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DEPARTMENT OF THE INTERIOR.

BUREAU OF GOVERNMENT LABORATORIES.

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BIOLOGICAL LABORATORY.

ENTOMOLOGICAL DIVISION.

BULLETIN No. 1.

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PRELIMINARY BULLETIN ON INSECTS OF THE CACAO.

PREPARED ESPECIALLY FOR THE BENEFIT OF FARMERS.

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By CHARLES S. BANKS,

Entomologist, Bureau Government Laboratories.

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MANILA:

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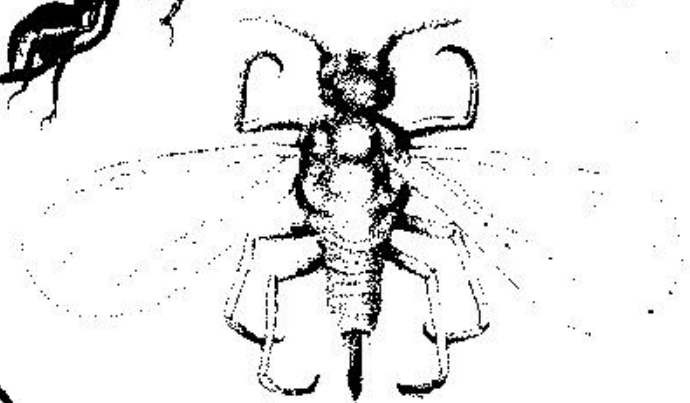
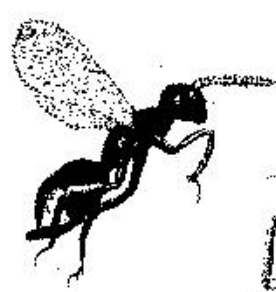
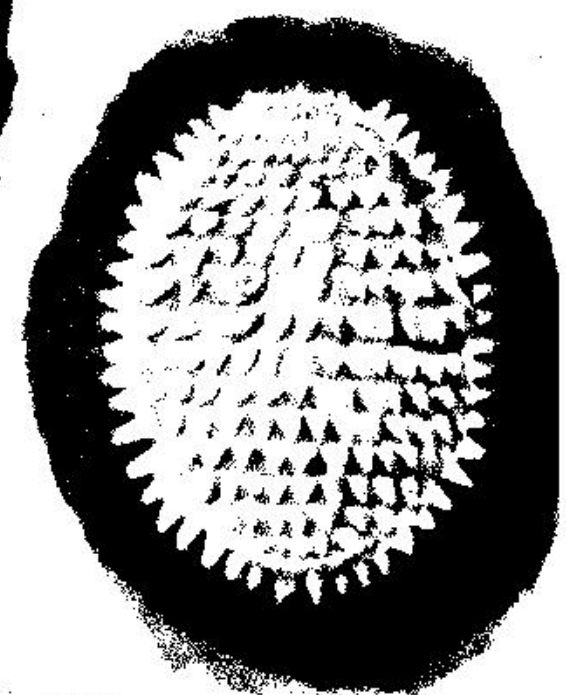
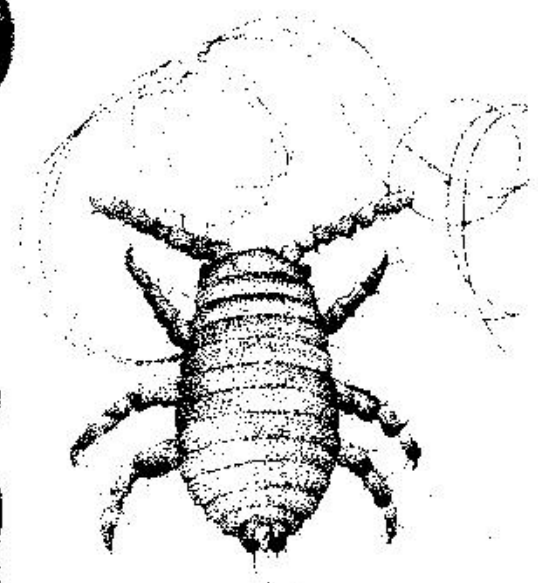
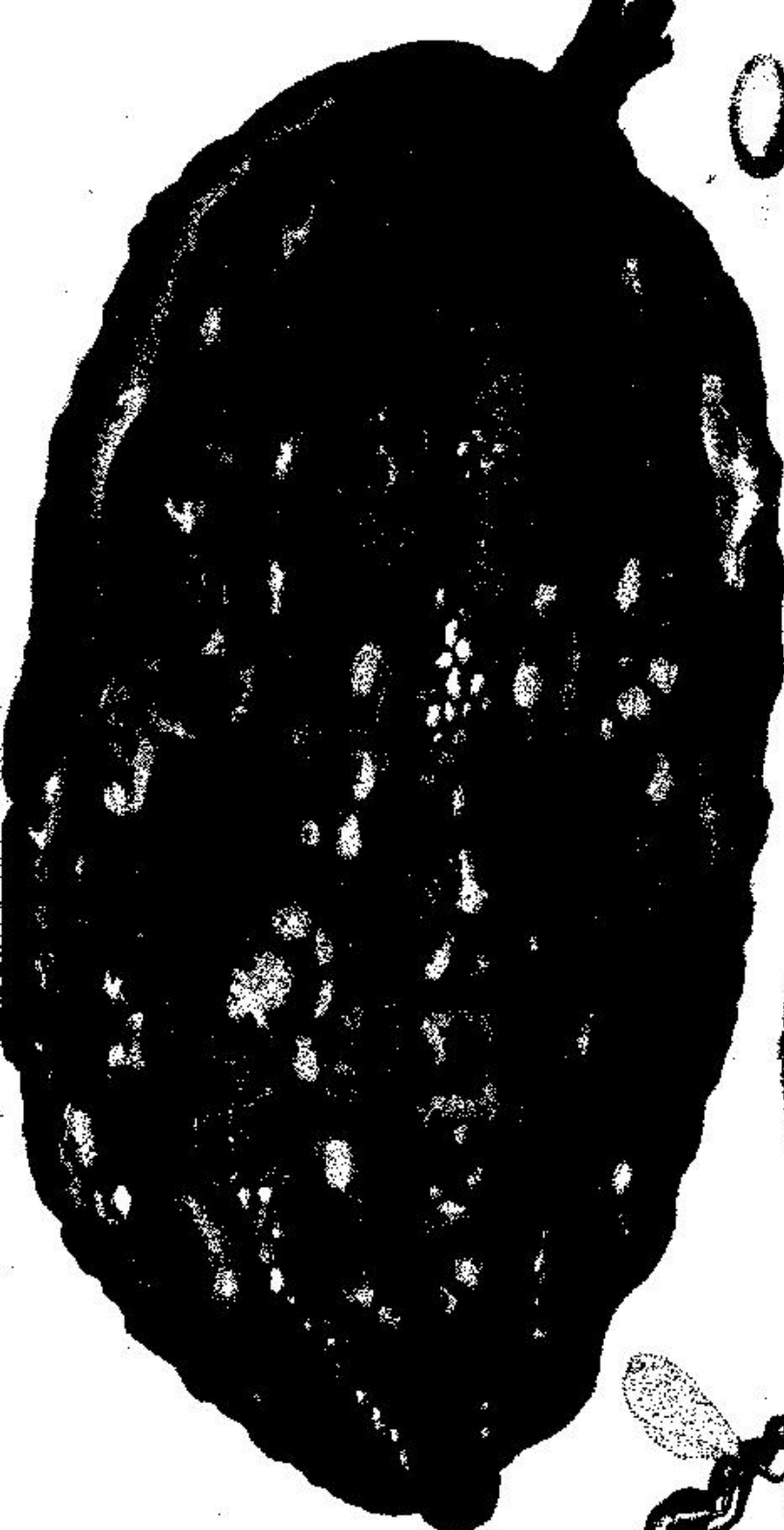
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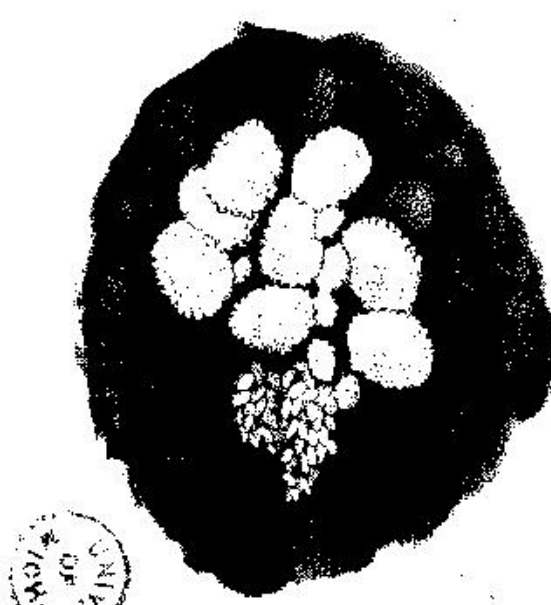
[Drawn from nature, by Charles S. Banks, 1903.]

