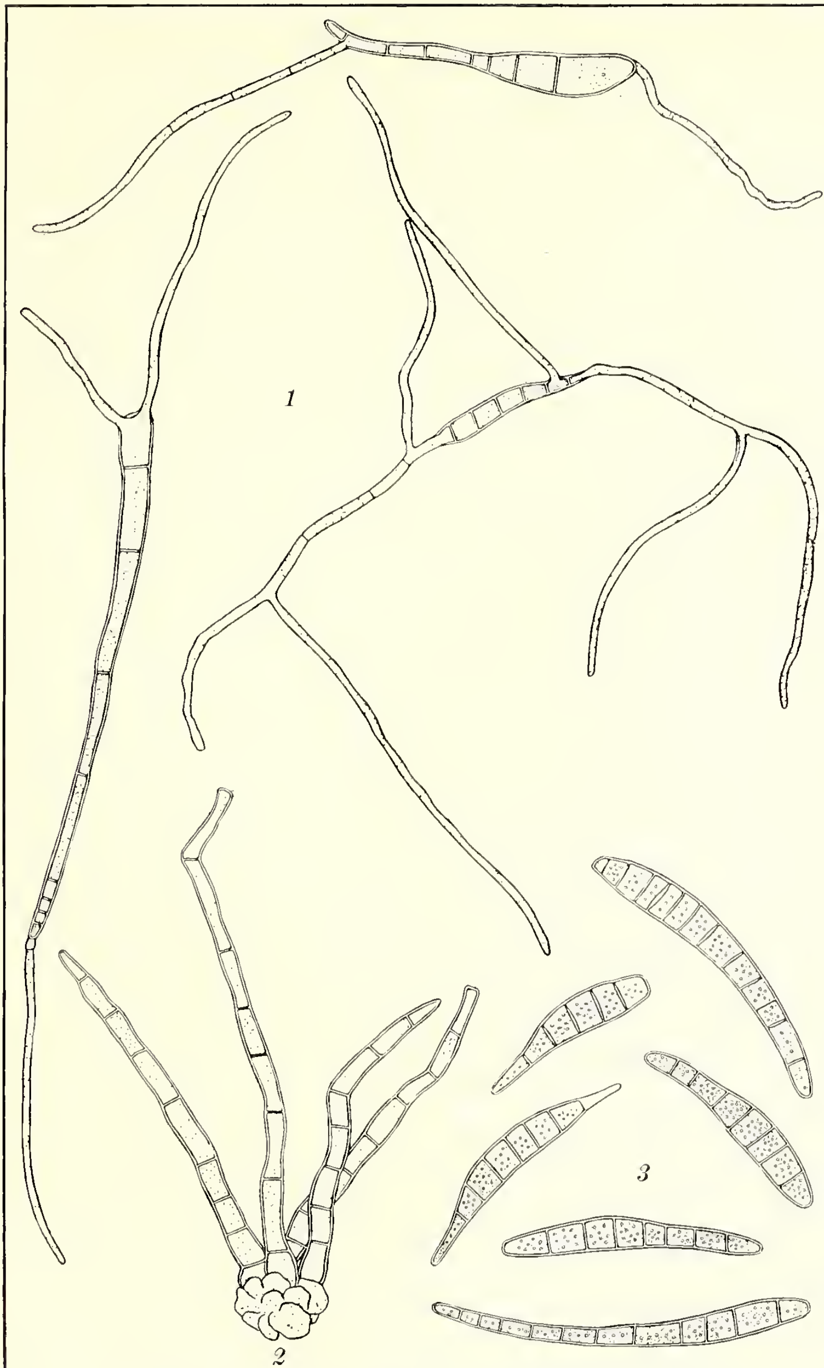


PLATE 1. CERCOSPORA COFFEICOLA BERKELEY AND COOKE.

CERCOSPORA LEAF SPOT OF AVERRHOA CARAMBOLA [1]

By Colin G. Welles

Associate Professor of Plant Pathology, College of Agriculture, University of the Philippines

TWO PLATES

A very serious leaf spot, causing partial or complete defoliation of *Averrhoa carambola* Linnaeus has been observed in the experimental orchard of the College of Agriculture, Los Baños, Philippine Islands. The writer is unable to find any note that describes a *Cercospora* leaf spot on the above-named host.

