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NOTICE.

The serial *Indian Museum Notes*, issued by the Trustees of the Indian Museum, Calcutta, under the authority of the Government of India, Revenue and Agricultural Department, is to take the place of *Notes on Economic Entomology*, of which two numbers have appeared. For the views expressed, the authors of the respective notes are alone responsible.

The parts of the serial are published from time to time as materials accumulate. Communications are invited; they should be written on one side only of the paper and addressed to—

THE EDITOR,
INDIAN MUSEUM NOTES,
Calcutta.

Correspondence connected with Economic Entomology should be accompanied by specimens of the insects to which reference is made. Caterpillars, grubs, and other soft bodied insects can be sent in strong spirit; chrysalids and cocoons alive, and packed lightly in leaves or grass; other insects, dried and pinned, or wrapped in soft paper. Live insects should be sent when there is a reasonable probability of their surviving the journey. Caterpillars, grubs, and other immature insects can often be only approximately determined; they should therefore, where possible, be accompanied by specimens of the mature insects into which they transform; when this is not possible, they should still be sent, as they can always be determined approximately, and uncertainty must necessarily arise in discussing insects when actual reference to the specimens cannot be made.

Insects forwarded for determination should, in all cases, be accompanied by a detailed report showing precisely in what their economic importance is believed to consist.

CALCUTTA;
17th May 1899.

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Vol. V.] [No. 1.

1.—ORIGINAL COMMUNICATION.

REMARKS ON INDIAN SCALE INSECTS (COCCIDÆ), WITH DESCRIPTIONS OF NEW SPECIES. BY E. E. GREEN, F.E.S., GOVERNMENT ENTOMOLOGIST, CEYLON.

(WITH PLATES I AND II.)

The following notes are founded upon a collection of Coccidæ formed by Dr. G. Watt (Reporter on Economic Products to the Government of India), chiefly during a recent tour through the Tea districts of Assam and Kangra. Many of the species had not previously been observed in India, from which country the records of Coccidæ are extraordinarily meagre.

A rich harvest awaits any one who will undertake the study of this obscure but interesting group of insects throughout the Indian region. The small number of species now known from India proper can scarcely represent the fiftieth part of the existing species, amongst which are doubtless many remarkable and beautiful forms at present unknown to science. That this estimate is not exaggerated may be judged from the fact that my own researches in Ceylon during the past six years have resulted in raising the previous records from the paltry number of 7 to at least 150 (including species in course of publication).

The late Mr. E. T. Atkinson, writing in 1886,* collects together the few records of Indian Coccidæ then known. I find therein the following species recognized as occurring on the Indian Continent :—*Ceroplastes ceriferus ; Monophlebus atripennis, leachii, saundersi, burmeisteri ; Margarodes* sp. ; and *Tachardia* (*Carteria*) *lacca ;*—just seven species! There is besides a list of eight species noticed by Dr. J. Anderson in his 'Letters to Banks (1786-89)' ; but, as noted by Mr. Atkinson, his descriptions are so meagre and imperfect that they are quite unrecognizable.

Subsequently Mr. Atkinson published a description and figures† of a new genus and species to which he gave the name *Pseudopulvinaria sikkimensis.*

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* 'Journal of the Asiatic Society of Bengal', Volume LV, Part II, No. 3, 1886, pages 267 to 298.

† 'Journal of the Asiatic Society of Bengal', Volume LVIII, Part II, No. 1, 1889.

The next records appear in the 'Indian Museum Notes', Volume II, No. 1 (1891), page 59, where the late Mr. W. M. Maskell describes *Aspidiotus theæ, Chionaspis theæ* and *Eriochiton cajani.* On page 17 of the same part *Chionaspis aspidistræ* is recorded from the Areca palm.

In Volume II of the same publication, No. 6 (1893), page 168, *Lecanium viride* is reported from South India, and *Dactylopius adonidum* from Mysore.

In Volume III, No. 5 (1894), page 21, Mr. Newstead adds to the list several new species collected in Madras, *viz.*, *Pulvinaria obscura*, *Dactylopius ceriferus* (= *D. virgatus*, Ckll.), *D. viridis*, *Aspidiotus orientalis:* and records *Icerya ægyptiaca* Dougl., from the same locality.

Volume IV, No. 2 (1896), contains records of *Carteria decorella*, Mask. and *Chionaspis prunicola*, var. *theæ*. Mask. from tea plants; and *Aspidiotus ficus* from orange trees.

Aspidiotus moorei and *A. artocarpi* were described by myself in the '*Ent. Mo. Mag.*,' Volume VII (1896), page 199, from Madras and Bombay respectively.

Ceronema japonica recorded by Mr. Maskell from the tea plant in India (Trans. New Zealand Institute, 1898,) will, I think, complete the list, making a total of but twenty-six species to the credit of the vast continent of India.

Dr. Watt's collection contains the following species :—

1. *Aspidiotus aurantii* Mask.—On stems of rose bushes: Tezpor district.

2. *Aspidiotus camelliæ* Sign.—Received from Darjeeling as doing considerable damage to tea plants; and found by Dr. Watt throughout Assam.

3. *Aspidiotus dictyospermi*, Morg. var. *arecæ*, Newst.—(Plate 1, figs. 1-3). On leaves of an undetermined shrub from the Kangra district.

Both type and variety of the species were originally described from Demerara. I have found the same insect in Ceylon upon various plants, including tea. Under the name of *Diaspis pinnulifera*, Maskell describes an insect that corresponds in every particular with the above species. He somewhat doubtfully refers his insect to the genus *Diaspis*, having received Diaspidiform male scales with the puparia of the females. It is probable that these male scales belonged

EXPLANATION OF PLATE I.

ALL FIGURES EXCEPT 4 AND 9, MORE OR LESS ENLARGED.

FIG. 1. ASPIDIOTUS DICTYOSPERMI, Morg. var ARECÆ, Newst.; scale of adult ♀.

" 2. Do. do. scale of early stage.

" 3. Do. do. extremity of pygidium of adult ♀.

" 4. FIORINIA THEÆ, Green. Tea leaf with insects in situ, nat. size.

" 5. Do. scale of adult ♀.

" 6. Do. adult ♀, removed from scale, ventral view.

" 7. Do. adult ♀, anterior extremity, showing antennae and interantennal tubercle.

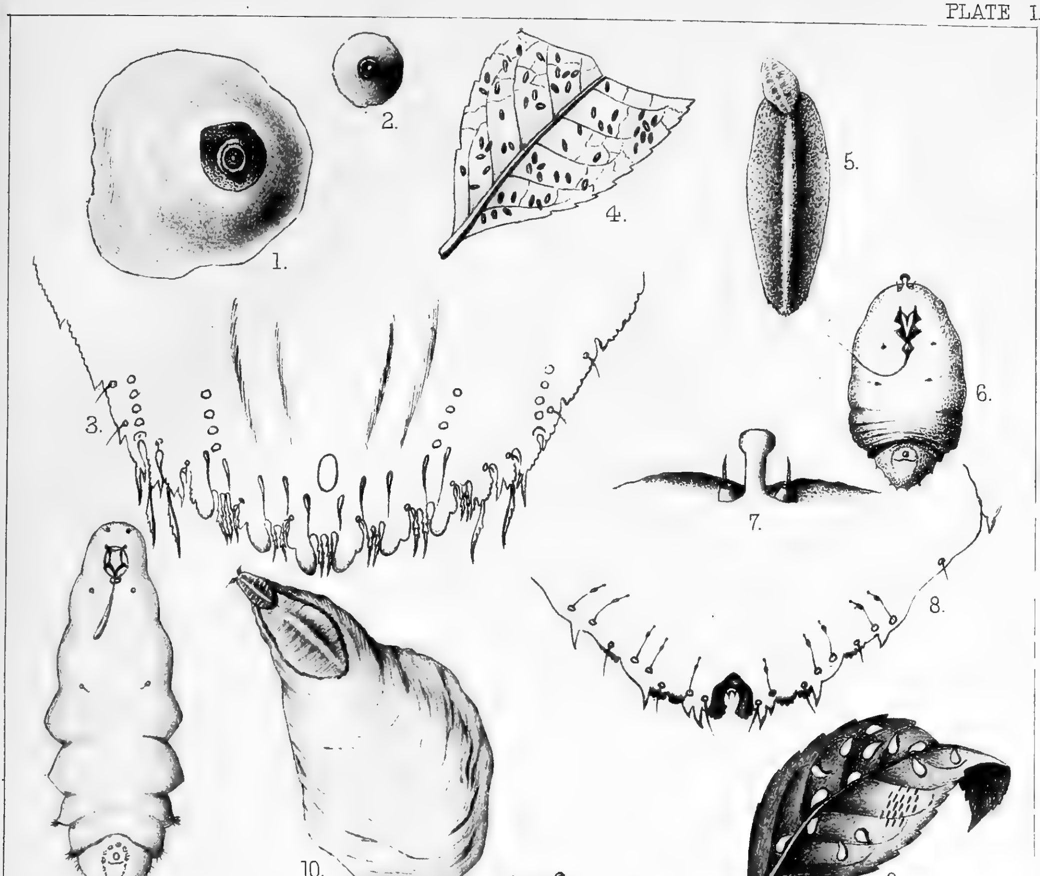
" 8. Do. adult ♀, extremity of pygidium.

" 9. CHIONASPIS SEPARATA, Green. Tea leaf with insects in situ, nat. size.

" 10. Do. scale of adult ♀.

" 11. Do. adult ♀ removed from scale, ventral view.

" 12. Do. do. pygidium.



E. E. Green, del.

Photogravure. Survey of India Offices, Calcutta, December 1899.

1-3, ASPIDIOTUS DICTYOSPERMI, MORG. VAR. ARECÆ, NEWST.
4-8, FIORINIA THEÆ, GREEN, *N. Sp.*
9-12, CHIONASPIS SEPARATA, GREEN, *N. Sp.*

to some other insect. It is by no means unusual to find two or more distinct species occurring together on the same plant.

The ♀ scale (figures 1 and 2) and the extremity of the pygidium (figure 3) are figured herewith. The central boss and raised circle are conspicuous in the early stages, but become more or less obliterated on the scale of the adult insect. The remarkable stalked processes, immediately following the lobes on each side, are characteristic of this species.

4. *Aspidiotus orientalis* Newst.—Occurred abundantly on leaves of *Cycas revoluta* at Calcutta.

5. *Aspidiotus theæ*, Mask.—Dr. Watt has found this species on tea throughout the Kangra Valley. He considers that it is confined to that district, and is replaced in Assam by *Aspidiotus camelliæ* which does not appear to occur in Kangra.

6. *Fiorinia theæ*, n. sp. (plate 1, figures 4 to 8).—When this insect was first submitted to me I supposed it to be merely a local form of the world-wide *F. fioriniæ*. A more critical examination shows me that it is quite distinct. It differs from *fioriniæ* in the absence of lateral lobes on the pygidium: in the form of the antenna which has no stout spine; and in the presence between the antennæ of a proboscis-like projection. The scale also is larger, stouter and more opaque. I now describe the species under the name of *F. theæ*.

Female puparium (fig. 5) consisting of the indurated pellicle of the second stage which completely encloses the adult insect and is without any secretionary margin. Elongate; narrow; with a moderately distinct median longitudinal carina. Colour bright castaneous to dark ferruginous brown, median longitudinal area darkest: opaque; not revealing the form of the insect beneath. First pellicle colourless or very pale yellow; projecting from anterior extremity of scale. Length 1·25 to 1·50 mm. Breadth, 0·50 mm.

Adult ♀ pale yellow; of normal form (fig. 6). Antennæ close together, on anterior margin; each antenna consisting of an irregular tubercle with a single curved bristle on one side. From between the antennæ springs a stout spatulate process (fig. 7) which is not chitinous but of the same consistency as the surrounding parts of the body. Margin of thorax and abdomen with a series of minute spinneret ducts opening on to small conical tubercles. Pygidium (fig. 8) with a conspicuous median cleft, on the margins of which are situated the moderately large serrate median lobes. First pair of lateral lobes represented only by small serrate thickenings of the margin: second lateral lobes obsolete. Spines normal, the dorsal series rather long; one pair springing from within the median cleft. Circumgenital glands in five groups; the median and upper lateral groups together forming an almost continuous arch. Median group with 4 or 5 orifices; upper laterals 10 to 13; lower laterals 15 to 18. A very few circular pores with accompanying ducts, on dorsal surface, near the margin. Length 0·50 to 0·75 mm.

Neither the male scale nor the adult male are represented in the material under examination.

The pale yellow eggs are deposited in two rows within the hinder part of the female scale,—the female insect shrinking up after oviposition and occupying the anterior extremity only.

Habitat.—On leaves of the tea plant in Assam and Kangra, and probably throughout the tea districts of India. The scales are most abundant on the under surface of the leaves (fig. 4), but occur on the upper surface and stems also. Individuals from the upper surface of the leaf are usually more brightly coloured than the others.

The presence of the proboscidiform process on the anterior margin allies this insect to a curious Ceylon form, to be shortly described under the name of *F. proboscidaria*, in which this organ is still more largely developed. The process is homologous with the spinous tubercle of *F. saprosmæ*.

Dr. Watt, in his elaborate and valuable report on 'The Pests and Blights of the Tea plant,' draws attention to the fact that plants affected by this pest are usually conspicuous by their dust-coated appearance. He suggests that this may be due to dust and dirt adhering to a sugary exudation from the insects. But members of the *Diaspid* group of scale insects (to which the present species belongs), do not produce any appreciable secretion of the kind.

7. *Chionaspis theæ*, Mask.—This species, which was described and figured by the late Mr. Maskell (whose unexpected death is greatly deplored) in Volume II, No. 1, of 'Indian Museum Notes,' occurs commonly throughout the tea districts of India and Ceylon, though seldom in sufficient numbers to do any appreciable harm to the plant. A sample from Darjeeling, however, shows both stems and leaves thickly covered with the scales, which must have seriously affected the productiveness of the plants.

8. *Chionaspis vitis*, Green.—Some leaves of an undetermined jungle plant were affected by this species which occurs in Ceylon upon *Vitis* and *Loranthus*.

9. *Chionaspis separata*, n. sp. (plate 1, figs. 9-12).—On tea leaves from Darjeeling, are numerous conspicuous white pyriform scales (fig. 9) resembling in outward appearance those of the European species *Ch. vaccinii.* But a microscopical examination of the female insect proves it to belong to the group of which *Ch. aspidistræ* may be taken as the type, and consequently to be allied to *Ch. theæ*, from which, however, it is readily distinguishable by the snowy white puparium of the female and its much larger size, besides other less conspicuous though important points. As it will not agree with any of the known species, I here describe the insect under the name of *Ch. separata* ;— the specific name being suggested by a peculiarity of the circumgenital glands noted below.

Female puparium (fig. 10) white, sometimes tinged with pale brown, opaque. Pellicles pale straw colour. Form varying according to position, normally pyriform, one side often restricted by pressure against a prominent vein of the leaf. Length 3 mm. Breadth averaging 1·50 mm.

Male scale similar to that of *Ch. theæ*, snowy white, strongly tricarinate. Grouped as in *Ch. theæ*.

Adult ♀.—Colour of dried insect reddish brown. Form oblong (fig. 11) : abdominal segments well defined and produced into lateral tubercles, 2nd and 3rd each with a marginal group of spiniform squames. A small group of parastigmatic glands at each spiracle. Pygidium (fig. 12) with the median lobes rather small; their inner edges closely approximated; the free edge with a single notch. First lateral lobes duplex; lobules dilated at extremity. Second lateral lobes with single lobule only. Squames and spines normal. The usual marginal dorsal pores, with stout cylindrical ducts. A single dorsal pore situated between the lower lateral gland groups and the margin, and a scattered series of pores across the basal area of the pygidium. Circumgenital glands in five groups. The median group (in every example examined*) more or less distinctly *separated* into two parts together containing from 10 to 12 orifices. Upper lateral and lower lateral groups each with from 20 to 23 orifices. Anal

* It is very possible that examples from other colonies of the insect may not exhibit this peculiarity which may be confined to the particular brood under observation.—*E. E G.*

anterior to genital aperture. Length 1·50 to 1·80 mm. Breadth about 0·50 mm.

Habitat.—On the upper surface of tea leaves ; Darjeeling.

Differs from *Ch. theæ* and *Ch. aspidistrae* in its greater size, in the white colour of the puparium, and in having the anal aperture situated anterior to the genital orifice ; from *Ch. albizziæ* by its greater size and by the relative positions of the anal and genital apertures: and from *Ch. mussœudæ* by the small median lobes and the presence of both lateral lobes, as also by the colour of the puparium.

10. *Lecanium Watti*, n. sp. (plate 2, figs. 1-5).

These large scales were found on the twigs and stems of a tea plant in Assam. Though the insect is really very flat, the scales take the curve of the stem to which they are attached (fig. 1). These flat forms of *Lecanium* are usually leaf-infesting species, but *Lecanium Watti* was observed on the stems of the plant only, though the leaves and the whole plant were covered with the sooty fungus that usually accompanies members of this family. The species appears to be quite distinct, and I have very much pleasure in naming it after the distinguished author of 'The Pests and Blights of the Tea plant,' who has done such valuable work in bringing together all the scattered information on that subject and has enriched it by his own personal observations.

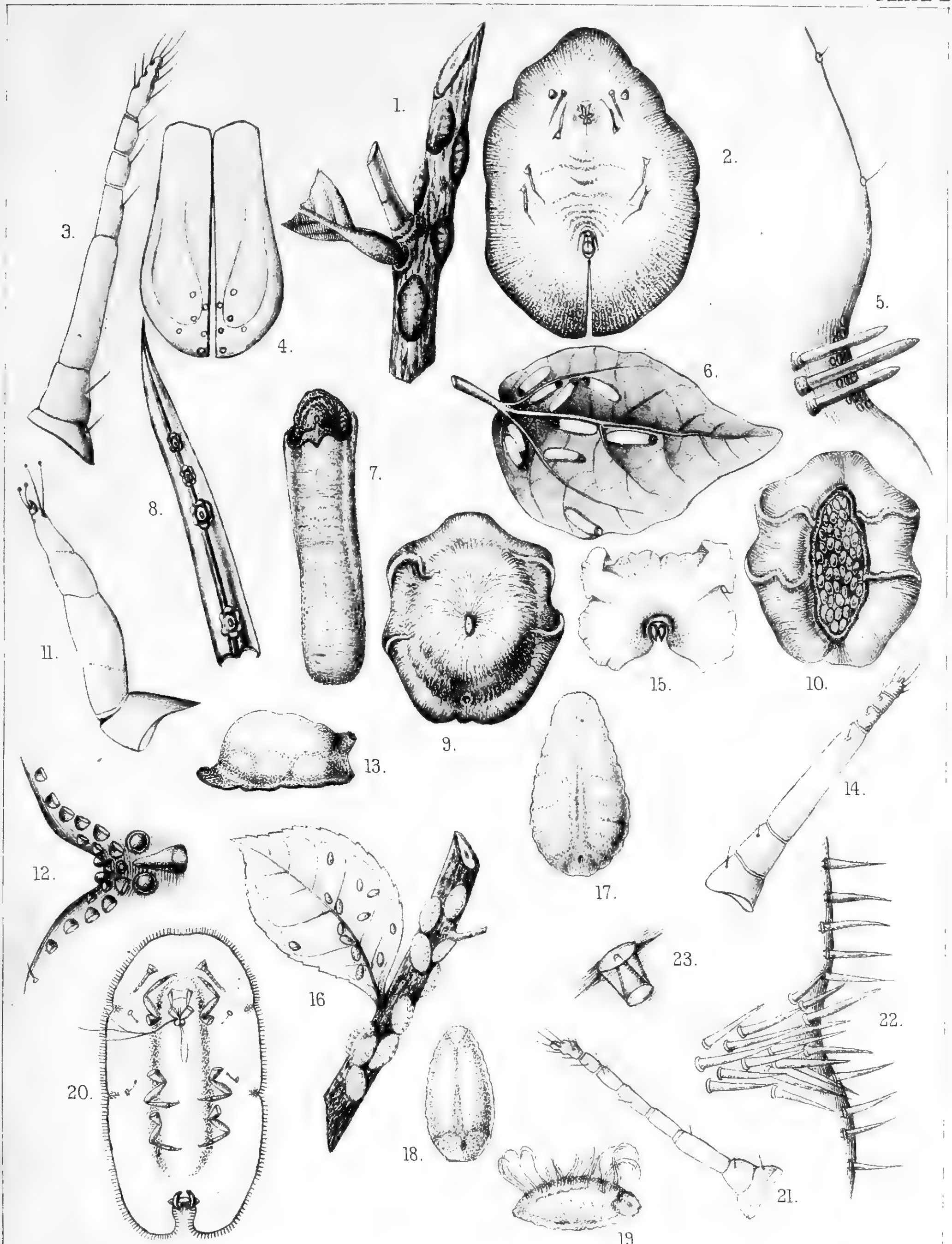
Adult ♀ (fig. 2) irregularly oval, with marginal indentations opposite the stigmatic orifices and a deep cleft from the posterior extremity extending inwards for more than one-fourth the total length of the insect: flattish, or slightly convex : undersurface curved to the shape of the stem upon which it rests. Dorsum coated with a tough colourless coarsely granular secretion which gives the surface a dull lustreless appearance*. Below this secretion the skin is polished, but coarsely granulate or mammillate. Colour bright castaneous (beneath the superficial covering) ; marginal area darker. Derm glands very small, approximately circular, scattered rather closely over the entire surface, rather more conspicuous (by reason of their darker surroundings) upon the marginal area. Eyes situated at some distance within the margin ; large and prominent ; conspicuous in macerated examples but obscured by the secretionary coating in the living insect. Antenna (fig. 3) 7-jointed, 3rd joint very long, equal to 4th, 5th and 6th together : the division between 3rd and 4th often incomplete and some-

* The specimens submitted for identification had been preserved in alcohol which may possibly have altered the nature of the superficial coating of secretion.

EXPLANATION OF PLATE II.

ALL FIGURES EXCEPT 1, 6, 8 AND 16, MORE OR LESS ENLARGED.

FIG. 1. LECANIUM WATTI, Green. Tea stem with insects in situ, nat. size.
" 2. Do. adult ♀, ventral view.
" 3. Do. do., antenna.
" 4. Do. do., anal plates
" 5. Do. do., stigmatic cleft.
" 6. PULVINARIA FLOCCIFERA, Westw., Acalypha leaf with insects in situ, nat. size.
" 7. Do. adult ♀, with ovisac.
" 8. CEROPLASTES MYRICÆ, Linn., Cycas leaf, with insects in situ, nat. size.
" 9. Do. adult ♀, dorsal view of waxy test.
" 10. Do. do., ventral view.
" 11. Do. do., leg.
" 12. Do. do., stigmatic cleft.
" 13. Do. do., removed from test, side view.
" 14. Do. do., antenna.
" 15. Do. do., Chitinous plate surrounding anal aperture.
" 16. ERIOCHITON THEÆ, Green. Tea stem and leaf, with insects in situ, nat. size.
" 17. Do. adult ♀, in test, dorsal view.
" 18. Do. ♂ puparium, dorsal view.
" 19. Do. do., side view.
" 20. Do. adult ♀, removed from test, ventral view.
" 21. Do. do., antenna.
" 22. Do. do., stigmatic cleft.



E.E.Green, del.

Photogravure - Survey of India Offices, Calcutta, December 1899.

1-5, LECANIUM WATTI, GREEN, *N. Sp.*
6 & 7, PULVINARIA FLOCEIFERA, WESTW.
8-15, CEROPLASTES MYRICAE, LINN.
16-23, ERIOCHITON THEÆ, GREEN, *N. Sp.*

times absent, in which case the number of joints is reduced to six : several longish hairs on terminal joint, and one or two on each of the others. Legs well developed, rather slender : feet normal. Stigmatic clefts (fig. 5) semicircular, with 3 longish straight cylindrical spines with bluntly rounded tips, attached to dorsal surface, the median spine longest. Marginal hairs minute and inconspicuous, simple, pointed. Anal plates (fig. 4) narrow : base very short : outer edge sharply rounded towards extremity : inner edge straight. Anal ring with 6 hairs. Size of average example 7 × 5 mm.

Male scale and adult male unknown.

Habitat on stems and twigs of the tea plant : Assam.

11. *Lecanium hemisphæricum*, Targ. var. *coffeæ*, Walk., *L. coffeæ*, occurs commonly on the teaplant in Ceylon, and doubtless so also in India. Dr. Watt's collection contains examples from Upper Assam, associated with *Ceroplastes myricæ*. The specimens under examination have been attacked, and mostly destroyed, by a parasitic fungus which appears to belong to the genus *Aschersonia* erected by Weber for a fungus parasitic upon a species of *Aleurodes* in America. The scales are covered and entirely concealed by a buff-coloured growth.

12. *Pulvinaria floccifera*, Westw. (plate 2, figs. 6-7).—On undersurface of leaves of *Acalypha* from Calcutta.

This species bears a very close resemblance to *Pulv. camellicola*, Sign., having a long narrow snowy white ovisac which makes it a conspicuous object on the dark *Acalypha* leaves (fig. 6). But Signoret distinctly states that his species has 6-jointed antennae, the 3rd joint being very long. *P. floccifera* has 8-jointed antennae ; none of them exceptionally long.

In a recent paper by Drs. Berlese and Leonardi,* there are several figures of *P. camellicola* in different stages, and one showing the antenna of the adult female, which is there represented with 8-joints. This is either a case of mistaken identification, or the number of joints must be variable. Possibly the 3rd, 4th and 5th joints may sometimes become fused into the single long joint described by Signoret. Under these circumstances, I think it very probable that Westwood and Signoret may have described the one species under the two names. As Westwood described *P. floccifera* in 1870 (Gardener's Chronicle, 1870, p. 308, fig. 52), while Signoret's description of *P. camellicola* is dated 1873, the former name would have precedence.

* Annalidi Agricoltura, 1898. "Notizie intorno alle Cocciniglie Americane cho minacciano la Frutticoltura Europea."

P. floccifera occurs rather commonly in English greenhouses on Camellia and various shrubs, also on orchids.

The actual insect is quite small and inconspicuous, represented by a shrivelled olive-green or brownish scale at the anterior extremity of the white cottony ovisac (fig. 7). The ovisac is longitudinally fluted.

13. *Ceroplastes ceriferus*, Anderson, occurs not infrequently upon tea in India and Ceylon. Dr. Watt's collection contains examples from Assam.

14. *Ceroplastes floridensis*, Comstock, is also found on tea and many other shrubs in India and Ceylon. Neither this nor the preceding species occurs in sufficient numbers to do much harm. Dr. Watt records it from Assam and Darjeeling.

15. *Ceroplastes myricae*, Linn. (Plate 2, figs. 8-15).—A third species found by Dr. Watt in Upper Assam and North Lakhimpur would seem to be of more importance as a tea pest. The smaller branches and twigs were thickly encrusted with the waxy masses, and the whole plant was covered with the resulting sooty fungus. The same species occurred plentifully upon plants of *Cycas revoluta* in Calcutta (fig. 8). Dr. Watt remarks that in each instance the *Ceroplastes* was associated with some other Coccid. The examples from Assam were in company with *Lecanium coffeæ*. In another instance *Fiorinia theæ* was the companion. And upon the Cycas plant *Aspidiotus orientalis* occupied most of the space not taken up by the *Ceroplastes*. This association of species has nothing of the nature of symbiosis. It is an accidental circumstance due probably to the fact that a weakly or unhealthy plant is more readily seized upon by insect parasites of all kinds.

Fresh examples of the insect are very ornamental objects, of a delicate pink colour, resembling miniature sea-anemones.

It was somewhat doubtfully that I identified this insect as *Ceroplastes myricæ*, the existent descriptions of that species being rather vague. Signoret refers to it in the following terms, quoting from an earlier author:—

"The female is about the size of a small pea; the body of a pale red colour and in the form of a half oval; the apex elevated and pierced by a small point; the circumference cartilaginous, thick, whitish, marked on the sides with seven small raised bands."

The specimens under examination answer to this description as far as it goes.

Under the name of ***C. rubens*** Maskell describes a red species from New Zealand, but states that the apex of the waxy test is broadly depressed which is not the case with these Indian insects. It is possible that *rubens* may be only a variety of *myricæ*.

It may be as well to supplement the above brief diagnosis by a more detailed description of the species as represented in India.

Test of adult ♀ approximately hemispherical: margin with seven rather obscure rounded prominences (fig. 9). An examination of the earlier stages shows eight distinct areas giving rise to the marginal prominences, one anterior, one posterior, and three on each side. During subsequent growth the posterior prominence is often obliterated by the confluence of the third lateral prominence on each side. The waxy envelope is very thick on the margins. In old examples the body of the insect shrinks inwards and the cavity is occupied by the numerous eggs (fig. 10). Apex of test with a slight depression containing the larval pellicle. Colour pale translucent pink; margins whitish. Two irregular opaque white waxy bands on each side, starting from the stigmatic clefts and curving upwards over the sides of the test, the anterior pair sometimes almost meeting in front. Inconspicuous white points above the cephalic area and from the anal orifice. A well developed example measures 4·50 mm. by 3·50 mm., with a height of 3 mm. But the size varies greatly and some (apparently mature) individuals are less than half these dimensions.

After removal of the waxy test the insect appears of a very different form (fig. 13). It is of a simple oval outline; strongly convex above, but not approaching the hemispherical. The anal lobes are situated upon a prominent chitinous tubercle which often becomes detached in a single piece during the process of maceration (fig. 15). A definite semicircular area on the anterior margin is also strongly chitinous, of a darker colour, and dotted with numerous translucent dark rimmed pores. Stigmatic clefts each with a single stout (often bifid) spine set at some distance from the margin on the dorsal surface; and between it and the margin numerous rounded dome-shape spines, smaller as they approach the margin (fig. 12). In examples from Cycas the dome-shaped spines are not so numerous, forming only a single line along the edge of the cleft. Antennæ of six joints (fig. 14); third joint very long, almost equal to the sum of the other five joints: terminal joint very short and wrinkled, with several longish stout hairs. Legs short and stout, the tibia and tarsus fused together, with scarcely a trace of any division (fig. 11). Foot with 4 digitules. Length of body varying from 2 to 3·50 mm.

16. *Eriochiton theæ*, sp. nov. (Plate 2, figs. 16 23).—I have received branches and twigs of a tea plant from Darjeeling closely encrusted with the waxy tests of the female insect (fig. 16), while the smaller more glassy scales of the male are disposed upon the undersurface of the leaves, the upper surfaces of which are densely coated with sooty fungus. This pest would probably be a serious one, if allowed to increase.

Female test (fig. 17) completely enclosing the insect, oblong oval, broadest behind, rather strongly convex : compact and closely felted : with a small circular aperture at the hinder end. There is a very indistinct median longitudinal ridge, on each side of which are numerous transverse ridges and furrows, suggesting the confluence of stout waxy processes. On some examples small waxy points can be detected on the median ridge. The examples under examination are not in good order, and it is possible that these waxy points originally supported brittle curling filaments similar to those on the male scales. Length 5 mm. Breadth $2\frac{1}{2}$ mm.

Male test (figs. 18, 19) glassy ; oval ; with an indistinct double ridge. Posterior extremity with two hinged plates forming a valve through which the adult insect escapes. From the median ridge (in fresh examples) proceed long curled opaque white filaments. These filaments are brittle and easily dislodged, and many of the scales show no trace of them. Length 3 mm. Breadth 1 mm.

Adult ♂ not observed.

Adult ♀ (fig. 20) oblong oval ; moderately convex above ; reddish brown. Margin closely set with finely tapering pointed spines in a single row. A dense group of about 15 stout pointed spines on the dorsal surface above each stigmatic cleft (fig. 22). After maceration two median longitudinal densely crowded series of minute dots can be distinguished by transmitted light, commencing above and slightly in front of the rostrum and terminating a little anterior to the anal scales. Under a high power these dots are seen to consist of two kinds of spinnerets ; the larger in the form of broadly conical perforate spines, each sunk in a pit-like invagination of the derm (fig. 23) ; the smaller, simple narrow cylindrical ducts. Antennæ distinctly 8-jointed (fig. 21) ; 3rd longest, equal to 7th and 8th. The antennal formula usually 3, 4, (5, 8), (2, 6), (1, 7): 5 sometimes equals 4, or occasionally exceeds it. Legs rather stout: tarsus about $\frac{2}{3}$rds. length of tibia. Foot with 4 digitules ; (tarsals longish stout capitate hairs ; unguals broad and spatulate). Anal cleft broad. Anal ring with six stout longish hairs. Anal plates rather widely separate. Length 3·25 mm. Breadth 1·75 mm.

The late Mr. W. M. Maskell (in the Trans. New Zealand Institute, 1898), has described, under the name of *Ceronema japonica*, an Indian tea pest received from the Indian Museum, which in many respects very closely resembles the species here described. But in spite of many strong points of similarity, the discrepancies are so great and important that without reference to Mr. Maskell's examples (now alas impossible) I am unable to reconcile them. The points of resemblance are—the median row of curling filaments on the male scale: the fringe of pointed spines, and the dense group of pointed stigmatic spines. The 'two longitudinal series of short thick conical spines on the median dorsal region' of Maskell's *Ceronema japonica* correspond to the similarly situated series of sunk conical spinnerets of *E. theæ*.

Eriochiton theæ differs from Maskell's species in having a compact test completely enclosing the adult ♀. It has 8 distinct joints in the antennæ, while *C. japonica* is said to have 7-jointed antennæ with a false joint in the 4th. The anal ring in *E. theæ* bears 6 stout hairs only. *C. japonica* is said to have 'several hairs,' but is figured with 11 in each of the two rings represented. It is impossible to believe that the reduplication of the anal parts as described by Maskell is normal, though it is stated to have occurred in all the specimens examined—both from India and Japan. I would suggest that this extraordinary appearance may have been due to the examples being immature, or taken just before the final ecdysis, when the adult insect would be seen within the skin of the previous stage.

The species mentioned and described in the present paper raise the number recorded from the Indian Continent to 37, distributed amongst 14 genera, as below :—

DIASPIDINAE—

I. *Aspidiotus*—

aurantii, Mask.	1
artocarpi, Green	2
camelliæ, Sign.	3
dictyospermi var. *arecæ*, Newst.	4
moorei, Green	5
orientalis, Newst.	6
theæ, Mask.	7

* Typical *prunicola*, Mask. has been shown to be a synonym of *Diaspis amygdali*, Tryon. The variety is probably distinct and will require renaming.

NOTES ON INSECT PESTS FROM THE ENTOMOLOGICAL SECTION, INDIAN MUSEUM.

BY THE LATE E. BARLOW,

LATE ENTOMOLOGICAL ASSISTANT, INDIAN MUSEUM.

1. TEA PESTS.

Serica assamensis, Brenske.

(Order Coleoptera, Sub-fam. Melolonthini.)

Plate III, fig. 1.

Serica assamensis, Brensk. *Ind. Mus. Notes*, Vol. IV, No. 4, p. 176, pl. XIII, fig. 4.

In April 1899, from Messrs. Andrew, Yule & Co. were received specimens of a beetle reported to be very destructive to tea plants in one of their tea estates in the Duars, Assam.

The insect proved to be a Melolonthine beetle and quite distinct from the so-called "orange beetle." It is a new species and has been recently named, *Serica assamensis* by Brenske; the Latin description of it will be found in *Indian Museum Notes*, Vol. IV, No. 4, p. 176.

This beetle is, no doubt, a new accession to the already large number of known insect pests of tea in India. It was found last year for the first time as doing damage to tea in one of the Duars tea estates.

It is of a brown[1] colour, the head and thorax being reddish brown. Clypeus obscurely three-toothed, broadish, finely punctate and furnished with very short spines, the middle line being slightly keeled longitudinally. Thorax broad, sides slightly rounded anteriorly, straight posteriorly; posterior angles obtuse. Elytra with a series of stripes, the inter-spaces between them being little convex. Femora and tibiæ slightly broadened posteriorly. Antenna 10-jointed, 2 to 7 joints very short, the terminal joint faintly three-lobed in both

[1] Brenske describes the insect as yellow, this is owing to the specimens from which he described the species, having lost their natural colour by being immersed in strong alcohol. E. B.

sexes and hardly longer in the male. Length 6 to 6·8 millim. : breadth 4 to 4·3 millim.

The following interesting report has been furnished by the Manager of the Duars Tea Estate regarding the pest :—

Under date 13th April 1899.—These beetles appear to have flown on to the garden *last night*, there were none to be seen yesterday, and to-day they are to be found on nearly all sections of the garden.

In appearance they are not unlike the orange beetle described in Dr. Watt's book. " The Pests and Blights of the Tea plant ", pages 186 to 190.

They are, however, I think different, as my experience of the orange beetle on other gardens is that it only bites the *stems*, and this agrees with Dr. Watt's description of depredations.

This beetle, however, has eaten *nearly all the leaves*, as you will see.

They have done a deal of *damage in one night*. There are patches of about 100 bushes, with *nearly all the green leaves of this year's growth eaten up as well as the fresh stalks* eaten through.

There are no beetles on the bushes just now, but *on opening up the soil* near the bushes which are damaged, I have *found the beetles in great swarms.*

I have put all the children on to-day to collect them. If I find that the beetles go up from the ground on to the bushes to-night, as I fear they may, I will put all the women as well as the children on to collect them to-morrow.

I have been trying different things all day to see *what would kill this beetle*, with a view to spraying the soil.

I find them *very hard to kill*, as they resist phenyle, bluestone solution, carbolic acid solution, and kerosine oil, unless pure. We *cannot kill them by spraying the ground.*

Some of the coolies say this beetle appeared last year, and that it only stayed for a day or two. They say that if we get a day or two hot sun, instead of this *cold cloudy weather*, it will go away as it did last year.

Other of the coolies say the beetle which appeared last year was of a different species. *Most* of the coolies hold this opinion.

Later under date 13th April 1899.—I have been to the garden to *examine the bushes by lamp light.*

I have found the beetles *flying about.* I could not find many in the ground, neither could I find many on the bushes, but they are *flying about in great numbers near the bushes which were eaten last night.*

Under date 14th April 1899.—The beetles have *not done any more harm* although there are *still great numbers in the ground near the bushes*, which were eaten.

I think a great many have cleared out.

I have had *over 300 coolies collecting* them to-day, and you would be astonished at the great quantity brought in. It will take about the same number of coolies one more day to finish the collecting of them.

I cannot understand why the *beetles did not eat any more leaves last night.*

It was *very cold last night for the time of the year*, but I do *not* think the cold could have prevented them from eating the tea, had they wished to do so.

I am disposed to think the beetles were flying over the garden, and dropped down on different parts of it, and ate the tea leaves, but found they were not to their liking, and so did not eat them a second time.

Note.—The garden is in its 4th year. Ját of plant is Munipuri indigenous. Open garden free of tree jungle. Elevation about 1,800 feet at base of Bhutan Hills.

Heterusia cingala, Moore.

(Sub-order Heterocera, Fam. Zygænidæ.)

Heterusia cingala, Moore, *An. Nat. His.* 1877, p. 343; *id. Lep. Ceyl.* ii, p. 41, pl. 96, fig. 1; *C. & S.* No. 391; Hamp. *Faun B. Ind. Bur. Ceyl. Moths.* I, p. 262.

In March 1898 Messrs. Davenport & Co. forwarded to the Indian Museum specimens of a caterpillar said to be devastating some of their new extensions in the Darjeeling Tea Estates.

The insects proved to be the larvæ of an unknown Zygænid moth. However, some of the caterpillars that appeared to be alive were enclosed in a breeding cage where they very readily pupated. This looked like obtaining a moth for further identification. But instead of moths, numerous Tachinid flies emerged from the cocoons, which on examination were found to be so thoroughly parasitized by the flies that out of a dozen cocoons not a single moth was reared; each cocoon harbouring as many as ten pupæ of the fly.

On submitting specimens of the fly to Mr. Coquillett for examination, he identified it as the species he had some time ago described and named *Exorista heterusiæ*, a Tachinid parasite which had been bred from a tea pest *Heterusia cingala* by Mr. E. E. Green in Ceylon, the description of the fly appearing in *Indian Museum Notes*, Vol. IV, No. v, p. 279.

From the identity of the parasite and the similarity of its life-history with that of the species observed by Mr. Green, it was inferred that the caterpillar-host might also, probably, be identical with the Ceylon species, and this on examination proved to be the case—the larvæ and cocoons forwarded by Messrs. Davenport & Co., being identical with the larvæ and cocoons of *Heterusia cingala*, Moore presented to the Museum by Mr. Green.

The following is Mr. Moore's description of the moth, larva and pupa:

Moth ♂ and ♀ : forewing dark sap green, with a broad basal whitish blue-bordered band, crossed by a blackish-green streak; a discal zigzag series of yellowish spots, and a larger spot at end of the cell: hindwing with the base and a broad outer band black, the veins and marginal border steel-blue; a series of yellowish spots before the apex, which are indistinct in the male; middle band pale yellow. Thorax and base of abdomen in male steel-blue, lower part of abdomen yellow, tip black, antennæ black, shaft steel-blue. Underside as above, veins blue lined.