### LEGEND.

- FIG. 1. Cacao pod, showing mealy-bug, natural size, and the attendant ants and sheds built by the latter.
2. Female mealy-bug and young, enlarged four diameters.
  3. Egg about to hatch, enlarged forty diameters.
  4. Young insect just hatched, showing filamentous mouth-parts, enlarged one hundred diameters.
  5. Female mealy-bug, enlarged nineteen diameters.
  6. Male mealy-bug, adult, enlarged twenty-one diameters.
  7. Ant, attendant to the mealy-bug, enlarged nineteen diameters.
  8. Hymenopterous parasite of the mealy-bug, enlarged nineteen diameters.



LIT. GERMANIA (MANILA)



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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,  
BUREAU OF GOVERNMENT LABORATORIES,  
OFFICE OF THE SUPERINTENDENT OF LABORATORIES,  
*Manila, P. I., September 14, 1903.*

SIR: I have the honor to transmit herewith "A Preliminary Bulletin on Insects of the Cacao," by Mr. Charles S. Banks, Entomologist, Bureau of Government Laboratories.

I am, very respectfully,

PAUL C. FREER,  
*Superintendent Government Laboratories.*

HON. JAMES F. SMITH,  
*Acting Secretary of the Interior, Manila, P. I.*

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# A PRELIMINARY BULLETIN ON INSECTS OF THE CACAO, PREPARED ESPECIALLY FOR THE BENEFIT OF FARMERS.

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By CHARLES S. BANKS,  
*Entomologist, Bureau of Government Laboratories.*

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This bulletin is prepared particularly with a view to its practical value to the farmers of the Philippines in the cultivation and protection of an industry which promises much in the future for these Islands.

As this bulletin is the result of only three months actual investigation of cacao insects, it does not in any way cover all the insects which are directly or indirectly associated with the growing of cacao.

Much has yet to be learned of the habits and life-histories of many of the insects treated herein, owing to the fact that the periods of their transformation extend over a year or more. The publication of the material at this time is in response to an urgent demand upon the part of growers for information that will help them in combating the more serious pests.

All the illustrations, where not otherwise credited, are from photographs made by myself or by the Government photographer under my direction, or are from original drawings made by myself or under my supervision by Juan de Guzman and José García.

The frontispiece was drawn by me from nature, partly in the field and partly from material brought back from my trip.