Averrhoa carambola is a native of tropical America, but now occurs in all tropical countries. It is cultivated for its acid fruits. The trees under observation were brought to Los Baños about eight years ago from China and have shown fairly normal development since that time. No leaf spotting has been recorded on this host by any of the local plant pathologists or collectors.

The spotting was first noticed about June 25, 1921, approximately at the beginning of the wet season. At this time, however, spotted leaves were few in number and the attack was scarcely noticeable.

On July 15, a different condition existed. The trees showed partial defoliation, and a careful count showed that 100 per cent of the larger leaves were infected with from one to ten lesions. At this time it appeared that a thorough spraying would have to be resorted to if the trees were to be kept from complete defoliation.

This paper presents studies made upon the disease with special stress on the causal organism and control measures.

SYMPTOMS

The disease appears as a spotting of the leaves of *Averrhoa carambola*. When young the lesions appear as irregular, yellow, chlorotic spots, from 3 to 5 millimeters in the largest dimension. These chlorotic areas may coalesce and form a large irregular

[1] The author wishes to express his appreciation for the constructive criticism of Mr. H. Atherton Lee, of the Bureau of Science.

blotch, giving the leaf a mottled appearance. This type of lesion is found on both old and young leaves.

Later the tissue in the central portion of the lesion dies and turns grayish brown or dirt colored. This central area is always surrounded with a band of yellow, chlorotic tissue, from 1 to 2 millimeters wide.

The growth of the lesion seems to be definitely limited, for when the development has progressed to a certain point the tissue, both dead and chlorotic, falls out and leaves a shot-hole condition. After this shot-holing has taken place the leaf, if it is not too severely parasitized, lives and carries on to a greater or less extent its photosynthetic function.

A yellowing of the tissue develops with the more severely spotted leaves. This, in turn, is followed by defoliation which seems to be very serious in the present attack.

Black lesions form on many fruits, causing no noticeable damage, however. Many such lesions have been examined, but their connection with the *Cercospora* leaf spot has not been established. This connection, nevertheless, seems probable.

HOSTS ATTACKED

A related species, *Averrhoa bilimbi* Linnaeus, also pantropic, is grown in great abundance locally. Many trees have been observed, but no leaf spot caused by *Cercospora* has been found. The attack of the fungus seems to be confined to *Averrhoa carambola.*

ECONOMIC IMPORTANCE

The trees grown at the College of Agriculture number about forty. The fungus under discussion is found on each tree and causes no small loss. The leaves, which are more than half mature, show 100 per cent infection, with several lesions on each leaf. The trees which have been left uncontrolled have been nearly defoliated. If defoliation is repeated the loss of the trees is imminent (Plate 1).

CAUSAL ORGANISM

The organism that causes the leaf spot of *Averrhoa carambola,* discussed in this paper, belongs to the genus *Cercospora.*

The fruiting bodies, consisting of conidiophores and conidia, are born in the grayish brown central portion of old lesions. They occur on both sides of the leaf, but more abundantly on the lower surface.

The conidiophores are produced in clumps which arise in stomatal openings. They are light brown, simple, erect, and are 3- to 7-septate. The average conidiophore measures 52.51 μ long and 5.04 μ wide, the extremes being 61.64 to 47.84 μ long and 5.52 to 4.41 μ wide.

The conidia are hyaline, short, straight or slightly curved, erect, larger at the basal end, and taper slightly to a blunt point. The average conidium measures 45.26 μ long and 4.23 μ wide, the extremes being 67.52 to 27.96 μ long and 5.2 to 2.8 μ wide. They are 4- to 7-septate.

CULTURAL CHARACTERISTICS

Isolation is easily accomplished by plating the diseased tissue directly on corn meal medium. The mycelium develops with moderate rapidity.

At first the mycelium appears in a very thin growth. Later it develops into a rather thick mass of closely packed hyphae. With age the central portion of the mycelial growth turns grayish green and is surrounded with a thin band of white mycelium. The cultures have been kept for but a short period, so no fruiting bodies have developed.

CERCOSPORA AVERRHOI sp. nov.