Expanse, ♂ 2, ♀ 2½ inches.

Larva short, thick, anterior segments broadest, head small; ochreous-brown, the segments with six or seven rows of black tipped tubercles, from which spring two or three short black hairs.

Pupa pale ochreous-yellow beneath, pinkish and spotted above, in a narrow dense pale ochreous cocoon.

For an illustration of the moth, larva, and cocoon, see *Indian Museum Notes*, Vol. IV, No. V, plate XVIII, fig. 2, *a*—*b*.

Insect affecting coffee leaf.—In June 1898 Mr. W. M. Daly forwarded to the Indian Museum specimen of a coffee leaf said to be infested with insects from the Dalur Estate, Kadur.

The insects proved to be the eggs of an Orthopterous insect, belonging to the family Locustidæ (Long horned grasshoppers), which usually lay their eggs in neat rows upon leaves and branches upon which they live and feed. The eggs are oval in shape and each overlaps its neighbour slightly.

The eggs were apparently alive when they arrived in the Museum, but all efforts to rear them artificially for conclusive identification proved unsuccessful.

II.—INSECTS DESTRUCTIVE TO CEREALS AND CROPS.

Hispa aenescens, Baly.

THE RICE HISPA.

Reports and specimens of this very destructive and common rice beetle, locally known as 'Pamari' or 'Maria poka,' were received in the Indian Museum from the Director, Land Records and Agriculture, Bengal, as attacking paddy crops in the Backergunge district during the year 1898.

The following is an extract taken from a report furnished by the Manager, Court of Wards, Backergunge, dated 15th August 1898 :—

"These insects generally make their appearance in June and July ; but where they come from, nobody can say with certainty. Some say they come flying from the distant jungles, and others hold that they are originated in the decomposed earth of the paddy fields. But the former seems to be more probable.

"The attack commences when the ears begin to shoot out. The insects first fall upon the upper part of the leaves and after sucking the juice in them and causing them to wither away, they go down and cut the ears.

"Whenever the attack is made, the havoc is more or less complete. On the whole two annas of the *aus* crops is supposed to have been damaged by these insects. The insects have also attacked some of the *aman* paddy plants.

"The tenants did not adopt any means to drive away the insects. The travelling overseer of the Department of Land Records and Agriculture, who was lately here, suggested sprinkling of sulphate of copper lotion (one tola sulphate of copper with $2\frac{1}{2}$ seers of water). We tried this in presence of the said overseer, but without any effect."

Epacromia dorsalis, Thunb.

Specimens of grasshoppers attacking the young wheat crops in the Kopargaon Taluka of the Ahmednagar Collectorate were forwarded to the Museum in December 1898, through the Survey Commissioner and Director, Land Records and Agriculture, Bombay, from the Collector of Ahmednagar.

The Mamlatdar of Kopargaon wrote :—

"I have visited the villages of Derde Khd., Derde Bk., Modhi Khd., and Modhi Bk., in this Taluka and noticed that the young wheat crops in about 20 number have been almost destroyed by small insects. I personally went through some of the fields and found the insects too numerous to be easily destroyed."

The insect proved to be an Acridid grasshopper belonging to the species *Epacromia dorsalis*, Thunb., which has previously been reported as attacking crops in several parts of India. Accounts of it may be found in *Indian Museum Notes*, Volume II, pp. 104 and 171; Volume III, No. 1, pp. 27, 29 and 30.

Cricket injurious to bajri and other crops.

In May 1898 specimens, which proved to be the immature forms of a cricket, probably belonging to the genus *Gryllodes*, were received in the Indian Museum from the Collector of Ahmednagar, through the Survey Commissioner and Director, Land Records and Agriculture, Bombay, as destructive to bajri and other crops in the villages of the Kopargaon Taluka.

The following is from a report dated 13th May 1898, from the Mamlatdar of Kopargaon :—

". . . That a flight of insects called 'Naktode' has arrived in most of the villages from Kopargaon to Chitali from the East from villages in the Newasa Taluka and H. H. the Nizam's territory. They eat tender leaves of khindi and kodwal and thus destroy the stem. They also eat bajri and jowar corns; they jump about a foot. They have got no points to their legs like a saw like the locusts nor any wings. There is very little of khindi and kodwal in this taluka, and particularly in the portion visited by them, and hence there is no possibility of any damage for the present, but if they lay eggs there is a fear of fresh insects being produced just at the next sowing season. They might eat up the seed as well as the plant. The best remedy in my opinion would be to burn every cultivable land with a little rubbish or rab after ploughing it a little before the sowing season so that the little insects as well as their eggs may be burnt. The burning must, however, begin at one and the same time in all villages on a fixed night like the general census. . . . . The insects bite people at night, enter private houses, eat bread flour and corn and disappear in the day time. The mail was detained for about half an hour at Chitali on Wednesday night on account of the rails being covered by these insects. . . ."

Chrotogonus trachypterus, Blanch.

In September 1898 specimens were forwarded by the Survey Commissioner and Director, Land Records and Agriculture, Bombay, of an insect reported to have done damage to young bajri and other crops in the Ahmednagar and Bijapur districts.

The specimens consisted of larvæ and imagos of the Acridid, *Chrotogonus trachypterus*. A small thickset brown grasshopper which appears to be very destructive to young crops of almost all kinds. Accounts of it will be found in the pages of these *Notes*.

Hieroglyphus furcifer, Sauss.

(Ord. Orthoptera fam. Acrididæ.)

In September 1898, damage to some extent was caused in the Kerowlee States, and in the Bombay Presidency, etc., by grasshoppers belonging to the species *Hieroglyphus furcifer*, Sauss. In the Surat district, the village officers report that these insects are destroying the bajri and rice crops as also the grass. It is said that the insects have their origin in grass and that they are found every year in grass only. This year they are found in other crops which they are destroying.

In *Indian Museum Notes* reference is made of this insect as destructive to crops in the Rajpipla State, and in the Panch Mahals, Broach, and Thana districts in the Bombay Presidency, etc.

The following extract is taken from the translation of a report compiled by the Revenue Department of the Kerowlee State on the birth, etc., of the "Kata" insect :—

"'Kata' is an insect whose legs, wings and body resemble those of the locust . . . .

The egg-laying is generally believed to take place during the rains like other insects of the rainy season.

When these insects are very numerous and cause serious injury to crops attention is drawn towards them. As it cuts and devours leaves the people here called it 'Kata' (cutter). It is not known by any other name here.

At the time of birth some say it is of green or khaki colour like mosquitoes, ants and flies . . . .

Others say it lays eggs like locusts. Some say that small white eggs about the size of mustard or even smaller were found in masses of fifty to hundred underneath the ground when the land was prepared before the rains. Afterwards in the same fields large number of these insects were found.

The colour of the young insects is generally green and as it increases the colour changes. Some say that the colour of the crop it devours affects its colour. The majority of the insects submitted are of a yellow colour.

In the beginning it creeps from one plant to another. When it acquires wings, it hops by slightly flying, because it has not sufficient power of flight. It cannot fly in swarms as locusts do from one place to another.

The chief crops it attacks are jowar, bajri, moth, masina, sugarcane and others. It wholly devours the foliage of the plants. It eats the shoots of the bajra crop in such a way as to leave no grain in them.

It generally eats the jowar and bajra crops whose leaves are long. The majority of these insects is found at present in the bajra fields and in others, not so much . . . .

When young this insect dies by the abundance of rain. As it did not rain heavily this year, the insect did not decrease . . . .

It is said that at the commencement of the winter season, these insects naturally die away.

Some eye-witnesses say that this insect casts off scales like the snakes. When it casts off the covering it is of yellow colour. It also casts off the wings and then gets new wings afterwards. From the specimens it will be seen that the wings are proportionately smaller than the body. This shows that new wings are growing out. Some have larger wings.

Those who have smaller wings can hop for three or four feet. The more it moves backward to hop, the more it leaps forward, and thus it can go from one field to another . . . .

Those who have wings cannot fly more than forty or fifty feet at a time.

The length of the insect is from two to three fingers or more or less. Some of the zemindars say that there are even larger and winged insects of this kind to be found in the fields, which cannot be got hold of. These insects were never found in such large numbers before as this year."

THE SORGHUM BORER MOTH.

Chilo simplex, Butl.

Chilo simplex, Butl., *P. Z. S.*, 1880, p. 690.

Crambus zonellus, Swinh. *P. Z. S.*, 1884, p. 528, pl. 48, *fig.* 16; *C.* & *S.* No. 4703.

Crambus partellus, Swinh. *P. Z. S.*, 1885, p. 879; *C.* & *S.* No. 4700.

During the year 1898 the Sorghum borer was exceedingly abundant in the Central Provinces. Samples of juar (*Sorghum vulgare*) stems affected by it were repeatedly forwarded to the Indian Museum through Dr. G. Watt, Reporter on Economic Products to the Government of India, from Seoni, Chappara, Central Provinces.

Half-grown caterpillars taken out of juar stalks that had become dry and useless, were reared in sugarcane; they seemed none the worse for the change of the food plant, but very readily tunnelled into it, and in due time as many as a dozen moths were obtained. These on comparison proved to be *Diatraea saccharalis* as doubtfully named by Mr. E. C. Cotes, an insect that commonly bores into sugarcane in India.

To clear the doubt that has long existed as regards the correct identity of the insect, specimens were submitted to Sir G. F. Hampson, who very kindly identified them as belonging to the species *Chilo simplex*, Butl. He describes the species as follows :—

Male: yellowish brown suffused with fuscous. Fore wing with the costal area rather darkest; traces of dark specks below middle of cell and at lower angle; the veins of outer area slightly streaked with fuscous: a marginal series of black specks. Hind wing whitish with slight fuscous tinge.

Female paler: the hind wing white.

The form *partellus* has on the fore wing of male a highly curved antemedial series of short fuscous streaks, a slight yellowish patch in end of cell, an oblique series of diffused fuscous streaks from apex to middle of inner margin, and a sub-marginal series of specks; female with some diffused fuscous from apex round lower angle of cell, or sometimes nearly evenly suffused with fuscous, with a dark fuscous patch beyond cell.

Hab. Japan; Chusan; Formosa; Punjab; Karachi. Exp. 22 millim.

Heliothis armigera, Hubn.

In April 1898, from the Sub-divisional Officer, Naogaon, were received some samples of ganja plants injured by insects. He wrote :—

"I have the honour to advise despatch by rail of one wooden box containing ganja plants infested with insects called 'Hirkati,' spider, etc., and affected by diseases locally called 'Bhuachatta' or 'Ambola,' etc . ... I may mention here that 'Bhuachatta' or 'Ambola' is a sort of disease, which, when appears in plants causes the resinous portion to disappear from the plants and in consequence of which no ganja is produced."

The samples reported to be suffering from 'Ambola' or 'Bhuachatta' and 'Hirkati' all appeared to be atacked by caterpillars of one species, namely, *Heliothis armigera*, Hubn., which has previously been recorded as attacking crops such as paddy, hemp, poppy, etc., in almost all parts of the world. Accounts of it may be found in the pages of these Notes.

In the sample said to be affected by 'Mukra' no insect was discovered.

The description of the moth *Heliothis armigera* is quoted below as given by Sir G. F. Hampson in his Fauna of British India Series, Volume II.

Ochreous with a pale brown, olive, or red-brown tinge. Fore wing with indistinct double-waved antemedial lines; a dark speck representing the orbicular; an indistinct curved medial line; the reniform indistinct; postmedial and sub-marginal waved lines, the space between them somewhat darker and with a series of pale or dark specks on the nervules; a marginal series of dark specks. Hind wing white; the veins fuscous: a broad blackish outer border usually with a pale sub-marginal central patch. Underside of fore wing with the orbicular and reniform stigmata conspicuously black; a broad blackish band beyond the postmedial line; the apices of both wings and outer area of fore wing pinkish.

Larva.—Dorsal area pale brown; a lateral whitish band; ventral area pale green: each segment with some black specks; head red-brown. Or green with a dark dorsal and two yellow lateral lines; the thoracic somites speckled brown and black, 5th to 10th somites with lateral brown blotches, anal somite with an irregular black dorsal mark.

Hab.—Universally distributed. *Exp.* 31—41 millim.

III.—IDENTIFICATION OF INSECT PESTS INJURIOUS TO CROPS OF VARIOUS KINDS, FORWARDED TO THE INDIAN MUSEUM DURING THE YEAR 1898.

1. Specimens of immature insects forwarded by the Secretary of the Agri.-Horticultural Society of India, as eating up hundreds of bigahs of crops in Jamalpore. These appeared to be the larvæ of the Noctues moth *Heliothis armigera*, Hubn.

2. From the same officer were received specimens of an insect doing considerable injury to growing indigo in the Allahabad District. The insect proved to be a bug of the family Pentatomidæ. They are identical with *Apinis concinna*, Dallas, which has previously been reported as attacking rabi crops in the North-West Provinces ; *vide Indian Museum Notes*, Vol. I, pp. 111 and 127.

3. Specimens of an insect locally called 'korapoka' were forwarded by the Collector of Murshidabad as injurious to crops.

This appeared to be the immature form of a beetle belonging to the family Scarabæidæ, sub-family Melolonthini.

4. Specimens sent by the Professor of Madras College of Agriculture as causing injury to Dholl (*Cajanus indicus*), grown in the Government Farm, Saidapet, were identified as belonging to the species *Mylabris pustulata*, Thunb. a Cantharid beetle reported for the first time as a pest to agriculture. (See plate III, fig. 2.)

5. Insects said to have caused great damage to the *bhada dhan* in the Sub-division of Bettiah. These were identified with *Leptocorisa acuta*, Thunb., the common rice sapper of Bengal. The specimens were forwarded by the Director of Land Records and Agriculture, Bengal.

6. Insects doing damage to the green leaves of the potato plants in Shillong were sent by the Officiating Director, Land Records and Agriculture, Assam. These proved to be a Cantharid beetle belonging to the genus *Epicauta*.

The specimen being new to the Museum Collection.

7. From the Professor of Agriculture, Baroda College, were received specimens of an insect attacking cotton bolls in the College Farm.

This insect belongs to the species *Oxycarens lugubris*, Mostch. It has previously been reported both from the Madras Presidency and Ceylon in connection with cotton.

IV.—LOCUSTS.

Acridium succinctum, Linn.—Specimens, taken from the flights of locusts that had appeared in the Bombay Presidency during the latter end of the year 1898, as doing damage to crops, were forwarded to the Indian Museum through the Survey Commissioner and Director, Land Records and Agriculture, Bombay.

These insects proved to be the same as *Acridium succinctum* Linn. the locust which has previously been recorded as attacking crops in several parts of India. Accounts of it may be found in Indian Museum Notes, Vol. II, pp. 10, 28, 100, 110, and 169; Vol. III, p. 32.

The following reports have been furnished by the Survey Commissioner and Director, Land Records and Agriculture, Bombay, regarding the flights :—

(1) " I have the honour to forward herewith a bottle containing specimens of locusts for identification and remarks. They appeared on the 27th ultimo at Mhaswandi, Sangamner Taluka, Ahmednagar District, and destroyed standing crops. The village officers there, with the assistance of the people, are trying to destroy them " (dated 9th November 1898).

"(2) In advising despatch of a bottle containing specimens of locusts for favour of identification and remarks, I have the honour to inform you that the insects have appeared in about 60 hill-side villages of the Mabad Taluka of the Kolaba Collectorate."

" These insects have not appeared in large numbers and as the nagli, vari, and unripe paddy crops on which they have been feeding, have now mostly been cut, no great damage to these crops is feared. If, however, they continue long in the district, the yield of grass and of summer crops may suffer" (dated 3rd December 1898).

Acridium peregrinum, Oliv.—The migratory locust of North-West India.

The following are reports (with specimens) which have been forwarded to the Indian Museum, regarding the appearance of the locust (*Acridium peregrinum*, Oliv.) during 1897-98 :—

(1) From the Officiating Collector of Pabna, through the Director of the Department of Land Records and Agriculture, Bengal, dated 29th January 1898.

"I have to report that a large swarm of locusts made its appearance on the 9th instant on the west bank of Jamuna in the jurisdiction of outpost Chauhali, Thana Shazadpur, Sub-division Sirajganj of this district.

"The swarm was estimated by my Kanungo who saw it to be two miles long and came from a north-westerly direction. The locusts settled on mango trees and on the young china, barley and pulse crops. They did not attack the hemp crop.

"Three specimens of the locust are sent . . ."

(2) From the Collector of the Panch Mahals, through the Survey Commissioner and Director, Land Records and Agriculture, Bombay, dated 17th March 1898.

"Forward herewith some samples of locusts sent to this office by the Mamlatdar of Godhra, who reports that a flight of locusts passed over Mehlol in Godhra Taluka on 5th February. The locusts appeared to have arrived from the south of Mehlol and passed on towards the north, and no damage is reported to have been caused by them."

(3) From the Deputy Commissioner, Upper Sind Frontier, through the Survey Commissioner and Director, Land Records and Agriculture, Bombay.

"I have the honour to inform you of the appearance of locusts in three talukas of this district and to give the necessary information in the subjoined form :—

TALUKA.	Date of appearance.	Extent to which damage was caused by locusts.	REMARKS.
Jacobabad .	17th and 29th September 1898.	*Nil.*	Came in flights from the east and passed on to the west.
Thal . .	14th, 17th, and 18th September 1898.	Standing Bajri crops in 10 acres of land in Det Jamal.	Came from the north-easterly direction and went to the west.
Kashmor . .	14th and 15th September 1898.	Damage caused insignificant.	Came in flights from the north and went towards the south.

The specimens sent by the Mukhtiarkars of Thul and Kashmor Talukas are forwarded."

The following are the reports (without specimens) that have been received in the Museum regarding the appearance of locusts :—

(4) Through the Under-Secretary to Government, Revenue Department, Bombay.

(*a*) From the Mamlatdar, Taluka Bassein, District Thana, dated 12th November 1898.

"I have the honour to report the appearance of a small flight of locusts in Bassein Fort. It appears that these insects came in the night some 2 days ago, and it is not known therefore what direction they came from. Some of them are green, some red and some yellow, the size of all being two inches in length. Rice crops in the Fort were already reaped and removed and tur crops planted. The plants of the two crops are almost eaten up by the locusts. Some of these locusts are seen now on the north side of the Bassein town, and it seems therefore that the direction of their flight is northward."

(*b*) From the Collector of Hyderabad (dated 20th December 1897).

"I have the honour to submit a statement showing the extent of the damage done by locusts in the Hyderabad District.

"The Tando Division, it will be observed, has escaped with very little damage, three pies in the rupee being estimated as the greatest in any part. The Hala Division has not been quite so fortunate. The damage done in the Hala Taluka is reported as 4 annas in the rupee. The Naushahro Division, however, has suffered severely. The lowest estimate of the damage done has been reported as six annas in the rupee in the Kandiaro Taluka, while in the Moro Taluka it is said to have reached the high figure of 12 annas."

Statement showing the extent of damage done in Hyderabad District.

Name of Taluka.	Damage shown by annas in a rupee.
Hyderabad	1 anna.
Hala	4 annas .
Tando Allahyar	3 ,,
Shahdadpur	3 ,,
Kandiaro	6 ,,
Nowshahro	8 ,,
Moro	12 ,,
Sakrand	10 ,,
Guni	2 pies.
Dero Mohbat	3 ,,
Tando Bago	1 pie.
Badin	1 ,,

(*c*) From the Collector of Shikarpur (dated 20th November 1897).

"I have the honour to report that the damage done by locusts is by no means extensive nor the injury widespread though their presence was general. In many talukas the injury has been so slight as not to necessitate any remission of revenue at all. In some places the loss was exaggerated at Nasirabad where the Acting Mukhtiarkar had reported that something like R25,000 remission would be granted, but prompt enquiries on the spot by Mr. Pringle have proved the loss to be much smaller and the amount of remission is now estimated at R3,000 only.

"The taluka of Sukkur has suffered to some extent. There the locusts appeared just while the crops were ripe and were being actually reaped. Here the loss of revenue is estimated at R8,000.

"In other talukas the injury is more or less scattered. The total loss of revenue in this district on account of locusts is at present estimated to be under R20,000."

(*d*) From the Deputy Commissioner of Thar and Parkar (dated 23rd December 1897).

Statement showing damage done by locusts to kharif crops in the Thar and Parkar district taking sixteen annas to be an average crop.

Name of Taluka.	Kharif crops.				
	Bajri.	Til.	Cotton.	Jowari.	Indigo.
Umarkot	6 annas	4 annas	2 annas	...	...
Khipra	14 "	4 "	8 "	13 annas	...
Sanghur	7 "	...	8 "	...	6 annas
Mirpur	4 "	4 annas	6 "	...	...
Mithi	10 "	10 "	10 "	10 annas	10 annas
Dipla	10 "	10 "	10 "	10 "	10 "
Chachro	6 "	6 "	...	...	4 "
Nagar	2 "	2 "	2 annas	2 annas	2 "

(*e*) From the Collector of Karachi (dated 21st May 1898).

"I have the honour to give below the information called for as regards the area, in each taluka, over which the crops were affected."

Taluka.	Total area cropped.		Area affected.	
	A	G	A	G
Dadu	55,883	...	2,000	...
Johi	56,817	...	99	...
Sehwan	88,041	...	200	...
Manjhand	13,365	...	1,306	...
Kotri	13,520	...	1,690	...
Kohistan	8,000	...	3,000	...
Karachi	41,374	19	7,987	...
Totta	6,374	22	2,468	22
Sakro	3,219	22	2,304	10
Mirpur Bathoro	460	37	27	20

(*f*) From the Deputy Commissioner, Upper Sind Frontier.

"I have the honour to subjoin a statement showing the extent of damage caused by locusts in this district."

Name of Taluka.	Total number Dehs.	Number of Dehs in which damage was caused.	Area in which standing crops were damaged.	Total loss.	Remission to be given on account of damage caused by locusts.	Remarks.
			Acres.	R	R	
Jacobabad	98	42	9,000	30,000	8,000	Locusts appeared in this taluka on 1st November 1897.
Thul	131	121	21,100	22,000	9,000	Locusts appeared in this taluka on 10th and 30th October 1897.
Kashmor	112	54	20,000	35,000	12,000	Locusts appeared in this taluka on 16th October 1897.
Shahdadpur	58	63	8,055	9,750	2,50	Locusts appeared in this taluka on 2nd November 1897.
Total	399	270	58,155	95,750	31,500	

(5) From the Baluchistan Agency.

Extract from the Baluchistan Agency diary for the week ending the 31st May 1898.

The Political Agent in Southern Baluchistan reports in his diary for the week ending 24th May that locusts visited Kauraj in Las Bela on the 3rd idem and damaged the jowari crops at that place.

Extract from diary of the Baluchistan Agency for the week ending the 8th July 1898.

In his diary for the week ending 30th June 1898, the Political Agent, South-Eastern Baluchistan, reports that large swarms of locusts visited the neighbourhood of Qir Tyara on the 17th idem, and that after destroying the crops there they passed on in the direction of Sheh. On the 19th another swarm was seen at Bela. Considerable damage is also reported to have been done to the jowar and moong crops in the District of Kaurach.

Extract from the diary of the Baluchistan Agency for the week ending 24th September 1898.

The Political Agent reports that locusts appeared at Fort Sandeman and Loralai during the first week of September. Some damage has been done to the millet and vegetable crops.

Extract from diary of the Baluchistan Agency for the week ending the 8th October 1898.

Locusts are reported to have visited the Niabut of Kamraj, in the Las Bela State, and to have destroyed the moong crops.

Extract from diary of the Baluchistan Agency for the week ending the 16th October 1898.

The Extra-Assistant Commissioner, Lower Zhob, reports that locusts appeared at the village of Chhap in the Musakhel Tahsil on the 11th September 1898, and destroyed the moong and millet crops to some extent.

V. INSECTS INFESTING FRUIT TREES.

MANGO TREE PESTS.

Limacodid moth.—In August 1898, the Assistant Superintendent of the Poona Farm reported and forwarded specimens to the Museum of a caterpillar that were eating off all the leaves of the mango trees in the Poona Farm Garden.

The insects proved to be the immature forms of a Limacodid moth, the specimens being insufficient for precise identification.

(2) *Melolonthine beetle.*—Specimens of an insect said to be damaging the roots of the mango trees in the Badaun District, were received in the Museum through the Director, Land Records and Agriculture, North-Western Provinces and Oudh, in September 1898. These appeared to be the larvæ of a beetle probably belonging to the sub-family Melolonthini (cockchafers).

(3) *Scale insect.*—A few mango twigs infested with insects were submitted for examination to the Entomological section, Indian Museum, in January 1898.

The twigs were found to be attacked by a scale insect (*Coccid*), probably belonging to the genus *Aspidiotus*.

Grape pests.—In June 1898 Mr. J. Cameron, Superintendent, Government Museum, Bangalore, wrote:—

"The insects which I have forwarded for your acceptance with a few damaged grapes, have been attacking the grapes cultivated in the Darin Dowlet Bagh at Seringapatam."

The insects which proved to be Staphylinid beetles and new to the Museum Collection, were so far identified as belonging to the genus *Carpophilus*.

Mons. Fauvel to whom specimens were sent for examination, reported that they belonged to four different species of Staphylinidae, namely, *Carpophilus marginellus*, Mots., and *C. mutilatus*, Erich., *C. hemepterus* Lin., and *C. bipustulatus*, Heer. (see pl. III, figs. 3—6).

None of these insects are thought to be pests to growing grapes as in their larval stages they are said to live on raisins, while in their adult stage they are believed only to touch fruit that has previously been attacked by birds, Hymenoptera or fungi.

VI. FOREST PESTS.

Teak tree pests.

Arctiid moth.—In July 1898, through the Director, Imperial Forest School, Dehra Dun, from the Deputy Conservator of Forests, Kurseong Division, were received in the Indian Museum specimens of a moth said to be doing considerable damage to teak trees in the Bamonpokri plantation.

The Deputy Conservator of Forests wrote :—

"The caterpillars first appeared in August last and by October they had completely stripped all the trees of their leaves, and again in January last they destroyed the young leaves."

The insect is an Arctiid moth, but the specimens sent had been so badly rubbed and broken that it is quite impossible to identify the species; they, however, appeared to be a new teak pest and differed widely from the two known species previously recorded in the pages of these *Notes*.

2. *Hyblæa puera*, Cram.—In June 1898, some moths were forwarded to the Museum by Mr. T. T. Bourdillion, Conservator of Forests, Quilon, as doing immense damage to teak plantations of Southern India.

The specimens were identified with *Hyblœa puera*, Cram. a common teak pest in India.

The following is an extract taken from a report furnished by the Forest Ranger :—

"The attacks generally begin in April when the teak tree has put on its new foliage and they last for about six weeks, when the caterpillars begin to disappear, but one or two may always be found on the teak, if a search be made for them. The wet weather probably prevents the moth from increasing, and very little is seen of it until September or October, when, if the North-East monsoon is light, its caterpillar may again attack the teak, the attack lasting about a month. Both very wet and very dry weather seem detrimental to the spread of the insect.

"When the caterpillar begins to pupate it suspends itself by threads at either end to a leaf not necessarily a teak leaf, spins a cocoon round itself and folds the leaf over so that it is quite snug.

"The caterpillar will eat the leaves of some jungle plants as well as teak, and it has been found in the jungle.

"The caterpillar when it has once begun feeding, never leaves the tree, though it may shift from branch to branch when its food is exhausted in one place. It does not drop by a thread to the ground when it wishes to change its skin and therefore the system of tarring the stems of the trees employed in Germany to prevent the caterpillars re-ascending them, is inapplicable."

3. *Paliga damastesales*, Walk.—From Mr. R. S. Hole, Divisional Forest Officer, Damoh, were received in September 1898 specimens of the larva, pupa and imago of the Pyralid moth *Paliga damastesales*, Walk. as injurious to teak trees in the forest of Damoh.

The insect has previously been recorded as attacking teak in the Rangoon district, *vide Indian Museum Notes*, Vol. III, No. 2, p. 94.

The following notes have been furnished by Mr. R. S. Hole regarding the pest:—

"Full grown caterpillar is about ¾ inches long, of a grayish to yellowish green colour, dark above and lighter beneath. When young the caterpillar is a light yellowish green . . .

"The caterpillars feed on the leaves of teak trees, devouring the leaf parenchyma but leaving the vascular tissue untouched, and in this district the caterpillar does a great deal of damage, principally during the rains, from June to October. Teak trees on a whole hill-side may frequently be seen which are absolutely defoliated. The caterpillar pupates on the back of the leaves it has been feeding on, the pupa being kept in position in a hollow of the leaf by a weft strung across it. I have watched the caterpillars making this, they swinging their heads quickly from right to left and left to right as they attach the thread on each side and draw it across to the other. The pupa falls to the ground with the dead leaves, but I do not know where the eggs are laid; I fancy somewhere on the trees, for I have frequently seen very young caterpillars apparently just out of the egg feeding on the leaves. I also fancy this insect must have two generations in one year, for frequently the second flush of leaves put out towards the end of the rains is also destroyed by the caterpillars.

"The trees which receive most damage are those on dry stony hill-sides, particularly if the teak there is nearly pure. Trees in moisten situations, especially where the growth is luxuriant, seem to be little damaged. Whether this is due to the effect the locality has on the insect and its life history or to the fact that the trees are better able to repair or withstand the damage I do not know."

SÂL TREE PESTS.

Leucoma diaphana, Moore.—In February 1898 Mr. J. Campbell, Deputy Conservator of Forests, Assam, Golaghat Division, despatched to the Museum two varieties of caterpillars which had been defoliating sâl trees on a very large scale in the forest of Dubri.

The insects were (*a*) some larvæ of a Noctues moth of the species *Leucoma diaphana*, Moore; (*b*) small caterpillars, apparently the larvæ of a Bombycid moth, but as the specimens were decomposed, nothing could be made of them.

(2) *Bombycid moths.*—In June 1898 the same officer forwarded specimens of moths defoliating sâl in the forest of Dubri.

These belonged to the following species, but as the specimens were so much rubbed and damaged, the identifications are to a certain extent doubtful (1) five specimens of the moth *Lymantria grandis*, Walk.; (2) one specimen of *Trabala vishnu*, Lef.; (3) one specimen of a moth *Dasychira*, sp.

Casuarina tree borer.

In February 1898 the Director, Imperial Forest School, Dehra Dun, forwarded particulars and specimens to the Museum of an insect found boring into casuarina trees in the forest of Nellore.

The worms proved to be the larvæ of a moth probably one of the Hepialidæ. The specimens being insufficient for further identification.

The following is an extract taken from a report furnished by the District Forest Officer, Nellore:—

"So far as I know as yet the borer is doing no great damage, especially as the trees are used for fuel and not timber. But in matters of this kind—and the more so in plantations where only one species of tree is grown—it is well to take advice at as early a stage as possible not only with a view to providing a remedy against the attack itself, but to be on one's guard against other possible complications which may arise from the vigor of the trees being interfered with."

DETERMINATION OF FOREST PESTS FORWARDED TO THE INDIAN MUSEUM DURING THE YEAR 1898.

Deodar cone pest.—Insects reported to be attacking the deodar cones in the forest of Jaunsar, forwarded through the Director, Imperial Forest School, Dehra Dun.

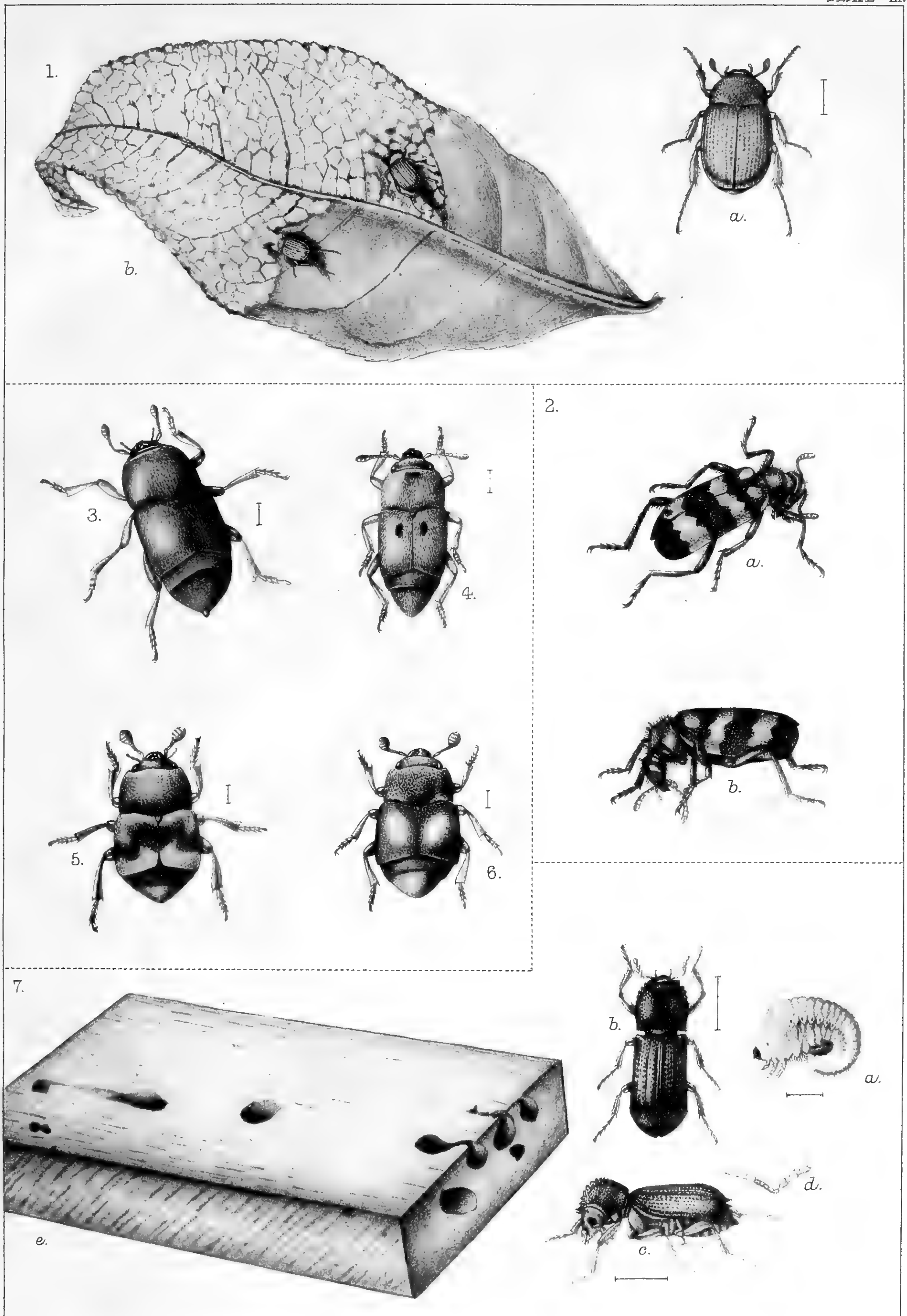
The specimens proved to be a Pyralid moth of the species *Euzophera punicœella*, Moore, which has previously been recorded in Indian Museum Notes, Volume II, page 28, as boring into the fruit of the pomegranate in Baluchistan.

The identification of the insect has been kindly furnished by Sir G. F. Hampson, Bart.

2. *Bombax malabaricum wood pest.*—The Bostrychid beetle, forwarded by the Superintendent, Government Museum, Madras, as doing a good deal of damage by boring into tea boxes made of the wood of *Bombax malabaricum* at Calicut, has been identified by Mons. Lesne as belonging to the species *Bostrychus aequalis*, Wat. The insect is illustrated in plate III, fig. 7.

3. *Coppice shoot pest.*—The insects forwarded by the Conservator of Forests, Punjab, as damaging young "jaud" coppice shoots in his district, were determined as *Homœocrus variabilis*, Dallas, a bug of the family Coreidæ.

G. I.C. P. O.—No. 142 R. & A.—21-5 1900.—1,000.—J.W.G.



G. C. Chuckraburtty, del.

Photogravure. Survey of India Offices, Calcutta, December 1899.

1. SERICA ASSAMENSIS, BRENSK.
2. MYLABRIS PUSTULATA, THUNB.
3. CARPOPHILUS MARGINELLUS, MOTS.
4. Do. MUTILATUS, ER.
5. CARPOPHILUS HEMIPTERUS, LIN.
6. Do. BIPUSTULATUS, HEER.
7. BOSTRYCHUS ÆQUALIS, WAT.

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NOTICE.

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The parts of the serial are published from time to time as materials accumulate. Communications are invited; they should be addressed to—*The Editor, Indian Museum Notes, Calcutta*, and should be accompanied by specimens of the insects to which reference is made. Soft-bodied insects can be sent in strong spirit; chrysalids and cocoons alive, and packed lightly in leaves or grass; other insects, dried and pinned, or wrapped in soft paper. Live insects should be sent when there is a reasonable chance of their surviving the journey. Caterpillars, grubs, and other immature insects can, in the present state of our knowledge, be only approximately determined; they should therefore, where possible, be accompanied by specimens of the mature insects into which they transform.

CALCUTTA;
15th October, 1900.

A. ALCOCK, MAJOR, I.M.S.,
Superintendent, Indian Museum.

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Vol. V.] [No. 2.

ORIGINAL COMMUNICATIONS.

1.—DESCRIPTION OF A NEW SPECIES OF *PSYLLA* DESTRUCTIVE TO FOREST TREES.

By G. B. Buckton, F.R.S., etc.

Psylla obsoleta, n. sp.

Plate V. figs. 10-15.

Antennæ filiform obscurely ten-jointed, basal joint large. Apex with two minute bristles. Thorax robust with two small spines underneath. Ferruginous colour above, shining black below. Abdomen similarly coloured and having rings with pale edges. Fore-wings veined as in ordinary Psyllidæ. Hind wings obsolete or represented by mere membranous flaps. When first emerging from the pupæ the insects are uniformly pale luteous. Like some other species of Psylla this insect forms small galls on the leaves of forest trees, but none of the examples of galls seen by me were perforated although the winged forms were abroad under the trees.

The galls are yellowish-red, rough, and somewhat recall the appearance of the oak spangles known as Robin's pincushion in England.

This new Psyllid was received from Mr. G. M. Ryan, Deputy Conservator of Forests, Western Circle, Thana, Bombay, who writes as follows—

" The damage done by it so far is observed to be entirely to the younger plants of *Diospyros melanoxylon*, a tree the Mahratti name of which is *Temiboornee.* The leaves of the young plants, perhaps 6 or 7 years old and about 3 or 4 feet from the ground generally, are attacked, and the insect seems to quit its abode (the gall) in

January or February of each year. After the insects have deserted the galls, the latter too disappear leaving holes all over the leaf.

"I have seen the leaves of larger trees, 8 to 10 feet high, so attacked, but the damage is but slight. My observations extend only over the Shahapur taluka of the South Thana Forest Division."

2.—DESCRIPTION OF A NEW SPECIES OF *ALEURODES* DESTRUCTIVE TO BETEL.

BY G. B. BUCKTON, F.R.S., etc.

Aleurodes nubilans, n. sp.

Plate V. figs. 7-9.

Legs long and hairy with dimerous tarsi. Antennæ rather long and with seven (?) joints in the ♀, which is a larger insect than the ♂. Wings four, rounded at the apices, and fringed with minute hairs. A single unforked central nervure, not continued to the margin. Membrane smoky in patches, with a darker blurred spot. The ♂ smaller with a large thorax, taper abdomen, and furcate at the apex and with hinder legs longest.

The larvæ crowd the undersides of the leaves of the betel in the form of small scales very difficult to detach. They appear like scales of some Coccidæ, but these showed no distinct organs such as antennæ, legs, or eyes. Their outer surfaces were more or less spined, and some larvæ were tufted with wooly matter, each thread being formed of a continuous spiracle.

This new Aleurodid was received on betel leaves from the Manager, Court of Ward's Estates, Backergunge, who reported that it was doing considerable damage to the plants.

3.—DESCRIPTION OF A NEW SPECIES OF *RIPERSIA* DESTRUCTIVE TO SUGARCANE.

BY E. E. GREEN, F.E.S., Government Entomologist, Ceylon.

Ripersia sacchari, n. sp.

Plate VI. figs. 5, 6.

Adult ♀ pinkish, the colour more or less concealed by a white powdery waxy secretion which is collected more particularly round the margins of the insect. Form elongate ovate, more or less flattened from its position beneath the sheathing leaves of its food plant. Legs and antennæ comparatively small but well formed. Antennæ of six joints only (fig. 6), sixth always the longest, rather longer than the second and third together; fourth always shortest; relative lengths of other joints slightly variable; average formula 6 (1, 2, 3), 5, 4; sometimes 6 (1, 2, 3, 5), 4, or 6, 3 (1, 2), 5, 4. Foot with apparently only two digitules, fine pointed hairs without knobs, 1 on claw and 1 on tarsus; occasionally a second still finer hair on tarsus; tarsus shorter than tibia, the two together shorter than combined femur and trochanter. Anal ring with six stout hairs arising from a compact circumscribed patch of glandular cells (fig. 5). Anal lobes obscure; scarcely—if at all—prominent; the usual caudal setæ scarcely longer than the hairs of the anal ring; without groups of conical spines or definite patches of spinnerets. The whole derm dotted with circular spinnerets of two forms which are more crowded on the posterior segments, where they are also mingled with a few stout pointed hairs. The larger spinnerets have a simple circular pore. The opening of the smaller spinnerets is 3 or 4 foliate.