I wish to acknowledge my personal thanks to Sr. Don Juan A. Araneta, of the hacienda "Louisiana," Maaó, Occidental Negros, for the many ways in which he aided me in the work of investigation which I carried on upon his plantations.

C. S. B.

MANILA, P. I., August 28, 1903.

## CACAO INSECTS.

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Up to the present time, so far as search has revealed, very little has been published upon the subject of economic entomology in the Philippine Islands. In the several admirable works on the entomology of the Archipelago, we find not only that the economic side has been entirely neglected, but also that the same thing is true from the biological standpoint. The only attempts made in the past have been to determine the names of specimens, in most cases collected by one man and classified by others. For even the most common species of insects, few or no data are given regarding their habits, life-history, or relative abundance at certain periods of the year or in stated localities.

In preparing this brief preliminary bulletin on the insects of the cacao, I realize that I am but hinting at some of the more important pests which have been encountered during a comparatively short period of the year; so that all the conditions as they would occur consecutively during the course of twelve months, and undoubtedly changing slightly with each succeeding year, are not now noted, nor are all the subjects mentioned treated exhaustively, the object being at the present time only to set forth as clearly as possible some of the most common and more destructive insects, with practical suggestions for the prevention or treatment of their ravages. At the same time it is proposed to mention a few of those insects, which, because of their predatory habits in feeding upon the injurious forms, should be considered as beneficial to the farmer.

Perhaps one of the most valuable crops produced in the Philippine Islands in proportion to the quantity raised, is the cacao bean, the product of a tree of the family *Sterculiaceæ* and botanically known as *Theobroma cacao*. The tree averages from 4 to 12 meters in height, and, as grown in these Islands, usually assumes a somewhat oval form in its mode of branching, like the pear tree of the United States.

Like nearly all other plants, when brought into cultivation, it is subject to many diseases and the attacks of a large number of