Conidiophores light brown, simple, erect, 52.51 by 5.04 μ, the extremes being 61.64 to 47.84 by 5.52 to 4.41 μ; tufted, arising from stomatal openings, on both surfaces of the leaf but more commonly on the lower surface. Conidia hyaline, short, straight or slightly covered, erect, 4- to 7-septate, average measures 45.26 by 4.23 μ, the extremes being 67.52 to 27.96 by 5.2 to 2.8 μ. Readily cultured on starchy media, producing first thin, white hyphae, with age becoming thickly matted and grayish green; spores not commonly produced in culture.

On leaves of *Averrhoa carambola* Linn., causing amphigenous, circular or irregular, grayish brown spots with yellow borders, 3 to 5 millimeters in width; at Los Baños, Laguna Province, Philippine Islands.

CONTROL

Control experiments with Bordeaux mixture were commenced on July 13, 1921, about the beginning of the rainy season. The Bordeaux mixture was made up according to the following formula: 1.8 kilograms copper sulphate, 2 kilograms stone lime, 190 liters of water.

The ten diseased trees that were used were not especially selected for the purpose. A count of the older leaves showed that 100 per cent on all trees were infected.

Six of the trees were sprayed thoroughly with Bordeaux mixture and were examined after two weeks. The sprayed trees were not defoliated to a great extent and the number of leaves were in striking contrast with those on the unsprayed trees. Plate 1 shows the results very distinctly.

Counts were made of diseased leaves from sprayed and unsprayed trees at this time. The number of leaves exhibiting young lesions on the sprayed trees was 20 per cent of all observed. One hundred per cent of the leaves from unsprayed trees were parasitized, showing from one to four young lesions and frequently as many old ones. The number of new infections, then, was reduced 80 per cent due to the Bordeaux mixture application. Frequent heavy rains gave optimum conditions for infection.

By August 1 a different condition existed. The trees that had been sprayed were still holding their less seriously diseased leaves. The unsprayed trees had become entirely defoliated and had put forth new leaves, which by August 8 had not developed any lesions.

This experiment conclusively proves that Bordeaux mixture, if applied carefully, will give perfect control. If the spray is used once every two weeks until the disease disappears and if the fungus does not attack other hosts, eradication should be easily accomplished.

SUMMARY

1. A very serious *Cercospora* leaf spot was found in the experimental orchard of the College of Agriculture, Los Baños, Philippine Islands, on *Averrhoa carambola*.

2. It attacks leaves and perhaps fruits. The young leaf lesions are yellow, later turning grayish brown, and finally either falling out or causing the death of the leaf.

3. *Averrhoa bilimbi* is not attacked.

4. The leaf spot threatens the life of the trees in the orchard by repeated defoliation.

5. The name *Cercospora averrhoi* sp. nov. is suggested to designate the causal organism.

6. Control by spraying with Bordeaux mixture is very efficient. By repeated sprayings every two weeks the disease can be efficiently controlled. Complete eradication would seem to be possible.

ILLUSTRATIONS

Plate 1

Fig. 1. Appearance of a tree, *Averrhoa carambola*, two weeks after one application of Bordeaux mixture. Young lesions reduced 80 per cent.

2. Appearance of a tree, *Averrhoa carambola*, that was not sprayed. Partial defoliation due to *Cercospora averrhoi* sp. nov. Both trees had the same percentage of infection when the spray was applied.

Plate 2

Fig. 1. Diseased leaves showing position and appearance of lesions, × 1. Drawn by E. Roldan.

2. Group of conidiophores, × 600.
3. Conidia, × 600.
4. Mycelium from pure culture on potato-glucose-agar.

Figs. 2, 3, and 4 were drawn with the aid of the camera lucida by C. C. Nacion.

Fig. 1.

Fig. 2.

PLATE 1.