Length 3·25 to 5 mm. Breadth 1·75 to 3 mm.

Habitat.—At the base of the sheathing leaves of sugarcane, from the Gorakhpur district.

The specimens having been preserved in alcohol, the waxy secretion has become sodden and decomposed; but from the distribution of the spinnerets on the surface of the body of the insect, it is probable that there are no definite waxy appendages. The species is distinguished by the unusually compound character of the anal ring and by the large size of the insect, which is only equalled by that of *R. montana*, Newst; but that species is of a more or less globular form, secretes a thick felted ovisac and has caudal setæ twice the length of the hairs of the anal ring. In general structure and habitat *R. sacchari* approaches most nearly to *R. pulvinaria,* Newst., which occupies a similar position beneath the sheathing leaves of various grasses ; but this latter species is of a much smaller size and has a more simple anal ring.

The insects were found on damaged sugarcane from Gorakhpur, sent by the Director of Land Records and Agriculture, North-West Provinces and Oudh.

4.—DIAGNOSES MELOLONTHIDARUM NOVARUM EX BANGALORE.

BY ERNST BRENSKE.

Adoretus bangalorensis, n. sp.

Plate IV. figs. 1, 2.

Long. 11-13. Lat 6-7. mm. ♂. ♀.

Caput magnum, oculi magni, flaveobrunneus parum metallescens, brevissime pilosus. Clypeo rotundato, fortiter marginato subtiliter dense punctato. Fronte parva. Thorace angulis posticis rotundatis, minus dense punctato. Elytris subtiliter costulatis, æqualiter pilosis. Labro magno, subtillissime carinato. Tarsis parvis, flabello parvo stipite breviore. Pygidio dense piloso, apice parum nitido.

Adoretus caliginosus, Burm., var. *bicolor*, nov.

Plate IV. figs. 3, 4.

Capite toto fusco, pygidio subtilissime piloso.

This species is widely distributed throughout British India.

Both the above insects were received from the Superintendent, Mysore Government Botanical Gardens, Bangalore, where they wree found attacking rose-bushes.

5.—NOTE ON *DORYLUS ORIENTALIS*, West.

By E. E. Green, F.E.S.

On page 198, Indian Museum Notes, Volume IV, No. 4, I see a statement on Dr. Forel's authority that all species of *Dorylus* feed on animal food and that *Dorylus orientalis*, West., cannot therefore be obnoxious to potatoes. With all due deference to Dr. Forel's acknowledged learning on the subject of ants, I most emphatically contradict this statement, as far as it refers to *Dorylus orientalis*, West. The workers of this species (determined for me by Colonel Bingham) live entirely underground, and I can assert from repeated personal observation, that they are most confirmed vegetarians. I found it quite impossible to grow potatoes in Pundalnoya, solely on account of this insect, and they were most aggravating in their systematic attacks upon the tubers of dahlias, and the roots of the common sunflower (*Helianthus*, sp.). In the case of tubers they form galleries through and through the substance, and in the case of roots they eat off the tender bark below the collar. I have made very careful observations on the point and have completely satisfied myself that the *Dorylus* was really feeding upon the vegetable tissues, and was not merely hunting for another insect.

NOTES ON INSECT PESTS FROM THE ENTOMOLOGICAL SECTION, INDIAN MUSEUM.

During the past year we have received reports of the damages done by insects to the following crops, namely, sugarcane, rice, wheat, maize, millet, cotton, ground-nuts and market produce, as well as to growing timber, coconut-orchards, tea-plantations and stored grain.

As these reports depend entirely on voluntary agency, and as, even then, many of them are misdirected to the Economic and Art Section of the Museum instead of being put at once and without any retarding mediation into the hands of the Entomologist, it is difficult to judge how far they cover the whole field of enquiry. But so far as they go, they seem to show that the two most pronounced events of the agricultural year, in this connection, have been the havoc wrought by the larvæ of certain moths to growing sugarcane, and the comparative immunity of the whole country from the visitations of locusts.

In Lower Bengal young rice-fields seem to have suffered severely from the attacks of their constant enemy *Hispa ænescens*, but fortunately the Tiger-beetle, *Cicendela sexpunctata*, has appeared to exercise a timely check upon the ravages of the insect.

If we may take the meagreness of our reports as negative evidence, tea appears to have suffered little during the year from insect pests.

A friendly critic has recently objected against these *Notes on Insect Pests* their neglect of the important subject of remedies. But our reply is that this subject lies completely outside the scheme of a general Museum.

To propose remedial measures—unless we would follow the example of the sages of the Academy of Laputa—demands, to make no mention of time and special appliances for experiment, a first-hand knowledge of all the conditions under which any given pest is carrying on its depredations such as it is impossible for a busy Museum-curator to obtain.

All that a Museum officer can be expected to do in this direction is to make suggestions, for others, whose interests are affected, to carry into practice, and to hope that the results may be communicated to him for record. The part that a Museum officer can legitimately take in Economic inquiries is to identify, describe, and figure, as well as to preserve and distribute specimens of, the various insects which are reported to be of economic interest, and further to record for reference the season, place and manner in which their economic influence is said to be exercised.

In this endeavour, which is all that we have set before us, at any rate during the last 7 years, we have, within the limits of the present number, to record our thanks for assistance, freely and promptly rendered, by the following gentlemen, namely, Sir G. F. Hampson, Bart., Messrs. E. Brenske, G. B. Buckton, F.R.S., W. L. Distant, A. Fore and E. E. Green, F.E.S., all of whom have very kindly named specimens for us.

I.—PESTS OF THE SUGARCANE.

During the year numerous reports of the ravages of insects on sugarcane were received from the North-West Provinces, from Bengal and from Madras.

In February 1899, the Director of Land Records and Agriculture, North-West Provinces and Oudh, forwarded some samples of sugarcane said to be injured by insects. He wrote :—

"The specimens have been collected in Pipra, a village in Gorakhpur district. It is stated that when the cane is affected, the pith becomes red and the juice dries up gradually. This happens in one internode after another till the whole cane dries up and becomes woody. In a clump sometimes only one cane is affected, and the others remain healthy until the cane affected first is destroyed. The healthy canes then get diseased . . . . It is known locally as *Lewahi*. The disease makes its appearance about the middle of the rainy season, and continues its damage until February or March. Sometimes a whole crop dries up from the effects of the disease a short time before it is fit for crushing. The variety of cane known in Gorakhpur as *Pansalie* and in other places as *Kalara* is specially liable to the disease, and its cultivation is therefore diminishing rapidly."

The sugarcane sent was examined and was found to contain the following insects :—

(*a*) A chrysalis of the common borer moth *Chilo simplex*, Butler.

(*b*) Two chrysalids of a Microlepidopterous moth, one of which was reared in the Museum, and found to be new to our collection. It has been identified by Sir G. F. Hampson as *Scirpophaga excerptalis*, Wlk.

(*c*) Numerous specimens of a scale insect which being new to our collection were forwarded to Mr. E. E. Green for identification, and proved to be new to science. Mr. Green has named it *Ripersia sacchari*, and his description will be found on page 37, the insect being figured on plate VI (figs. 5 and 6).

The borer, *Chilo simplex*, Butler, is one of the most serious of sugarcane pests, reports as to its ravages being continually sent in from all parts of India. Cutting down and burning all sickly-looking stems, in which in all probability a caterpillar is concealed, might be of use in checking its ravages.

As to the scale insect, it is probably a pest, but Mr. Green has not given any opinion on this point.

In March 1899, the Director of Land Records and Agriculture, North-West Provinces and Oudh, again brought to our notice some sugarcanes, which he said were being badly damaged by what was believed to be a fungus.

No insects were discovered, so very possibly the plants were attacked by a fungus. In Queensland the Department of Agriculture found that it was a fungus locally known as the rust, which caused serious damage to sugarcane in the Colony. It was only by expensive experiments extending over a period of years that a fairly rust-proof variety was selected. This method of selection is, we believe, the only one that gives any promise of stopping the ravages of rust.

In June a further communication was received from the same office, together with fresh samples of sugarcane pests, with the following report:—

"Sample 1.—Locally called *Pehk Safed,* an insect which burrows into the main stalk of the young sugarcane plant in April or May when the crop is two or three months old. The stalk attacked by this insect rots inside and the leaves dry up. Fresh shoots begin to spring from the root if watering is kept up.

"Sample 2.—Local name, *Pinka Surfh.* This insect only differs from No. 1 in colour and is found with No. 1 in abundance, in the same plant doing the same sort of mischief as No. 1.

"Sample 3.—No local name, only one insect of this kind could be got inside the young stem of a plant which has been attacked by Nos. 1 and 2.

"Sample 4.—*Kunga* or *Ahola.* It was collected several months ago and cannot be got at this time of the year . . . . . It is a borer and attacks the full-grown plant from the month of August onwards by burrowing through the top and gradually eating into the first two to four internodes. When it has attacked a plant the growth of the cane at the top is stopped, and new shoots begin to spring from the upper joints of the cane.

"Sample 5.—White ants which eat into the seed-cuttings planted.

"Sample 6.—*Kari* an insect which has done considerable mischief in Azamgarh to full-grown canes."

On examination sample No. 2 proved to be an ant of the species *Dorylus orientalis,* Shuck., and No. 1 the pupa of the same.

Mons. Favel who identified the insect for us writes as follows:—

"Your ant said to be infesting sugarcane plants is *Dorylus orientalis,* Shuck. This species like the whole of the genus, lives *exclusively* on animal food. All species of *Dorylus* are driver ants, hunting insects and small living animals underground."

If this is so, the ant so far from being a pest might be regarded as beneficial; but Mr. E. E. Green (see page 39) says that he must "most emphatically contradict this statement so far as it refers to *Dorylus orientalis*, West."

Samples 3 and 4 were the larval forms of the moth *Chilo simplex,* Butler. Sample 5 consisted of some specimens of the worker form of a "white ant" *Termes taprobanes,* Walk. A single specimen of a "big caterpillar" included in the sample appears to be the grub of a Melolonthine beetle (cockchafer).

Both these insects when in abundance might do a considerable amount of damage by boring into the roots of the sugarcane.

Sample 6 consisted of the immature forms of a bug belonging to the family Lygæidæ. Mr. W. L. Distant sent the following interesting note about them :—

"The immature forms of the *Hemiptera* reported as attacking sugarcane in Cawnpore, North-West Provinces, are undoubtedly those of a species of *Blissus*, and most probably, so far as can be ascertained from non-mature specimens, *Blissus gibbus*, Fabr., a well-known Indian species. This genus is a formidable one to agriculturists, *Blissus leucopterus*, Say., is the well-known "Chinch bug" of North America, one of the most noxious and injurious insects to agriculture. According to Riley the injury is caused by the insect sucking, by aid of its rostrum, the grasses and cereals 'thereby causing them to shrink, wilt, and wither, not by biting their substance as many suppose.' The multiplication of the insect in North America appears to have been conterminous with the increase of grain cultivation in that country and the injury it occasioned to the 'small grain' in the North-Western States in 1871, amounted to upwards of thirty million dollars, whilst in 1874 the damage was computed at twice that sum. It has been found by Riley to be two-brooded in some of the States, and its eggs are deposited 'occasionally' above ground in the blades of grain, but far more often and normally underground upon the roots of the plants infested. The same author remarks that, though abundantly able to fly, the chinch bug does not take to wing readily, and in their immature stages, before their wings are developed, they migrate from field to field for food 'often in solid columns inches deep." It multiplies most in hot and dry seasons, moisture proving unfavourable to its existence."

These details relating to a very nearly allied species are of great interest in the present case.

In July 1899 the Director, Department of Land Records and Agriculture, Assam, forwarded some caterpillars which were reported to be injuring the sugarcane crop in the Barpeta Sub-Division.

These on examination proved to be the larvæ of *Chilo simplex*, Butler.

Dictyophara pallida, Donv. In January 1900 this insect which belongs to the Hemipterous family of *Fulgoridæ* or Lantern flies, was reported to be damaging the sugarcane crop in the North Arcot district, South India. The Agricultural Inspector writes :—

"These insects are seen to perch on the underside of the cane leaf avoiding sun and on shaded leaves. They are good springers. The bug is soft-bodied and is very easily killed by slight handling. These are known to the ryots only since ten years. The cane crop when infested gets stunted and damaged. These appear when cane is six to nine months old. No remedy is known to the ryots. They collectively go by the name of *Cheeda purugu*. In Coimbatore the bug is known as *Thathoopoochi*, and the winged insect as *Thaloocupoochi*."

The insect is figured on plate V. (figs. 1—6).

Scirpophaga auriflua, Zell. In February 1900, some pieces of sugarcane from Kushtea were forwarded to the Museum by the Director of Land Records and Agriculture, Bengal. The sugarcane was found to be tunnelled by grubs, the moths of which emerged in the Museum. They were identified by Sir G. F. Hampson as *Scirpophaga auriflua*, Zell., a species which much resembles *Scirpophaga excerptalis*, Wlk., which has been reported to be attacking sugarcane in the Gorakhpur district. The caterpillar of *S. auriflua* appears to attack the growing tips of the sugarcane, and to burrow down the middle of the pith, in precisely the same manner as *S. excerptalis* is reported to do. The insect is figured on plate VI (figs. 1—2).

Aleurodes sp.—In January 1900 pieces of sugarcane leaf from South Arcot, were forwarded to the Museum by G. Rajagopaul Naidoo, Agricultural Inspector. He writes :—

"The pest appears as numerous small ash-coloured oval spots underneath the leaf blade. In some places only dark spots of similar dimensions are seen indicating the marks left by the insects. The development of green colouring matter is arrested by the pest, causing the cane plant to look pale and stunted in growth. No name is yet given to the pest though the cultivator of the field says that he is aware of it for the last ten years. The soil of the field was loamy, in nature disposed to be saline."

Specimens were forwarded to Mr. E. E. Green who identified it as an Aleurodid.

To sum up ; the damage done to growing sugarcane during the past year, so far as our reports go, is the work of the following nine insects :—

(*a*) Lepidoptera :—

1. *Chilo simplex*, Butl.
2. *Scirpophaga excerptalis*, Wlk.
3. *Scirpophaga auriflua*, Zell.

(*b*) Hemiptera :—

4. *Blissus* sp., probably *gibbus*, Fabr
5. *Dictyophara pallida*, Donov.
6. *Aleurodes* sp.
7. *Ripersia sacchari*, Green.

(*c*) Pseudoneuroptera :—

8. *Termes taprobanes*, Walk.

(*d*) Hymenoptera (doubtfully destructive) :—

9. *Dorylus orientalis*, Shuck.

II.—INSECTS DESTRUCTIVE TO CEREALS AND CROPS.

(*i*) PADDY PESTS.

1. *Hispa ænescens*, Baly.

[Order *Coleoptera*, Family *Chrysomelidæ*.]

The Rice Hispa.

Reports have been sent in from several parts of India from which it would seem that considerable damage has been done to the rice crops by this beetle during the past year.

In September 1899 specimens were sent by the Department of Land Records and Agriculture, Assam, with the following report:—

"Charaka Pok. This is a kind of black insect furnished with tiny wings. So long as the Kothias (*i.e.*, young plants growing out from broadcast seedlings) remain young and soft, they are eaten away by these insects which flock in numbers like locusts. The green plants then become more and more yellow and partially wither away. These plants, however, do not altogether die out, but the villagers inform me that in the case of *Sali* paddy these damaged plants yield a very poor (and sometimes no) crop.

"In the case of *Ahu* too, the damaged plants yield a very poor crop. The damage alone in Baligaon, Hazari, and Charigaon mauzas of this subdivision is estimated at $\frac{1}{3}$, *i.e.*, a third of the whole area under cultivation, is said to be damaged. This, however, seems to me to be an overestimate; my personal inspection of some parts of Baligaon and Hazari mauzas has convinced me that one-sixth only of the cropped area is affected."

The following is an extract from a report sent in May 1899 by Mr. N. N. Banerji, Assistant Director of Land Records and Agriculture, Bengal, reporting the damage done by this pest at Backergunge:—

"At Betagi I found that the damage being done by the insects was really serious. The *aus* crops here is generally transplanted and not broadcasted as usual.

"The seed of this crop had already been sown in nurseries and the plants had attained the height of about eight inches. *Aman* paddy, which is also cultivated here, had also been sown out in nurseries, but the sowing of this crop was made later than that of the *aus* crop, and the seedlings had not accordingly advanced as much as *aus* seedlings. Both *aus* and *aman* were found to be equally attacked. Some were more badly attacked than others. Insects (*Hispa ænescens*) were found in abundance on the leaves of the seedlings, and the general appearance presented was a black dotted appearance on a groundwork of yellow, the leaves having lost their fresh greenish colour, owing to the ravages of the insects.

"An examination of the leaves clearly shewed that they were punctured all over by the insects, and they were practically sapless. The insects were generally found in couples and were evidently pairing. In some cases eggs seemed to have been laid on the upper surface of the blade of the leaves, which felt more or less rough and powdery. This is stated with reserve as I was not quite positive whether this powdery substance really consisted of the eggs of the insects. It is hoped that some light will be thrown on the subject by a study of the specimens I have brought down for the Museum.

"I went to a village called Goleman and thence to another village called Kamarkali. A field-to-field inspection shewed that the damage done here was even greater than that at Betagi. Here, as at Betagi, both *aus* and *aman* had been sown out in nurseries and both were equally attacked, some nurseries were completely destroyed.

"The insects appear in paddy fields generally in the months of Bhadra and Sravan and disappear mostly in Kartik. This year they appeared as early as Baisakh. With sunshiny and fine weather their numbers may diminish; but when the sky is cloudy and the weather drizzly the numbers increase. In all cases however, the plants are continuously attacked from the early stages of their growth up to the time of harvesting.

"Coming with the west wind in one day the full fledged insects are found to alight on the fields. They stay on the same field for some days, suck out the sap from the parenchyma of the leaves and from the stalks, and then, having laid their eggs, so it is said, fly away to some other fields.

"In this way they fly about from field to field leaving the plants in a thoroughly withered condition. No information could be given me as to what emanates from these eggs, if eggs at all, that are laid by the departing insects on the leaf blades. Nothing is known to the ryots of the larval or pupal stage of the insect, the fully developed beetle being the only creature familiar to them. It is to be hoped that the study of the insects at the Museum will throw some light on their life history. When the plants are levelled to the ground at the time of harvesting, the insects take shelter round the root stalks, and in one or two days, just as the paddy is about to be gathered for threshing, they fly off, the ryots cannot say where, but I believe they return to the bheels. Some may be found on the threshing floor, but they generally die off. When attacking the nurseries as they have generally done this year, the damage is great, as the seedlings attacked are all but destroyed. Those that are left do not put forth a vigorous growth after transplantation, and it is said that the rice from such fields had a bitterish taste. Last year it appears that the insects came during the rains and attacked the crops after they had been transplanted. In this case, the effect of the pest was to stunt and weaken the plants, which afterwards yielded but a small outturn.

"It is very difficult to form an idea of the actual damage done. The cultivators say that already 10 annas of their crops have been destroyed. They might have been exaggerating a bit, but when one considers that in some nurseries almost every seedling, without exception, has insects on it—4 to 6 on each blade of leaf—there can be no doubt that the damage that will eventually be effected will be very appreciable. It would be rash to form any positive estimates of the damage already done; but from my own personal observations of fields very badly attacked, and of fields comparatively free from the attacks of the insects, I would say that from six to eight annas of the seedlings will be damaged in those places visited by me.

" Coming now to the question of remedies, which is always a difficult one, and doubly so when crops are so badly attacked as they have been this year, I may say that I started with very little hope of doing much good in this direction, and my apprehensions were shared by the Museum authorities. Unless and until the whole life-history of the insect is known, no definite remedies can be suggested. Specimens of insects and leaves have been brought by me and made over to Major Alcock, Superintendent, Indian Museum. Some of these have been put into spirits; others have been brought in a live state, and Major Alcock has kindly offered to breed and study them as far as possible. In this way it is hoped that it will be possible to find out the different stages of development of the insect. He will also see what substances are unpalatable or deadly to the insect with a view to suggesting some practical remedy.

" In addition to procuring different kinds of specimens, several remedies were tested by me at Betagi and Kamarkali. At Betagi, sulphuring was tried at the suggestion of Major Alcock. Two small plots of land were chosen (which were marked out with sticks), one badly attacked by insects, and one yet unattacked, and powdered sulphur was sprinkled over them. The daroga was asked to report the effect in a week.

" Smoking with and without sulphur was also tried. The smoke did drive away the insects temporarily, but they returned. It appears, therefore, to me that the smoking operation is not very practicable. Continuous smoking on small selected plots would no doubt prove effectual, but the operations could hardly be carried out on acres and acres of land.

" Insecticides were not sprayed at Betagi, as it was raining continuously. At Kamarkali, however, three plots were chosen, and the following insecticides sprayed over them :—

1. Copper sulphate solution—one part of copper sulphate to 200 parts of water.
2. Copper sulphate solution—one part of copper sulphate to 100 parts of water.
3. Carbolic acid solution—one part of acid to 20 parts of water.

" The last named insecticide had the best immediate effect. The insects dropped off the leaves one by one as they came in contact with the solution, but they were only stunned and did not die off. After a few minutes they appeared to recover and to fly on to the leaves again. The daffadar has been asked to report results in a week to the Sub-Inspector, Surupkati thana. The writer constable has also been similarly instructed. In addition to the above, a fourth plot was limewashed, but the operation did not appear to have much effect on the insects. The plots were all marked out with sticks, and the numbering of them was explained both to the cultivators and to the daffadar.

" In addition to the work sketched above several enquiries were made by me *en route* to Barisal and back, and while I was travelling about in my boat, but I heard of no particular injury being done beyond the outposts and thanas visited by me. The insects appear to me to be confined more or less to the west of the district, and in some places outside the thanas visited by me, insects had not yet appeared, but this was probably due to the fact that in these places very little *aus* is grown, and consequently very little paddy had already been sown, the *aman* being sown generally later than the *aus* paddy."

The insects forwarded by Mr. N. N. Banerji were alive when they reached the Museum, and were let loose in a large breeding cage which was arranged as far as possible as a sort of miniature paddy field. Shortly after they were put into the cage, they died off—dying, it is believed, after pairing. The breeding cage is being carefully watched in the hope that possibly eggs have been laid, if such is the case, the life-history of an exceedingly troublesome pest will be worked out.

In July 1899, the Director of Land Records and Agriculture, Bengal, forwarded specimens of the Rice Hispa and reported that much damage was being done to the paddy crops around Jessore by these insects. Two kinds of insects reported to be damaging the paddy seedlings in the Government Experimental Farm at Sibpur were also forwarded. These proved to be *Hispa ænescens* and *Cicendela sexpunctata*, Fabr., (a tiger beetle). The latter is a well-known carnivorous beetle, and had evidently come to feed on the Hispa. The Manager, Government Experimental Farm, Sibpur, was recommended to take steps to prevent the destruction of the tiger beetle, as it promises to be a natural check to the spread of the Rice Hispa.

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2. *Spodoptera mauritia,* Boisd.

[Order *Lepidoptera*, Family *Noctuidæ.*]

Specimens (larva, pupa and imago) of this moth were forwarded by the Director, Department of Land Records and Agriculture, North-West Provinces and Oudh, with the information that they were attacking the rice crops in Naini Tal. Specimens were submitted to Sir G. F. Hampson, who identified them as *Spodoptera mauritia*, Boisd., Hampson's Moths, F. B. I., Vol II, p. 248. It is practically cosmopolitan in its range, being found in North and South America, Africa, North China, and throughout the Oriental and Australian regions.

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3. *Heliothis armigera,* Hubn.

[Order *Lepidoptera*, Family *Noctuidæ.*]

In September 1899, the Superintendent, Madras Central Museum, forwarded some caterpillars reported to be damaging the paddy seedlings in a village in the Madurantakam taluk of the Chingleput district.

The caterpillars appeared to be the larvæ of the Noctuid moth, *Heliothis armigera*, Hubn., a serious pest which does not confine itself to rice alone but attacks pulse, poppy, ganja, safflower and other crops.

In the United States where it does serious damage to the cotton crop of the Southern States it is known under the name of the "Boll worm."

In November some further specimens were sent by the Superintendent, Madras Central Museum, who reported that it was destroying the paddy seedlings in some of the villages in the Tirutturaippundi Taluk of the Tanjore district. The insects are known locally as *Kottiapuchi*.

In September 1899, the Director of Land Records and Agriculture, North-West Provinces and Oudh, forwarded specimens of larvæ of probably the same moth, *Heliothis armigera*, reporting them to be causing great damage to the rice crop in the Azamgarh district by eating into the stems of the plants. Similar attacks being also reported from other districts.

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4. *Hieroglyphus furcifer*, Sauss.

[Order *Orthoptera*, Family *Acrididæ*.]

In September 1899, the Collector of Cuttack forwarded, through the Director of Land Records and Agriculture, Bengal, specimens of insects which he reported to be destroying the paddy crop in his Collectorate. On examination the insects proved to be *Hieroglyphus furcifer*, Sauss.

(*ii*) Wheat Pest.

In February 1899, the Director of Land Records and Agriculture, Bengal, forwarded some wheat which had been damaged by insects in the Muzaffarpur district. A few dried aphids were found on the wheat stems, but it was impossible to identify them owing to the state they were in.

(*iii*) Kutki (*Panicum sp.*) Pest.

In October 1899, the Reporter on Economic Products to the Government of India forwarded us specimens of a small beetle, said to be attacking the Kutki (*Panicum sp.*) crop in the Central Provinces. These beetles on examination proved to be *Epicauta rouxi*, Cast. They were reported in 1893 to be attacking crops of Yellow Cholum (*Solgum vulgare*).

(*iv*) Maize Pest.

In March 1899, the Director of Land Records and Agriculture, North-West Provinces and Oudh, forwarded specimens of caterpillars which were reported to be damaging maize. It was impossible to identify the caterpillars with any certainty, but they were apparently the *larvæ* of a Noctues moth.

(*v*) Juar Pests.

In March 1899, the Reporter on Economic Products to the Government of India forwarded some insects which were found in Juar received from Burma.

On examination these proved to be the common rice weevil *Calandra oryzæ*, Linn., together with three specimen of a beetle belonging to the family *Cucujidæ*, and six specimens of a Tineid moth, both unrepresented in our collection.

(*vi*) Ground-nut Pests.

In January 1900, two moths, reared from caterpillars infesting the ground-nut crops in the South Arcot district, Madras, were received from Mr. C. A. Barber, Government Botanist. They proved to be *Creatonotus moorei*, Butl.; and *Creatonotus albistriga*, Walk.— moths of the family *Arctiidæ*. *C. albistriga* is figured on plate VI (figs. 3—4).

In 1892 a specimen of *C. moorei* was reared in the Museum from caterpillars forwarded from Madras, which were reported to be damaging the ground-nut crop in Panruti, South Arcot district.

Together with these two moths Mr. C. A. Barber also forwarded some specimens of a Microlepidopterous moth. These he reported to be even more injurious to the ground-nut crop. Unfortunately the specimens arrived in too rubbed and battered a condition to be possibly identified.

(*vii*) VEGETABLES, ETC.

In December 1899, vegetables were reported to be much damaged in Backergunge by cutworms. Some specimens were forwarded through the Director of Land Records and Agriculture, Bengal, by the Manager, Court of Ward's Estates, Backergunge. He writes:—

"During the day the insects lie hidden under earth and in the night they come out and cut the stems of the young plants of cabbages, cauli flowers, etc."

The caterpillars resemble those of *Agrotis suffusa*, Fabr. The caterpillar of this moth does a deal of damage in India by biting off young plants of all kinds close to the ground.

In May 1899, the Superintendent of the Central Jail, Bhagalpur, forwarded some insects which he reported to be damaging the vegetables in the Jail garden. On examination they proved to be bugs of the family *Pentatomidæ* species *Apinis concinna*, Dallas. They have been previously reported as attacking *rabi* crops in the North-West Provinces.

In April 1900, the Reporter on Economic Products to the Government of India forwarded beetles which were reported to be attacking tomatoes in Sibpur. On examination they proved to belong to two different species of Melolonthine beetles (Cockchafers). They have been identified by Mr. E. Brenske as *Schizonycha fuscescens*, Blanch., and *Apogonia Blanchardi*, Rits. var. *carinata*, Brenske.

(*viii*) COTTON PEST.

The Director of Land Records and Agriculture, North-West Provinces and Oudh, forwarded some caterpillars which were reported to have attacked the cotton crop at the Government Farm, Cawnpore. It was impossible to identify the larvæ with any certainty, but they appeared to be the larvæ of a Noctues moth, possibly *Heliothis armigera*, Hubn., a noctuid moth whose larvæ attacks various crops in India. It is known in America, in the Southern States, where it does immense damage to the cotton crops, as the "Boll worm."

III.—TEA PESTS.

Larvæ (preserved in alcohol) of a Geometrid moth were received through the Reporter on Economic Products to the Government of India, together with the following note :—

"They have been doing great damage to tea, having been in millions, and having denuded acres of tea bushes of all their leaves. Although basket loads were brought in daily by the coolie children until apparently no more were left—this was about July and August last—they are again pretty plentiful and children are again picking them off. They have never before been seen here."

In March 1900, Mr. E. E. Green sent some weevils, identified by Mr. C. O. Waterhouse of the British Museum as *Brachyaspistes tibialis.* He says :—

"They have been responsible for serious injury to clearings of young tea plants in the Bogawantalawa district, Ceylon. The beetles eat off all the young shoots of the growing plants leaving the stems quite bare."

The insect is figured on plate IV (figs. 5—6).

IV.—COCONUT PALM PEST.

In August 1899, specimens of the bettle *Rhynchophorus ferrugineus,* Oliv., were forwarded by the Officiating Collector of Noakhali, through the Department of Land Records and Agriculture, Bengal, as destructive to coconut trees.

In November 1899, Mr. B. N. Iyer, Superintendent, Agricultural Farm, Trivandrum, reported that the coconut and mela palms on the coast were being attacked by grubs and beetles, the damage in all probability being done by the above-mentioned species.

V.—FOREST PESTS, ETC.

1. In September 1899, the Deputy Conservator of Forests, Western Circle, forwarded some caterpillars which he reported to be defoliating teak trees in the Thana district. On examination they proved to be the larvæ of the moth *Paliga damastesalis,* Walk. It has been reported almost every year as defoliating teak in various parts of India.

2. In September 1899, the Reporter on Economic Products to the Government of India, forwarded a series of the larva, pupa and imago, of a moth, the larvæ of which were said to be defoliating sâl trees in Jalpaiguri. On examination the moth proved to be *Lymantria grandis*, Wlk. It has been frequently reported before as defoliating sâl in India.

3. In January 1899, we received from Mr. J. C. MacDonald, through the Superintendent, Madras Central Museum, some coccids which were reported to be attacking the roots of *Erythrina*, six months old. Mr. MacDonald writes :—

"These insects attack the roots of *Erythrina* plants six months old, and have in fact wiped out wholesale a field of fifty acres, which is shaded by the above tree. The damage began to be apparent about the burst of the N. E. monsoon in November or so. The soil is quite a dry light and very friable one. This is the first that I have seen of this sort of damage after an experience of over 18 years of planting."

The specimens were forwarded to Mr. R. S. Newstead for identification, and his report has not yet been received.

4. In March 1900, some beetles were forwarded by Mr. G. M. Ryan, Deputy Conservator of Forests, Western Circle, from Thana district, Bombay, which he found burrowing into Khair (*Acacia Catechu*) trees. This beetle (*Sinoxylon sp.*) has been frequently mentioned in Indian Museum Notes as attacking Sâl (*Shorea robusta*), *Terminalia belerica*, the guava (*Psidium guava*) and other trees in different parts of India.

5. In February 1899, Mr. G. M. Ryan, Deputy Conservator of Forests, Western Circle, forwarded some leaves of *Diospyros melanoxylon* which were covered with galls. The leaves were forwarded to Mr. G. B. Buckton, who discovered a *Psylla* within the galls, which on examination proved to be new to science. He has described it as *Psylla obsoleta*. His description will be found on page 35 and the insect and gall are figured on plate V (figs. 10—15).

6. In July 1899, the Manager, Court of Ward's Estates, Backergunge, forwarded, through the Director, Department of Land Records and Agriculture, Bengal, some betel leaves covered with insects. These on inspection proved to be Aleurodids, and being new to our collection were forwarded to Mr. G. B. Buckton for examination. The insect proving to be unknown to science, Mr. Buckton has described it under the name of *Aleurodes nubilans*. His description will be found on page 36 and the insect itself is figured on plate V (figs. 7—9).

VI.—PESTS OF STORED GRAIN.

In February 1899, the Reporter on Economic Products to the Government of India, forwarded some moths, which he had received from Burma as attacking rice. This proved to be a Tineid moth new to our collection. This moth has been reported as infesting stored grain in several parts of India.

In April 1899, the Reporter on Economic Products to the Government of India forwarded some weevils, reported to be damaging rice. Mons. A. Grenville identified them as *Tribolium confusum*, Duv.

REPRINTS AND EXTRACTS.

The following remedies are summarised from the valuable and interesting report of Miss Eleanor A. Ormerod, LL.D., on Injurious Insects and Common Farm Pests of the British Islands for the year 1899:—

1. Cabbage Butterflies.

Prevention and remedies for Cabbage Butterflies. Genus Pieris.

" In the course of the infestations of the past two seasons I have tried two preventive experiments on the cabbage beds in my own garden, the first of wihch (in 1898) so *totally* failed that it may perhaps save waste of time to others just to mention it. At my desire my gardener dressed the plants with a good mixture of lime and soot, well powdered and thrown on the leaves. This did *not* appear to do the least good. The leaves were eaten back until little or nothing remained, but the midrib and the side-veins standing or hanging like strings and of the plants which recovered so as to make something like growth, the result was really hardly worth cooking.

" In the past season I was much more successful. Not long after the White Butterflies appeared as a regular infestation, my gardener syringed various kinds of the Cabbage plants in the different beds with the mixture known as Little's Antipest. This is a mixture of soft soap and mineral oil so far as I am acquainted with its chief ingredients; in fact may be described as our British counterpart of the ' Kerosine emulsion ' which is so greatly and successfully used in the United States and Canada for destruction of caterpillars, as a spray on leafage.

" Shortly after syringing there were noticeably fewer White Butterflies in the kitchen garden than in the flower garden adjoining, and the result was such a much smaller appearance of caterpillars that though two beds were a good deal injured, the other two borders and some lines of luxuriant cauliflower plants were practically little harmed, and even the first two named were in fairly good order; whilst in various other gardens in the neighbourhood the condition of the attacked plants was stated to be nearly or quite as bad as in 1898. From this success (although only on the scale of experiment in my own garden) it seems to me that the plan would be at least worth trying for garden use.

"With regard to lessening amount of caterpillar attack by capture of the butterflies.

"Where cabbage is grown as a field crop, probably neither hand capture nor syringing could be brought to bear, but there are very many gardens, where for an extremely small sum a couple of boys might at an hour a day for a few days do a deal towards preservation of the cabbage and cauliflower supply for house service. Syringing may very easily be managed without inconvenient loss of time for the few successions of applications needed.

"For those who may care to try the kerosine emulsion itself, I give one of the United States of American Department of Agriculture recipes for proportion of ingredients and method of mixing:—

"Add one gallon of water in which a quarter of a pound of soft soap (or any other coarse soap preferred) has been dissolved *boiling* or *hot* to two gallons of petroleum or other mineral oil. The mixture is then churned as it were together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap and water are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, *if the operation has been properly performed,* separate again.

"This is diluted with three or four times its bulk of water for a watering; if required for a wash, *at least nine times its bulk is needed*—that is, three gallons of 'emulsion' as it is termed, make thirty gallons of wash. Warning is given that care must be taken with each new crop to ascertain the strength that can be borne by the leafage.

"To those who have not the knack of combining the soap wash and oil the process is very tedious, and unless these are so thoroughly incorporated *as not to separate,* the application is likely to be very injurious from the (then) undiluted mineral oil burning the leaves.

"For this reason I use the so-called Antipest sold by Messrs. Morris, Little and Son, Doncaster, as it only requires diluting, and I have found it answer very well as an insect wash, and save both time and risk.

"It might be well worthwhile to try the effect of syringings with a solution of soft soap, without any addition. This would be to some degree a deterrent of attack, and would help to some slight degree to support the plants by causing a damp air round them, and moistening the surface of the ground with a slightly stimulating wash *without at the same time attracting* the White Butterflies. Their attack is most prejudicial in the hot and dry weather, and, so far as my own observation goes, the application of water alone is almost immediately followed by an increased amount of prevalence of the butterflies on the beds."

---

2. Corn and Grass Pest.

Ravages by Crane-flies (Daddy longlegs). Genus Tipula.

Prevention and remedies.

"*Nitrate of soda acts well,* as being a rapid fertilizer, and also obnoxious to the grub; and has been reported as having thoroughly good results, given at the rate of 1 cwt. the acre, to barley when just above ground, on badly grub-infested land. In whatever way applied, nitrate of soda, or any other good fertilizer which will act at once, if melted and driven down by rain, has been found to have a good effect, unless the rainfall is so great as to wash the fertlizer away.

" Mechanical measures such as compress the ground and so prevent the larvæ 'travelling' are of use; and so are the opposite methods of treatment, such as hoeing, harrowing, etc., which act by throwing the earth open and disturbing the grubs and throwing them open to bird attack. But what is commonly most needed is preventive treatment to the ground applied well beforehand."

---

3. Flour and Grain Beetles.

Rust-red Flour Beetle, Tribolium ferrugineum, *Fab.*
Confused Flour Beetle, Tribolium confusum, *Duv.*
Prevention and remedies.

" A very important point in household or store treatment is scrupulously cleaning all barrels, tubs, lockers, bins, or other wooden depositories in which flour or grain that has been found to be infested by Flour Beetles may have been kept. A thorough scrubbing applied with *scalding hot water* by a good hard scrubbing brush of the make with a few rows of longer bristles at one end, so that all chinks and crannies could be well cleared out, would probably be very effective. If soft soap and a little mineral oil of any kind could be used in solution in the scalding water without danger of tainting the flour which might subsequently be placed in the cask or other wooden receptacle,—this of course would be a great additional safety.

"The *transmission of attack* in connection with infested bags or packages is a most fertile source of mischief. Independently of bags *containing* flour, those that are returned empty convey the infestation, whether of the special kinds of flour beetles under consideration, or the 'granary weevils' or the 'Mediterranean mill moth' in legions, and it is not only in traffic to and fro, but where these infested bags are used *without proper purification* as ship packing material (technically I believe, known as 'dunnage'), that enormous mischief is done.

" *Preventive measures* are especially desirable in case of flour infestation as *remedial* attempts are costly in any case, and may be injurious to the material, a rise of temperature, for instance, of from 120° to 150° F. will (it is stated) kill most insects, but a greater heat will injure the flour, and even this may be prejudicial.

"*Sieving* removes the beetles and larger maggots (at a cost of so much per stone), but the eggs and small young maggots will probably pass through the meshes in numbers together with the flour.

" *Fumigation* by bisulphide of carbon is efficacious but is dangerous both with regard to its great inflammability, and also *may* be prejudicial to the operators."

4. Click Beetles and Wireworms. *FAM. ELATERIDÆ.*

Effect on Wireworms of Castor-oil seed-cake, Rape-cake, and also of absence of food.

"The following details of experiments, carried on during a period of three months by Dr. Bernard Dyer (Laboratory, 17 Great Tower Street, London, E. C.) relatively to effect of Castor-oil seed-cake and Rape-cake on wireworms, was kindly placed by him in my hands, with the remark (Nov. 14th, 1898):—

"I have been trying if cotton-oil cake (very deadly to mammals) would kill wireworms. The experiment is a very rough one. Enclosed is a description of what happened: —

"*Description of experiments on wireworms.*—One hundred worms were placed in each of three jars of earth and fed, respectively, with Castor-oil seed-cake, with Rape-cake, and with nothing. The cake was given in great abundance, in both cases, being applied as fast as the worms seemed to dispose of it, that is to say, as fast as it disappeared, though the disappearance may not have been entirely due to its consumption as food, but partially to decomposition.

"By the end of two months about a third of an ounce of cake had been supplied to each jar. The soil in each case only weighed about ten ounces, and the cake applied must have been at the rate of far more than one hundred tons per acre; so that the experiment, even if an exaggerated one, seemed well calculated to show whether there might be any specific difference in the effects of the food supplied. The earth was of course kept equally moist in all three cases.