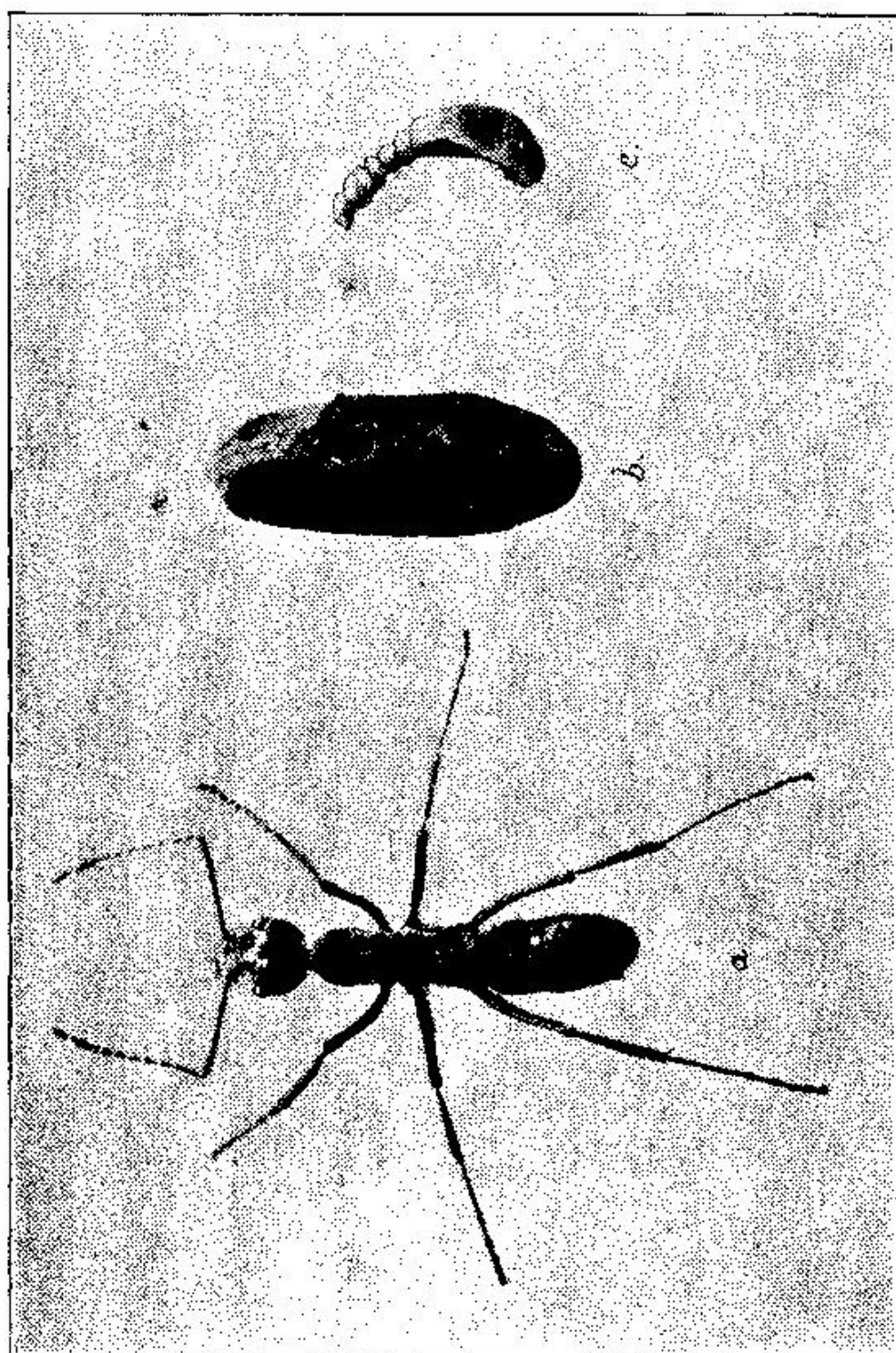


Fig. 1.

insects. This is more or less true in all parts of the world where it is grown, in Venezuela, Trinidad, Java, and particularly, it would seem, in the Philippines.

In this bulletin some of the injurious forms of insects will be mentioned, together with what has been learned of their life histories up to the present time. As it is very necessary to know the most susceptible stage of an insect's life in order to know what is the easiest remedy to apply to it, we can readily see the necessity for becoming familiar with its life-history. It is hoped that further observations will enable me to treat the subject more exhaustively at a future time.

In suggesting remedies, those are given which have been found most effectual for similar pests in the United States, but the effort has been made to so modify them as to make them fit local conditions.

For convenience, the subject has been divided according to the part of the plant attacked. Thus, beginning with the roots, we will in order discuss the insects of every part of the tree, giving their habits and mentioning the best means to be used against them.

## INSECTS ATTACKING THE ROOTS.

### BLACK ANTS.

The principal insects at present known to attack the roots are a species of large, ferocious ant, a species of *Cicada*, and the grub of a beetle belonging to the genus *Anomala*, but not yet identified.

The ants are black and are characterized by the ability to inflict a very severe sting. The abdomen is constricted between the first and second segments, the first segment having two backward-pointing spines on the upper part. The head, thorax, and first and second abdominal segments are beautifully corrugated. The legs and antennæ or feelers are very long. The light-brown cocoons, made of a silk paper, are usually very abundant in the nests, which are located at the base of the tree among the larger roots. Within these cocoons may be found the white grubs, which are shaped very much like a long-necked gourd, the head being at the smaller end. (See fig. 1 c.) The larvæ or grubs, before spinning their cocoon, and the eggs are simply deposited by the workers in any convenient part of the nest. The adults are the only injurious forms of these insects. They gnaw the bark from the large roots,



thus inviting decay, and making an opening for the entrance of the insidious white ant, another very serious enemy of the cacao, belonging to the genus *Termes*. The latter is called *anay* in Visayan and Tagalog, and is probably the most serious insect pest in the Philippines, destroying, as it does, nearly every conceivable class of material except articles made of metal. It has hitherto been supposed to attack only woods which had been previously cut, but in the work of investigation on cacao insects it has been conclusively proven that it also attacks the living tree, at least in the case of cacao. (See fig. 2.)