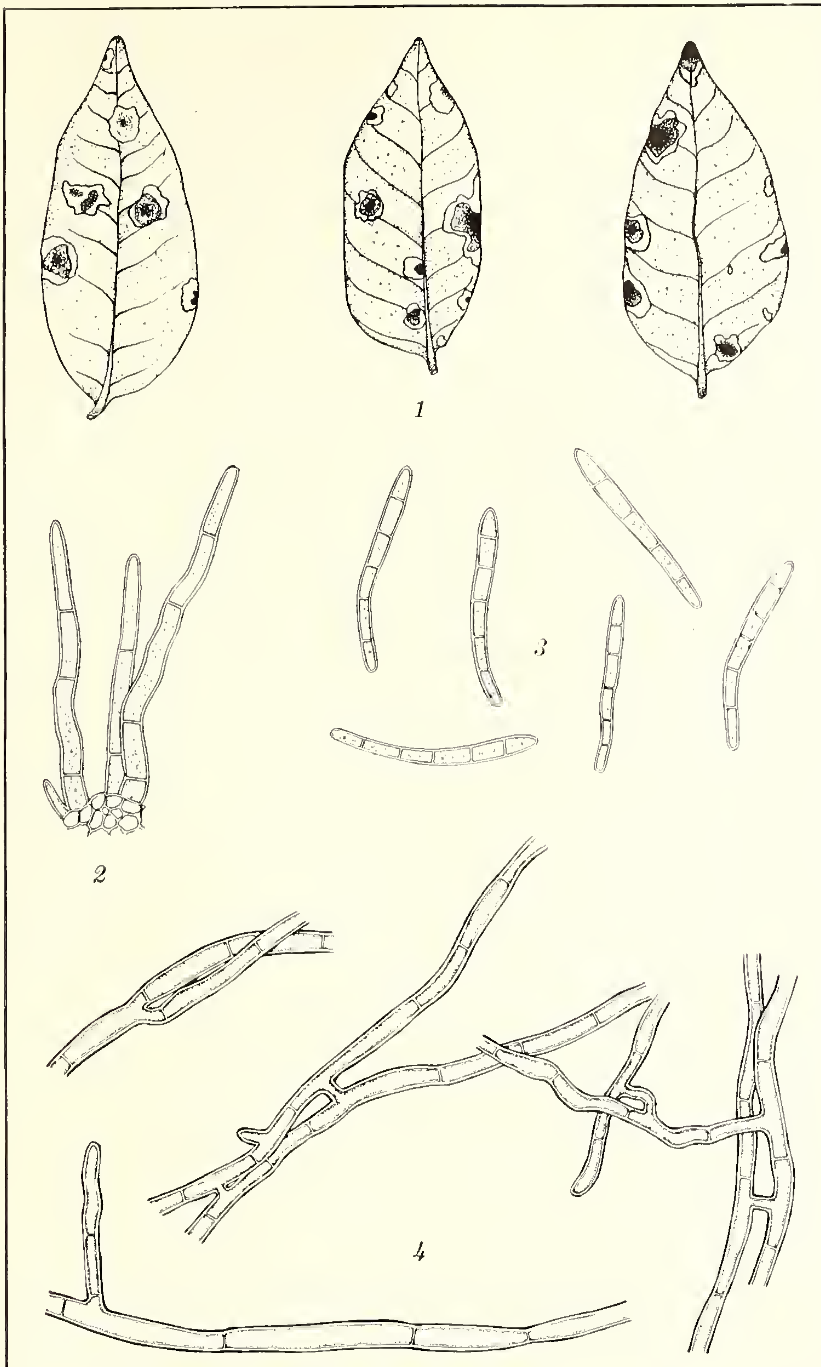


PLATE 2. CERCOSPORA LEAF SPOT.

REVIEW

An Introduction to | Bacterial Diseases | of Plants | by | Erwin F. Smith | in charge of Laboratory of Plant Pathology, | Bureau of Plant Industry, | United States Department of Agriculture, Washington, D. C. | [inscription and motto, 7 lines] | Philadelphia and London | W. B. Saunders Company | 1920 | Cloth, pp. i–xxx + 1–688, including index. Price, $13.25.

Dr. Erwin F. Smith has been associated with the study of the bacteria in relation to plant diseases since the earliest days of the subject; in fact his insistence is almost entirely responsible for the standards of experimentation in this subject which compare favorably with those from any other field of scientific endeavor. His knowledge of the development of the subject and his intimacy with the other earlier workers, for example, Burrill, Waite, and Arthur in America, and Wakker and Savastano in Europe, place him in a position to discuss the present and earlier status of this branch of science much more fluently and with more authority than any other person has been or will be able to do.