'At the end of three months the pots were turned out, and it was found that, of the hundred worms which had had no food at all in addition to the earth in which they lived, ninety-eight were alive, though their condition was very meagre; of the hundred worms supplied with castor-oil seed-cake, ninety-three were alive and in good condition; of the hundred, however, that had been fed upon ground Rape-cake only six were alive.

'*It would appear, therefore, that Rape-cake when supplied in such superabundance as in this experiment, brought about a large destruction of the worms, though it does not by any means necessarily follow that it would do when used on the small scale adopted in actual farming.* On the other hand, it seems to be abundantly clear that Castor-oil seed-cake, although it is virulently poisonous to higher animals, fails to excercise any poisonous effect upon wireworms, which are apparently indifferent to its acrid poison.

'Still more cake was given, but this cake, the weather being warmer, decomposed, and the soil became infested with smaller life, which seems to have brought about conditions uncongenial to the wireworms; and it may be also that the effects of crowding for so long a time without change of soil were bad for them; for first the cake-fed ones died; and then those without food.'

"The foregoing observations need no comment beyond Dr. Dyer's own remarks as to the presumable cause of the ultimate death of the wireworms *after* the period of three months had expired, of which notes are given. But two of the special points recorded well deserve attention; one of these is the observation that wireworms *can exist* (although they did not thrive) for three months upon an almost infinitesimal amount of food, a fact which may be utilised for field work, as showing that, *with this pest,* leaving the ground uncropped for a time, would be of no service in clearing the land of the infestation, as it is with various other of our field attacks. The experiment with the castor-oil seed-cake, showing its *harmlessness to wireworm life,* is also a valuable record, both as a scientific fact and also as a reliable authority to turn to, which may save unnecessary outlay, and also some disappointments in field experiments as to preventive treatment for wireworms."

---

5. Pear Gnat Midge.

Genus Diplosis.

Prevention and remedy.

"The Gnat or Midge, which causes the injury, is a very small two-winged fly, gnat-like in appearance, and about the twelfth of an inch or rather more in length.

"Gathering and destroying infested fruit has had very good results, so has removal of the infested surface, or digging it in; and this stands in contrast to conditions of trees on pasture land, whree, of course, the infested surface could not be removed.

"Kainite, so strongly recommended in United States of American Practice, has answered well; and there is a good note of successful use of woodashes. No special benefit appears to have followed use of lime or of nitrate of soda. A few notes are also given of kinds of Pears which are considered less or more subject to infestation, with some remarks on what is conjectured to be the reason of this circumstance.

"The little maggot-infested Pears, should, if possible, be picked from the trees before the maggots leave them to go down into the ground, and should be burned or otherwise carefully destroyed. On no account merely thrown aside.

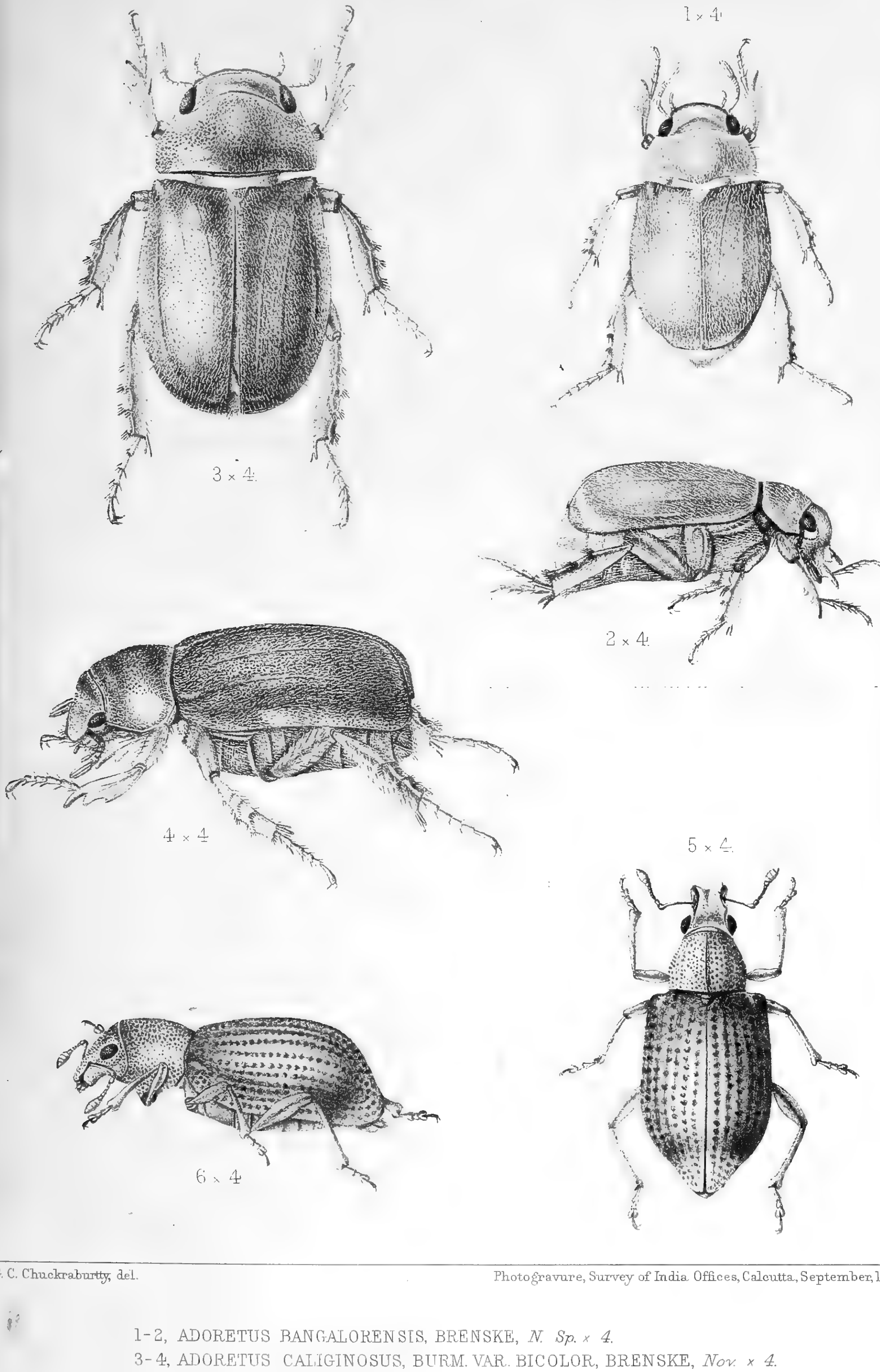
"When the trees are not growing in grass, and the ground beneath them is free of crop, and also the Pear roots not too near the surface, the plan of skimming the surface and destroying the surface earth with its contained infestation, would answer well.

"Where digging is admissible, this, if properly carried out, is serviceable; but if the operation only consists in breaking up the surface, as in the common method of digging, it is not likely to do much good. The infested earth should (as noted) be carefully buried away.

"The best application to use for dressing appears, both from the published experiments of Professor J. B. Smith, and also from our own trials *to be kainite.* With regard to amount given in an experiment on infested Pear orchard land in New Brunswick, United States of America, a heavy top-dressing of kainite was applied in late summer, and under the infested trees it was applied at the rate of over half a ton an acre. The result was that in the following year scarcely any of the fruit was found to be infested; while in another orchard close adjoining, in which the ground had not been treated, on close examination it was found that of one kind especially grown, fifty per cent. were 'midged,' and of the other kind named not one could be found to have escaped. In a laboratory experiment Professor Smith found that where nitrate of soda was sprinkled in quantity that would represent a fair top-dressing in ordinary field use, on sand which maggots had gone down, that not ten per cent. of the larvæ were alive (so far as examined) in their cocoons; and where a double quantity of nitrate was applied, a still lesser proportion of the maggots were found to be alive.

"Muriate of potash in about the same quantities showed results of respectively nearly one-half or three-quarters of the maggots dead in their cocoons."

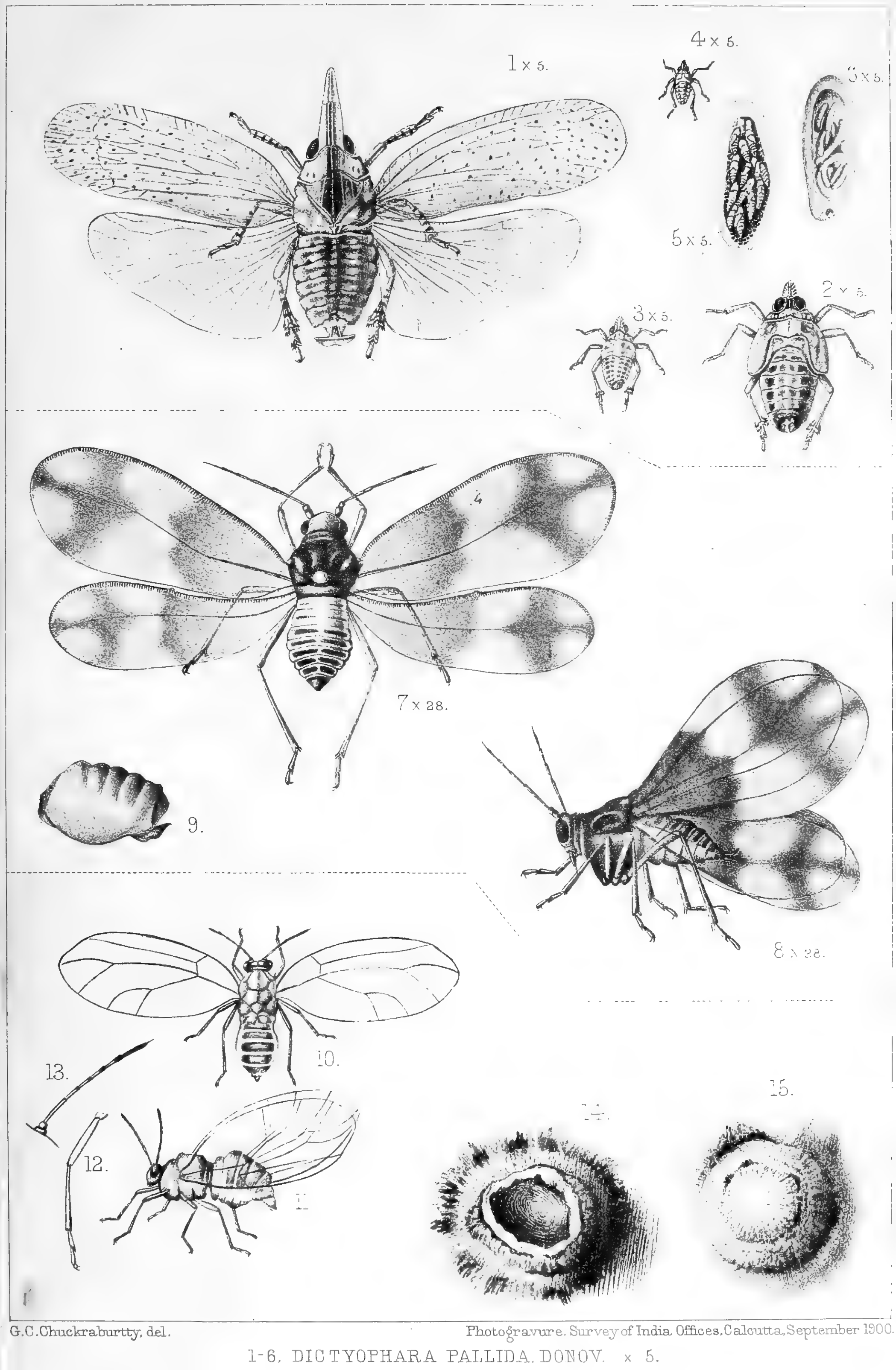
G. I. C. P. O.—No. 161 R. & A.—2-8-1900.—1,000.—R. B.



G. C. Chuckraburtty, del.

Photogravure, Survey of India Offices, Calcutta, September, 1900.

1-2, ADORETUS BANGALORENSIS, BRENSKE, *N. Sp.* × 4.
3-4, ADORETUS CALIGINOSUS, BURM. VAR. BICOLOR, BRENSKE, *Nov.* × 4.
5-6, BRACHYASPISTES TIBIALIS, × 4.



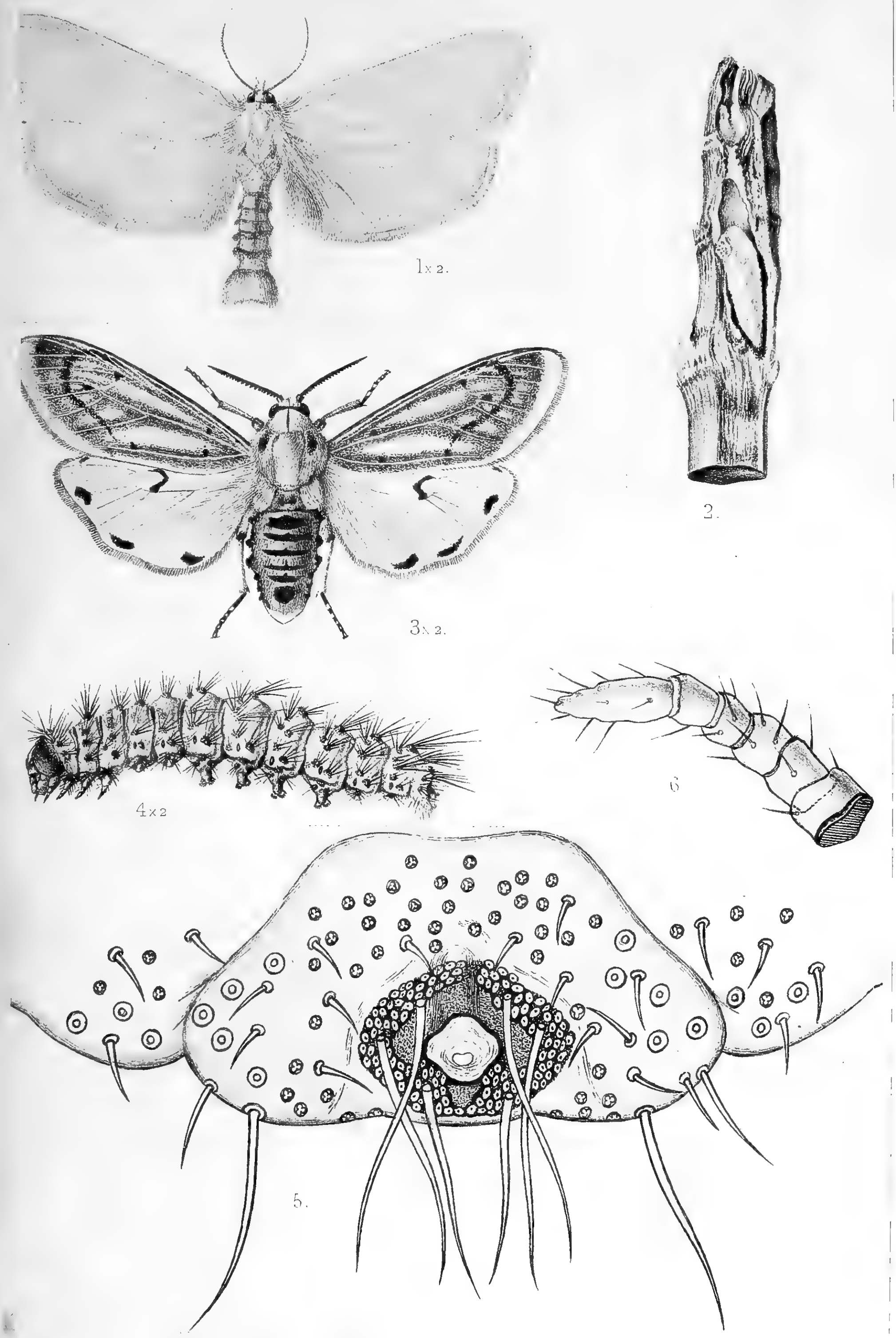
G. C. Chuckraburtty, del.

Photogravure. Survey of India Offices, Calcutta, September 1900.

1-6, DICTYOPHARA PALLIDA, DONOV. x 5.

7-9, ALEURODES NUBILANS, BUCKTON, *N. Sp.* x 28.

10-15, PSYLLA OBSOLETA, BUCKTON, *N. Sp.* Much enlarged.



C. Chuckraburtty, del.

Photogravure-Survey of India Offices, Calcutta, August 1900.

1-2, SCIRPOGHAGA AURIFLUA, ZELL. ×2.
3-4, CREATONOTUS ALBISTRIGA, WLK. ×2.
5-6, RIPERSIA SACCHARI, GREEN. *N. Sp.* Much enlarged.

INDIAN MUSEUM NOTES.

ISSUED BY THE TRUSTEES.

EDITED BY THE LATE

LIONEL DE NICÉVILLE, F.E.S., C.M.Z.S.,

ENTOMOLOGIST TO THE INDIAN MUSEUM.

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NOTICE.

THE serial *Indian Museum Notes* is devoted to Economic Entomology, and is issued by the Trustees of the Indian Museum, Calcutta, under the authority of the Government of India, Revenue and Agricultural Department. For the views expressed, the authors of the respective notes are alone responsible.

The parts of the serial are published from time to time as materials accumulate. Communications are invited; they should be addressed to—*The Editor, Indian Museum Notes, Calcutta*, and should be accompanied by specimens of the insects to which reference is made. Soft-bodied insects can be sent in strong spirit; chrysalids and cocoons alive, and packed lightly in leaves or grass; other insects, dried and pinned, or wrapped in soft paper. Live insects should be sent when there is a reasonable chance of their surviving the journey. Caterpillars, grubs, and other immature insects can, in the present state of our knowledge, be only approximately determined; they should therefore, where possible, be accompanied by specimens of the mature insects into which they transform.

CONTENTS.

ORIGINAL COMMUNICATIONS RELATING TO INSECT PESTS.

NOTES ON INSECT PESTS FROM THE ENTOMOLOGICAL SECTION, INDIAN MUSEUM.

PREFACE TO VOLUME V.

THIS number of "Indian Museum Notes" is the first to be issued under the editorship of Mr. Lionel de Nicéville, who has occupied the position of Entomologist since the 19th January 1901, and who takes the entire responsibility for its contents and their manner of arrangement.

The first three volumes of "Indian Museum Notes" were planned and executed by Mr. E. C. Cotes, who was ab e to devote most of his official hours to the new undertaking. When Mr. Cotes left the Museum the duties of Editor devolved upon the Superintendent, who could, of course, spare only a small portion of his time to work which, though in itself of high importance, must always take a secondary place in the economy of a museum intended for the general public; so that the fourth volume, which was edited by the Superintendent, may quite frankly be confessed to be inferior to its predecessors in compass and ambition.

However, now that an acknowledged specialist, such as Mr. de Nicéville,* holding a position which corresponds with that of State Entomologist, has succeeded to the editorship of "Indian Museum Notes," it is hoped that this publication will take its proper place as a Journal of Economic Entomology, wherein shall be found not only illustrated records of the life-histories of all the insects that affect, whether for ill or good, the various agricultural industries of the country, but also a compendium of the means by which the hurtful species may be brought under some control and their ravages restricted.

Such a consummation, however, is beyond the powers of a single man however experienced and however energetic: it can only be attained by the sustained co-operation of planters and district officials throughout the country. But this co-operation must be intelligent and real. For instance, desultory consignments of dead caterpillars and grubs are, at present, of no help to us. If living caterpillars cannot be sent, then some of them should be kept in

* Since this note was printed, we have had to lament the death of Mr. de Nicéville. He died on the 3rd December 1901, of fever contracted in the Darjeeling Terai, where he had gone to study the life history of the mosquito-blight. Dying practically in harness, with much enduring good work accomplished, it may be said of him, as of Tellus the Athenian, "τελευτὴ του βίου λαμπροτάτη ἐπεγένετο."

confinement at the place where they are giving trouble and the resulting chrysalids should be sent: or, if there be any doubt about the vital powers of the chrysalids, these should be kept until the perfect insects emerge from them. Again, when the Entomologist suggests a remedy against the ravages of any insect, the correspondent should endeavour to return, for record, some account of its effects, whether they are successful or not.

A. ALCOCK, MAJOR, I.M.S.,
Superintendent,
Indian Museum.

ORIGINAL COMMUNICATIONS.

1.—DESCRIPTION OF A NEW GENUS IN THE *PIRENINÆ*, FAMILY *CHALCIDIDÆ*, ORDER *HYMENOPTERA*.

By William H. Ashmead.

Eurycephalus, new genus.

This genus differs from all the other genera in the *Pireninæ* except *Ecrizotes*, Förster, by the non-pubescent eyes, and in a table of the genera comes between *Pirene*, Haliday and *Ecrizotes*, Förster, the last mentioned being the only other genus with non-pubescent eyes.

These two genera may be separated as follows :—

Females.

Ovipositor not exserted ; antennæ clavate, 9-jointed, the funicle joints 3—5 unequal, wider than long; post-marginal and stigmal veins short, much less than half the length of the marginal vein ; head much wider than the thorax, deeply concave behind, the eyes large, round ; metathorax very short, the hind angles acute, the scutellum convex, projecting and covering the very short abdominal petiole.

EURYCEPHALUS.

Ovipositor exserted ; antennæ 10-jointed, the funicle joints 2-5 of an equal length ; post-marginal and stigmal veins not short, at least half the length of the marginal vein.

ECRIZOTES, Förster.
(=*Henicetrus*, Thomson.)

Males.

Marginal vein more than twice longer than the stigmal vein ; antennæ 9-jointed, the flagellum filiform, the pedicel very small, not longer than wide, the first funicle joint the longest, curved, nearly five times as long as thick, the second joint about thrice as long as thick, the third and fourth about equal twice as long as thick, the club 3-jointed, not longer than the first funicle joint.

EURYCEPHALUS.

Marginal vein not more than twice the length of the stigmal vein ; antennæ 10-jointed. . . . .

ECRIZOTES, Förster.

Eurycephalus alcocki, new species.

♀.—Length 1.3 mm. Head and thorax above aëneous black, the face below eyes, the thorax at sides and beneath blue-black ; eyes greyish ; antennæ and legs, except coxæ, brownish-yellow, the pedicel and club of antennæ faintly dusky, the tarsi except terminal joints which are fuscous, pale yellowish. Wings hyaline, the veins brown. Abdomen rufous, seen from above cordate, flat, beneath carinate.

♂—Length 0·9 mm. Head and thorax above aëneous black, the face, cheeks, scape above, thorax at sides and beneath, the coxæ and the abdomen blue ; scape beneath and the filiform flagellum light brown. Femora fuscous with a violaceous tinge, rest of the legs light brown. Wings hyaline, strongly iridescent, the venation blackish.

Habitat.—Calcutta, India.

Types.—Cat. No. 5441, U. S. N. M.

Described from 3 ♀ and 2 ♂ specimens, received by Dr. L. O. Howard from Major A. Alcock, I.M.S., Superintendent of the Indian Museum, Calcutta, and reared from *Ceroplastes actiniformis*, Green, [Family *Coccidæ*, Order *Hemiptera*].

2.—DESCRIPTION OF A NEW COCCID.

By E. E. Green, F.E.S.,

Government Entomologist, Ceylon.

On ***Oryza sativa***, Linn., Natural Order ***Gramineæ.*** Rice or paddy.

Chionaspis decurvata, Green, n. sp., Family *Coccidæ*, Sub-order *Homoptera*, Order *Hemiptera*. Plate XVII, Fig. 1, *pygidium of female, greatly enlarged.*

On leaves of rice plants grown under shelter in the Museum in July, 1900, a coccid was found, and was sent to Mr. E. Ernest Green, F.E.S., Government Entomologist, Ceylon, who has furnished us with the following description of it, as it appeared to him to be a species new to science.

"Puparium of female white: pellicles very pale straw-colour: moderately convex: oblong: broadest across a point a little behind the extremity of the second pellicle: tapering posteriorly. Ventral scale well developed. Long :—1·50 to 1·75 mm. Broad :—0·75 mm."

"Puparium of male white, semi-transparent: obscurely tricarinate. Long :—1·10 mm. Broad :—0·40 mm."

"Adult female yellow: elongate: broadest across the metathorax and the base of the abdomen. Rudimentary antenna with a single stout curved hair. Segments of the body not strongly marked. Pygidium with a rounded extremity. A moderately deep median cleft with a chitinous margin. Median lobes prominent, narrow, widely divergent, inner edge strongly convex, outer edge concave, extremity slightly dilated and curved downwards. First lateral lobes duplex, prominent; inner lobule largest, narrowed at base. Second lateral lobes obsolete. Squames large, spiniform: 1—2 on each of the first, second, and third spaces: one on the fourth space; and three on the base. Two or three similar squames on the penultimate segment. Dorsal oval pores large and conspicuous; communicating with short cylindrical ducts. Circumgenital glands in five groups: median group 7 to 8: upper laterals 11 to 14: lower laterals 10 to 12. Anal orifice on a level with the lower lateral gland groups. Long :—0·75 to 1·15 mm. Broad:—0·30 to 0·50 mm.

"Adult male not observed."

"Allied to *Ch. spartinæ*, Comstock, but differs in the form of the median lobes, and in the proportions of the female puparium."

Plate XVII Fig. 1 shows the pygidium of an adult female.

A lady-bird beetle (Family *Coccinellidæ*) which has been identified by Mr. L. O. Howard, Entomologist to the United States Department of Agriculture, Washington, as *Platynaspis villosa* of Mulsant, preys on this coccid both in its larval and imaginal forms. It is figured on Plate IX, Fig. 3, imago × 14.

3.—INSECT PESTS OF THE SUGARCANE IN INDIA;

By E. P. Stebbing, F.E.S.,

Indian Forest Service.

Sugarcane all over the world is attacked by a variety of insect pests, and I propose to give here what is at present known of the life histories and methods of attack of those particular forms of insect life which prey upon, and often irretrievably ruin, our Indian sugarcane crops.

In an article published in the *Pioneer* of November 12th, 1900, under the title of the "Sugarcane Committee and Insect Pests," I briefly enumerated some of the insects reported as attacking the cane in India, mentioning shortly the methods of procedure of each. I propose here to elaborate and add to that article and with the assistance of full descriptions and life histories of the insects (where known) and diagrams to draw up a bulletin on the subject which will be of practical use to indigo planters and others who may intend taking up the cultivation of the cane on a large scale.

In my article in the *Pioneer* I stated that "some eleven pests in all have been reported at various times as attacking the sugarcane crop." I will add here six more to this number. They belong to the great orders of *Coleoptera* (beetles), *Lepidoptera* (butterflies, moths), *Hemiptera* (scale insects, bugs), *Orthoptera* (locusts, grasshoppers), and *Pseudoneuroptera* (white ants, etc).

In this note I have not taken the insects in the order of their generally accepted classification amongst scientists, having deemed it more advisable to divide them up into two groups according to the nature of their attacks upon the plant as follows:—

I. Insects attacking and boring into the root and stem of the sugarcane.

II. Insects attacking and defoliating the leaves of the cane. Either of these different forms of attack may result in the death of the plant, and consequently, if the insects are numerous, in the ruin of the crop. A knowledge of their habits is therefore of the first importance to the cultivator as, without it, it is impossible to attempt to introduce any methods of counteracting them. We will first consider:—

I. Insects attacking and boring into the sugarcane.

As at present known these are six in number—*Chilo simplex*, *Scirpophaga auriflua* and *Scirpophaga excerptalis* (Ord. *Lepidoptera*), *Xyleborus* sp. (Ord. *Coleoptera*), and *Termes taprobanes* (Ord. *Pseudoneuroptera*), of which the *Chilo* is by far the most important. I may add *Dorylus orientalis* (Ord. *Hymenoptera*) which is doubtfully destructive.

1. *Chilo simplex*, Butl. The Sugarcane Borer.

References { *Chilo simplex*, Butl., P. Z. S., 1880, p. 690.
Crambus zonellus, Swinh. P. Z. S. 1884, p. 528; Pl. 48 fig. 16; C. and S. No. 4703.
Crambus partellus, Swinh. P. Z. S., 1885, p. 875; C. and S. No. 4700.
Indian Museum Notes, Vol. I. 1. 22; Vol. II; Vol. III.

Classification: Order *Lepidoptera*, Sub.-Order *Heterocera*. Family *Pyralidæ*.

The exact classification of this insect has only recently been determined. It was considered for a long time to be identical with the American sugarcane borer *Diatraea saccharalis*, Fabricius, but specimens reared from sugarcane in the Indian Museum, Calcutta, and sent to Washington for identification were determined by Dr. Riley, late United States Entomologist, to belong to a different genus. He wrote:—

"I must confess that I am rather disappointed in finding that your sugarcane borer is not the same as ours. It is a *Chilo* and not a *Diatraea*, and comes near *C. plejadellus*, Zinck, which bores into rice in our Southern States, but it differs in the very clear cut terminal dark line between the black spots and fringe. The specimen is badly rubbed and I cannot be certain of its exact specific position. It is possible that it may be identical with *Chilo infuscatellus*, Snell., which infests sugarcane in Java." . . . .

The matter was set at rest, however, in 1898 when moths reared from sugarcane in the Indian Museum were sent home to Sir G. F. Hampson for identification and was determined by him as *Chilo simplex*, Butler.

Life history and description of the pest.—The life history of this destructive insect has not as yet been fully determined in India, but many observations on its habits have been made and, excepting the fact that it would appear to pass through the various stages of its metamorphosis in shorter periods, it closely resembles, if it is not identical in habits with its American confrère, *D. saccharalis*. The life history of this latter was published by Dr. Riley in a Report of the United States Department of Agriculture.[1]

1. Entomology, 1880, p. 240.

The various stages of its metamorphosis may be described as follows :—

EGG.—The eggs are laid by the moth near the axils of the leaves of the plant. They are flat, circular, one-twenty-fifth of an inch in diameter, and are white when first deposited, turning yellow as they approach the hatching point. The period passed in the egg stage is not at present known.

LARVA.—The young larva hatches out and penetrates the stalk at or near the joint and commences to tunnel through the soft pith. The growth of the borer worm is very rapid, but the approximate number of days passed in this stage has not been observed. The borers are quite active and occasionally leave their burrows and crawl about on the outside of the stalk seeking another place to enter. When full grown the larva is about an inch long, rather slender, nearly cylindrical and creamy-white in general colour, and often speckled with black spots ; head yellow, mouth parts black. Upon attaining its full size the larva bores to the outside of the cane and makes a large round hole for its future exit—a hole which is usually one-fifth of an inch in diameter. It then retires to its burrow and transforms into a pupa. The insect hybernates (*e.g.*, passes the winter) almost exclusively in the larval stage, and the grubs are often to be found very abundant in the seed cane, discarded tops left in the fields, and, to some extent, in the stubble.

PUPA.—The pupal stage is passed in the burrow within the cane stalk. The pupa is slender, brown, three-quarters of an inch in length. This stage lasts but a few days.

IMAGO.—The moth is light greyish-brown in colour with a spread of wings of about an inch and a quarter. In the female the hind-wings are nearly the same colour as the forewings, but in the male the former are silvery white. Sir G. F. Hampson in his identification of the insect described the species as follows :—

"Male : yellowish-brown suffused with fuscous ; forewing with the costal area rather darkish ; traces of dark specks below middle of cell and at lower angle ; the veins of outer area slightly streaked with fuscous : a marginal series of black specks. Hind wing whitish with slight fuscous tinge."

"Female : paler, the hind wing white."

"The form *partellus* has on the forewing of male a highly curved antemedial series of short fuscous streaks, a slight yellowish patch in end of cell, and oblique series of diffused fuscous streaks from apex to middle of inner margin, and a sub-marginal series of specks ; female with some diffused fuscous from apex round lower angle of cell, or sometimes nearly evenly suffused with fuscous, with a dark fuscous patch beyond cell."

There are several broods of the pest during the year, but it is not known how many. It is this great productiveness that renders this insect so dangerous, as for several months during the growing season the borers are continually at work.

Distribution.—*Chilo simplex* is to be found all over India. It has been reported from the North-Western Provinces under the local name of *silai* and from Cawnpore where it is called *reotha;* from Baroda where it flourishes under the name of *narkote,* from the Rungpur, Burdwan, and Hooghly Districts as *dhosah,* from Mymensingh as *mandaruah,* from Sibpur as *majera* and from Ganjam as *monjikila purugu.* It occurs also in Chittagong where I have watched it.

Reports of bad attacks in the cane fields.—As I have already mentioned, reports of bad attacks of this pest have been received from various parts of India. In 1857, Babu Joykissen Mukerji described [1] the total destruction by the pest he called '*dhosah*' of an imported variety of sugarcane (known as the Bombay or red sugarcane) in the districts of Rungpur, Hooghly, and a portion of Burdwan. The cultivation of this variety had been carried on for some years, and had proved very profitable, but when the pest appeared, its cultivation had to be entirely given up, as it was found to be very much more subject to attack than the country varieties of cane. The '*dhosah*' proved to be the sugarcane borer *Chilo simplex.* In 1888, the Personal Assistant to the Director of Land Records and Agriculture, North-Western Provinces, wrote that the pest, which appeared in dry seasons, had destroyed as much as a fourth of the sugarcane crop in the neighbourhood of the Cawnpore Experimental farm. A similar report relating to the country adjacent to Burdwan and Sibpur was sent by the Director of Land Records and Agriculture, Bengal. The letter forwarded was from the agricultural officer of the above mentioned places. He wrote—

"The sugarcane planting season extends from the beginning of February to the end of May. If there be no rains in April or May, and if the cane fields are not frequently irrigated, which from the scarcity of water at this time is hardly possible, the pest makes its appearance. The pest first shows itself by the drying of the middle stalk of the plant, and is hence called by the ryots the *majera* (a Bengali term meaning relating to the middle); on pulling, the stalk now easily comes out, and its lower end is found to have become a rotten mass. Very soon the whole plant dies away, and from the root stock a number of smaller plants make their appearance, to be in their turn attacked by the worm. If the rains hold off a long time, or if the fields are not thoroughly irrigated, three or four generations of plants are in this way attacked and destroyed. At last, when the

[1] In a paper published by the Agri-Horticultural Society, India, Volume IX, p. 355 (1857).

rains set in the fields become free from the insect, and a number of sickly-looking cane plants shoot out, but these make very little progress and never attain the proper size of the cane plant. If only one generation of plants is lost, and if this happens at an early stage of the growth of the plant, the damage done is not much."

Writing from Baroda in 1892, Mr. T. H. Middleton refers to the great damage done to cane in Gujrat in the preceding dry year, and stated that the same occurred every dry year.

In February and again in June 1899, the insect was again reported in conjunction with others from the North-Western Provinces and Oudh. This report is given under the insect *Scirpophaga excerptalis* below.

(The insect was not plentiful during the season of 1900 in Chittagong.)

Remedies.—I have already mentioned that the insect passes the winter in the larval stage inside the seed cane and dead tops and refuse left in the fields and in the stubble. A great number of remedies have from time to time been proposed for the destruction of the pest, but it is practically established that it can to a great extent be controlled by burning or burying all the discarded tops, and clearing the fields of all waste sugarcane stalks after the crops have been cut. This destroys the larvæ, which would otherwise as moths lay eggs in the spring.

In his report already quoted from, Dr. Riley recommends the burning of all 'tops' during the winter so as to destroy the larvæ which hybernate in them, selecting seed cane from the least infested portion of the plantation and laying it down in furrows during the winter, covered with earth as deeply as should be found possible without inducing decay, and only uncovering it as it is wanted in the spring for planting out, thus preventing the egress of moths from the larvæ which have hybernated in the seed cane. If these two recommendations are carefully carried out, the loss caused by this pest should be greatly minimised.

Another reason for burning over the dead tops, etc., even should there be a rotation of crops on the areas over which the cane is planted (and therefore no cane put out the following year), is to be found in the fact that it has been almost proved that this *Chilo* borer lives equally well in the cholum (*Sorghum vulgare*) and maize (*Zea Mays*). The gravity of this habit will be at once apparent. Should areas covered with either of these crops be in the neighbourhood, the moths coming out of the tops and refuse stalks lying in the cut over cane fields (if not burnt over) will lay their eggs in the cholum and maize, and thus continue to flourish in the neighbourhood ready to re-attack the cane when next planted out. In this connection I extract the following from *Indian Museum Notes*[1]:—

"A number of moths have been reared in Calcutta from affected sugarcane that has been sent to the Indian Museum, and though they differ from each other, a good deal both in size and colouration, they seem likely to prove to be merely varieties of one species. Moths also have been reared in the Indian Museum from caterpillars found in maize, and these seem also without doubt to be identical with the moths reared from sugarcane. In the case of cholum, a number of infested stalks were sent to the Museum, but the attempts that were made to rear the moth were not successful, owing to the fact that almost all the caterpillars were found to be suffering from the attack of a chalcid parasite[2] which proved fatal to all its victims. As far as could be made out the caterpillar was the same as the one found in sugarcane. It is interesting to notice, in this connection, that owing to the fact that it is always much easier in Calcutta to procure sugarcane stalks than either sorghum or maize stalks, sugarcane was used for rearing the borers sent to the Museum as attacking both maize and sorghum. Borers taken out of maize shoots were reared in sugarcane from the time they were comparatively small caterpillars until they emerged as moths, and a sorghum borer (the only one of a set received from Poona that escaped the chalcid parasite) was reared in sugarcane from the time it was a half-grown caterpillar until it reached the chrysalis stage, when it was accidentally injured and thus prevented from emerging as a moth. The caterpillars taken both from maize and sorghum stalks seemed none the worse for being fed upon sugarcane, and this appears of itself to be a strong reason for supposing that the three insects are identical."

The American *D. saccharalis* had been proved to feed on all these plants, and with a view to determining whether the Indian and American species were identical, a moth reared from sugarcane in Calcutta was sent to Washington for comparison with specimens reared in the United States. As I have already mentioned, Dr. Riley was disappointed in finding the insect to belong to a different genus. With reference to the insect attacking all three crops he wrote—

"I believe that you are perfectly right in assuming that the borers in sugarcane, sorghum and maize are all the same, and it is interesting to know that at least one other crambid agrees with *D. saccharalis* in this particular."

The following forms additional proof on the subject:—

During the year 1898 the sorghum borer was exceedingly abundant in the Central Provinces, and species were repeatedly sent to the Indian Museum through Dr. G. Watt, Reporter on Economic Products to the Government of India. Half grown caterpillars taken out of juar stalks which had become dry and useless were reared in sugarcane; they seemed none the worse for the change of the food plant,

[1] Vol. III, No. 1, pp. 51-52.

[2] Since described by Mr. Peter Cameron as *Cotesia flavipes*, n. sp., see Mem. Manchester Lit. and Philos. Soc. 1891.

but very readily tunnelled into it, and in due time as many as a dozen moths were obtained. These on comparison proved to be the sugarcane borer moths and as above mentioned were identified by Sir G. F. Hampson as *C. simplex.*

The importance of the point is obvious since it so enormously facilitates the multiplying power and consequent spread of the insect.

2. *Scirpophaga auriflua*, Zell.

References.—Zell. Mon. Chil. and Cramb, p. 2; C. and S. No. 4655 Ind. Mus. Notes, V 2. 41.

Classification.—Order *Lepidoptera.* Sub-Order *Heterocera.* Family *Pyralidæ.*

Life history and description.—The life history of this insect as regards its attacks on the sugarcane has not yet, I believe, been worked out in India, its attacks having been but recently reported. As its larva is an internal borer its habits are likely to resemble those of *Chilo simplex* already described above.

LARVA.—Attacks the growing tops of the cane and then burrows down the middle of the pith.

IMAGO.—The moth is pure white in colour, the anal tuft orange, sometimes brownish in the female or rosy pink; palpi porrect, extending from once to twice the length of head, slightly clothed with hair, and with the third joint down curved; antennæ of male minutely serrated, ciliated; abdomen long in female expanding at extremity and with a very large anal tuft; wings long and narrow.

Distribution.—This insect is to be found all over India, Ceylon and Burma.

Report of attacks in the cane fields.—In February, 1900, some pieces of sugarcane from Kushtea were forwarded to the Indian Museum by the Director of Land Records and Agriculture, Bengal. The sugarcane was found to be tunnelled by grubs, the moths of which emerged in the Museum. They were identified by Sir G. Hampson as *Scirpophaga auriflua*, Zell., a species which much resembles *S. excerptalis*, Walker, described below.

Remedies.—As it is not improbable that this insect passes the winter in the larva stage inside the cane stalk, since the cane sent to the Museum in February contained grubs, the remedies to be employed for its extirpation would be the same as already described under *Chilo simplex.*

3. *Scirpophaga excerptalis*, Walker.

References.—Wlk. Cat. xxvii, p. 142; C. and S. No. 4672.

Classification.—Order *Lepidoptera.* Sub-Order *Heterocera.* Family *Pyralidæ.*

Life history and description.—The life history has not been fully worked out. It is not improbable that it will be found to have two or more generations in the year.

LARVA.—Lives and burrows in the interior of the cane.

PUPA.—In specimens sent to the Indian Museum, Calcutta, pupæ were found in the cane stems in February.