In the United States the members of the genus *Cicada* are restricted to not more than five species. In the Philippines there are several, some being large and black and others grey, while still another species is of a very light yellowish green. A singular thing about the individuals of the genus is that the males give forth a strident noise, produced by means of two drum-like organs on the lower side of the first segment of the abdomen. Unlike the members of this genus in America and Europe, which generally "sing" in the hottest days of summer, the individuals found in the Philippines almost invariably reserve their serenade till the falling of darkness, when their strident notes may be heard on every hand, especially near wooded lands.

All observations thus far made upon this interesting insect would lead me to infer that the habits and life history are the same in the Philippine Islands as in other parts of the world, particularly so in the case of the dog-day cicada in the United States.

Here the species may be found at all times, and the insects are so common as to be used as playthings by the native children, who capture them to make them sing. In Visayan they are called "*Ceriritan*" and in Tagalog "*Culiclic*."

The adult of the species which attacks the cacao tree measures 42 mm. to the tip of the wings, which project 13 mm. beyond the tip of the abdomen. The body is robust, somewhat conical, and is composed of a series of very regular segments, which may be more easily distinguished on the abdomen than on the thorax. (See fig. 3.) The insect has four very beautifully marked, transparent wings, the fore ones being much larger than the hind. The venation is shown in fig. 4. When at rest the insect's wings are laid over the abdomen, roof-like. The *Cicada* has a swift but erratic flight. This is due to the lack of coördination between the



FIG. 2.



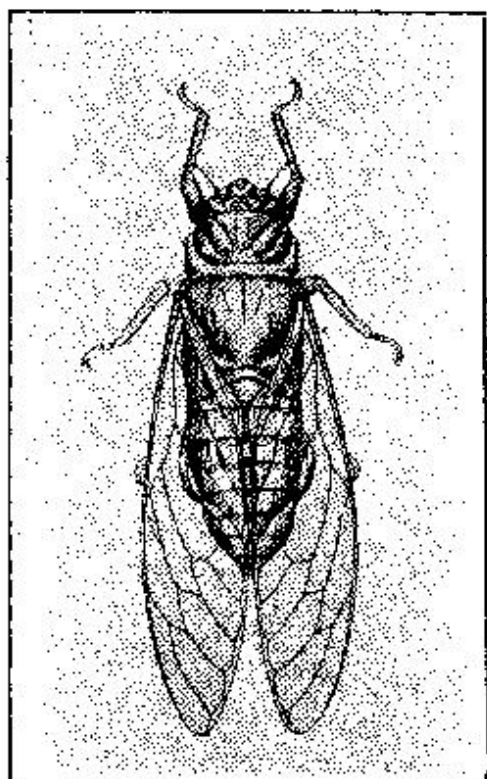


FIG. 3.

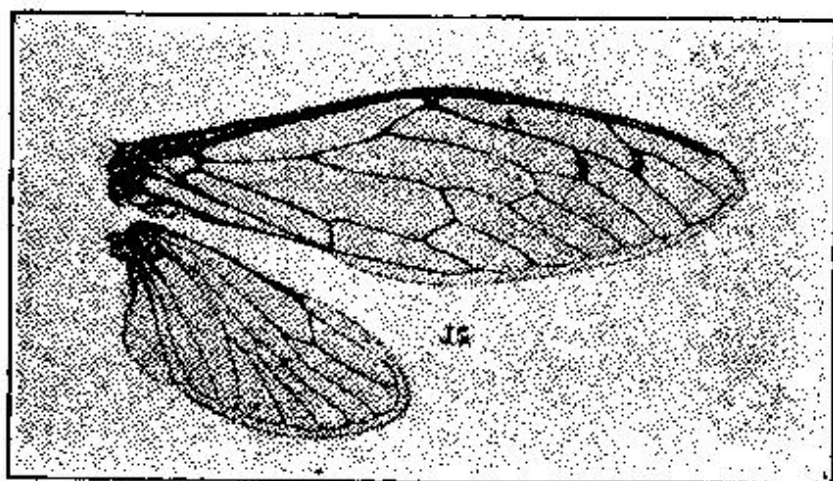


FIG. 4.