The book is of chief merit to plant pathologists in that it reflects the personality of Dr. Erwin Smith; it will live long after Doctor Smith, perpetuating his scientific attitude which, even more than his many notable additions to our knowledge of plant diseases, is his greatest contribution to our profession. Doctor Smith discusses in his last chapters such subjects as ethics, ideas, coöperation in research, and the ownership of a man's research—subjects upon which few men have the courage to define their attitude. He is the only man in our science from whom we would take such a discussion, and we will appreciate it more as the years go on.

Part I of the book is probably the first comparative discussion of the different bacterial diseases of plants and their causal organisms that we have had. Here also Doctor Smith's personal association with the researches on the diseases under discussion makes the work extremely valuable. If we should criticize we would ask Doctor Smith to present this discussion more in detail, from the wealth of knowledge he has on the subject. Part II on methods of research also could be made into one or several volumes by Doctor Smith.

Part III, a discussion of fourteen selected bacterial diseases, although intended primarily for the undergraduate student, contributes much that is valuable to pathologists in unknown fields, as an aid in diagnosis and general knowledge. Doctor Smith is not subject to the criticism applicable to many authors in that he has not confined the horizon of plant diseases to the District of Columbia, or the United States, or even North America. There is frequent mention of plant diseases in the Tropics and the oriental countries as well as in Europe, South America, and South Africa.

Part IV contains extremely interesting chapters on the production of tumors in the absence of parasites and on experimental teratosis. Several of the reviewer's associates in the medical sciences have been interested in these chapters. They are of great interest to all biologists. Part V is really the most important of the book, containing some good honest fundamental advice on the presentation of results, ethics, and coöperation. Many investigators in the Philippine Bureau of Science in fields of research other than plant pathology have read the chapters on these subjects and have appreciated the great stimulus conveyed in these discussions.

Few typographical errors are to be found; among those noted is the misspelling of Philippines (p. 694) and *Phyllosticta* (p. 59).

The book is a contribution not only, as it was primarily intended, to the younger students of plant pathology, but to research men in all sciences. It is a valuable stimulus to a correct scientific attitude and many an investigator would do well in the rush of work to sit down for an hour and reread Part V of this book. With the publication of this book, we must, moreover, acknowledge appreciation to Doctor Smith for his achievement almost unaided in building up and placing on a firm foundation a comparatively new science.

H. A. L.

ERRATA

Volume 18, number 4, page 460, line 6, *for* plastogamy *read* plasmotomy.

Volume 19, number 1, page 7, line 29, *for* $N \infty N{=}O$ *read* $N \underline{\infty} N{=}O$.

Page 9, line 3, *for* way *read* may.

Page 17, line 1, *for* $\begin{array}{l} H\diagdown \\ \qquad {=}O \\ H\diagup \end{array}$ *read* $\begin{array}{l} H\diagdown \\ \qquad C{=}O \\ H\diagup \end{array}$

Plate 1, *for* Calotermes *read* Kalotermes.

Volume 19, number 3, page 380, line 18, *for* Archimenes sesamoides Vahl *read* Achimenes sesamoides Vahl.

Volume 19, number 5, page 584, line 14, and page 589, line 34, *for* maculipes *read* maculicrus.

Doctor Heller has requested the last change as he has recently noted that the name *Mecistocerus maculipes* is preoccupied, having been used for an African species described by Faust.

INDEX

[New generic and specific names and new combinations are printed in **clarendon**; synonyms and names of species incidentally mentioned in the text are printed in *italic*.]

183013——9

D

E

M

Q

R

183013——10

T

○

CONTENTS

The Philippine Journal of Science is issued twelve times a year. The sections were discontinued with the completion of Volume XIII (1918).

Yearly subscription, beginning with Volume XIV, 5 dollars United States currency. Single numbers, 50 cents each.

Publications sent in exchange for the Philippine Journal of Science should be addressed: Library, Bureau of Science, Manila, P. I.

Subscriptions may be sent to the BUSINESS MANAGER, Philippine Journal of Science, Bureau of Science, Manila, P. I., or to any of the agents listed on the third page of this cover.

Entered at the post office at Manila, P. I., as second-class matter.