IMAGO.—This insect differs from *S. auriflua* in having the outer hairs of the anal tuft white, the inner being brown, underside of forewing in male is suffused with fuscous. The moth is also larger in size. The remainder of the description of *S. auriflua* equally applies to *S. excerptalis.*

Distribution.—According to Hampson this insect in India has only as yet been reported from the North-Western Himalayas.

Report of attacks in the cane fields.—In February, 1899, the Director of Land Records and Agriculture, North-Western Provinces and Oudh, forwarded some samples of sugarcane said to be injured by insects. He wrote:—

"The specimens have been collected in Pipra, a village in Gorakhpur District. It is stated that when the cane is affected, the pith becomes red and the juice dries up gradually. This happens in one internode after another till the whole cane dries up and becomes woody. In a clump sometimes only one cane is affected and the others remain healthy until the cane affected first is destroyed. The healthy canes then get diseased[1] . . . It is known locally as *Lewahi.* The disease makes its appearance about the middle of the rainy season, and continues its damage until February or March. Sometimes a whole crop dries up from the effects of the disease a short time before it is fit for crushing. The variety of cane known in Gorakhpur as *Pansalie* and in other places as *Kalara* is specially liable to the disease, and its cultivation is therefore diminishing rapidly."

The cane sent was found to contain two pupæ of *S. excerptalis, Chilo simplex* (described above), and a scale insect, *Ripersia sacchari* (to be described later on) were also present.

Remedies.—This insect would also appear to pass through the winter in the larval or pupal stage, probably the former. The remedies to be employed therefore for its extirpation will be those described under *Chilo simplex.*

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[1] This would mean that the larva after devouring the internal contents of a cane bores its way out and moves on to a fresh one which it tunnels into and treats in the same way—E. P. S.

4. *Xyleborus*, sp.

References.—Gage, Department Land Records and Agriculture, Bengal, Bul. No. 7, 1900.

Classification.—Order *Coleoptera*. Family *Scolytidæ*.

This beetle has not at present been fully identified, but it is considered probable that it will be found to be closely allied to *Xyleborus perforans*, the beetle popularly known as the "shot borer" which does so much damage to the sugarcane in the West Indies.

I propose here giving a description of the genus *Xyleborus*, and a few notes on the life history of the West Indian *X. perforans*, as it is more than probable that our Indian form will be found to have identical (or nearly so) habits.

THE GENUS *Xyleborus*.

It is distinguished by the following characters: Beetles, small and cylindrical. Head globular, hidden under a rounded or cylindrical thorax, whose anterior half is densely asperate, or grater-like, the hinder half smooth, and finely punctured. Prothorax excised ventrally up to the anterior coxæ. Tibiæ flattened, dilated towards the apex, with the outer edge rounded and serrate; the tarsi can be folded up against them.

Body cylindrical, elytra punctured in rows, without a depressed line along side of suture. Males much smaller than females, of shorter and more convex shape, they are wingless, and fertilise the females in the plant when they are bred. They are by far the rarer of the sexes, the relative numbers varying from about one in four up to one in 30 or more, according to the species.

Life History: EGG.—In the case of *X. perforans* the females are fertilised by the wingless males in the burrows when they are born and never in the air. The female enters by a hole made in a node and bores out a series of galleries near the node in which the eggs are laid.

LARVA.—The larva is a minute white footless grub. Head horny and white, the jaws being tinged with brown. They are supposed to feed on the juices of the cane, the burrowing being almost, if not entirely, done by the female.

The larvæ are soon hatched and feed for about 1½ months.

PUPA.—The pupæ are found in the galleries, they are white, about the length of the perfect insect, and of the ordinary beetle type. The insect spends from two to three weeks in this stage.

IMAGO.—When the beetle emerges from the pupal skin it is almost white in colour and slowly turns brown. *X. perforans* has a very wide range. It has been found in British India, where it has been reported as burrowing into beer casks (being dubbed in consequence 'Tippling Tommy' by the Commissariat Sergeants), Ceylon, Burma, the Malay Archipelago, Madeira, the Canary Isles, Mauritius, Northern and Central America, Brazil, Peru, etc.

As I have already mentioned, it has not yet been identified as injuring sugarcane.

Xyleborus. sp., the beetle which has been reported as injuring the cane, has been forwarded home for identification. Much has yet to be ascertained about it. Amongst others the following points require further investigation:—

1. The time of year when the cane is usually attacked.
2. The capability of the larva to bore and the character of its food.
3. The time of development of the individual and the time spent in the different stages of its metamorphosis.
4. The number of generations passed through in a year and of those passed in individual canes (if more than one).

This latter is specially important.

5. Their ability to lay eggs in the cane without leaving it.
6. The ability of the beetles to attack or to breed in dead dry wood. Very important since it would largely add to their power of destruction, since with a rotation of the cane crop they would be able to remain and multiply on the spot awaiting a fresh crop of the cane.

Distribution.—This insect has been reported from various districts and places in the province of Bengal. I have myself noted a species of *Xyleborus* in the Chittagong District.

Reports of bad attacks in the cane fields.—Through the kindness of the Director of Land Records and Agriculture in Bengal, Lieutenant Gage, I. M. S., Curator of the Herbarium, Royal Botanic Garden, Sibpur, was enabled to study specimens of diseased cane sent him from many districts of the Province of Bengal, and his observations are embodied in a note he has drawn up on the subject.[1] He found that in addition to being attacked by fungi many of the diseased canes were bored into by a small beetle. He describes this attack as follows:—

"On the surface of the cane there were several small circular openings about the size of a large pin head or small shot hole. The canes were somewhat

[1] Department of Land Records and Agriculture, Bengal, Agricultural Series No. 6, Bulletin No. 7 (1900).

flattened, and had a peculiarly light sort of feel. On splitting up the canes, the interior of each was seen to have been transformed into white long fibres, with a somewhat silky lustre. These fibres were quite isolated, and could be torn up through the crumbling tissue of the nodes with ease and without breaking. The fibres were in fact the fibrovascular bundles of the cane, which had become quite separate from one another by the destruction of the intervascular-cellular tissue. The cause of this destruction was not at first evident, but further examination of canes sent from other districts, and showing the same appearance as the Banka ones, left no doubt on the matter.

"In almost all the other canes, showing their interior transformed into strands of fibre, there were detected in abundance small beetles, belonging evidently to the genus *Xyleborus*. These small beetles were seen busily occupied in burrowing in all directions through the cane, and reducing the intervascular tissue to fine powder. They seem to be particularly fond of congregating about the nodal tissue. They were repeatedly seen in the tunnels leading from the "shot holes" on the outside of the cane. Specimens of the beetles were submitted to Major Alcock, I.M.S., Superintendent of the Indian Museum, for identification. They proved to be new to the Entomological collection there, but are probably closely allied to *X. perforans*, if not identical with that species."

I can corroborate much that Lieutenant Gage has above described from my own observations, although I am at present inclined to believe that my Chittagong specimens will not be found to be *X. perforans*, although undoubtedly closely allied.

Another point that I have observed is one that has been noticed in the case of the West Indian *X. perforans*, and that is that the female does not always bore her way into the cane but at times takes advantage of the borings of the larvæ of the *Chilo simplex*, etc., and enters the cane by these. Burrows running from these holes and forking repeatedly can be seen if searched for, proving that the beetle must have entered in this way. The observations were not made sufficiently early to enable me, however, to discover eggs.

Lieutenant Gage discovered beetles in the cane sent him from the following Bengal districts:—

Bhagalpur, Beheea (E.I.R.), Bogra, Burdwan, Dacca, Durbangha, Dinajpur, Faridpur, Jessore, Midnapore, Monghyr (Begusarai and Jamni Sub-division), Murshidabad, Mymensingh, Nadia (the Sub-divisional Officer of Kushtia alluded to a disease of the cane he called '*Bonga*' attributed to an insect which enters the cane between two nodes and eats into it), Noakhali, Pabna (the disease *Bonga* also alluded to here), Rangpur, and Saran.

To the above I add Chittagong.

The curious part about the information at present collected on this pest is the fact that when it is present the borer *Chilo simplex* appears to be far from abundant. It is too soon to lay much stress on this point with the insufficient data at present to hand. It is worth while recording, however, that Lieutenant Gage, out of 79 sets of diseased canes examined, found traces of a moth borer in one only, whereas the *Xyleborus* was present in 65 out of the 79.

I noticed this curious absence of the *C. simplex* in Chittagong or rather its scarcity as compared with the *Xyleborus*. It may be but a coincidence due to a peculiarity of the season.

Remedies.—Since this insect lives its life within the cane in a not very dissimilar manner to the way in which *C. simplex* spends its existence, the remedies applicable are much the same as those described above for the sugarcane borer.

The Editors of the Kew Bulletin write in connection with its attacks on the West Indian cane :—

"There should be no difficulty experienced by intelligent planters in the West Indies in dealing with this cane borer. The infested canes should be destroyed either by burning or passing through the rollers of the cane mills. Care should be devoted to the selection of plant canes, to ensure that they are free from the grubs and eggs of the beetle, and precautions should be taken to get rid of all the cane refuse in a decayed state in the neighbourhood of the cultivated fields. In other respects the same steps are necessary with this borer as have been found effective in the case of the moth borer. This latter has been known to attack sugarcanes at intervals for nearly sixty years, but its influence has been rendered comparatively harmless by the systematic destruction of infested canes, and by examining and dressing the 'plant' canes before they are put into the fields. These simple and effective methods are fortunately within the reach of everyone."

5.—*Termes taprobanes*, Walker ('White ant').

References.—List Neurop. Inx. B. M. Pt. III (Termit.), p. 252-59.

Classification.—Order *Orthoptera Pseudoneuroptera.* Family *Termitidæ.*

This insect is the well-known so-called 'white ant', or termite, of India.

Life History.—*T. taprobanes* lives in communities which consist of the following four sets of individuals :—

(1) A female or queen with enormously distended abdomen ; she is incapable of locomotion and lays all the eggs of the community.

(2) Small ant-like neuters, which may be compared to the worker bees. They are of two kinds, *viz.*, individuals with large heads and sharp mandibles to defend the nest, and individuals with small heads to build the passages

and nests, collect food, and do all the work of the community.

(3) Wingless larvæ which develop into winged males and females.

(4) Winged males and females. The males and females fly out of the nest in clouds generally after rain. Those of them that escape their numerous enemies are said to drop their wings and copulate. The female finds her way back to the original nest or starts a fresh nest for herself. Her abdomen grows by distention of the membranes between the chitinous plates until she becomes like a sausage, two or three inches in length with a minute head and thorax at one end. Queens in several stages of development may sometimes be found in a single nest.

Termes taprobanes never willingly exposes itself to daylight except in the male and female forms. The insects work in earthen galleries, which they build over themselves as they advance.

Distribution.—This insect is to be found in most parts of India.

Reports of attacks on cane by T. taprobanes.—In 1888 the Commissioner of Chota Nagpur wrote that sugarcane in the Giridih Sub-Division was reported by the officer in charge to be especially liable to attacks by white ants. The manager of the Chota Nagpur Raj states that its mode of attack is to eat up the root of live crops and thus cause the death of the plants. The ryots, he stated, were not acquainted with any remedy for it. The Personal Assistant to the Director of Land Records and Agriculture in the North-Western Provinces reported in 1888 that until the sugarcane borer (*Chilo simplex*) appeared near Cawnpore white ants had been found to be the most serious pest with which the sugarcane had to contend, although, he continues, they could always be more or less efficiently checked by heavy watering.

Remedies.—Many and varied have been the methods made use of in the attempt to exterminate this pest. A popular theory that was long believed in and adhered to was that a nest may be got rid of by digging up and killing the queen. This is now known to be a fallacy. It has been recognised that *termites* are perfectly well aware of the presence or absence of the king and queen, and should they be removed the workers start about providing fresh ones, *i.e.*, substitute royal forms, by introducing deviations in the normal development of the larvæ. Thus it becomes impossible to completely eradicate white ants. But whilst this latter is true as far as total extermination is concerned, something may be done to minimise the effects of bad attacks.

To begin with, when new cane fields are being prepared it is important that all adjacent anthills should be levelled. I would recommend hoeing in a strong mixture of wood ashes and slaked lime. The soil should then be left for several months and then heavily manured. The mixture will kill all insects living in the ground, and the manure will counteract the poisonous (to plants) [1] effects which white-ants seem to have on the soil. Mr. Bamber mentions that the tea plant will not grow either on the anthill or when it has been cleared away unless heavy manuring is done and the soil thoroughly pulverised afterwards.

In the case of anthills which it is considered too expensive to remove, a good plan which has been tried with success in Ceylon is by the use of bisulphide of carbon. Dig two or three shafts down through the anthill or make use of the main tunnels and plug them with about half a pound of the bisulphide. Close all the other openings with clay. The nest should then be left for twelve hours or more. The poisonous fumes will kill off the colony in its entirety if properly done. Another plan to try would be to light fires of brushwood on the windward side and sprinkle them over with sulphur, or cover them with damp straw, green branches, or old bamboo mats. This will create a thick smoke, which will be forced into the interior of the anthill and kill off the colony. This will save expense, as if it is not actually within the proposed cane field area or any adjacent to it (in the latter case it would be advisable to remove it) there is no absolute necessity for its removal.

6.—Dorylus orientalis, Westw. (doubtfully destructive).

References.—Westw. Proc. Zool. Soc. 1835, p. 72; Shuck, Ann. & Mag. Nat. Hist., 1st Ser. v. 320, 7 (1840). Westw. Arc. Ent. 1.80.7; Ind. Mus. Notes. V. 2, 42, 44.

Classification.—Order *Hymenoptera.* Family *Formicidæ.* Sub-family *Dorylides.*

Description.—IMAGO[2]. Pale testaceous with a long shiny, silky pubescence, especially in front of the head and throughout the thorax: head red, mandibles and scape of the antennæ castaneous, the latter about one-fifth the length of the entire organ, which is filiform and elongate; ocelli disposed in a triangle at the vertex, large, with less

1. Chemistry and Agriculture of Tea including growth and manufacture by M Kelway Bamber.

2. *Vide* Shuckard's Ann. and Mag. Nat. Hist. 1st Ser. V. 320, 7 (1840).

space than the diameter of one between the posterior and anterior, in front of (while the face which is very convex) is deeply sulcated: mandibles very broad and very slightly curved, thin inner edge acute and nearly straight.

Thorax silky, the pleuræ shining, gibbous in front and at the scutellum, which is slightly longitudinally impressed in the centre; metathorax rather elongate, slightly rounded at the apex, very pubescent: wings clouded with a fuscous tinge, thin nervures dark brown, the cubital deeply bisinuate, the first sinus dipping into the second discoidal cell, and the second beyond the recurrent nervure which is straight and inverted at rather more than two-thirds of the length of the first sub-marginal cell: legs castaneous, the femora, elongate-ovate, thin outline rounded both above and below.

Abdomen with a rich satiny reflection, the peduncle quadrate, gibbous, the ventral portion slightly produced and boat-shaped, the remaining segments transverse, the sexual organ protruding at the apex of the terminal segment and fringed.

Distribution.—It has been reported from Bengal.

Reports of attacks in cane fields.—In June, 1899, the Director of Land Records and Agriculture sent amongst other insects pupæ and imagoes of this insect which were reported as burrowing into the main stalk of the young sugarcane plant in April and May, when the crop is two or three months old. The stalk attacked by this insect rots inside and the leaves dry up. It is stated that fresh shoots begin to spring from the root if watering is kept up, this presumably drowning the aggressors. The insects were found in abundance in the plant.

Mons. Forel, the expert who identified the insect, stated in his letter 'This species like the whole of the genus lives *exclusively* on animal food. All species of *Dorylus* are driver ants, hunting insects and small living animals underground. This was the accepted theory but it would appear to be not correct as regards all species of the genus. The following is a note on the subject by Mr. E. E. Green, Government Entomologist, Ceylon, and I can from personal observation support Mr. Green's contention as far as some parts of India are concerned. Mr. Green writes:—

"On page 198 of *Indian Museum Notes,* Volume IV, No. 4, I see a statement on Dr. Forel's authority that all species of *Dorylus* feed on animal food, and that *Dorylus orientalis,* Westw., cannot therefore be obnoxious to potatoes.[1] With all due deference to Dr. Forel's acknowledged learning on the subject of ant I most emphatically contradict this statement, as far as it refers to *Dorylus orientalis,* Westw. The workers of this species (determined for me by

[1] Or to other vegetable food.—E. P. S.

Colonel Bingham) live entirely underground, and I can assert from repeated personal observation, that they are most confirmed vegetarians. I found it quite impossible to grow potatoes in Pundalnoya, solely on account of this insect, and they were most aggravating in their systematic attacks upon the tubers of dahlias, and the roots of the common sunflower (*Helianthus*, sp.). In the case of tubers they form galleries through and through the substance, and in the case of roots they eat off the tender bark below the collar. I have made very careful observations on the point and have completely satisfied myself that the *Dorylus* was really feeding upon the vegetable tissues, and was not merely hunting for another insect."

Remedies.—As the ants' nest will probably be in the ground, our attention must be turned here in the application of remedies. Wood ashes and slaked lime are commonly used in America either pure or in mixtures against root-feeding insects. They should be buried in the earth among the roots by hoeing or ploughing. The applications should be weak or they will injure the roots. Lime in any reasonable quantity could hardly cause injury. The application of either of these is generally beneficial and tends to destroy and repel insects from the base and roots of trees. The ashes act in addition beneficially as a fertilizer.

We will now consider the second group, consisting of those insects which defoliate the sugarcane :—

II.—Insects attacking and defoliating the leaves of the cane.

Our present knowledge comprises eleven insects only coming under this head. These include two chrysomelid beetles, *Haplosomyx elongatus* and *Leptispa pygmæa*, the larva of one butterfly *Mancipium nepalensis*, and two moths, *Ophiusa melicerte* and *Dragana pansalis*; four Hemipterous insects, *Blissus gibbus* and *Dictyophara pallida* and the scale insects *Aleurodes eugeniæ* and *Ripersia sacchari* and two locusts, *Ædalus marmoratus* and *Pœcilocera hieroglyphica.*

The most injurious and dangerous of the above insects as far as it is at present known is :—

1. *Leptispa pygmæa.* Baly.

References.—Cat. Ceylon Hispid. Baly 1858 ; I. M. N. III 5,44, IV 3,122,123.

Classification.—Order *Coleoptera.* Family *Chrysomelidæ.* Sub-Family *Hispineæ.*

A small slenderly-built beetle which feeds on the developing buds of the sugarcane.

Very little is at present known about its habits.

Imago.—The following is Baly's description of this insect:—

"It is a narrow, elongate, cylindrical, deep metallic green beetle. Head slightly flattened above, covered with irregular punctures; basal joint of antennæ compressed and dilated externally, at its apex truncate. Thorax sub-quadrate; sides straight and parallel, rounded near their apex, narrowly margined, anterior margin indistinctly produced, rounded; above convex, coarsely punctured, puncturing rather less deeply impressed and less crowded, especially towards the sides, than in *L. filiformis.* Scutellum black, impunctate. Elytra scarcely broader than the thorax; sides parallel; apex less acutely rounded, dehiscent at the suture; above convex, deeply punctate-striate, striæ towards the apex of the elytra subsulcate. Beneath entirely black."

Distribution.—The insect has been reported from the Poona Farm, Kirkee; and it also is found in the Malabar District, Madras.

Reports of attacks in the cane fields.—In November, 1893, the insect was reported by the Assistant Superintendent of the Poona Farm, Kirkee, to be attacking the developing leaf of the sugarcane, checking the growth of the plant and eventually killing it. It has also been reported from the Malabar District, Madras, where it attacks paddy, and it is not unlikely to be found on the sugarcane as well.

Remedies.—In the case of bad attacks of these leaf-feeding insects it is probable that one of the arsenical insecticides, such as 'Paris-green' or 'London-purple', could be used with safety with ordinary care. They are employed by fruit growers in the United States on a very considerable scale, and could be probably used without danger to the crop to rid *young* cane fields of this and similar leaf-feeding pests.

It is during the young stages of its growth that the cane chiefly suffers from these insect pests, and dilute solutions of these arsenical sprays should prove effective in ridding the crop of them. Paris-green and London-purple are arsenical compounds much alike both in composition and also in the effect which they have on insects. They are applicable to caterpillars and other mandibular insects attacking the foliage of crop plants. The poison is sprayed on to the plants and consequently taken internally by the insects feeding on their leaves. These compounds can be obtained from various London Firms[1] made up into 1 ℔ packets with directions for their application. They are sprayed on by means of a force pump.[2] London-purple is preferable to Paris-green as there is less risk of injury to the foliage. For general use on mature foliage half a

[1] Messrs. Hemingway & Co. of 60 Mark Lane, London E. C., for instance.

[2] Good pumps are made by Messrs. Rumsay & Co. of Sineca Falls, New York. Their catalogue should be consulted.

pound of London-purple to 50 gallons of water is recommended. First mix the London-purple separately with a small quantity of water, then add to it the whole supply. It must be remembered that the powder does not dissolve in water, and therefore all washes containing London-purple must be constantly stirred to keep it in suspension or it will sink to the bottom. The proportion of powder to water should not be exceeded and an even more dilute solution may be tried to begin with and strengthened if not found effective. An addition of flour to the mixture has been strongly recommended in the United States because of the greater adhesiveness thus given, and also because the difference of colour helps to show the amount that has been distributed on the leaves. Two or three pounds has been named as the quantity for the above mixture, but the amount used would appear to be immaterial. Great care must be taken not to drench the foliage. The spray should only be allowed to fall upon the cane *until it begins to drop from the leaves and no longer.*

It will probably be found best to do the spraying towards evening, as the insects, if beetles, will not be so ready to fly away before the spray as during the daytime. Two or three sprayings should be given if required, but two or three days should be allowed to intervene. Although beetles may still be seen flying about the crop after the poisoning, they will in all probability not do much harm on an area that has been properly sprayed. In recommending the above remedy for these leaf-eating insects, it must be pointed out that very little has been done in this direction in India to mitigate bad attacks of crop-feeding insects. Taking into consideration, however, the excellent results that are daily being obtained in America and now in England with these insecticides, I am of opinion that it will be found that much may be done towards saving thousands of acres of crops that annually suffer or are entirely ruined by insect pests.

2. *Haplosomyx elongatus,* Baly.

References.—Indian Museum Notes, IV. 1. p. 30.
Classification.—Order *Coleoptera.* Family *Chrysomelidæ.*

A small brightly coloured leaf-feeding beetle.

Very little is at present known about its life history.

Distribution.—Khasi and Jaintia Hills, Assam.

Report of attacks in the cane fields.—In July, 1894, specimens of this insect were forwarded to the Indian Musuem, Calcutta, by the Director, Department of Land Records and Agriculture, Assam. It was reported to be attacking young sugarcane.

Remedies.—The same remedies as advised above under *L. pygmæa* should be tried to get rid of this beetle.

3. *Mancipium nepalensis,* Grey.

References.—Indian Museum Notes, II. 1. 45.

Classification.—Order *Lepidoptera.* Sub-order *Rhopalocera.* Family *Pierinæ.*

This insect may be looked on as the Indian form of the destructive European species *Pieris* (*Mancipium*) *brassicæ,* Linn.

It is doubtful whether the larvæ of this butterfly would ever seriously damage the sugarcane. I mention it here as it has been forwarded to the Indian Museum in this connection.

At present too little is known as to its habits in this country to render it possible to write with any certainty on the subject.

Distribution.—Umballa, Punjab.

Report of attacks in the cane fields.—In January, 1890, the Deputy Commissioner of Umballa forwarded to the Indian Museum, Calcutta, through the Director of Land Records and Agriculture, larvæ of this butterfly which he reported as defoliating, amongst other things, sugarcane.

Remedies.—The Deputy Commissioner of Umballa in his letter above mentioned stated that the only known remedy tried against this caterpillar was ashes, which in some cases were thrown over the plant, with what effect is not stated.

The arsenical spraying mixtures above mentioned would be found, if tried, most effectual. Two applications would in all probability kill off all the larvæ. Kerosine emulsion, which will be described later, should also prove effective if sprayed over the crop.

4. *Ophiusa melicerte,* Drury.

References.—Drury, Ill. Exot. Ins. 1, p. 46, pl. 23, fig. 1; Moore, Lep. Ceyl. iii, pl. 168, figs. 2, 2 *a*, *b* (larva); C and S. No. 2624. *Indian Museum Notes* (=*Achæa melicerte*) ii, 6, 159.

Classification.—Order *Lepidoptera.* Sub-Order *Heterocera.* Family *Noctuidæ.*

Life history and description.—EGG. No observations on the time and manner of laying the eggs seem to have been recorded.

LARVA.—It has been noted that the larval stage lasts about fifteen days, the worms appearing just before the rains. Larva bluish-grey speckled with blue-black; lateral and sub-lateral yellowish bands with intervening blue-grey line ; a dorsal black stripe bordered by reddish-white spots between fourth and fifth somites ; a pair of dorsal red tubercles on anal somite ; spiracles and fore legs red ; the head black-striped.

PUPA.—This stage is stated to last about ten days.

IMAGO.—According to the above observations the imago would appear on the wing at about the end of June or first week in July. No notes seem to have been recorded as to when the female lays her eggs, or of the number of generations, if more than one, passed through during the year. The moth is pale reddish-brown. Fore wing with the markings usually prominent, but sometimes almost obsolete ; a short sub-basal waved line ; obliquely waved antemedial and excised postmedial lines, often with black suffusion inside them ; a speck at end of cell ; a diffused rufous band beyond the postmedial line. Hind wing black, with medial white band ; three large white spots on outer margin ; the cilia whitish. Underside both wings suffused with grey ; fore wing with an oblique white postmedial band not reaching the costa ; two crenulate medial lines on each wing. Exp. 60—76 millim. (*Hampson*).

Distribution.—The insect has a very widespread range, being found all over India, in Ceylon, the Malay Archipelago and Australia.

Report of attacks in the cane fields.—The Collector of Ganjam in a report dated September, 1888, which was forwarded to the Indian Museum, Calcutta, by the Revenue and Agricultural Department of India, stated that sugarcane crops were being attacked in his district by caterpillars of this insect. The insects were defoliating the plants.

Remedies.—The arsenical sprays should prove effectual in ridding the sugarcane of this pest.

5. *Acantholipes pansalis*, Wlk.

References.—Wlk. Cat xvi, p. 200; Hmpsn. Ill. Het. ix, pl. 167, fig. 3 ; C. and S. No. 2941.

Apphadana evulsalis, Wlk. Cat. xxxiv, p. 1213.

Poaphila concors, Wlk. Cat. xxxv, p. 1969.

Dragana pansalis, *Indian Museum Notes*, I. 1. 57.

Classification.—Order *Lepidoptera*. Sub-Order *Heterocera*. Family *Noctuidæ*.

Life history and description.—Nothing much seems to be known about the life history of this insect in India.

IMAGO.—Hampson gives the following description of the genus and moth in Volume II of his Fauna of British India (moths):—

"Palpi obliquely upturned, the second joint very broadly fringed with hair, the third minute; thorax and abdomen smoothly scaled and slender; tibiæ without spines and not fringed with long hair. Forewing with the apex quadrate or slightly acute. Antennæ of male bipectinated, the branches short.

Moth ochreous or reddish-brown. Forewing slightly irrorated with black scales; very indistinct antemedial, two waved medial, and more prominent postmedial line, with the areas beyond it darker and often with obscure fuscous patches beyond it at centre and inner margin; a marginal series of black specks. Hindwing with sinuous postmedial line; the area beyond it darker and with traces of a submarginal line. Exp., ♂ 22, ♀ 24 millim."

Distribution.—The insect is to be found throughout India, Ceylon, Burma and the Andamans.

Report of attacks in the cane fields.—In the collection of the Indian Museum, Calcutta, is a specimen of this moth ticketed as injurious to sugarcane. It was identified by Mr. Moore.

No further information has been obtained about it, and it is therefore impossible to prescribe remedies.

6. *Blissus gibbus*, Fabr.

References.—Fabr. Ent. System. *Indian Museum Notes V.* 2, 42, 43.
Classification.—Order *Hemiptera.* Sub-Order *Heteroptera.* Family *Lygæidæ.*

Life history and description.—The life history of this insect in India has not as yet I believe been worked out. The genus is a formidable one to agriculturists. *Blissus leucopterus,* Say., is the well known 'Chinch bug' of North America, one of the most noxious and injurious insects to agriculture. According to Riley, late United States Entomologist, the injury is caused by the insect sucking by aid of its rostrum or beak the grasses and cereals, thereby causing them to shrink, wilt, and wither, not by biting their substance as many suppose. The multiplication of the insect in North America appears to have been conterminous with the increase of grain cultivation in that country, and the injury it occasioned to the 'small grain' in the North-Western States in 1871 amounted to upwards of thirty million dollars, whilst in 1874 the damage was computed at twice that sum. It has been found by Riley to be two-brooded in some of the States, and this will probably be found to be the case in some parts of India with our own species. It multiplies most in hot and dry seasons, moisture proving unfavourable to its existence. The following is the life history of the 'Cinch bug.' It is considered worth while giving it here, as it is probable that our Indian species will have a development very similar to the American bug growing in the hotter Southern States.

EGG.—The eggs are deposited 'occasionally' above ground in the blades of grain, but far more often and normally under ground upon the roots of the plants infested.

LARVA.—The eggs give rise to larvæ which, by moulting, *i.e.*, shedding their skins, finally develop wings and become the mature insect. In this stage they migrate from field to field for food often in solid columns inches deep.

IMAGO.—The following is the description given in Fabricius, Entomologica Systematica:—

A. atra scutello elytusque albis: puncto apicis nigro.
Parva, gibba atra. Antennæ breves, triarticulatæ.
Scutellum album puncto apicis nigro.
Elytra lævia, alba puncto apicis atro.
Alar albæ, immaculatæ.

Distribution.—The Indian species is common in most parts of India.

Reports of attacks in cane fields.—In June, 1899, the Director of Land Records and Agriculture, North-Western Provinces and Oudh, sent to the India Office specimens of mature sugarcane with a report that they were attacked by an insect locally named *Kari*, which had done considerable mischief to the full grown canes in Azamgarh. The insects sent were immature, but were undoubtedly those of a species of *Blissus* thought to be probably *Blissus gibbus*, a well-known Indian species.

Remedies.—Since this insect feeds on the plant by means of suction through its rostrum or beak, the arsenical insecticides above described for application to mandibulate or biting insects, and which are taken internally by these when feeding on the foliage of the cane, cannot be made use of, for insects which feed by suction a wash is required which will kill by contact, and of insecticides of this nature there are none probably to equal those prepared from petroleum. Experience in America has shown that those made from kerosine are the best. The ease and practicability of emulsifying and diluting kerosine to any desired strength (it should never be used pure as it will injure the plant) has been fully demonstrated, and I propose to describe here the preparation of the wash known as the kerosine emulsion, which has been used on a very large scale in America to counteract the attacks of insects on fruit trees and crops. It consists of kerosine, soap and water.

An emulsion, if properly made, always contains a greater per cent. of kerosine than of other ingredients. This percentage may vary from 60 per cent. to 90 per cent., but experiment has shown that 66 per cent. kerosine will give the most satisfactory results.

The formula for the preparation of kerosine emulsion recommended is as follows :—

Kerosine	2 gallons	= 67 per cent.
Common soap or whale oil soap .	½ pound	} 33 "
Water	1 gallon	

Dissolve the soap in the water by heating and add the solution, boiling hot, to the kerosine, and churn the mixture by means of a force pump and spray nozzle for five minutes. The emulsion, if perfect, forms a cream which thickens on cooling and should adhere without oiliness to the surface of glass. Dilute, before using, one part of the emulsion with nine parts of cold water. The above formula makes 3 gallons of emulsion, and when diluted gives 30 gallons of wash.

The mixture is sprayed over the crop and should rid it of *B. gibbus* and in addition of all soft-bodied mandibulate insects, such as caterpillars, etc.

7. *Dictyophara pallida,* Donov.

Reference.—Cat. Spec. of Homop. Ins. in Br. Museum, Pt. II, p. 310. *Fulgora pallida,* Donov. Ins. Ind., pl. 8, f. 2. *Indian Museum Notes,* V. 2, 43.

Classification.—Order *Hemiptera.* Sub-Order *Homoptera.* Family *Fulgoridæ.*

Life history and description.—Not very much appears to be known about this insect. Under the name of *Pseudaphana pallida* it is described shortly and figured in Westwood's Natural History of the insects of India. The description given by Westwood is Donovan's, and, as he states, it is far from concise enough. It is as follows :—

Trunk linear, ascending ; thorax pale green with red lineations ; wing cases hyaline, length with the wings closed, ½ an inch.

Distribution.—Has been reported from Southern India. It occurs also in Bengal (Donovan).

Report of attacks in the cane fields.—In January, 1900, the Agriculture Inspector reported that this insect was damaging the sugarcane crop in the North Arcot District, Southern India. He wrote :—

"These insects are seen to perch on the underside of the cane leaf avoiding sun and on shaded leaves. They are good springers. The bug is soft-bodied and is very easily killed by slight handling. These are known to the ryots only since ten years. The cane crop when infested gets stunted and damaged. These appear when cane is six to nine months old. No remedy is known to the ryots. They (the insects) collectively go by the name of *Cheeda purugu.* In Coimbatore the bug is known as *Thathoopoochi,* and the winged insect as *Thaloocupoochi.*"

Remedies.—The same remedies as given under *Blissus gibbus* should be tried for the extermination of this insect.

8. *Aleurodes barodensis,* Maskell.

References.—Maskell. Trs. N. Z. Ins. 1895; *Indian Museum Notes* III. 5. 53.

Classification.—Order *Hemiptera.* Sub-Order *Homoptera.* Family *Aleurodidæ.*

Life history and description.—The following is taken from Mr. W. M. Maskell's description of the insect:—

EGG.—"The eggs of this insect are orange-coloured, rather large, oval, pedunculated; length about $\frac{1}{160}$ in. The eggs and empty shells are found in large numbers on the leaves of the plant attacked."

"LARVA.—Dark brown, becoming later almost black; elongated elliptical; slightly convex; abdominal segments fairly distinct, length about $\frac{1}{45}$ in. Margin minutely crenulated and bearing a short white waxy fringe, which is frequently very fragmentary or absent. Dorsum bearing, within the margin, a row of about thirty-two small simple circular pores; within these is a transverse row of four on the anterior thoracic region, another transverse row of four on the anterior abdominal region, a longitudinal row of four on each side of the abdomen, and one on each side of the vasiform orifice. Vasiform orifice subconical, the posterior extremity slightly produced; operculum short, rounded, subconical; lingula cylindrical at the base, afterwards widened, finally tapering, not quite reaching the edge of the orifice."

"PUPA.—Pupa-case very dark brown or glossy, black, very elongated, elliptical, with sides nearly straight, the width only about one-third of the length. Dorsum sometimes slightly convex, sometimes flat, sometimes slightly concave; abdominal segments indistinct. Vasiform orifice apparently as in the larva, but difficult to make out on account of the very dark colour of the case. Margin crenulated, and bearing a very elegant, long, snowy white fringe of slender waxy cylindrical tubes. There is frequently some white powdery meal on the dorsum, which probably bears pores as in the larva, but it is most difficult to detect them. The ventral surface is flat, brown, the rudimentary organs are not distinct, owing to the dark colour. *Adult form* unknown."

The very elongated form is distinctive, besides the colour.

Distribution.—The insect has been reported from the Bombay Presidency.

Report of attacks in the cane fields.—In September, 1893, specimens of a scale insect reported as attacking the sugarcane leaves in Baroda were forwarded to the Indian Museum, Calcutta, by Mr. T. H. Middleton. The insect which is locally known as *masi* was sent to

Mr. Maskell for identification and was named by him *Aleurodes barodensis.*

Remedies.—A remedy that should be tried for attacks of this pest and one that is widely made use of in America against scale insects is the kerosine emulsion already described. It has been favourably reported on for destroying the green scale bug, one of the most inveterate blights of the coffee tree, and also has been said to have been successfully used in the Kangra Valley for destroying scale insects on tea.

NOTE. *Aleurodes sp.*—An unnamed species of *Aleurodes* has been reported as attacking sugarcane. It may prove identical with the above, but all mention of it should not be omitted here.[1]

In January, 1900, species of sugarcane leaf from South Arcot were forwarded to the Indian Museum by G. Rajagopaul Naidoo, Agricultural Inspector. He writes :—

"The pest appears as numerous small ash-coloured oval spots underneath the leaf blade. In some places only dark spots of similar dimensions are seen indicating the marks left by the insects The development of green colouring matter is arrested by the pest, causing the cane plant to look pale and stunted in growth. No name is yet given to the pest, though the cultivator of the field says he is aware of it for the last ten years. The soil of the field was loamy, in nature disposed to be saline."

Specimens forwarded to Mr. E. E. Green, Government Entomologist, Ceylon, were identified by him as an Aleurodid.

9. *Ripersia sacchari*, Green.

Reference.—Indian Museum Notes, V. 2, 37.

Classification.—Order *Hemiptera.* Sub-order *Homoptera.* Family *Coccidæ.*

Life history and description.—The following is Mr. Green's description of the adult insect :—

"ADULT ♀ pinkish, the colour more or less concealed by a white powdery waxy secretion which is collected more particularly round the margins of the insect. Form elongate ovate, more or less flattened from its position beneath the sheathing leaves of its food plant. Legs and antennæ comparatively small, but well formed. Antennæ of six joints only, sixth always the longest, rather longer than the second and third together; fourth always shortest; relative lengths of other joints slightly variable. Foot with apparently only two digitules, fine pointed hairs without knobs, 1 on claw and 1 on tarsus; occasionally a second still finer hair on tarsus; tarsus shorter than tibia, the two together shorter than combined femur and trochanter. Anal ring with six stout hairs arising from a compact circumscribed patch of glandular cells. Anal lobes obscure; scarcely—if at all—prom-

[1] See *Indian Museum Notes,* v. 2, 44.

inent; the usual caudal setæ scarcely longer than the hairs of the anal ring; without groups of conical spines or definite patches of spinnerets. The whole derm dotted with circular spinnerets of two forms, which are more crowded on the posterior segments, where they are also mingled with a few stout pointed hairs. The larger spinnerets have a simple circular pore. The opening of the smaller spinnerets is 3- to 4-foliate. Length 3·25 to 5 mm. Breadth 1·75 to 3 mm. The insects are found at the base of the sheathing leaves of sugarcane."

Distribution.—Has been reported from the Gorakhpur District in the North-Western Provinces and Oudh.

Report of attacks in cane fields.—As mentioned under *Scirpophaga excerptalis* above, this insect was reported in February 1900, by the Director of Land Records and Agriculture, North-Western Provinces and Oudh, as attacking sugarcane in the Gorakhpur District in company with the larvæ of that moth and of *Chilo simplex* (described above).

Remedies.—Kerosine emulsion sprayed over the crop should prove effective in ridding it of this pest.

10. *Ædalus marmoratus*, Linn.

References.—Indian Museum Notes. I. 4. 212, II. 1. 10.

Classification.—Order *Orthoptera.* Family *Acridiidæ.*

This insect was sent in company with the locust *Pœcilocera hieroglyphica* mentioned below to the Indian Museum. It was stated to be doing serious defoliation in the cane fields.

Distribution.—The insect has been reported from North-Western Provinces and Oudh and Bombay.

Report of attacks in the cane fields.—This insect was observed at work attacking and destroying the leaves of the sugarcane in the North-Western Provinces and Oudh. The Director of Land Records and Agriculture, North-Western Provinces and Oudh, who reported the injury, stated that the insect was locally known in the North-Western Provinces as *Aukh-phutta* and in Oudh as *Bhunga.*

They were reported as seriously defoliating the cane in Cawnpore. Nothing further would seem to have been reported about the insect in this connection.

Remedies.—The predatory habits of locusts are well known, and the methods employed for their suppression are numerous. The arsenical insecticides described above, sprayed on, should prove effective as a remedy. Another good plan, if water is available, is to trench round the cane field and fill the trench with water on which a layer of petroleum is afterwards poured. This will keep out the young larvæ who appear in myriads during a locust swarm, from marching into the cane fields and devastating them.

11. *Pœcilocera hieroglyphica*, Klug.

References.—Decticus hieroglyphicus, Klug. Symb. Phys. Dec. 1. pl. 25, f. 1.2. *Pœcilocera hieroglyphica*. Burns. Handb. Ent. ii. 623. *Indian Museum Notes* I. 4. 212 ; II. 1. 10.

Classification. Order *Orthoptera*. Family *Acridiidæ*.

Life history and description.—The following is a description of this insect[1] :—

Corpus pallide flavum. Antennæ vix thorace longiores, obscure cœrulear, articulis 7, 9, 11, 13 et 15 apice flavis. Caput luteo maculatum, margine lineisque lateralibus abbreviatis cœruleis. Thorax sparsim luteo-maculatus, dorso lateribusque cœruleo-lineatis, lineis lateralibus arcuatis subinterruptis, lobo postico basi immaculato, margine cœruleo-maculato. Metathorax et scutellum omnino immaculata. Abdominis segmenta tria priora immaculata, reliqua macula utrinque lutea macula elongata supera, lineolis plurimis abbreviatis et flexuosis inferis, punctis denique lineolisque dorsalibus cœruleis ornata. Pedes anteriores cœruleo-annulati, postici maculati. Elytra confertim nigro-cœruleo-punctata alar lacte rubræ, vel potius miniæ, apice flavescentes hyalinæ.