FIG. 5.

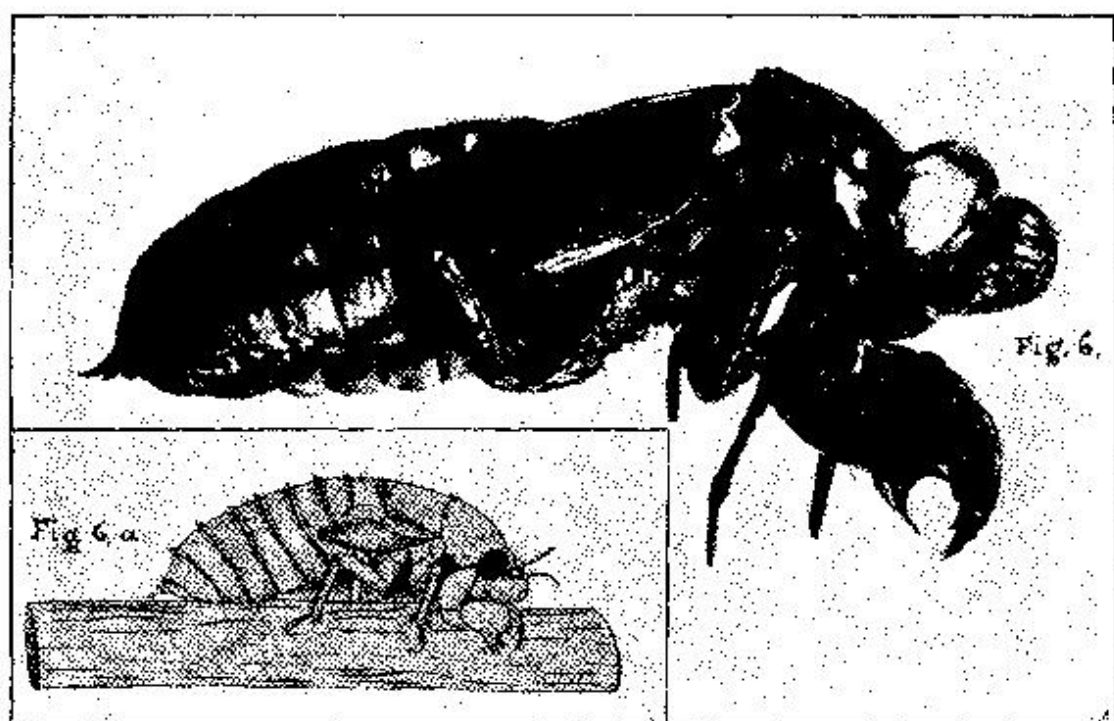


FIG. 6, FIG. 6 a.

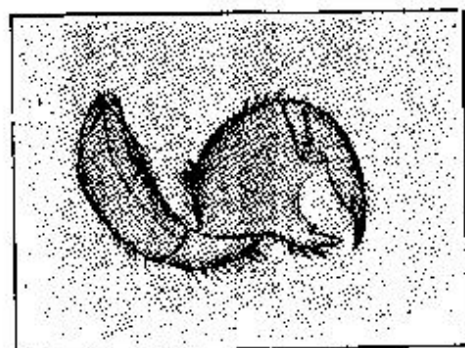


FIG. 7.

wing muscles of the opposite sides of the body. By holding the insect between the thumb and the forefinger, so that the wings are free to move, it will be seen that the opposite pairs move alternately.