Distribution.—Has been reported from the North-Western Provinces and from Oudh.

Report of attacks in cane fields.—This insect was reported to attack sugarcane in company with the locust, *Ædalus marmoratus*, above described, by the Director of Land Records and Agriculture, North-Western Provinces and Oudh, where it is known under the same local names.

Remedies.—The remedies to be tried have already been described under *Æ. marmoratus*.

Summary Remarks.—This forms all we at present know on the subject of insect pests of the sugarcane plant. That this is all that there is to be known, or that the above are the only insect pests against which the plant has to contend, will, I fear, not be found to be the case. It is a well known fact that the increase in the cultivated area of any particular plant is followed by the increase in the number of its insect enemies. Forewarned is forearmed, and by

[1] Klug Symb. Physc. Dec. 1. pl. 25. f. 1. 2.

knowing what is at present known on the subject of these pests, the sugarcane cultivator will be in a position to minimise their attacks.

In paragraph 4 of the Bengal Government Resolution appointing the Sugarcane Committee, it is stated that—

> " It may be profitable to the indigo planter of North Behar to take up the cultivation of sugarcane and the manufacture of sugar, either by growing cane as a rotation in alternate years and keeping up the growth and manufacture of indigo or . . . ."

From the point of view of minimising the danger from insect attacks, this suggestion is a most happy one. I have pointed out that the *Chilo* borer, and not improbably the *Xyleborus* and others as well, spend the cold weather in the refuse cane and tops, and that these should accordingly be carefully removed and burnt. However carefully this may be done grubs, etc., in varying proportion, will be sure to escape, and thus be ready to start and spread the attack in the following season. If there is no crop the succeeding season these grubs will perish, and thus the rotation of crops would prove the best of all remedies against insect pests.

To sum up. In order to lessen the chance of insect attacks on a sugarcane crop, it is important to bear in mind the following:—

(1) The greatest care should be taken in choosing the seed cane. The intending cultivator should find out exactly where it comes from and whether the crop from which it was taken suffered from any bad insect attacks in the previous year.

(2) It will probably be found that the local canes are safer to plant out than imported better qualities. The latter may give a better return, but in their new environment will be likely to suffer much more severely from insect attacks.

(3) After cutting the crop, every care should be taken to clear off the ground and burn all refuse cane, which, if insect pests are about, will certainly harbour their eggs, grubs, or other stages of their metamorphosis.

NOTE.—It may be remarked that a weevil (*Coleoptera*) by name *Sphenophorus sacchari* does great damage to sugarcane in the West Indies. It will not unlikely prove that the Curculionid family (weevils) of beetles contains species injurious to our Indian cane. This point further investigation on the subject will enable us to settle

4. ON A NEW GENUS OF TINEID MOTHS.

BY J. DURRANT.

DASYSES, Drnt, gn. n.

(δασύς = shaggy; σής = a moth.)

Type—***Cerostoma rugosella***, Stn.

Antennæ, ♂ (1); ♀ somewhat shorter; rather thick, simple. *Maxillary palpi* not developed. *Labial palpi*, median joint with a thick rough triangular tuft projecting forward on the underside, terminal joint erect. *Head* and face rough. *Haustellum* short. *Thorax* not tufted. *Forewings* with the costa evenly rounded, termen evenly rounded; with strong tufts of raised scales. *Neuration:* 12 veins; 7 and 8 stalked, 7 to costa; other veins separate. *Hindwings* (1), elongate ovate. *Neuration:* 8 veins, all separate. *Abdomen* long; ♀ with extruded ovipositor. *Legs*, hind tibiæ with long hairs above. ♂ smaller than ♀.

Allied to *Euplocamus*, Ltr. but differing in the simple antennæ and in possessing raised scales on the forewings.

1363(1) ***Dasyses barbatus***, Chr.

Morophaga (?) *barbata*, Chr. Bull. Sve. Imp. Nat. Mosc. LVI. 432-3. No. 132 (1882) [1]: *Sep.* 195-6 (1882) [1]; Wlsm. Pr. Z. Soc. Lond. 1885. 883 (1886).

Hab.: E. SIBERIA—Askold Id[1].

This species should be referred to the genus *Dasyses*.

1363 (2) ***Dasyses rugosellus***, Stn.

Cerostoma rugosella, Stn. Tr. Ent. Soc. Lond. (n. s.) V. 113-4 (1859) [1]; Wkr. Cat. Ip. Ins. Bm. XXX. 1017. (1864) [2]; Moore, Pr. Z. Soc. Lond. 1867; 669 [3]; Wlsm. Pr. Z. Soc. Lond. 1885. 883 (1886) [4]; Swinh. and Cotes Cat. Moths Ind. 709, No 4839 (1889) [5].

Hab.: INDIA—Calcutta [1-5]; Bombay [4-5] IX [4]; Poona [4-5] X [4], XII [4]; Bekpur 25. VII. 1886 (*Minchin*), CEYLON—*Peradeniya*. *Larva* in galleries in the fibrous stem of a dead *Cycas circinalis*.

5.—REMARKS ON INDIAN SCALE INSECTS (COCCIDÆ), WITH DESCRIPTIONS OF NEW SPECIES.

By E. Ernest Green, F.E.S.,

Government Entomologist, Ceylon.

Part II.

(With Plates XVIII, XIX and XX.)

The following notes are in continuation of my earlier contribution on the subject, in Vol. V, No. 1, of this Journal. Sixteen species, not included in my first list, are now enumerated, bringing up the total number of records to 53, a figure which must still bear but a very small proportion to the number of species occurring on the Indian continent.

With several new collectors in the field, I anticipate the early publication of a third part of these notes.

Aspidiotus (*Targionia*) *glomeratus*, sp. nov.

Female puparia crowded and adhering together in such a manner that it is difficult to isolate a single individual. Form irregularly circular, slightly convex. Colour smoky-brown or grayish-black. Pellicles large, shining, black; normally concealed beneath a covering of the fuliginous secretion. Ventral scale whitish, stout, entire. Diameter 2·50 mm.

Male puparium similar to that of female, but much smaller and more oval. Long diameter 1 mm.

Adult ♀ of normal oval form (pl. xviii, fig. 1); cephalothorax evenly rounded, spiracles without parastigmatic glands, surrounded by a concentrically wrinkled area. Pygidium (fig. 1, *a*) deltoid. Lobes six, prominent, well defined, with evenly rounded edges; the thickened bases extending inwards (fig. 1, *b*.). Four claviform thickened processes (paraphyses) extending inwards between the lobes, two on each side. Margin beyond the lobes strongly but irregularly serrate. Pectinate squames between the lobes. No circumgenital glands. A strong chitinous bar—interrupted in two places—extending across base of pygidium. Genital aperture anterior to anal. Numerous oval pores, with thickened chitinous rims, on both dorsal and ventral surfaces, connected with long filiform ducts. Length 1·50 to 1·75 mm. Breadth 1·20 to 1·40 mm.

Adult ♂ not observed.

Habitat: Beneath the sheathing bases of leaves of sugarcane (*Saccharum officinale*) in association with *Aclerda japonica*, Newst. Collected by Dr. Geo. Watt (Reg. No. 11830-9). No locality given.

Lecanium imbricans, sp. nov.

Adult ♀ (pl. xviii, fig. 2) very irregular in form owing to the crowded habit of the insects. When separate and examined under pressure, the form appears to be irregularly deltoid, the anterior extremity narrowest. Marginal area flattish: median area irregularly convex. The derm is so densely chitinous that it is extremely difficult to make out the characters. Margin with a close series of pointed spines. I have been unable to detect any stigmatic clefts or stigmatic spines, unless three of the marginal spines grouped together at one point (fig. 2, *a*) represent the latter.

Derm with moderately large polygonal or rounded cells on dorsum, and many conspicuous oval translucent cells on ventral surface, especially towards the dense median area. There are four remarkably large depressed glandular patches on the dorsum, at about equal distances from each other: each patch (fig. 2, *b*) surrounded by a densely chitinous ring, within which is a mass of minute circular pores similar to those composing the circumgenital glands in the *Diaspidinæ*. Anal scales (fig. 2, *c*) with outer edge convex, longer than base, which has a concave outline. Antenna (fig. 2, *d*) apparently 7-jointed, with one or more incomplete joints in the 7th: 1st shortest, 7th longest: formula, 7, 3, 4, 5, 2, 6, 1. Legs small and slender. Foot with 3 simple hair-like digitules, 1 on claw, 2 on tarsus. Length of largest example examined, 12 mm. Breadth, 11 mm.

Habitat: On stem and branches of *Ficus mysorensis*; Nilgiris (coll. Dr. Geo. Watt, No. 14675). Received also from Mr. L. de Nicéville, who quotes, as follows, from his correspondent, Dr. Lehmann, of Mysore: . . . . "so far as I have been able to find out, it has only been found on a tree locally known as the 'red cedar' (probably *Ærocarpus fraxinifolius*) which is used as a shade for coffee."

A very distinct and interesting species: the comparatively great size (nearly half an inch in diameter) far exceeding that of any other known species. The marginal spines and glandular pits suggest affinity with *L. mirificum*, Mask. The function of these glandular patches is obscure. My specimens do not show any definite waxy or other secretion at these points.

Eriochiton cajani, Mask.

(*Indian Museum Notes*, Vol. II, No. 1, p. 59, (1891.)

This species should be removed to the genus *Ceroplastodes*, Cockerell,

Aclerda japonica, Newst.

(Ent. Mo. Mag. April, 1901.)

Dr. Watt has sent me examples of this species, infesting sugar-cane, where it occurs beneath the sheathing bases of the leaves, in company with *Asp. glomeratus*, as described above.

Inglisia bivalvata, sp. nov.

Adult ♀ (pl. XVIII, fig. 3,) oval: strongly convex above, the dorsal area rising steeply into a bicuspid median point. Dorsum completely covered by two glassy shell-like plates meeting along the median longitudinal line. These plates are most delicately fluted in radial curves, the rays meeting at each cusp and are easily separable from the body of the insect. In dried specimens they usually become detached, when they resemble the valves of some minute mollusc. A fragmentary fringe of small glassy plates can often be distinguished at the posterior extremity. Colour of test very pale fulvous or brownish-yellow. Colour of insect brown. Antenna (fig. 3, *a*) small, the joints rather confused: six separate joints distinguishable: two basal joints short and broad, then a long stout joint, almost as long as all the others combined, with one (sometimes two) incomplete divisions: the three terminal joints small and short. Mentum monomerous. Leg (fig. 3, *b*) well developed: tarsus (exclusive of claw) ⅔rds length of tibia: ungual digitules broadly dilated; tarsals fine knobbed hairs. Anal aperture (fig 3, *c*) surrounded by dense chitinous skin: the anal scales widely divergent, triangular, outer edge longer than base, a small tooth-like process on inner edge near apex; anal ring with 6 long stout hairs. Margin of body with a series of sharply-pointed conical spines alternating with an equal number of sessile bilocular pores: both spines and pores communicating, by delicate ducts, with a remarkable system of ramifying vessels (fig 3, *d*) resembling the circulatory system in higher animals. Slight marginal indentations at the stigmatic regions, marked by slight by stouter spines. Test, 4 to 5·50 mm. long: 3 to 3·50 mm. broad. Insect 3·50 to 5 mm. long; 2·50 to 3·25 mm. broad.

Adult ♂ not observed.

Male puparium (fig 3, *e*) a remarkably ornamental object when perfect; but the waxy laminæ are very brittle and easily detached. Anterior extremity with a single fluted plate marked like the valve of a cockle shell. Median dorsal area occupied by an elongate plate with a prominent central compressed cone surrounded by radiating ribs. Posterior part covered by a large heart-shaped slightly concave plate, forming a valve for the exit of the imago, the apex pointed and cleft, with a median conical prominence and radiating lines. The sides occupied by wing like laminæ of striated wax, two on each side. The whitish radiating lines and bars give the scale the appearance of being ribbed or fluted: but the surface is in reality quite smooth and glassy, the paler markings lying below this transparent surface. Length, 2 mm.

Habitat: On twigs of *Thespesia populnea* (fig. 3, *f*): Rameswaram Island, South India.

This insect, in the form of the test, approaches *I. fossilis*, Mask., but differs in the possession of well developed legs.

Tachardia.

It has been customary, in describing species of the genus *Tachardia*, to speak of the "lac-tubes", presuming these organs to be principally concerned in the secretion of the lac with which these insects invest themselves. I believe this to be a mistaken assumption. A study of the early stages of the insect shows that the lac is exuded from the general surface of the skin. It first appears, in the larva, in the form of separate plates on the dorsal surface of the several segments in the same manner as the waxy matter of *Ceroplastes* commences in isolated waxy plates, afterwards increasing in area and coalescing. No definite glands can be distinguished as responsible for the secretion, just as no definite glands can be shown to be responsible for the dense waxy covering of *Ceroplastes*. In fact, these dorsal prominences, which may be more justly styled the stigmatic processes, are, with the caudal extremity, the only parts from which no lac is produced. Their extremities are provided with glands of the same nature as those appearing on the chitinous plates of the anal ring, the function of which appears to be the secretion of waxy filaments insulating those parts, preventing the accretion of lac there and ensuring the permanence of the three orifices in the wall of the test, namely, the two stigmatic orifices for respiratory, and the anal orifice for excretory and sexual purposes.

The function of the remarkable dorsal spine still remains a mystery. There is apparently no analogous (nor homologous) organ in any other known coccid. It appears only in the adult stage, and might therefore be supposed to have some connection with the reproductive process. But Professor Cockerell has recently recorded species of *Tachardia* in which this organ is absent. It cannot therefore be an essential part. It is not a mere chitinous spine, but contains a duct connected with glandular bodies.

Tachardia fici, sp. nov.

Test of mature ♀ subglobular in isolated examples (pl. xix, fig. 4, often with supplementary globules of lac attached to the surface. Even where the insects are crowded together and the tests have become confluent, the original form can be roughly distinguished (fig. 4, *a*.) Colour bright fulvous or castaneous. Apex pierced with the usual three apertures, the two stigmatic apertures closer together than their distance from the anal orifice : the anal aperture the largest surrounded by a prominent rim : the stigmatic apertures small and slightly sunk, usually blocked by white pulverulent wax. The remains of the larval test occupy a position between the stigmatic orifices. Surface roughened with numerous nodules of lac. Immature tests smaller, more oval and dorsally depressed. Early larval test oblong, with a more or less conspicuous median longitudinal rounded ridge. Diameter of a single isolated adult test averaging about 3·50 mm.

Test of ♂ (fig. 4, *b*.) irregularly oblong oval, slightly constricted on each side in front of the posterior orifice, with a median longitudinal rounded ridge representing the larval test : a large oval aperture at posterior extremity which, during the pupal stage, is closed by an operculum of lac. Colour dark reddish brown. Length, 1·60 mm.

Adult ♀, after oviposition (figs. 4 *c*, *d*,) oblong oval : placed in an erect position, cephalic extremity downwards. Ventral area somewhat concave. Dorsal area rounded. Before oviposition the insect must have been globular, filling the test. Mouth parts with prominent spatulate processes arising immediately below the mentum. Antenna (fig. 4, *e*) small and vestigial : composed of 4 (?) joints which are vaguely indicated by darker chitinous bands : 3 or 4 stout hairs at apex. The parts become so distorted during gestation that their true nature may be easily misunderstood. The position of the spiracles, for instance, is completely reversed. What was originally the anterior pair, finally assumes a position caudal of the true second pair and are placed dorsally. This change of position can be demonstrated by a study of the earlier stages, described below. It will be advisable therefore to speak of the dorsal and ventral spiracles, instead of the first and second pairs. Ventral spiracles small, close to rostrum. Dorsal spiracles large and conspicuous, situated at the base of the stigmatic processes (the so-called "lac-tubes"), which are prominent but rather short and truncate: the truncate extremity with a circular chitinous plate, in the centre of which is a shallow cavity with lobular outline bearing numerous minute circular pores and some 5 or 6 larger pit-like depressions communicating with chitinous cylindrical ducts (fig. 4, *f*). Anal process (fig. 4, *g*). very prominent, the apex strongly chitinous and surrounded by spines and spiniform prominences. Anal ring composed of four broad chitinous plates bearing 10 long stout hairs: the two ventral plates with two hairs each: the dorsal pair each with 3. Anal spine on a stout elongate fleshy tubercle: the spine dilated at base, and surrounded by some small chitinous points. Derm with some scattered catenulate groups of minute circular pores on the dorsal surface. Judging from the dried specimens, it is probable that both crimson and yellow forms occur, as is the case in the Ceylonese species *T. albizziæ*. Length from 2·50 to 4 mm.

Early adult female (fig. 4, *h.*) quite small and very different in form from the insect as it appears after gestation. It may be recognised as adult by the presence of the dorsal spine, which appears only in this final stage. The stigmatic processes and perforate plates are at first sessile, and the associated spiracles open dorso-laterally. The body is trilobate, the lateral indentations marking the openings of the dorsal stigmata which are placed in a more forward position than in the fully grown insect. Viewed from the side (fig. 4, *i.*), the anal process projects dorso-posteriorly, while the dorsal spine is directed upwards and forwards. Round the base of the anal process are some irregular crowded groups of glands, each group taking the form of a hollow sphere, the walls of which are closely set with the orifices. In macerated specimens it is difficult to interpret the proper relation of these glands to the surrounding tissues; but they correspond with an area of dense waxy matter which encircles the caudal extension in the living insect.

Female of second stage (fig. 4, *j.*), oblong-oval: cephalic extremity narrow and demarked from the thorax by a slight lateral indentation on each side, from which proceeds a deep tubular invagination containing the anterior spiracle, this area being covered dorsally by the glandular plates. The second pair of spiracles opens on the ventral surface. The subrostral processes appear as fleshy rounded papillæ immediately below the mentum. There is no trace of the dorsal spine. The anal ring (fig. 4, *k.*) has 10 hairs each arising from a chitinous plate; but there is a tendency for 8 of the plates to combine in pairs, and, in some examples, they actually coalesce. The antennæ are very small and inconspicuous, even more vestigial than in the adult.

Young larva (fig. 4, *l.*) elongate-oval: either crimson or yellow, the two forms occurring in about equal numbers. Antenna with 6 joints: 3rd long and dilated at extremity: 6th very irregularly fusiform: 5th with two very long whip-like hairs. Mouth-parts large and conspicuous. Legs well developed: tarsal digitules set one behind the other (fig. 4, *m.*), a single hair-like ungual digitule. Anal ring with 6 hairs, each arising from a small circular plate. Spiracles small and inconspicuous: a perforate chitinous plate covering the anterior pair.

Habitat: On the small terminal branches of *Ficus religiosa* and *F. bengalensis*; Monghyr. (coll. Dr. Geo. Watt, Register No. 14916).

This species is most closely related to the lac insect of commerce (*Tachardia lacca*, Kerr.); differing from that species principally in the much smaller, more globular, and more isolated tests of the adult female. The structural differences of the insect itself are more of degree than of quality. The stigmatic processes are shorter and more truncate than those of *T. lacca*, and have fewer depressed spots on the extremity. The antennæ are more developed: in *T. lacca* they are mere truncate tubercles, without trace of segmentation. From *T. mexicana* it may be distinguished by the form of the test and contained insect, which is 6-lobed in that species. From other described species it is more easily separable.

Genus **Monophlebus,** Leach.

The sub-family *Monophlebinæ* was defined by Signoret as containing all those species having 11-jointed antennæ in the adult female. But at that time not a single adult female of any species of *Monophlebus* proper appears to have been known to Signoret. Maskell has since described *M. crawfordi*, with 9-jointed antennæ, and *M. fuscus* which has only 7 joints. Signoret himself described what he supposed to be an immature female of *M. leachii*, with 7-jointed antennæ: but, as suggested by Maskell, this may very possibly have really been an adult. It is evident that the characters of the female *Monophlebus* have been taken too much on trust. No female *Monophlebus* has as yet been described having more than 9 joints in the antennæ. I am now able to describe the females of two new species, in which the sexually adult insects have 8-jointed antennæ. They were both found by Mr. E. P. Stebbing, Entomologist to the Imperial School of Forestry, Dehra Dun, North-Western Provinces. I have much pleasure in naming one of them after its discoverer.

Monophlebus Stebbingi, sp. nov.

Adult ♀ (pl. xx, fig. 5) robust. Margin somewhat flattened and forming a distinct lateral keel. Median dorsal area tumescent: divisions of segments well defined. Colour, slaty-gray, thickly dusted with white mealy powder. Legs and antennæ black. Margin with irregular fringe of longish black hairs: the whole ventral surface covered with a short pubescence, denser on the margins and intersegmental regions. Both dorsum and ventral surface with numerous circular pores, some with single, some with double orifice (fig. 5, *a*), the orifices guarded by small raised points. Antenna (fig. 5, *b*.) with 8 joints: first seven subequal in length, 3rd sometimes longer: 8th longer than previous two together: all the joints with many blackish hairs. Legs stout, spiny: tarsus short, scarcely half the length of the tibia: claw long and stout, with a pair of simple hair-like digitules. Anal aperture on dorsum, at some distance from extremity, surrounded by a group of stout hairs. Length of early adult female (taken in coitû with the male), 8·50 mm. Breadth, 4·50 mm. Older examples attain a considerably larger size. The largest I have examined measures 13 mm. by 8·50 mm., and it is possible that others may exceed these dimensions.

Adult ♂ (fig. 5, *c*.) dull red: notal and sternal plates black: the whole body dusted with mealy powder, giving it a pruinose appearance: a lunate pale patch in the centre of mesonotum and a pale space between the mesonotal plates and the scutellum. Legs and antennæ black: wings fuscous, corrugated, with two white creases, one on each side of the discal nervure. Halteres with 5 stout hooked bristles at extremity. Antenna 10-jointed: 3rd to 9th each with three nodes, 10th with four nodes: each node with a whorl of long hairs. Eyes large, compound: a single ocellus on the dorsal surface at inner margin of each eye (fig. 5, *d*). Abdomen with 3 elongate fleshy hairy processes on each side: the first shortest, the third longest. Genital sheath not projecting beyond the posterior margin of abdomen: penis usually partially everted, densely clothed with short reversed hairs. Length: 5 mm. Expanse: 11·50 mm.

Habitat: On stems and branches of the "Sal" tree (*Shorea robusta*). It is said to be a pest of some consequence, as it "weakens leading shoots of young saplings and the smaller branches of older trees, tending to check the spring growth of the tree". It makes its appearance about the end of January.

M. stebbingi may be distinguished from *M. crawfordi* by the three nodes on the antennal joints in the male, 2 nodes only being present in the same parts of *M. crawfordi*.

It is possible that the present insect may be eventually proved to be identical with *M. fabricii*, Westw., from Sumatra: but the description of that species is so meagre and inadequate that, taking into consideration also the difference in locality, I hesitate to accept that description.

Monophlebus dalbergiæ, sp. nov.

Adult ♂ considerably larger than *M. stebbingi*. Abdomen with 4 elongate fleshy appendages on each side (fig. 6). Halteres with 10 stout hooked bristles (fig. 6, *a*). Colour and form otherwise similar to *M. stebbingi*. Length, exclusive of appendages, 7 mm. Expanse: 17 mm.

Adult ♀ differs only from *M. stebbingi* in the denser and stronger pubescence on the under surface. Size of early adult, 8·50 × 4·75 mm. Fully grown examples would probably double these dimensions.

Habitat: On *Dalbergia sissoo*: Sutlej Valley, Punjab, India.

Differs from *M saundersi*, Westw. in its larger size (the ♂ of *Saundersi* has an expanse of 14 to 15 mm. only, and a length of 4 to 5 mm.): and in the absence of the small tubercle on each side at the base of the penis—(See "Essai sur les cochenilles", Pl. xix, fig. 3).

Other new records for India, since the publication of my last paper, are:—

From Mr. H. W. Peal—

Aspidiotus trilobitiformis, Green: on unidentified plant, Calcutta. This species infests cultivated Mango plants in Mauritius. The present examples are extensively parasitized, so there is little fear of the insect becoming a pest in India.

Aspidiotus lataniæ, Sign, on unidentified plant, Calcutta. This is the insect wrongly determined as *A. cydoniæ*, in "Coccidæ of Ceylon," Part I. (See also Journ. Bomb. Nat. Hist. Soc., Vol. XIII, No. I.)

Parlatoria zizyphi, Lucas, on *Citrus* plants, Ballygunge, Calcutta.

Dactylopius citri, Risso. on *Erythrina*, Calcutta.

It is probable that the earlier records of *D. adonidum* are really referable to the present species.

Mr. Stebbing has sent me examples of *Fiorinia theæ*, Green, infesting Olive plants, from the Sutlej Valley, N.-W. Himalayas.

Dactylopius sacchari, Cockerell, has been received from Mr. I. Burkill, affecting sugarcane from Poona. The insects were crowded beneath the sheathing leaves, just above the nodes of the plant. This species was originally described by Prof. Cockerell from Trinidad. Maskell identified the same insect from specimens collected in Mauritius. It differs from *Ripersia sacchari*, Green (*Indian Museum Notes*, vol. V, No. 2), in the presence of 7 joints in the antennæ: in its smaller size: and in the simple anal ring.

Eriococcus paradoxus, var. *indica*, Mask. (*Indian Museum Notes*, vol. IV, No. 4), was accidentally omitted from my earlier list of Indian *Coccidæ*.

Cerococcus ficoides, Green. Collected by Dr. George Watt on Tea-plants in the Duars. Was described and figured in "The Entomologist's Monthly Magazine," October 1900.

Chionaspis decurvata, Green, is described in another part of the present number.

The total additions to my first list will therefore be as follows :—

DIASPIDINÆ—

Aspidiotus glomeratus, Green.
,, *trilobitiformis*, Green.
,, *lataniæ*, Sign.
Parlatoria zizyphi, Lucas.
Chionaspis decurvata, Green.

LECANIINÆ—

Lecanium imbricans, Green.
Inglisia bivalvata, Green.
Aclerda japonica, Newst.

ASTEROLECANIINÆ—

Cerococcus ficoides, Green.

DACTYLOPIINÆ—

Dactylopius citri, Risso.
" *sacchari*, Ckll.
Ripersia sacchari, Green.
Eriococcus paradoxus, var. *indica*, Mask.

TACHARDIINÆ—

Tachardia fici, Green.

MONOPHLEBINÆ—

Monophlebus stebbingi, Green.
" *dalbergiæ*, Green.

NOTES ON INSECT PESTS FROM THE ENTOMOLOGICAL SECTION, INDIAN MUSEUM.

I.—INSECT PESTS OF FOREST TREES.

On ***Shorea robusta***, Gaertn. Natural Order ***Dipterocarpeæ***. The Sāl tree.

On ***Helicteres Isora***, L. Natural Order ***Sterculiaceæ***.

On other trees and plants not specified.

1. *Monophlebus* sp. Sub-family *Monophlebinæ*. Family *Coccidæ*. Sub-order *Homoptera*. Order *Hemiptera*.

In June, 1900, Mr. F. Gleadow, Deputy Director, Imperial Forest School, Dehra Dun, sent some coccids which do much damage to the twigs and leaves of the Sāl tree (*Shorea robusta*, Gærtn., Natural Order *Dipterocarpeæ*), and were also found on *Helicteres Isora*, L. Natural Order *Sterculiaceæ*, and other trees and plants in the Dehra Dun district from January onwards. Mr. Gleadow notes that the insect is of two colours, one orange, the other brown.

The insects were forwarded to Mr. E. Ernest Green, Government Entomologist, Ceylon, who noted that they are immature examples of a coccid of the sub-family *Monophlebinæ*, but that it is impossible to determine either genus or species without adult material. "The mature female will probably be a comparatively large insect, possibly as much as half an inch in length, and should be looked for on the branches and trunks of the trees."

On ***Boswellia serrata***, Roxb. Natural Order ***Burseraceæ***.

1. *Dasyses rugosellus*, Stn. Family *Tineidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate XV, fig. 3, ♀ imago enlarged.

In "Indian Museum Notes," vol. iii, n. 5, pp. 46, 47 (1896), it is recorded that a moth was reared in the Museum from the wood of *Boswellia serrata*, Roxb., vernacular name "Salai", growing in the North-Western Provinces. On 7th March, 1893, the moth was sent to Lord Walsingham for identification, and he stated that he considered it to be congeneric with *Hapsifera rugosella,* n. sp. On 25th March, 1901, Mr. John Hartley Durrant returned the moth to the Indian Museum, noting that it is *Dasyses rugosellus*, Stn., ♀ and that he has received specimens of it bred from *Cycas circinalis,* Linn., Natural Order *Cycadaceæ*, in Ceylon. Mr. Durrant's original description of the genus *Dasyses*, and the synonymy of the two species he places in it is given on page 92 *ante*. Mr. E. E. Green notes that his "acquaintance with the insect is due to its destruction of a museum [in Ceylon] specimen of the trunk of *Cycas circinalis,* Linnæus. The larvæ drove their galleries into the soft core of the stem. They were in thousands, and eventually reduced the stem to a mass of decayed fibre. They had no particular season, but worked on until they had consumed the entire trunk." A process-block of the moth is given on p. 47 l. c., but as it is not very clear it has been reproduced on plate XV, fig. 3, and shows a female twice enlarged.

On ***Cedrela Toona,*** Roxb. Natural Order ***Meliaceæ.*** The Toon tree.

1. *Hypsipyla robusta*, Moore. Family *Pyralidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

In June, 1901, Mr. A. W. Fremantle, Manager, Patahi Indigo Concern, Chakia, Champaran, Bengal, forwarded some larvæ which he reported to be doing great damage to an avenue of young toon trees he had planted in his garden. On rearing them they proved to be *Hypsipyla robusta*, Moore, which is recorded by Sir George Hampson to be found at Dharmsala and Simla in the Western and in Sikkim in the Eastern Himalayas, in Dehra Dun, Roorkee, the Western Duars, Madras, and in Ceylon.

In August, 1901, I visited Patahi, and found this insect in large numbers, both larvæ and pupæ, in Mr. Fremantle's young toon trees, which are from 8 to 15 feet high. The larva is a borer, and is found in the young shoots and petioles of the leaves. The young larva starts from near the top of a shoot and burrows a tunnel downwards towards the trunk of the tree, leaving only the bark. The shoot dies off almost at once, becoming rotten at the top and breaking off. At intervals the larva bores a hole through the shoot to the outside; through this hole the frass is ejected and accumulates in a large lump on the outside, held together by the transparent gelatinous white juice of the tree, these lumps of coagulated sap being found also in the bores made by the caterpillar. Below the point of injury to the bored shoot numerous fresh shoots sprout out. The effect on the tree is that it remains short and stunted, it becomes bushy instead of growing up into a tall straight tree.

The larva till about half-grown is ferruginous, afterwards turning to a pretty pale blue colour. When full-grown it is an inch in length, stout, cylindrical, rather broader in the middle than at either end. The usual three thoracic pairs of legs, four pairs or abdominal or pro-legs on the 7th—11th segments, and anal claspers. The head is dark ferruginous, sprinkled with short sparse bristles; the second segment bears dorsally a large black plate; the other segments have two rows of small round shining deep black spots on each side (no dorsal row); the anterior row consists of three equi-distant spots; the posterior row has a single spot only, placed behind and a little posterior to the anterior spot of the other row; the under-surface and legs are blue like the rest of the body; some of the black spots bear each a rather long bristle. The larva is very active when removed from its tunnel in a shoot, and spins a large quantity of thick very sticky silk in the breeding cage. The pupa is formed inside the tunnelled shoots within a very thick and dense cocoon of white silk. It is ·6 to ·7 of an inch in length, smooth, shining, brown, the head rounded, the dorsal area straight, the abdominal segments ending in a sharp point. The chrysalis stage is about a fortnight.

References to this moth* will be found in "Indian Museum Notes," vol. i, pp. 35, 36, pl. iii, figs. 3 *a*, *moth*; 3 *b*, *pupa*; 3 *c*, *larva in a toon shoot* (1889), where it is recorded to damage toon trees in Ceylon, the larvæ being described as "white with black and yellow spots"; Mr. E. Ernest Green writes to me that the larvæ he has bred in Ceylon are "of a dull purplish colour;" from Alipur in the Western Duars destroying mahogany trees; from Nilambur, Madras, attacking mahogany trees; and from Dehra Dun, attacking toon trees. On pages 65, 66 of the same volume it is again reported to injure mahogany in the Duars. In Vol. ii, p. 16 (1891) it was recorded as damaging toon trees in Dehra Dun; and is again referred to on page 163, n. 141 of the same volume. Lastly in vol. iii, n. 5, p. 66 (1896), it is recorded that a mass of matted silk containing numerous cocoons of this moth was received from Roorkee in the Punjab, where every toon tree in the station was covered with the web from base to top. The habits of this moth evidently differ in different places. Where the trees affected are few in number, and short so that they can be easily reached, it would suffice to destroy this insect to cut off and burn every affected twig and thus prevent the pest from increasing in

* Where it is referred to under the generic name *Magiria*, which is a synonym fi Hypsipyla.

numbers. Where the trees are large and numerous this remedy would obviously be ineffectual.

On ***Acacia Catechu,*** Willd. Natural order ***Leguminosæ.***

1. *Sinoxylon crassum*, Lesne. Family *Bostrychidæ.* Order *Coleoptera.* Plate viii, figs. 2, 2*a*, *dorsal and lateral views.*

In July, 1900, Mr. J. W. Oliver, Director of the Imperial Forest School, Dehra Dun, sent a wood-boring beetle, found by Mr. F. Gleadow, Deputy Director, Imperial Forest School, on *Acacia Catechu,* Willd., Natural Order *Leguminosæ,* vernacular name "Khair." The specimens were sent to Mr. P. Lesne of the Natural History Museum, Paris, who pronounced them to be *Sinoxylon crassum*, Lesne, Family *Bostrychidæ,* and who thus described the species in Ann. Soc. Ent. Belg., vol. xli, p. 21, n. 12 (1897):—

"*Sinoxylum crassum,* n. sp. (*S. captura,* Guérin, médit.) Oblongum, latum parallelum, portice leviter dilatatum, omnino brunneum, sat nitidum, antennis tarsisque rufis. Dentes frontales bene distincti vel indistincti. Elytra fortiter punctata portice striata; interstitiis alteris costalis, in margine superiore declivitatis posterioris gibbosis; sulculo marginali elytrorum usque ad apicem æqualiter perducto; spinis subsaturalibus contiguis, compressis, in sutura insertis.—Long 7—8½ mill."

"Province de Bombay: Belgaum, en avril, à la lumière (Andrewes) et Canara (T. R. D. Bell); Birmanie (G. Q. Corbett)."

"Cette espece, voisine du *S. capillatum,* Lesne (Ann. Fr.. 1895, p. 175), est répandue dans les deux péninsules sud—orientales de l'Asie; on la trouve aussi aux iles Philippines."

This beetle is probably the one referred to in "Indian Museum Notes, vol. v, n. 2, p. 53 (1900) as burrowing into "Khair" (*Acacia catechu*) trees in the Thana district of Bombay by Mr G. M. Ryan, Deputy Conservator of Forests, Western Circle. It is noted (l. c.) as attacking "Sal" (*Shorea robusta*), *Terminalia belerica,* the guava (*Psidium Guyava*), and other trees in different parts of India.

The figures show dorsal and lateral views of the beetle twice natural size.

On ***Terminalia Catappa,*** Linnæus. Natural Order ***Combretaceæ.*** The country almond tree or "desi badam."

Sub-order *Phalænæ*, Order *Lepidoptera.*

The insects noted below all of which are moths, were found during the rainy season in Calcutta feeding in the larval state on the leaves of *Terminalia Catappa*, Linnæus, of the Natural Order *Combretaceæ.* It is a large and highly ornamental tree, reaching a height of eighty feet, and is planted throughout India, Ceylon, Burma, and many tropical countries. It is known in Calcutta as the "desi badam" or "country almond."

1. *Trypanophora semihyalina*, Kollar. Family *Zygænidæ*. Pl. x, figs. 4*a* and 4*b*, larvæ *at two stages* × 4; 4*c*, *cocoon with the anterior half of the pupa after the moth has emerged projecting therefrom* × 2; 4, *female moth* × 2.

This moth has been recorded from Hong-Kong in China, Burma, Sikkim, Calcutta, and the Western Himalayas.

2. *Parasa lepida*, Cramer. Family *Limacodidæ*.

This moth occurs throughout India and in Ceylon, also in Java. Both sexes of the moth and its larva are figured in "Indian Museum Notes, vol. iii, n. 4, p. 13 (1896). The larva is recorded as defoliating tea and coffee bushes in Ceylon, mulberry trees in Calcutta, also found on the "Ashphal" tree (*Nephelium Longana*, Camb., Natural Order *Sapindaceæ*) in Calcutta.

3. *Trabala vishnu*, Lefebre. Family *Lasiocampidæ*.

Found in China, all over India, Ceylon, and Burma, also in Java. The larva is recorded in "Indian Museum Notes, vol. iv, p. 136 (1895), as eating the leaves of the castor-oil plant (*Ricinus communis*, Linn. Natural Order *Euphorbiaceæ*); and in vol. v, p. 33 (1900) as destructive to the sāl tree (*Shorea robusta*, Gœrtn. Natural Order *Dipterocarpeæ*). The male moth is figured on plate xi, fig. 2, the female fig. 2*a*, the larva fig. 2*b*, the cocoon fig. 2*c*. The larva is subject to the attack of a dipterous parasite, as recorded in "Indian Museum Notes," vol. iv, p. 136 (1899), the *Crossocosmia sericareæ* of Rondani. It is figured on plate xvi, fig. 2, and its pupa fig. 2*a*. The larvæ now bred were found to be parasitized by two hymenopterons, which have been identified by Colonel C. T. Bingham as *Mircrodus tuberculatus*, Cameron, and *Microdus fumipennis*, Cameron, the latter Ichneumon-fly is figured on plate vii, fig. 1, twice enlarged. *M. tuberculatus* appear to differ from the latter only in having the abdomen entirely yellow.

4. *Antheræa paphia*, Linnæus. Family *Saturniidæ*.

The "Tussur Moth" is found in China, throughout India and Ceylon. References to it under its synonymic name *Antheræa mylitta*, Drury, will be found in "Indian Museum Notes," vol. i, pp. 157—162, pl. x, *male, female, cocoon*, and *larva* and n. 4, p. 211, where a tachinid parasite is mentioned as attacking the larva (1899), vol. ii, n. 2, pp. 77, 79, 80 and 86 (1891), vol. iii, n. i, p. 16, 27, n. 5, p. 9, where the tachinid fly is named *Crossocosmia sericariæ*, Rond., again referred to on p. 42 (1896). The caterpillar is not uncommon on the country-almond tree, but no parasites have been reared from them.

5. *Dasychira mendosa*, Hübner. Family *Lymantriidæ.*

This moth occurs throughout India, Ceylon and Burma; in Java and Australia. In "Indian Museum Notes," vol. ii, n. 1, p. 43 (1891), this species under the synonymic generic name *Olene*, was recorded to feed on the leaves of tea bushes in Darjiling. It is referred to again in n. 6, p. 159, n. 113. In vol. iii, n. 4, p. 21 (1896), the moth is again mentioned as destroying tea in Darjiling, and on page 22 a woodcut is given of a female moth and a caterpillar. The larva was parasitized by a fly, *Tricholyga bombycis*, Beeher, Family *Tachinidæ* This fly is figured in "Indian Museum Notes," vol. i, pl. v, fig. 1 (1889), and is also noted in vol. iii, n. 5, p. 11, n. 3 (1896) as being parasitic on *Olene mendosa.* Another parasite, *Masicera subnigra*, Vander Wulp, of the *Muscidæ*, is described as affecting *Olene, mendosa*, and is figured and described in vol. iii, n. 5, p. 14, n. 7, pl. i, fig. 5 (1896). Lastly in n. 5, p. 42, the two parasites *Masicera subnigra* and *Tricholyga bombycis* are cited as being found in the larva of *Olene mendosa.* The former fly is again referred to in vol. iv, n. 4, p. 119, n. x (1899).

6. *Euproctis scintillans*, Walker. Family *Lymantriidæ.*

The moth is found throughout India and Ceylon, in Burma and the Andaman Isles. The same insect is referred to on page 135 as affecting the castor-oil plant, *Ricinus communis*, Linn.

7. *Lymantria ampla*, Walker, Family *Lymantriidæ*, plate xi, figs. 3 *b*, *larva ; 3 c*, *pupa shell ; 3*, *male moth ; 3 a*, *female moth*, all × 1½. This moth occurs throughout India, Ceylon, and Burma. The larva, pupa, and male and female moths are figured in "Indian Museum Notes," vol. iii, n. 6, p. 14 (1896), from specimens found feeding on the leaves of the Pipal tree (*Ficus religiosa*, Linn., Natural Order *Urticaceæ*). These larvæ were parasitized by a dipterous insect which has not been identified.

8. *Leucoma* (*Kanchia*) *subvitrea*, Walker, Family *Lymantriidæ.* Plate xi, figs. 4 *a*, *larva* × 3; 4 *b* ; *pupa* × 2 ; 4, *female moth* × 2.

This moth is found in Hongkong, Bengal, the Nilgiri Hills and Ceylon.

9. *Plotheia celtis*, Moore, Family *Noctuidæ.* Plate xii, figs. 10*a*, *larva ;* 10*c*, *the lower half of the inside of the cocoon showing the ventral side of the pupa ;* 10 *b*, *showing the upper half of the cocoon, the outside thickly studded with pellets of the frass of the larva ;* 10, *the female moth* all × 2.

This moth is recorded from the Naga Hills, India generally and Ceylon.

10. *Ræselia fola*, Swinhoe. Sub-family *Nolinæ*. Family *Arctiidæ*. Plate x, figs. 1, ♀ *imago* × 2; 1*a*, *larva front and lateral views* × $1\frac{1}{2}$; 1*b*, *cocoon* × $1\frac{1}{2}$; 1*c*, *pupa* × $1\frac{1}{2}$.

Proneca fola, Swinhoe, Trans. Ent. Soc. Lond., 1890, p. 195, n. 178, pl. vi, fig. 8, *female*; id., Hampson, Fauna British India, moths, vol. i, p. 402 (1892), vol. iii, p. 106 (1895).

Ræselia fola, Hampson, Cat. Lep. *Phalænæ* B. M., vol. ii, p. 52, n. 105, pl. xix, fig. 24, *male* (1900).

Hitherto recorded from Ceylon (Colombo), and Burma (Thyetmyo). Mr. G. C. Dudgeon, to whom the moths were sent for identification asks, "If the larva carries the shed skins of the heads of its former moths upon a tuft of hair attached to the first somite as does its congener of the same section of the genus, *R. lignifera*, Walker, *vide* my description published by Sir George Hampson under the synonymic name of the species, *Cyphotopsyche ustipennis*, Hampson, in Trans. Ent. Soc. Lond., 1895, p. 297?" From some larvæ of this species preserved in spirit in the Museum it is evident that *R. fola* when a larva does carry its shed head-cases in the manner described by Mr. Dudgeon.

Since the note above was written a few caterpillars of this species have been found after much searching on a country almond tree in the neighbourhood of Calcutta. The larvæ were almost full grown when found, all turning to pupæ in two days. In appearance they are extremely remarkable, being exactly like a lump of very fine and fluffy cotton wool. They are very conspicuous on the dark green glossy leaves of the tree, but appear to feed only on the lower side of the large leaves, and only eating the tender ones. The body of a larva when full grown is ·75 of an inch, but if the long white fluffy hairs are taken into measurement they are a full inch or a little more in length. The segments of the body are entirely hidden by the thick snow-white down with which they are clothed, this down radiating in all directions. It is thicker and longer anteriorly than posteriorly. In one young example with four cast heads the general coloration is pale ochreous instead of snow-white. The head is dark brown. The most interesting feature in the larva is the carrying in a graduated series, the smallest at the top, the shed horny cases of its head thrown off at successive moults. These head-cases are piled up one above the other at right angles to the axis of the body, and are pale ochreous in colour, the only touch of colour the larva shows. These head-cases are supported in position by being mixed with the matted hairs of the second segment. The larva has the usual three pairs of true or thoracic legs, three pairs only of pro or abdominal legs (the usual anterior pair being wanting) and the usual pair of anal claspers. The larva spins an extremely irregularly shaped triangular cocoon, its long base resting on the leaf, the apex being capped with a bunch of the white fluff with which the larva's body is covered, the rest of the cocoon is made up of chips of the brown bark of the veins of the leaves fastened together with silk. The cocoon is made on the underside of the leaf, generally on the mid-rib and is very inconspicuous, looking like an excrescence of the rib. It measures ·7 of an inch in length, by ·4 in height. The pupa is ·4 in length, dark brown in colour, the abdominal segments well marked, cylindrical in shape generally, but slightly tapering from anteriorly backwards; the head is rounded, the dorsum straight, the anal segment abruptly pointed.

In Miscellaneous Publication, No. 405, of the Department of Agriculture, Sydney, New South Wales (1900), on plate opposite page 9, fig. 1, the larva of *Nola metallopa*, Walker, is figured by Mr. Walter W. Froggatt. He notes: "On the summit of the head rises a regular pyramid, apparently formed of the successive moulted skins of the head, which, becoming attached to the hairs upon either side, are not cast off with the rest of the skin, but remain one above the other like an ornamental headdress." This very extraordinary characteristic of the larvæ of the *Nolinæ* is probably found throughout the sub-family.

On *Terminalia belerica*, Roxb. Natural Order *Combretaceæ.*

1. *Baridius* sp. Family *Curculionidæ*. Order *Coleoptera*.

In June, 1900, Mr. F. Gleadow, Deputy Director, Imperial Forest School, Dehra Dun, sent the Indian Museum, Calcutta, some small black beetles of the family *Curculionidæ*, found inside the ripe fruits of *Terminalia belerica*, Roxb., Natural Order *Combretaceæ*. These were sent to Mr. Desbrochers des Loges for identification, who writes under date 17th April, 1901, that they belong to the genus *Baridius* of Schonherr, and are probably new to science. Another beetle of the genus *Sinoxylon*, Family *Bostrychidæ*, is recorded in "Indian Museum Notes," vol. iii, n. 3, p. 123 (1896), to tunnel into the wood of *Terminalia belerica*. The beetle is shown in a process block at the top of the page.

On *Diospyros melanoxylon*, Roxb. Natural Order *Ebenaceæ*

In "Indian Museum Notes," vol. v, n. 2, pp. 36, 37 (1900), appears a description by Mr. G. B. Buckton of *Psylla obsoleta*, n. sp., which was found to attack the leaves of the young plants of

Diospyros melanoxylon, Roxb., Natural Order *Ebenaceæ*, in the Shahapur taluka of the South Thana Forest Division, Bombay Presidency. On plate v, figs. 10 and 11, the perfect female insect front and side views, fig. 12, a leg, fig. 13, an antenna, figs. 14 and 15, the gall, all much enlarged, are shown.

In January, 1901, Mr. Walter W. Froggat, Government Entomologist, New South Wales, wrote to the Museum, asking for specimens of *P. obsoleta*, as he was much interested in the family *Psyllidæ*, of the order *Homoptera*. In May, 1901, specimens of *P. obsoleta*, together with the galls, were sent to him. In his reply dated 20th June, 1901, he notes:—

"I am sending a note [printed below in full] on the classification of the insect. It does not belong to the genus *Psylla*, or even to the sub-family. The remarkable point about the insect is the aborted hind pair of wings, in all the species of *Psyllidæ* the hind wings are as well developed as the fore wings, and are even used by some writers in defining species. Were the insects you sent taken out of the galls or allowed to emerge after a full course of development? [I am sorry I cannot answer this question, as the specimens were sent to the Museum before I joined it as Entomologist.—*Ed.*] If they were taken out of the galls before they were quite ready, the wings would very likely remain aborted or imperfect; in the specimens you send they consist of small wrinkled flaps that could be the unfolded wings."

The note referred to above is given in full below:—

NOTE ON MR. G. B. BUCKTON'S DESCRIPTION

OF

"A NEW SPECIES OF *PSYLLA* DESTRUCTIVE TO FOREST TREES."

Indian Museum Notes, *Vol. v, No. 2, p. 35, pl. v, figs. 10—15 (1900).*

In this very brief description of a new *Psylla*, the author gives none of the generic or specific characters that would give one any idea where to place the insect, if it were not for the drawing of the wings on plate v. He says "wings veined as in ordinary *Psyllidæ*," and then calls the species *Psylla obsoleta*. Now this family of the *Homoptera* is subdivided into several very characteristic sub-families based on the different forms of wing neuration; in the sub-family, *Psyllinæ*, containing the genus *Psylla*, the stalk of the cubitus is shorter than the stalk of the subcosta, in the sub-family *Aphalarinæ* the stalk of the cubitus is as long or longer than the stalk of the subcosta, while in the sub-family *Triozinæ* the stalk of the cubitus is wanting.

An examination of Mr. Buckton's specimens and drawing show clearly that *P. obsoleta* must belong to the *Triozinæ*, and from the form of head and general structure I should place it in the genus *Trioza*, but the aborted hind wings (if constant) might justify creating a new genus for its reception.

With one exception all the Australian gall-making *Psyllidæ* belong to the *Triozinæ*, but I have never found any species without well developed hind wings, when they have emerged from the galls of their own accord.

WALTER W. FROGGATT,
Government Entomologist,
Department Agriculture, N. S. W.

On *Tectona grandis*, Linn. Natural Order *Verbenaceæ*. The Teak tree.

1. *Pyrausta machæralis*, Walker. Family *Pyralidæ*. Sub-order *Phalænæ*. Order Lepidoptera.

Plate XIV, figs. 6 and 6*a.*, *imago* × 2, 6*b*, *larva* × 2, 6c., *larva dorsal view of two segments, greatly enlarged*; 6*d*, *larva full fed in cocoon before turning to pupa*; 6 *e*, *pupa, ventral view* × 2.

In September, 1900, caterpillars were found attacking teak trees in Calcutta. They were reared in the Museum, and proved to be *Pyrausta machæralis*, Walker, Family *Pyralidæ* of the Moths. The well-known teak pest *Paliga damastesalis*, Walker, is according to Sir George Hampson (The Fauna of British India, Moths, vol. iv, p. 432, n. 5231 (1896), a synonym of this species, and is referred to as *Palyga* [sic] *damastesalis* in "Indian Museum Notes," vol. iii, n 5, page 65 (1896), as *Paliga* (*Scopula*) *damastesalis* in vol. iii, n. 2, page 94, with a process block of the larvæ, pupa and imago; in vol. iii, n. 3, page 111; and vol. v, pp. 32, n. 3 and 52, n. 1 (1900), as doing damage to the same tree in various parts of India.

Mr. W. M. Green, the Deputy Conservator of Forests, Kurseong Division, Bengal, in letter No. 401 G., dated 12th February, 1901, reports that this insect has been doing much damage to the teak trees in the Bamonpokri forest of the Kurseong division near Punkabari.

2. *Hyblæa puera*, Cramer. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

In October, 1900, caterpillars found feeding on the leaves of the teak tree in Calcutta were reared in the Museum. They proved to be the well-known teak pest, *Hyblæa puera*, Cramer, Family

Noctuidæ of the moths, a process block of the larva, pupa and imago of which are given in "Indian Museum Notes," vol. iii, page 93 (1896). See also vol. iii, n. 3, page 111 (1896), and vol. v, n. 1, p. 32 (1900).

Some bugs were found to be attacking the caterpillars of *Hyblæa puera*, Cramer. They have been identified as *Canthecona furcellata*, Wolff. Sub-family *Asopinæ*, Family *Pentatomidæ*, Order *Hemiptera* by Mr. W. L. Distant, and one of them has been figured on plate xvi, fig. 5.

On ***Gmelina arborea,*** Linn. Natural Order ***Verbenaceæ.*** The Kumbhár or Gumbhár tree.

1. *Plotheia celtis*, Moore. Family *Noctuidæ*. Sub-order *Phalænæ*, Order *Lepidoptera*.

In June, 1901, the larva of this moth was found commonly in Calcutta feeding on the leaves of *Gmelina arborea*, Linn., a tree which produces the wood which is largely used for making native drums or "tom-toms." Further notes on this moth will be found on page 108, as the larva is found also on the country almond tree *Terminalia catappa*, Linn.

On ***Mallotus Roxburghianus***, Muell. Natural Order ***Euphorbiaceæ.*** Vernacular name Phasari Malabar.

1. Prox. *Sinoxylon basilare*, Say. Family *Bostrychidæ*. Order *Coleoptera*.

Plate viii, figs. 3, 3*a*, and 3*b* show the adult beetle × 4.

In April, 1900, Mr. C. Gilbert Rogers, Deputy Conservator of Forests, Darjiling division, sent to the Indian Museum, Calcutta, three pieces of branches of a tree known as "Phasari Malabar" by the natives which were found to be tunnelled by the larvæ of some beetle. On emerging they proved to be specimens of a bostrychid beetle. They were forwarded to Mr. L. O. Howard, Entomologist, United States Department of Agriculture, who kindly had them identified by Professor A. D. Hopkins, who pronounced them to be a new species prox. *Sinoxilon basilare*, Say., Family *Bostrychidæ*, Order *Coleoptera*. Subsequently Mr. Howard wrote that Mr. Schwarz examined the specimens, and says that it belongs to the genus *Sinoxylon*, but that it is a new species, which will probably be described in Mr. Lesne's monograph of the Bostrychidæ now being published in the Annales of the Entomological Society of France. Mr. Howard further notes that the *Sinoxylon* figured at the top of page 123 of vol. iii of "Indian Museum Notes" is the same species. It was reported as tunnelling into the wood of the tree *Terminalia belerica*, Roxb., Natural Order *Combretaceæ.* This beetle is again referred to on page 22 of the same volume.

On ***Ficus religiosa,*** Linn. Natural Order ***Urticaceæ.*** The Pipal tree.

1. *Glyphodes negatalis,* Walker. Sub-family *Pyraustinæ.* Family *Pyralidæ.* Sub-order *Phalænæ.* Order *Lepidoptera. Plate XIV, fig. 5, ♂ imago.*

The caterpillar of *Glyphodes negatalis,* Walker, has been found in Calcutta in December feeding on the leaves of the Pipal tree, *Ficus religiosa,* Linn., Natural Order *Urticaceæ.* It also feeds on the fruit of *Dillenia indica,* Linnæus, Natural Order *Dilleniaceæ* in November. This fruit in Calcutta is known by the vernacular name "Chalta." Sir George Hampson gives the habitat of this moth as "throughout India, Ceylon, Burma, and Australia."

Plate XIV Fig. 5 shows a male of *Glyphodes negatalis* of the natural size. Its coloration is almost exactly similar to that of the figure, the markings being fuscous.

2. *Trigonodes ino,* Drury. Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

Plate XIII, Fig. 6, shows the upper and under side of the imago; Fig. 6a, lateral view of the larva; Fig. 6b, lateral view of the pupa—all natural size.

On July 10th, 1901, Mr. R. S. Hole, Divisional Forest Officer, Jubalpur, Central Provinces, sent some larvæ, pupa, and imagines of *Trigonodes ino,* Drury, to the Indian Museum, Calcutta. He notes:—

"The larvæ were found by me in large numbers on May 12th 1901, defoliating a pipal tree in this division. The larvæ appear to be of nocturnal habits, and do most of their feeding at night. The full-grown larva is stout, about 1·00 to 1·25 inches in length; yellowish white or dark pink above, and yellowish white below; the head dirty white, pinkish or brown; two lateral light-coloured lines, more or less distinct, one on each side of the larva; a few scattered colourless bristles on each segment. The pupa stage appears to last about nine days; the moths emerged on May 22nd and 25th. The larva when about to pupate forms no cocoon and the pupa is naked. Pupation takes place in the soil below the tree which was being defoliated, where I found several larvæ lying in the ground beneath the stems of the tree in a mixture of fine earth, wood-dust, débris of leaves, bark, etc., which had accumulated between the buttresses of the lower part of the tree-trunk."

The moth, which is new to our collection, is recorded by Sir George Hampson to be found in Sikkim, Nepal and Madras. It is a very pretty and distinct species, pale salmon-pink in colour with fuscous markings.

On ***Salix elegans,*** Wall. Natural Order ***Salicineæ,*** Willow.

1. *Oligotrophus saligneus* n. sp. Family *Cecidomyiidæ.* Order *Diptera.*

In June, 1900, Mr. F. Gleadow, Deputy Director of the Imperial Forest School, Dehra Dun, sent some gall-gnats and galls formed on *Salix elegans,* Wall, from Tehri Garhwal in the Western Himalayas at 9,000 feet. He reports that the perfect insects emerge in the month of May, and that the pupa-cases remain fixed in the holes of emergence.

Plate xvi, fig. 1, ♀ *imago, dorsal view;* 1*a,* ♀ *imago, lateral view;* 1*b., front view of head of* ♀ ; 1*c, antenna of* ♂ ; 1*d, antenna of* ♀ ; 1*e, genitalia of* ♂ ; 1*f, ovipositor of* ♀ ; 1*g and* 1*h, pupa at different stages ;* 1 *i, gall—all much enlarged except the gall.*

On ***Picea morinda,*** Link. Natural Order ***Coniferæ.*** The Himalayan Spruce Fir.

1. *Eucosma* sp. (? *tedella,* Cl). Sub-order *Phalænæ.* Order *Lepidoptera.*

Plate XV, figs 1*a, larva* ; 1*b pupa ;* 1 *male imago—all twice natural size.*

In "Indian Museum Notes," vol. iv, n. 1, pages 19 to 21 (1896) appears a note on a microlepidopterous caterpillar said to be destroying the Himalayan Spruce Fir (*Abies Smithiana,* Forbes, which is a synonym of *Picea morinda,* Link.) in the Jaunsar forests of the Western Himalayas. A specimen of the moth was reared in the Museum and sent to Mr. J. H. Durrant of Tretford, who writes under date 25th March, 1901, that it belongs to the genus *Eucosma,* and reminds one of *E. tedella,* Cl., a European species with similar habits, and may not improbably be that species, but the example is not perfect enough for certain identification, the costal fold being in an unrecognisable condition.

Plate XV, figs. 1*a* shows the larva; 1*b,* the pupa; and 1 the ♂ moth—all ×2.

Bambusa sp. Natural Order ***Gramineae.*** The Bamboo.

1. *Matapa aria,* Moore. Family *Hesperiidæ.* Sub-order *Rhopalocera.* Order *Lepidoptera.*

The larva of this butterfly was found commonly in Calcutta feeding on the leaves of bamboo during the rains. As usual with the

"Skippers," the larva rolls up a leaf, fastening the rolled-up portion securely with silken threads, with an opening at either end and lives chiefly inside this shelter, only coming out to eat. The pupa is also made within a similar shelter, except that one end is closed, leaving only the end open at which the butterfly will escape. The head of the pupa is towards the open end. The pupa is quite active inside its shelter, rattling itself violently when disturbed and thus making a considerable noise. The *larva* when full-grown is an inch in length; head cordate, pale orange, slightly roughened but without hairs; body cylindrical, much wrinkled, of equal width throughout, chalky white, hairless; the second segment much smaller than the head, bearing a fine black line on each side, not quite meeting in the dorsal line of the insect; each segment has seven transverse lines or wrinkles, the distance between the first and second wrinkles is about the same as between any other four wrinkles; the second to the seventh wrinkles are about equi-distant; the spiracles are jet black; all the legs are white. The *pupa* is pale greenish-white, without any markings whatever; the head is square in the front view with a slight prominence or knob in the centre line; the thorax is slightly humped, the abdominal segments cylindrical, the anal segment ending abruptly in a sharp point.

The butterfly has a wide range, being found in Ceylon, almost throughout India, Burma, the Andaman Isles, the Malayan Peninsula, Southern China, Sumatra, Nias, Java, Bali, Lambok, Bamba, the Philippine Isles, and Hainan Island. All the genus are remarkable for their crimson eyes.

On ***Bambusa*** sp. Natural Order ***Gramineæ.*** The Bamboo.
On ***Andropogon sorghum,*** Brot. Natural Order ***Gramineæ.*** The Jawari plant.

1. *Ochrophara montana,* Distant. Sub-family *Pentatominæ.* Family *Pentatomidæ.* Sub-order *Heteroptera.* Order *Hemiptera.*

Mr. A. E Lowrie, Deputy Conservator of Forests, Chanda, Central Provinces, on 19th February, 1901, sent some bugs to the Museum which he reported to be destroying the bamboo seed wholesale. He further noted that "Owing to last year's drought an unprecedented flowering of the bamboo has taken place in the Chanda district of the Central Provinces, over 1,200 square miles having flowered. The district has not recovered from the effects of last year's famine, and great hopes were entertained that the bamboo seed would come in most handy. Unfortunately the bug has appeared everywhere, and every clump is simply swarming with them, and consequently the seed is almost an entire failure." Mr. Lowrie noted in his letter of 22nd February, 1901, that this same bug "Is now doing no end of damage to the "Jawari" crop"; but he sent no specimen, so it is not quite certain that the jawari and bamboo insects are the same species. The bamboo pest has been identified by Mr. W. L. Distant as *Ochrophara montana*, Distant, Trans. Ent. Soc. Lond., 1900, p. 165. Mr. Distant noted that he "Described it from a long series, and it is peculiar by having in some specimens the lateral angles of the pronotum spined, and in others not so, and that this is probably not due to accident." In his original description of this species (l.c.) which he recorded from the Naga Hills, Tavoy, and the Karen Hills, he said it "Is of the most extraordinary variability, not only as regards markings, which are not abnormal, but exhibiting a plastic mobility in structure which is very unusual. In a series collected for me by Mr. Doherty on the Karen Hills there is a specimen in which the anterior apices of the posterior pronotal angles are produced in acute spines directed forwardly and somewhat upwardly. This might be taken to denote a distinct species did not the series contain three specimens in which this spine is developed on *one side of the pronotum only*—left side in two specimens, and right side in the third." In the three specimens from Chanda in the Museum collection, the spines are present in one, absent in two.

II.—INSECT PESTS OF FRUIT TREES.

On ***Dillenia indica,*** Linnæus. Natural Order ***Dilleniaceæ.*** The "Chalta" fruit.

1. *Glyphodes negatalis,* Walker. Family *Pyralidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

The larva of *Glyphodes negatalis,* Walker, was found in Calcutta in December tunnelling into the fruit of the "Chalta". A note on this species will be found on page 114 under *Ficus religiosa,* Linnæus, the Pipul tree.

On ***Citrus decumana,*** Linn. Natural Order ***Rutaceae.*** The Shadock or Pomelo.

1. *Ophideres fullonica,* Linnæus. Sub-family *Quadrifinæ.* Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

On August 7th, 1900, the Editor and Proprietor, '*Indian Gardening and Planting,*' sent a "Butterfly, the grub of which causes great damage to the fruit of the pomelo (*Citrus decumana*) on the Bombay side." The Editor printed the following letter in his paper, vol. ix, n. 6, August 6th, 1901, from D. D. Jussawalla, opposite Trinker Sath Temple, Tardeo, Bombay, dated 4th idem :—

"I herewith enclose for your inspection a specimen insect which does great harm to pomelo fruit. From the middle of July to nearly the end of September these insects are at their work of piercing through the rind of the pomelo fruit to suck out the juice every night. If the fruits which are punctured by these insects are not taken out in a day or two, they fall from the tree. From one quarter to one-third of the above fruit crop is destroyed every year by these insects. Please, therefore, suggest in your paper some remedies to destroy these insects, or some means to lessen the injury to the above fruit. Please also give the common and scientific name of the insect and its history, and any other information which you may think fit to give."

As the Editor of '*Indian Gardening and Planting*' called the insect a butterfly, and spoke of it as doing damage in the grub state, I wrote to Mr. Jussawalla, who replied that the insect was a moth, and the moth itself did the damage; he also kindly sent some specimens of the insect, which is the large, handsome and well-known *Ophideres fullonica,* Linn., found in Africa, throughout the Oriental region to New Guinea and Australia.

Mr. F. Moore in Trans. Zool. Soc. Lond., vol. xi, page 65 (1880), notes :—

"This insect is stated to be dreaded by the Australian Colonists on account of the mischief the imago causes to the orange plantations—perforating the ripening fruit with its proboscis, and thus causing them to soon fall to the ground and rot."

On examining the proboscis of the moth it will be found to be short, stout and robust, armed at the tip with teeth, with which it doubtless pierces the rind of various fruits of the orange group and sucks up the juice, and causing the fruit to rot owing to the injury done to the rind.

The obvious remedy is to kill the moths as much as possible. From personal experience I know that they are passionately fond of fruit; over-ripe jack, pineapple, and guava fruit laid out on the ground in the gardens where the moths attack fruit of the orange varieties will certainly attack them at night, and with the aid of a hurricane lantern and a butterfly net they can be easily caught and killed. Spraying the fruit with kerosine oil would doubtless keep off the moths, as all insects strongly dislike the smell of mineral oil. This may not be practicable, however, as the rind of the pomelo is largely candied in India, and the oil would spoil the taste of the candied fruit. For eating fresh it would do the fruit no harm.

On ***Citrus*** species. Natural Order ***Rutaceæ.*** The Lemon tree.

1. *Papilio* sp., Sub-family *Papilioninæ.* Family *Papilionidæ.* Sub-order *Rhopalocera.* Order *Lepidoptera.*

In November, 1900, the Superintendent of Gardens, Raj Durbhangha, writing from Rajnagar, sent some caterpillars which he reported to be damaging the lemon seedlings in the gardens.

The insects were received in a rotten condition. They are the larva of some species of *Papilio*, probably of *P. demolius*, Linnæus, referred to in "Indian Museum Notes," vol. i, p. 93, pl. vi, fig. 1, *a, imago*; *b, pupæ, dorsal and lateral views*; and *c, larva* (1889), under its synonymic name ***P. erithonius***, Cramer. The larva of this butterfly is well known to damage young trees of orange, lime, pomelo, etc., but does practically no harm to old and well-established trees. Destroying the caterpillars which are easily seen by hand-picking is the best remedy for this pest.

On ***Vitis vinifera***, Linn. Natural Order ***Ampelideæ***. The Grape vine.

1. *Chærocampa butus*, Cramer. Family *Sphingidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. *Plate X, fig. 2.*

The larvæ of *Chærocampa butus*, Cramer, were found feeding on the leaves of a grape-vine growing in the compound of the Indian Museum during the rainy season. The moth is found throughout India, Ceylon, Burma, the Andaman Isles, in Borneo and in Java. The figure is taken from one of the moths which were bred on the vine.

2. *Scutellera nobilis*, Fabricius. Family *Scutelleridæ*. Order *Hemiptera*. *Plate XVI, figs. 3, imago; 3a, larva at first stage, enlarged; 3b, larva at larger stage, enlarged; 3c, double row of eggs, top view, natural size; 3d, top view of six eggs, enlarged; 3e, side view of one row of eggs, natural size; 3f, side view of four eggs, enlarged.*

On May 27th, 1901, Babu N. N. Banerjee, Superintendent of the Siripur Farm, Raj Hutwa, forwarded to the Indian Museum, Calcutta, three phials containing the eggs, young larvæ, and imagines of *Scutellera nobilis*, Fabricius. He notes that the insect "Has recently attacked the grape-vine in the garden, this being the first appearance of the insect in these parts. The eggs were laid upon the leaves in longitudinal rows generally two deep. The larvæ are of a bright red colour, and are found in clusters feeding on the leaves, which they perforated. The insects are active in the pupal stage also; the fruit being found attacked by the larvæ, pupæ and fully developed imago. The leaves when attacked shrivel up very noticeably." The measures he adopted to destroy the pest were hand-picking the eggs and the insects at all stages, subsequently applying a tobacco decoction. These remedies appear to have been so successful he reports that the vines were practically quite rid of the pest when he wrote.

In "Indian Museum Notes," vol. iii, n. 5, page 82, n. 2 (1896), this bug is reported as feeding on the leaves of *Casearia tomentosa*, Roxb., Natural Order *eamydaceæ*, at Kalsi on the Chakrata Road, Dehra Dun.

An excellent account of the insect is given by Mr. E. F. T. Atkinson in Journ. A. S. B., vol, lxvi, pt. 2, page 161, n. 76 (1887). It has been recorded from Karachi, the Punjab, the North-Western Provinces, Sikkim, Calcutta, Assam (Sylhet and Cachar), Burma, Siam, and various places in South India including Pondicherry. It is a very beautiful and highly coloured insect, with brilliant metallic reflections.

On ***Nephelium lit-chi***, Camb. Natural Order ***Sapindaceæ.*** The Lichi.

1. A mite. Order *Acarina,* Class *Arachnida.*

In March, 1901, Babu R. C. De, F.R.H.S., Superintendent of the Raj Darbhangha Gardens, Rajnagar, forwarded some lichi leaves to the Museum, which he said were attacked by some minute insects. He reports that the insects spread very rapidly, sometimes an entire tree being affected. To get rid of the pest he collected the leaves from the trees and burnt them on a fine evening beneath the trees together with any other vegetable refuse available, as he thought that the smoke engendered by the fire would fumigate the trees and so destroy the insects.

No insects being visible when the leaves arrived, they were sent to Major D. Prain, Superintendent of the Royal Botanic Gardens, Sibpur, who was unable from the dry condition of the leaves to say what had been the cause of the damage. At the end of May, Major Prain wrote that with fresh leaves it was perfectly easy to say what the damage done was due to. It is a peculiar proliferation of the epidermal tissue due to the irritation caused by myriads of mites that live amongst the hairs. When the leaves are gathered these mites are so abundant that the hairs can hardly be seen for them when a section is cut. But after the leaves are gathered the mites disappear very rapidly, which explains why they could not be found on the leaves received from Darbangha. Major Prain further adds that when he wrote all the leaves affected on the lichi trees in the

Botanical Gardens at Sibpur which were similarly affected as the trees at Darbangha have all fallen off and are lying beneath the trees, and there is no longer a diseased leaf on the trees; the young leaves now coming out are quite free from any trace of it. The old leaves that were unaffected by it have not fallen at all, and the trees are apparently none the worse for the visitation, though they have lost every leaf that was affected by it.

This interesting blight should receive further investigation next spring, and the mite identified.

2. *Cryptophlebia carpophaga*, Walsingham. Family *Tineina.* Sub-order *Phalænæ.* Order *Lepidoptera. Plate XV, figs. 2a, larva enlarged; 2b, half of a lichi fruit, showing the stone and the pupa of the moth; 2, male imago, enlarged.*

In June, 1894, a moth reared in Calcutta from a lichi fruit, was sent to Mr. J. H. Durrant for favour of identification. From the drawing of the fruit reproduced on plate XV it would appear that the larva of the moth feeds on the seed or stone of the fruit. Mr. Durrant identifies the insect as *Cryptophlebia carpophaga*, Walsingham, described in "Indian Museum Notes," page 106, plate vii, fig. 1*a, larva*; 1*d, pod of food-plant and pupæ*; 1*b, male*; 1*c, female* (1900). The type specimens were reared in Calcutta from the pods of both *Cassia Fistula*, Linn., and *C. occidentalis*, Linn. Natural Order *Leguminosæ.* It was again bred in the Indian Museum in June, 1901. The moth, pupa and larva of the lichi worm is figured on plate xv, figs. 2, 2 *a*, 2 *b*.

3. Tineid moth sent to Lord Walsingham for identification. *Plate xv, figs. 4, imago enlarged; 4 a, cocoon with empty pupa case.*

In June, 1901, Mr. I. Henry Burkill, Assistant Reporter on Economic Products to the Government of India, presented to the Indian Museum, Calcutta, two specimens of a tineid moth which attacks the lichi fruit in Calcutta, accompanied by the following note:—

The little white grub which, this year, was in 99 per cent of the lichi fruit of the Calcutta market, eats the funicle or stalk of the seed, but touches no part of the fruit. The funicle, being the way by which food passes to the seed, is probably highly nutritious as long as growth is actively going on above it. In it the grub tunnels.

When the fruit is perfectly ripe, and the funicle consequently is no longer full of nutrient matter, the grub emerges to the air by biting through the fruit-wall at the base close to the stalk and then makes a cocoon in some convenient angle. The cocoon is hammock-shaped, but may equally be above or below the object to which it is attached. My grubs sometimes spun in the angle at the base of a glass bottle, sometimes at the neck. The web is quite smooth and looks like very thin Japanese paper; the object to which it is attached is not lined. The chysalis is horn-coloured, and the moth emerges about seven days after pupation. The fore wing of the moth on the upper side is somewhat chocolate-brown with white markings and gold and white tips, and the hind wing is very narrow, deeply fringed, and smoke-grey."

The moth twice enlarged is shown on Plate XV, fig. 4 (the antennæ wanting), the pupa (4a) inside its transparent cocoon after the moth has emerged figured natural size.

4. *Diapromorpha melanopus*, Lacord. Family *Chrysomelidæ*. Order *Coleoptera*.

The "Orange Beetle" has been reported to do damage to lichi trees at Kalimpong, Sikkim, by Mr. A. C. Hartless. For further notes on the subject see page 125.

On *Mangifera Indica*, Linn. Natural Order *Anacardiaceæ*. The Mango.

1. *Idiocerus clypealis*, Lethierry. Family *Jassidæ*. Sub-order *Homoptera*. Order *Hemiptera*.

In "Indian Museum Notes," vol. i, pp. 4, 5 (1889), certain insects of the family *Jassidæ* of the homopterous section of the *Rhynchota* are recorded as doing very great damage to the mango crop in Saharanpur in the North-Western Provinces. The insects were described as three new species by Mons. Lethierry of Lille, and named by him *Idiocerus niveosparsus*, *I. atkinsonii and I. clypealis*. Descriptions of them will be found in "Indian Museum Notes," vol. I, pp. 187, 188 (1891), the nymph and imago of the first being figured on plate xii, figures 6, *a* and *b* of the same volume. Certain remedies were tried by Mr. Gollan, such as mixtures of soap, tobacco, sulphur, kerosine diluted with milk, etc., but without noticeable effect. Mr. Gollan reports that in some years these insects appear in myriads, followed by a very poor crop of fruit. Probably the remedies used were not skilfully applied, or were applied at the wrong time.

In the middle of April, 1901, I visited the Experimental Station, Cawnpore, in the gardens attached to which and in the large Public Gardens adjoining are numerous mango trees. The trees at this period had almost finished flowering, there being a very good show of flowers this season, but very few of the trees had set any fruit, and the mangoe crop may be said to be a failure. This is caused by the depredations of a small homopterous insect which in the imago stage measures about 22 mm. in total length. There were countless numbers of these insects on the trees, resting in the daytime on the shady sides of the leaves and avoiding the sun. They appeared to be eating nothing, unless they feed at night. Doubtless the eggs are laid on the very small and young spikes of the mango flowers when the flowers first make their appearance. The larvæ and nymphs apparently quite cover the flower-spikes, and suck up much of the sap or juice which should go to set the young mango fruit. The trees which had blossomed presented a most curious appearance. The flower-spikes, often a foot in height, were of a dull yellow colour, the flowers themselves dead, dried up and brown; all the leaves beneath the flower-spikes, whether of the mango tree or any other plant growing under the trees, were thickly covered with sticky sweet "honey-dew", the leaves being highly polished (glazed or varnished) in appearance in consequence. The "honey-dew" is the juice or sap of the mango tree which has dripped off from the flower-spikes on to the leaves below. Not only do the insects live on this liquid, but Mr. J. H. Hayman, the Deputy Director of Agriculture, who lives at the Experimental Station, and has watched the insects when immature, tells me that the sap actually drips off the flower-spikes, and one can hear it continually dropping, doubtless from the punctures made by the haustellum of the bug and its own evacuations. Not only, therefore, does the insect use a large quantity of the juice for its own sustenance, but there is a large wastage from the punctures made by it in the epidermis of the flower-spike. At the time of my visit the insects were all in the perfect or imago state, small brown "hoppers" which exist in thousands on each tree, and fly up when the branches are disturbed. During the heat of the day they rest in the shade on the under surface generally of the mango leaves by dozens and fifties on a single leaf, always with their heads upwards and all pointing in the same direction. On all the leaves surrounding a flower-spike were to be seen the shed skins of the insect when changing from the nymph to the imago stage. They are all facing the same way, looking upwards, their heads towards the stem or petiole of the leaf, and scattered very regularly over the leaf, a small space surrounding each skin, so that at ecdysis one insect does not interfere with another. I am informed that the pest is not an annual one, at least in ordinary years it does no great damage, the present year being one of the exceptions, the crop being practically *nil.*

In Muzaffarpur, Behar, the mango crop has practically failed from the depredations of this or a closely allied insect this (1901) season. There was I noticed both in March and April when I visited Behar a splendid show of blossom, but in the latter month hardly any fruit had set. The natives call this visitation "Muddson Lihee," the first word meaning honey, the second blight. The natives say that it is caused by an east wind, an easterly wind in Behar being always a moist one, and therefore probably favourable to the development of the insect, while the dry west wind is unfavourable for the insect but good for the mango.

In spite of Mr. Gollan's non-success in the measures he took to destroy the insect, I have but little doubt that a kerosine emulsion applied at the right time would actively protect the mango crop from the ravages of this insect. The parent insect doubtless lays her eggs on the very young flower-spikes as soon as they appear. These rapidly hatch out, and it is at the time of hatching and immediately afterwards that the remedy must be applied. The flower-spikes should at this period be carefully examined, and if "hoppers" are apparent in large numbers, the emulsion should be sprayed on them. This must be done at once and before the flowers themselves have opened, or the pollen will be destroyed and no fruit will set. The proportion of kerosine to beused must be the result of experiment; it must be strong enough to kill the insects, but not too strong to burn up and kill the flower-spikes. It would be difficult to apply the emulsion to lofty trees, but on low trees a comparatively weak force-pump would be sufficient to reach the highest branches.

2. *Ceroplastes floridensis*, Comstock. Family *Coccidæ*. Sub-order *Homoptera*. Order *Hemiptera*.

Babu Srish Chandra Panja sent through Major D. Prain, I.M.S., Superintendent of the Royal Botanic Garden, Sibpur, near Calcutta, in June 1900, some mango leaves attacked by a scale insect, the trees growing in Rajagram in the Bankura District of Bengal, and being described as "grafted mango."

The insects were sent to Mr. E. Ernest Green, Government Entomologist, Ceylon, who identified them as *Ceroplastes floridensis*, Comstock (Ann. Report, Department, Agriculture, U. S. A., 1880, page 331). Mr. Green notes that "The species occurs commonly in Ceylon on a large variety of plants, *e.g.*, Tea, Avocado Pear, Guava, Mango, Orange, and other *Citraceæ*, *Litzea*, *Loranthus*, and many others." He adds that he has "never seen the insect present in sufficient numbers to injure the plant." Mr. L. O. Howard, who examined the insect, notes that it "seems to be Green's *Ceroplastes actiniformis*. It was in very poor condition, however, and the determination is not positive."

The wax insects were parasited by a minute chalcid fly which was submitted to Mr. William H. Ashmead through Mr. L. O. Howard, for identification. It proved to be new to science, and has been named *Eurycephalus*, new genus, *E. alcocki*, new species. A detailed description of it appears on page 61 *ante*.

3. *Luperomorpha weisei*, Jacoby, n. sp. Family *Chrysomelidæ*. Order *Coleoptera*.

In August, 1900, Mr. W. H. P. Driver of Purulia, sent some chrysomelid beetles to the Museum which he reports as destroying all his mango trees.

On examination they proved to be *Luperomorpha weisei*, Jacoby, n. sp.,* on comparing them with named specimens by Mr. Martin Jacoby in the collection of the Indian Museum, from Ranchi, Bengal, from whence the species was originally described.

4. *Chlumetra transversa*. Walker, Family *Noctuidæ*. Sub-Order *Phalænæ*. Order *Lepidoptera*. *Plate xiii, figs. 1a, larva; 1b, pupa, 1 imago; all enlarged.*

The moth *Chlumetra transversa*, Walker, was found in Dehra Dun in October, 1900, boring into the tips of young shoots of the mango tree, thereby the shoots are killed back. This moth has only hitherto been recorded from Ganjam on the East Coast of India and from Ceylon. The figures show the larva, pupa and moth enlarged.

5. *Diapromorpha melanopus*, Lacordaire. Family *Chrysomelidæ*. Order *Coleoptera*.

On 29th August, 1901, Mr. A. C. Hartless, the Curator of the Botanic Garden, Darjiling, forwarded to the Indian Museum, Calcutta, some beetles which he found to be destructive to mango and lichi trees at Kalimpong, Sikkim, in the Government Experimental Fruit Garden, of which he has charge. He wrote:—

"They come in swarms whenever the sun shines, and pierce the tissue of the youngest growing points and leaves of mangoes and lichis which at once shrivel up and completely die off. When not feeding on the trees they seem to remain in the jungle and grass round about, so I am having everything cleared about the orchard so as to offer them no protection. We have killed hundreds by hand picking. It appears not to eat the tissues but to suck the juice, and they must also inject something poisonous, as around the punctures the tissues quickly shrivel up."

With regard to Mr. Hartless's note above quoted, that these beetles appear to suck the juice of the leaves and shoots of the fruit trees,

* Annales de la Société Entomologique de Belgique, vol. xlii, page 180 (1898).

and not to eat the leaves and shoots; also to inject some poisonous liquid, it is probable that his observations are at fault, as beetles being mandibulate insects invariably eat solid food and do not suck up juices as do the haustellate groups. Also the injection of poison is improbable. A young leaf or shoot when nibbled or eaten will often wilt and die from that cause alone. The spraying of the affected trees with Paris Green or London Purple would protect them from the depredations of this beetle by killing off all those that ate the poison. Clearing away surrounding jungle is also a good protection to the fruit trees.