The insects of this genus pass through a very remarkable series of changes from the egg to the adult stage. The total duration of the metamorphosis has not yet been determined, but it is safe to estimate that in this region the time occupied is not less than eighteen months. In America one species nearly related to this lives from thirteen to seventeen years in the ground before reaching maturity, while another completes its transformation in two years.

The female *Cicada* is provided with a very peculiar ovipositor or egg-laying apparatus (fig. 5), by means of which she slits the twigs of young branches of the cacao. Inasmuch as the wood of the cacao is comparatively soft, she finds no great difficulty in placing her eggs in branches which are larger than those ordinarily found with *Cicada* eggs in the United States. Within from four to six weeks from the time the eggs are laid, the young hatch. They are tiny white creatures which resemble very much the full-grown nymph, except in size. Their forefeet are adapted for digging in the ground, and they, dropping from the twigs, begin immediately to burrow down to the tender rootlets of the plant, where they settle and insert their beaks for sucking the juices of the roots. Fig. 6 shows the nearly full-grown nymph, and fig. 7 shows its forefoot. The larva or nymph forms a dirt cell around the spot where it decides to remain. This it does with its forefeet, using them as a mole would, and packing the earth at the rear and above it with its other legs. Thus is made a subterranean cavity where this little enemy of the roots of the cacao may live and feed.

The mouth of the insect is of the sucking class—that is, the various parts are modified to form a lancet for piercing the epidermis of the plant upon which it feeds, and a tube-like structure through which the sap is drawn up into the mouth cavity, whence it is conveyed to the stomach.

When very young, the larvæ may be found not more than 10 or 12 cm. below the surface of the ground, but as they grow larger they gradually work their way downward. In some cacao trees they have been found as deep as 80 cm. below the surface, clinging tenaciously to the roots by their beaks and their legs.

They are not at all able to defend themselves, nor to escape from any kind of enemy which might come upon them.

These insects do not change their form to a very marked degree in passing from the larval to the pupal and the adult stages, as do butterflies, beetles, and flies. Just previous, however, to their assuming the adult form, there appear tiny wing pads on the sides and within these are the wings in embryo. These pads appear in the second moult previous to the adult stage. (See fig. 6, which shows the wing pads lapping back upon the abdomen.)

When the insect is ready to assume its final or winged form it comes up out of the ground, leaving a tunnel behind, which may often be found when digging out trees. These tunnels are sometimes partitioned off and used as nests by a certain species of small tarantula, which will be mentioned below.

Upon reaching the surface of the ground the pupa of the *Cicada* climbs to some convenient place, usually the trunk of the cacao tree or the small scions which spring up around the parent tree, and there it clings, awaiting the final change, which consists in the bursting of the pupal skin and the emerging of the adult insect. This takes place as follows: The skin of the pupa splits longitudinally on the back, from between the eyes to the posterior edge of the thorax. The insect within this shell begins a forward wriggling motion and soon the head is free from the casing. The forelegs, which in the larval and pupal stages are much-shortened hooked claws, come forth from the pupal case, long, slender, and fitted for walking instead of digging. The insect grasps some projecting point upon the bark where it is resting, with these yet feeble claws, and thus is aided in its exit. The second pair of legs soon come forth, then the wings, which are very much doubled up and are very soft, are drawn out from the shell. At this stage the animal rests a while, apparently nearly exhausted. When it has thus rested, the insect makes its final attempt and the hind legs and abdomen are withdrawn. It now simply remains upon the tree, and the doubled and delicate wings begin to expand until they have reached their full length. It is supposed that this expansion is due to air pressure within the body. They are now very thin, of a beautiful translucence and very soft, so that the least breeze causes their fluttering. The body of the insect is also very soft and may be easily crushed. It is of a very pale, pinkish color, but soon turns grey, evidently owing to the action of the sunlight, all the