This insect is the "Orange Beetle" of the tea planters, and is found probably throughout Bengal, the Eastern Himalayas, Assam, and has been recorded from Siam, but has not hitherto been known to do damage to anything but the tea plant. It has been referred to in all the previous volumes of "Indian Museum Notes," and has been figured in vol. iii, n. 4, page 7 (1896).

On ***Carina carandus,*** Linnæus. Natural Order ***Apocynaceæ.*** The "Karunda."

1. *Nephele hespera,* Fabricius. Family *Sphingidæ.* Sub-order *Phalænæ. Order Lepidoptera. Plate X, fig. 3.*

The larvæ of *Nephele hespera*, Fabricius, were found at the end of the rainy season feeding on the leaves of the "Karunda" bushes growing in the compound of the Indian Museum. The moth occurs throughout India and Ceylon, and in Australia. It is very variable, our bred specimens, of which we have eighteen, sometimes have these silvery spots on the forewing, sometimes two or one, sometimes none at all. The figure shows a moth bred from the "Karunda."

On ***Phœnix sylvestris,*** Roxb. Natural Order ***Palmeæ.*** The Date Palm.

1. *Padraona palmarum,* Moore. Family *Hesperiidæ.* Sub-order *Rhopalocera.* Order *Lepidoptera. Plate IX, fig. 7, male; 7a, female.*

The larva of the butterfly *Padraona palmarum,* Moore, was found in Calcutta in December, 1900, feeding on the leaves of the date palm. If the *Padraona angiades* of Felder be included under this species, it has a very wide range, being found at Nagpur in Central India, in Calcutta, Sikkim, Assam, Burma, the Nicobar Isles, Sumatra, Java, Borneo, the Philippine Isles, the Natuna Isles, in

Celebes, Buru, the Ké Isles, and in Australia. The figures show both sexes of the insect from specimens from Calcutta.

On ***Phœnix sylvestris,*** Roxb., The Date Palm.

On ***Borasus flabelifer,*** Lin. The Palmyra or Tal Palm.

On ***Cocos nucifera,*** Linn. The Cocoanut Palm. All natural order ***Palmeae.***

2. *Rhynchophorus ferrugineus,* Oliv. Family *Curculionidæ, the Palm Weevil,* and *Oryctes rhinoceros, Linn., the Rhinoceros Beetle.* Family *Scarabæidæ.* Both Order *Coleoptera. Plate viii, fig. 1* ♂.

Specimens of the two above-named beetle pests were received from Mr. C. A. Barber, Government Botanist, Madras, in June and July, 1900, who reported that they were doing considerable damage to date, palmyra and coconut palms in Madras. He remarks that the palm weevil, *R. ferrugineus,* "Usually attacks the date-palms after tapping for toddy has commenced, working up from the cut surface into the young shoot. Unless extracted the tree dies. I have obtained the eggs, and I find them lightly attached in some cases by a small stalk. They are also sometimes buried in shallow holes in the leaf-bases when the insect is working from within. The grub or larva of the beetle spins a strong and thick cocoon of the date fibrovascular bundles."

These two beetles have been frequently reported in "Indian Museum Notes" as attacking palms in various parts of India. *R. ferrugineus* is figured in all stages in "Indian Museum Notes," vol. ii, pp. 8, 9 (1891), and a badly-infected coconut plantation at Singapore ravaged by both beetles in Vol. iii, p. 127 (1896). A male of the rhinoceros beetle, *O. rhinoceros,* is figured on plate viii, fig. 1, ♂.

III.—INSECT PESTS OF PLANTS.

On Crotalaria hirsuta, Wild.

1. *Chionaspis (Hemichionaspis) minor,* Maskell. Family *Coccidæ.* Sub-order *Homoptera.* Order *Hemiptera.* Plate xvii, fig. 2 *female; margin of extremity of pygidium greatly enlarged.*

In March, 1900, Major D. Prain, I.M.S., Superintendent, Royal Botanic Garden, Sibpur, near Calcutta, forwarded some coccids found on *Crotalaria hirsuta,* Willd., a plant of the Natural Order

Leguminosæ, growing in the gardens. Mr. E. Ernest Green, Government Entomologist, Ceylon, identified them as *Chionaspis* (*Hemichionaspis*) *minor* of Maskell. Mr. Green noted that " Professor R. A. Cooley, of the Montana College of Agriculture, United States of Amercia, who has recently been making a special study of the genus *Chionaspis*, considers that my *C. albizziæ* is a synonym of *C. minor ;* and I think that he is probably correct, though there are one or two small distinctions. In Ceylon, *C. albizziæ*, affects injuriously many leguminous trees and plants."

The following description of the insect is an extract from "the coccid genera *Chionaspis*, and *Hemichionaspis*" from the Special Bulletin, Hatch Experiment Station of the Massachusetts Agricultural College by Professor R. A. Cooley, B.Sc., dated August 10th 1899:—

Hemichionaspis minor, Maskell.

Chionaspis minor, Maskell, Trans. New Zeal. Inst., vol. xvii, p. 23, n. 3 (1884).

? *Chionaspis albizziæ*, Green, The Coccidæ of Ceylon, part ii, p. 115, pl. xxxiv 1899).

" Egg.—' Orange, numerous' (*Cockerell*)."

Scale of Female.—Length 1·8 to 2·3 mm. Elongated, broadened posteriorly. Moderately thick in texture, white. Exuvia 7 mm. long, yellowish brown.

" Female.—Median lobes distinctly darker than the rest of the pygidium; outer edge of each divided into from two to four crenations. Second pair rudimentary or wanting; occasionally fairly well developed. Third pair wanting. The gland-spines are arranged as follows :—1, 1, 1, 1, 2—3. The marginal orifice nearest the median lobes is situated on a broad conspicuous prominence. Dorsal gland orifices few in number. Second row wholly absent. Third and fourth rows with posterior groups numbering 1—3, their anterior groups being either absent or replaced by small and obscure almost circular orifices. Median group of circumgenital gland orifices 6—11 ; anterior laterals 12—20 ; posterior laterals 10—18."

" Scale of Male.—Length 9 mm. Very distinctly tricarinate. Exuvia, yellowish-brown."

" Remarks.--This insect was first found in New Zealand, from which country Maskell originally described it. Cockerell has frequently recorded it from the West Indies, and I have also published its occurrence in Panama and Florida. The species is very common in the West Indies, and it is probable that these islands are its original home."

" Maskell has taken the insect on *Parsonsia*, *Rhipogonum scandens;* Cockerell on *Hibiscus, Capsicum, Pelargonium*, ' Cotton,' ' Pepper, ' and ' Cocoanut-palm '; and I have recorded it on *Melia azedarach* also."

Of its destructiveness Cockerell says: " From its frequent abundance it becomes quite troublesome on garden plants." I have been informed by Professor Quaintance that the species severely attacks the "China-trees" (*Melia azedarach*) at Braidentown, Flo., and many trees were said to have been apparently killed by it. From what we know of the species it must be considered a very injurious one. From the above list of food-plants it will be seen that the insect has been known to attack cotton plants, and should it become established in the cotton fields of our southern States it might prove a serious pest." (*Cooley*, l.c.)

Plate xvii, fig. 2, is taken from an adult female of *Chionaspis* (*Hemichionaspis*) *minor*, Maskell, from Calcutta, and shows the margin of the extremity of the pygidium. Mr. E. Ernest Green has kindly supplied this drawing.

The coccid is attacked by the larva of a lady-bird beetle (family *Coccinellidæ*, Order *Coleoptera*) in Calcutta, a greatly enlarged drawing of the beetle is shown in plate ix, fig. 2; and on figs. 2 *a* and 2 *b* are shown the much enlarged larva of the same. The beetle stands in the collection of the Indian Museum, Calcutta, as *Chilocorus nigrita*, Fabricius.

On ***Erythrina indica,*** Lamk. Natural Order ***Leguminosæ.***

1. *Agathodes ostentalis*, Hübner. Sub-family *Pyraustinæ*. Family *Pyralidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

Caterpillars found feeding on *Erythrina indica*, Lamk., Natural Order *Leguminosæ*, a tree commonly used for shade and for hedges in Calcutta, were reared in the Museum. On emerging they proved to be the pyralid moth, *Agathodes ostentalis*, Hübner, given by Sir George Hampson in "The Fauna of British India: Moths," vol. iv, p. 345, n. 5,005, fig. 190, *male* (1896), as found throughout India, Ceylon and Burma, the Andaman Isles, Java, Sambawa. It may be noted that in life those parts of the moth described by Sir George Hampson as "pale fawn-colour" are really olive-green fading to yellowish-green along the costa and inner margin.

2. *Eupterote undata*, Blanchard. Family *Eupterotidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

Caterpillar found feeding on *Erythrina indica*, Lamk, in Calcutta; the moth bred in June. The larva is gregarious, and assembles in large numbers on the under side of the leaves of its food-plant when not feeding. Half-grown larvæ were found in August, these pupated in November, and emerged in June, so that there is probably only one brood of this species in Calcutta. Sir George Hampson gives twenty-six synomyms for this very variable moth, which is found from North India to the Nilgiri Hills and in Burma. The specimens bred in June are pale ochreous, those in July are much darker, pale ferruginous or castaneous; in all the markings are prominent.

On ***Rosa*** sp. Natural Order ***Rosaceæ.*** The Rose.

1. *Serica* (*Autoserica*) *calcuttæ*, Brenske, Family *Melolonthidæ* Order *Coleoptera.* Plate vii, fig. 4, ♀, ×4, dorsal view; 4*a*, lateral view.

The melolonthine beetle, *Serica* (*Autoserica*) *calcuttæ*, Brenske, was found on a rose bush in the compound of the Indian Museum, Calcutta, and was sent to Dr. Ernest Brenske for identification. It has previously been figured in Indian Museum Notes, vol. iv, n. 4, p. 176, pl. xiii, fig. 3 (1898). The figures now given show dorsal and lateral views much enlarged of the specimen mentioned above.

On ***Crinum latifolium,*** Linn. Natural Order ***Amaryllideæ.***

1. *Anomala dorsalis*, Fabricius, plate vii, figs. 5 and 5*a*, *dorsal and lateral views and A. dorsalis*, var. *fusca*, Brenske. Family *Melolonthidæ*. Order *Coleoptera.* Plate vii, figs. 6 and 6*a*, *dorsal and lateral views.*

In June, 1899, the Superintendent of the Victoria Gardens, Bombay, sent some melolonthine beetles, both larvæ and imagines, to the Museum, and noted that "They have been doing much damage to the lilies in my garden. They attack one particular kind of *Crinum* only, *viz.*, *C. latifolium.* They come flying in large numbers late in the evening and devour all the flowers most greedily, so that in the morning there is not a single open flower left on any of the plants. The larvæ are found eating up the leaves, etc., of eucharis lilies and tuberoses." Later on he notes that no more beetles could be found as the *Crinum* has done flowering. In June, 1900, he reported that the beetles had again appeared and were attacking the *Crinum* flowers.

As the beetles were new to the Museum collection they were forwarded to Dr. E. Brenske, who identified them as *Anomala dorsalis*, Fabricius, and *A. dorsalis*, var. *fusca*, Brenske; they are figured on plate vii, the former under figs. 5 and 5*a*, the latter under figs. 6 and 6*a*, front and lateral views of each.

IV.—INSECT PESTS OF VEGETABLES.

On ***Brassica (Eubrassica) olvaceæ botrytis.*** Natural Order ***Cruciferæ.*** The Cauliflower and "Kulmi sāg."

1. *Prodenia littoralis,* Boisduval. Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.* Plate xii, figs. 4*a, larva ;* 4*b,* pupa ; 4 imago.

The larva of the moth *Prodenia littoralis,* Boisduval, was found in Calcutta in January and February feeding on cauliflower, and in November on the pot-herb "kulmi sāg." In "Indian Museum Notes," vol. i, p. 210 (1889), it was reported to be destructive to mulberry trees at Balasore ; in vol. iii, n. 5, p. 59 (1896), the larva, pupa and imago are figured, and it is recorded that the larva is very destructive to the young tobacco plants in North-East Sumatra ; and on page 68 of the same volume to be destructive to potato plants at Berhampore. The moth is found in the Mediterranean subregion and throughout the tropical and subtropical zones of the Old World. The species is refigured here from fresh specimens in the larval, pupal and imaginal stages.

On ***Hibiscus esculentus,*** Linn. Natural Order ***Malvaceæ.*** The Bhindi or Lady's Fingers.

1. *Earias fabia,* Stoll, Cramer's pap. ex., vol. iv, p. 126, pl. ccclv, fig. H (1781). Sub-family *Gonopterinæ.* Family *Noctuidæ.* Sub-Order *Phalænæ.* Order *Lepidoptera.* Plate xii, figs. *1b, lateral view of larva ; 1c, lateral view of pupa ; 1 and 1a, moth, upper-side only—all natural size.*

The larva of this moth was found feeding on the flesh of the pods of the Bhindi in Calcutta in February and September 1901, and were bred in the Indian Museum, Calcutta. According to Sir George Hampson, "Fauna of British India: Moths," vol. ii, p. 133, n. 1509 (1894), it has three synonyms, *Aphusia speiplena,* Walker (1857), *Micra partita,* Walker (1865), and *Earias hügeli,* Rogenhofer (1870). He placed it in the *Arctiidæ,* but its larva proves it to be a true noctuid. Hampson gives the Punjab, Calcutta, Ganjam, South India, Ceylon and Java as its habitat. In the Indian Museum are specimens from Karachi and Bombay. The larva when full-grown is ·9 of an inch in length ; with the usual three thoracic, four abdominal and one pair of anal legs ; cylindrical, but tapering to either end ; the head small pale greenish, but with two large, shining, dark brown notches on the vertex; the first segment with a dorsal, shining, dark brown plate, its surface irregular; an orange patch below the plate on each side; the third segment irregularly blotched with orange, the remaining segments irregularly blotched with pale greenish on the dorsal line, and with dark brown and orange laterally; all the segments bearing a few low tubercles each with a short bristle; the spiracles black, oval, prominent. The pupa is ·5 of an inch in length, moth, dark brown above, gradually fading into pale green beneath; the head rather square; the thorax and abdomen cylindrical, the latter tapering rather rapidly to a point.

2. *Sylepta multilinealis,* Guenee. Family *Pyralidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.* Plate xiv, figs. 4*a*, *larva*; 4*b*, *pupa-case after the moth has emerged*; 4, *imago*—all × 2.

The larva of this moth was found in Calcutta in July and August 1901, feeding on the leaves of the Bhindi plant, and was bred in the Indian Museum, Calcutta. Further particulars regarding this moth will be found on page 182, under *Gossypium* sp., the Cotton-plant. A hymenopterous parasite was bred from one of the larvæ, which appears to be the same species as attacks the larva of *Scirpophaga auriflua,* Zeller, Family *Crambidæ,* at Sikta, Betteah, Champaran, Bengal, one of the sugarcane borers. See page 177.

On ***Pisum sativum,*** Linn. Natural Order ***Leguminosæ.***
The garden pea.

1. *Heliothis armigera,* Hübner. Family *Noctuidæ.* Sub-order *Plalænæ.* Order *Lepidoptera.*

The larva of the common cut-worm moth, *Heliothis armigera,* Hubner, has been found in Calcutta feeding on the pods of the garden pea in February. This omnivorous insect has been referred to constantly in "Indian Museum Notes," and is described and figured in vol. i, p. 97, n. 8, pl. vi, figs. 4*a*, *imago*; 4*b*, *pupa*, and 4*c*, *larva* (1889).

On ***Trichosanthes disica.*** Roxb. Natural Order ***Cucurbitaceæ.***
The pulwal or patal.

On *Cucurbita maxima,* Duchesne. Natural Order *Cucurbitaceæ.* The common gourd, squash, or red gourd; vernacular name Belati Komra or Meta [sweet] Komra.

1. *Aulacophora excavata*, Baly. Sub-family *Galerucinæ*. Family *Chrysomelidæ*. Order *Coleoptera*. Plate ix, Fig. 1, 1 *a*, *dorsal and lateral views*.

On April 25th, 1901, Babu Jadu Nath Das, of Pulsar, Bishnupur, Twenty-four Parganas, sent some beetles to the Indian Museum, Calcutta, saying that they were damaging the Patal and other vegetables of the cucumber order in his garden. On July 17th, 1901, he wrote that these insects had entirely destroyed his plants of squash, all the leaves and tender twigs being devoured; also that his Patal plants were also eaten up, but that after the recent rain the roots had thrown out shoots, and the plants may bear a meagre crop. He found hand-picking these beetles too tedious and did not attempt it, and that a sprinkling of very dilute phenyle seemed to have no effect.

Mr. Martin Jacoby has kindly identified the beetles as *Aulacophora excavata*, Baly. One of them is figured twice natural size on Plate ix, Figs. 1, 1 *a*. The antennæ, head, thorax, abdomen and legs are ochreous-yellow, the elytra shining steel-blue.

On ***Solanum melongena***, Linn. Natural Order ***Solanaceæ***. The egg-plant, or brinjal.

1. *Epilachna viginti-octo-punctata*, Fabricius. Family *Coccinellidæ*. Order *Coleoptera*.

In July 1900, Dr. George Watt, C.I.E., Reporter on Economic Products, Government of India, forwarded some lady-bird beetles and moths reported to be infesting the brinjal plants at Khaspur in the Twenty-four Parganas near Calcutta, with the remark that the lady-bird was, he presumed, in reality the planter's friend, and that the moth was the actual pest.

The beetles on examination proved to be *Epilachna viginti-octo-punctata*, Fabricius. The lady-birds forming the genus *Epilachna*, contrary to the usual habits of the family to which it belongs, are purely vegetable feeders, and are therefore pests, the more dangerous as they may be mistaken to be beneficial insects. This particular species has been frequently reported as attacking brinjals in various parts of Bengal. The beetle is figured in "Indian Museum Notes," vol. iii, n. 6, p. 9 (1896).

The moths received at the same time, apparently a species of *Tineina*, were too damaged for identification.

On ***Dioscorea alata,*** Linn. Natural Order ***Dioscoreaceæ.*** The khàm-alu.

1. *Crioceris impressa*, Fabricius, Family *Chrysomelidæ.* Plate viii, Figs. 6 and 6 *a, imago twice enlarged.*

The larva of this beetle was found in Calcutta in August, 1901, feeding on the leaves of the native vegetable kham-alu. On breeding them it was found that the species is *Crioceris impressa,* Fabricius, which is represented in the Museum collection from Maldah, Calcutta, Sikkim, Sibsagar, and the Andaman Isles.

V.—INSECT PESTS OF CEREALS AND CROPS.

On ***Brassica sp.,*** Natural Order ***Cruciferæ.*** The mustard plant.

1. *Syrphus* sp., Family *Syrphidæ,* Order *Diptera.*

Mr. J. D. Cargill, I.C.S., Officiating Collector of Noakhali, forwarded to the Indian Museum through the Director of Land Records and Agriculture, some pupæ of a fly locally known as "gunipoka", which was said to destroy the mustard crop in the Noakhali district in January. On breeding out the perfect insects they were found to comprise three species of the dipterous genus *Syrphus,* Family *Syrphidæ.* The genus is a very large one, some two thousand species being known, and as but few Indian species have been described, it is not possible to name the specimens under consideration more closely. A large number of the species of *Syrphus* feed on plant-lice (*aphides*), and as numerous specimens of these insects were present on the mustard sent by Mr. Cargill, it is almost certain that the *Syrphus* larva feed on the *aphides,* so instead of being a pest they are beneficial to agricuiture. No species of *Syrphus* is known to eat living vegetable matter.

On ***Sesamum indicum,*** D.C., Natural Order ***Pedalineæ.*** Til or sesamum.

1. *Aphanus sordidus,* Fabricius. Sub-family *Aphaninæ.* Family *Lygæidæ.* Sub-order *Heteroptera.* Order *Hemiptera.*

Mr. A. E. Lawrie, Deputy Conservator of Forests, Chanda, Central Provinces, sent on 22nd February, 1901, some bugs to the

Museum which he noted were simply destroying the "Tilli" (sesamum) crop in that district. Specimens were sent to Mr. W. L. Distant, who identified them as *Aphanus sordidus*, Fabricius. He notes that it is common to India and China.

On ***Ricinus communis***, Linn., Natural Order ***Euphorbiaceæ***.
The castor-oil plant.

1. *Ophiusa melicerta*, Drury, Family *Noctuidæ*, Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xiii, Figs. *2b, pupa; 2a, Cocoon with empty pupa-case projecting therefrom; 2, imago.*

In August, 1900, Dr. Adolf Lehmann, B. S. A., Ph. D., Agricultural Chemist in Mysore, forwarded to the Museum some live caterpillars reported to be destroying "field beans" and castor-oil plants (vernacular name "Haralu") in the Chitaldroog District of Mysore. It has also been bred in the Indian Museum, Calcutta, from the latter plant growing in Calcutta.

Only one specimen of the caterpillar attacking the castor-oil plants was received alive. This was reared in the Museum, and proved to be the noctuid moth *Ophiusa melicerta*, Drury, which has a vast range over the Ethiopian, Oriental, and Australasian regions. The figures show the pupa, the cocoon or shelter of the larva, and the moth.

2. *Ergolis merione*. Cramer, Sub-family *Nymphalinæ*. Family *Nymphalidæ*. Sub-order *Rhopalocera*. Order *Lepidoptera*. Plate ix, Figs. 5, *imago male; 5a larva; 5b, pupa.*

In August, 1900, some caterpillars found eating the leaves of the castor-oil plant in Calcutta were reared in the Museum. They proved to be the butterfly *Ergolis merione*, Cramer, which has a wide range in northern and continental India, Burma, the Malay Peninsula and Sumatra. A figure of the upper side of the male insect is shown on Plate X, Fig. 5; Fig. 5 *a, larva;* Fig. 5 *b, pupa.*

3. *Euproctis scintillans*, Walker. Family *Lymantriidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

A single specimen of the above-named moth was bred in Calcutta in May, 1901, from a larva found feeding on the leaves of a castor-oil plant growing in the Museum compound. The moth occurs throughout India and Ceylon, in Burma, and the Andaman Isles.

4. *Thosea cana*, Walker. Family *Limacodidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xi, Figs. 1, ♂; 1*a*, ♀; 1*b*, *full-grown larva twice enlarged*; 1*c*, *cocoon life-size.*

The larvæ of *Thosea cana*, Walker, were found in June feeding on the leaves of the castor-oil plant in Calcutta, and a pair of moths were bred from them in July. I have identified this species as *T. cana* with much doubt. Sir George Hampson in "The Fauna of British India: Moths," vol. i, p. 378 (1892), says that the male has the antennæ bipectinated to the tips, while my male has them simple, neither does his figure of the male nor Dr. Moore's figures of both sexes in "Lep. Cey." agree very well with my specimens. Hampson records the species from Kulu, Sikkim, Poona, the Nilgiris, and Ceylon, with an ochreous race from Dalhousie and Murree. In my specimens the male is brown white, the female is ochreous. During my absence my assistant Mr. Peal drew up the following description of the earlier stages:—YOUNG LARVA: Length 8½ mm. Shape elongate-elliptical; the sides of the body sloping inwardly giving it a triangular form; the dorsal area rather flat. The body bears forty tubercles in four rows, ten in a row, two subdorsal, two sublateral; the tubercles covered with a large number of whitish hairs, each hair black-tipped. Colour: on dorsum a narrow central bluish line, bounded on each side by a green line, and then by a lemon-yellow line, the green and lemon-yellow lines of equal diameter, the central bluish line one-third as wide as the others; the green lines are clouded with purple as far as the third pair of tubercles. The dorsal tubercles are yellow, the anterior pair reddish. The rest of the body is light green. Head greenish, except the mandibles which are brown. The dorsal and sublateral tubercles are united each to each by a ridge running diagonally down the side. OLDER LARVA: Length 11½ mm. Similar in colour to the young larva. The raised ridges on the sides which join the tubercles and the interspaces of which form shallow pits, are edged with yellow. FULL-GROWN LARVA: Length 20 mm. The dorsum is more suffused with yellow than in the earlier stages; the tubercles are still small, and no longer than in the larva at the second stage. The spiracles, one behind each of the sublateral row of tubercles, are light brown; the true or thoracic legs exceedingly small and pale coloured; there is a cream-coloured sublateral line below the spiracles. In one specimen (out of two examined) there are two claret-coloured patches on the dorsum between the third and sixth pairs of tubercles, both patches (which only cover the green lines) divided into two by the dorsal blue line. COCOON. Length 10 mm. Shape oval, hard, dirty-brown in colour, attached towards the outer edge of a leaf for about half its circumference, the leaf for that distance being wrapped around the cocoon.

On ***Oryza sativa***, Linn., Natural Order ***Gramineæ.*** Rice or paddy.

1. *Melanitis ismene*, Cramer. Sub-family *Satyrinæ.* Family *Nymphalidæ.* Sub-order *Rhopalocera.* Order *Lepidoptera.* Plate ix, Figs. 4, *male, wet-season form;* 4*a*, *female, dry-season form.*

Both wet and dry season forms of the butterfly *Melanitis ismene*, Cramer, were reared in Calcutta in October, 1900, from larvæ found feeding on the rice plant. As the butterfly is common, especially along the edges of paddy-fields where there is some cover for it—it flies chiefly in the evening after sunset and in the morning before sunrise, being markedly crepuscular in its habits—it is not unlikely to do a considerable amount of damage to the growing rice. The larva feeds commonly on coarse grasses also.

The figures show both the wet and dry season phases of the butterfly. It has a very wide range in the tropical portions of Africa, Asia, Australia and the South Sea Islands, but does not occur in the Americas.

2. *Baoris* (*Chapra*) *mathias*, Fabricius. Family *Hesperiidæ.* Sub-order *Rhopalocera.* Order *Lepidoptera.* Plate ix, Fig. 6, *imago, male.*

The larvæ of this hesperid (or "Skipper") butterfly were found feeding in October 1900 in Calcutta on the leaves of the rice plant. The insect has a wide range in Asia and Malaya. The figure shows both surfaces of a male bred from rice. The larva eats other grasses also.

3. *Remigia frugalis*, Fabricius. Family *Noctuidæ.* Sub-order *Phalænæ.* Order Lepidoptera. Plate xiii, Fig. 4, *imago.*

The larva of *Remigia frugalis*, Fabricius, was found feeding in the neighbourhood of Calcutta in October 1900 on the leaves of paddy and was reared in the Museum. Though apparently from the few larvæ discovered it does not appear to do any appreciable damage, it goes to swell the large number of pests that ravage the staple food crop of Bengal. The moth has a wide range, being found in West Africa and throughout the Oriental and Australian regions. The figure shows both upper and underside of the moth which was bred from rice.

4. *Leucania* sp. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xii, Figs. 7 and 8, *imago*, 8 *a*, *pupa*.

In "Indian Museum Notes," vol. i, p. 51 (1889), *Leucania loreyi*, Dup., is reported to have done great damage to the rice crop in the Sambalpur district of the Central Provinces, causing a loss of about one-eighth of the crop in some places. It is known locally as "haripok." This insect is referred to in vol. ii, n. 6, p. 160, n. 124 (1883) as "harnipok." The moth is figured in vol. iii, n. 6 (1896). The moth has a wide range in Europe and throughout India, Burma and Ceylon.

In "Indian Museum Notes," vol. ii, p. 5 (1891), *Leucania extranea*, Guenée, it is recorded that three different officers in the Rangpur District of Bengal reported "great," "immense," and "extensive" injury in November and December, 1890, to the paddy crops, by cutting off the unripe ears from the stalks. In the same vol., n. 6, p. 160, n. 123 (1893), this moth is reported to be doing much damage in Bengal by biting off young paddy, by eating ornamental oats (*Avena* sp., Natural Order *Gramineæ*) in Calcutta, and attacking the pea (*Pisum sativum*, Linn., Natural Order *Leguminosæ*) in Patna. It is figured in vol. iii, n. 3, p. 135 (1896), larva, pupa, and moth. In vol. iii, n. 5, p. 62 (1896), the notorious "leda poka" caterpillar, which attacks paddy, was received in the Museum from Backerganj, Bengal. They were bred and two species of *Leucania* emerged, one *L. extranea*, Guenée, the other smaller and differently marked. A dipterous parasite of the family *Tachinidæ*, *Masicera castanea*, van der Wulp, is recorded in vol. iii, n. 5, p. 12, n. 5, pl. 1, fig. 3 (1896), as having been bred from the larva of *L. extranea* from Patna. This parasite is again referred to in the same volume and part, p. 42, and in vol. iv, n. 4, p. 219, n. 11 (1899). Lastly, in vol. iv, n. 4, p. 191, n. *f.* (1899), the same process block that appeared in vol. iii, n. 3, p. 135, is reproduced. The name is changed to *L. unipuncta*, Haw., which is older than *L. extranea*. It is said to be doing an enormous amount of damage to the "jowari" crop (*Andropogon Sorghum*, Brot., Natural Order *Gramineæ*) in the district of Poona in the Bombay Presidency. Sir George Hampson notes that the moth is "universally distributed," occurring all over the world.

In October, 1900, in Calcutta, the larva of a species of *Leucania* which appears to be nearest to *L. homopterana*, Swinhoe (Trans. Ent. Soc. Lond., 1890, p. 219, n. 294, pl. vii, fig. 12) was found feeding on paddy leaves and reared in the Museum. The chrysalis is surrounded by a slight cocoon formed by drawing some of the paddy leaves together. The moth itself has a remarkable resemblance to the dried paddy leaves when at rest on them with its wings folded, in which position only the upperside of the front wings can be seen.

Plate xii, Fig. 7, shows the moth twice enlarged, upper and under side, from specimens bred in Calcutta. Fig. 8, *moth; 8a, pupa* shew the smaller species which was bred in Calcutta from larvæ received from Backerganj. They have not been exactly identified, the genus being a large and difficult one.

5. *Grammodes geometrica*, Fabricius. Family *Noctuidæ.* Suborder *Phalænæ.* Order *Lepidoptera.* Plate xiii, Fig. 7, *imago.*

In November, 1900, caterpillars found attacking paddy in the neighbourhood of Calcutta were reared in the Museum. On emergence they proved to be *Grammodes geometrica*, Fabricius, found in Europe, Africa, throughout India and Ceylon, Java, Formosa Island off the coast of China, and Australia. The figure shows both sides of the moth natural size.

6. *Tribolium confusum*, Jacq. Duv. Family *Tenebrionidæ.* Order *Coleoptera.* Plate viii, Figs. 4, *beetle dorsal view; 4a, beetle lateral view; 4b, larva.*

In April, 1899, the Reporter on Economic Products to the Government of India forwarded some rice weevils received by him from the Director, Land Records and Agriculture, Burma, which he reported to be attacking rice and paddy in Rangoon. Some of the specimens were sent to Mons. A. Granville, who identified them as *Tribolium confusum*, Jacq. Duv.

On ***Zea mays,*** Linn., Natural Order ***Gramineæ.*** Indian corn or maize, vernacular name "makai."

1. *Chilo simplex*, Butler. Family *Crambidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

On 20th July, 1901, Mr. C. A. Benn, of the Seeraha Indigo Concern, Champaran, Bengal, wrote as follows:—"In riding through some "makai" fields (Indian corn or maize) to-day I noticed that the central shoot of many of the plants was dead, exactly similar to what happens in the sugarcane when attacked by borers. On examining the plants I found they were attacked by borers. The native cultivators say that the borers in the "makai" are exceptionally bad this year. There has been very little rain—that perhaps may account for it. It is rather important for us as growers of sugarcane to know whether the insects are the same species as attacks the cane, for it will not be of much use if we eradicate the borers from the cane when they are flourishing all over the district in the "makai."

On examining the specimens sent I found them to be larvæ (numerous) and two pupæ of *Chilo simplex*, Butler, the most notorious of the Indian lepidopterous sugarcane borers. In a single shoot of maize I found as many as seven caterpillars, all nearly full-grown. four and three in a shoot were quite common. The shoots were riddled from end to end, the growing point was dead, and the interior of the shoots rotten, ill-smelling, and infested with maggots of flies (Order *Diptera*).

In "Indian Museum Notes," vol. ii, n. 1, pp. 2, 3 (1891), the larva of a moth which was almost certainly *Chilo simplex* was reported to have been sent to the Museum from Amritsar, where it had done much damage to the millet and maize crops. These insects emerged as moths on 31st March and the 4th and 5th June following, taking at least nine months to undergo one generation. It is highly improbable that this is the normal time the insect takes to complete its metamorphosis; under favourable conditions as to weather, abundance of food and temperature, a few weeks will be found to suffice for its life-cycle from egg to moth. Other references to this insect damaging maize will be found in "Indian Museum Notes," vol. iii, n. 1, pp. 51, 52 (1896).

Chilo simplex so far does not appear to be a bad pest in the sugarcane at Seeraha; it occurs far less frequently there than the other two borers. But if the insect thrives and multiplies greatly in the maize which is grown throughout the district during the rainy-season, it will certainly spread to the sugarcane if the two crops are grown near to one another. It would be of little use trying to exterminate it in the sugarcane and allow it to remain rampant in the maize. As it is difficult in India to induce the cultivators to systematically resort to remedies which involve much cost or labour, it would appear advisable as far as possible to prevent the growth of maize close to sugarcane, the latter being by far the more valuable crop. The perfect moth is sluggish, and would probably not travel far, so if the two crops were well separated, the borer though present in the maize would probably not spread greatly to the sugarcane.

As regards the damage done to the maize itself, searching for and destroying the eggs on the young plants would be an excellent remedy early in the season. Once the larvæ have emerged from the egg there would appear to be nothing to be done, but to cut out and destroy all shoots bored by the insect. The presence of "dead hearts" in the maize plants which have been bored into for any length of time will declare at once the presence of borers.

I spent the month of August at Seeraha in Chumparan, and found *Chilo simplex* at all stages in the maize, and bred many moths from larvæ and pupæ found in the maize stalks. This borer appears, however, to do the greatest damage to the plant when it is young. A young shoot or plant attacked dies out entirely, while an older plant, if attacked by a few (one or two) borers, will escape and produce seed-pods. It is almost certain that there are at least two generations of this insect during the time the maize is on the ground, probably three. My efforts to discover the eggs failed, though I kept many moths in a very large breeding cage and supplied fresh stalks of maize to them daily. No eggs were discovered, so probably the insect will not lay readily in captivity. In the first generation the larva burrows through the young maize stalks from end to end and entirely kills them. The second generation, though still to be found in the maize stalks even when as high as six feet, does but little damage to them, the quantity of pith or inner substance of each stalk eaten being but a small proportion of the whole. It also eats into the male flower buds at the tops of the plants when still in the rolled-up stage. At this period of the plant's growth the larva seems largely to abandon its former habits of boring into the growing stalks, and seems to prefer the succulent unopened flowers.

On August 12th, 1901, Mr. J. M. Hayman, Deputy Director of Agriculture, North-Western Provinces and Oudh, sent from the Experimental Station, Cawnpore, some larvæ of *Chilo simplex*, Butler, which was destroying the maize crops in that district. He writes :—"You will notice that the egg appears to be laid under the epidermis, at least I judge so by the marks on the leaves, which look as if the young larvæ had hatched from the egg, and proceeded to go down into the plant. I did not notice these marks (mostly along the midrib of the leaf) except on plants attacked. I also notice that there is a small white maggot with a black head about ·25 of an inch in length which preys upon the borer [larva] in the rotten parts of the plant." The stalks of maize sent me by Mr. Hayman were too decayed on reaching me to enable me to trace the ravages of the young larvæ. The eggs are doubtless laid on the leaves close to the point where the leaves join the stalk, the young larvæ burrow into the leaves and from thence into the stalk, gradually tunnelling down the stalk. The maggots referred to by Mr. Hayman are almost certainly a dipterous parasite, several species of which seem to invariably attack this and other borers of maize and sugarcane, destroying large numbers of the larvæ.

2. *Marasma trapezalis*, Guenée. Family *Pyralidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

This moth is thus described in Sir George F. Hampson's "Fauna of British India ; Moths," vol. IV, p. 277, n. 4819 (1896) :—"Pale ochreous suffused with fuscous brown; palpi blackish, white below: anal tuft striped with white. Fore wing with the costal and outer areas most suffused with brown; indistinct oblique subbasal and antemedial lines; two dark specks on the disco-cellular nervules; a fine oblique postmedial line excurved between veins 6 and 2, and with a diffused curved line beyond it. Hind wing with antemedial and medial oblique lines almost meeting at the anal angle; a postmedial line from the costa to vein 2, sometimes almost connected with the medial line; the outer area suffused with brown. Both wings with a dark marginal line and a line through the cilia, which are pale. *Habitat*: Neotropical, Ethiopian, Oriental, and Australian regions. Expanse 22 millim. In the Museum collection are two bad specimens from Kulu in the Western Himalayas.

I found the *larva* of this moth quite common at Seeraha, Champaran, Behar, Bengal, in August, 1901. It is a little under an inch in length when full grown, almost transparent, either pale ochreous (rarely) or glassy green (more commonly) in colour, cylindrical, very attenuated for its length, with the usual three pairs of thoracic legs, four pairs of abdominal legs on the 7th—10th segments and anal pair of claspers. The head is ochreous, the mouth parts dark brown; the body bears a few sparse black bristles; there is a dark, not very prominent, interrupted, dorsal pulsating line (the heart); each segment bears anteriorly a large oval spot defined outwardly by a narrow black line bearing two small round black spots with a central bristle one at each end of the length of the oval, behind which are two similar round separated spots, one on each side of the dorsal line of the animal each bearing a black bristle; the under surface and legs of the larva are pale yellowish green. The *pupa* is pale brown, darker above than below, narrow, the head rounded, the thorax straight (not humped), the abdominal segments narrow and ending in a fine point.

The larva feeds on the inner surface of the leaves of the maize plants, only eating the parenchyma of the leaf, never making a hole through the leaf. It rolls up one edge, fastens it down with strands of silk, and lives inside this shelter. The eaten surface of a leaf is white, and the larva eats the leaf in long lines which often form white patches. The pupa is formed in a slight cocoon in a rolled up, leaf. As a pest this larva at Seeraha seemed to do but little damage, but under favourable conditions it is probable that it might prove to be a dangerous pest by destroying all the leaves of the plant. The larva is very active when disturbed, running backwards and forwards equally rapidly, and dropping to the ground by a thread of silk. The pupal stage lasts about a fortnight. Probably after the "makai" is cut, this moth finds its food in some other crop, so that generation after generation exists all the year round.

Plate xiv, Fig. 3, *imago ; 3a, pupa, both* × 2.

3. *Cantharis rouxi*, Casteln. and *Cantharis tenuicollis*, Pall. Family *Cantharidæ*, Order *Coleoptera*.

On 21st September, 1901, Mr. J. M. Hayman, Deputy Director of Agriculture, North-Western Provinces and Oudh, forwarded two very distinct species of beetles which he says "appear to be destroying the male flowers and also eating off the stigmas (silky tuft of cob) of some late maize growing in the Experimental Station at Cawnpore. They appear to be very numerous."

On comparing the specimens with named examples in the collection of the Indian Museum, Calcutta, they were found to agree with *Cantharis rouxi* and *C. tenuicollis*. In "Indian Museum Notes," vol. i, n. 1, p. 60 (1889), a species of the same genus of beetles was reported to have destroyed a crop of yellow cholum (millet) in a village in Kurnool, Madras, by eating up the leaves. In vol. iii, n. 1, p. 23 (1896) of the same work these beetles were identified as *Epicauta rouxi*, Cast., and *Epicauta tenuicolli* [sic. !], Pall. The genus *Epicauta* according to Gemminger and Harold is a synonym of *Cantharis*. Again in vol. v, n. 2, p. 50 (1900) *Epicauta rouxi* is reported to have attacked the "kutki" (*Panicum* sp.) crop in the Central Provinces.

On *Corn*.

1. *Agonoscalis nubila*, Fabricius. Division *Eysarcoriaria*. Subfamily *Pentatominæ*, Family *Pentatomidæ*. Order *Rhynchota*. Plate xvi, Fig. 4, *imago* × 2.

Dr. Alfred Lingard, of the Imperial Bactereological Laboratory, Muktesar, North-Western Provinces, forwarded to the Museum in April some bugs which he reported as having devastated the corn crops in Ajmir or the surrounding districts. No further information was sent with the specimens, nor is the variety of the corn affected stated. The insects stand as *Agonoscalis nubila*, Fabricius, in our collection. It was described by the late Mr. E. F. T. Atkinson in the Journ. A. S. B., Vol. lvii, pt. 2, p. 48, n. 196 (1888). It has a very wide range, Mr. Atkinson reporting it as occurring in the Philippines, Java, Malacca, India, China, and Japan. The figure shows the dorsal surface of the mature insect enlarged twice.

VI.—INSECT PESTS OF INDIGO.

On ***Indigofera tinctoria***, Linn., Natural Order ***Leguminosæ.***
The indigo plant.

1. *Anoplocnemis phasianus*, Fabricius. Sub-family *Mictinæ.* Family *Coreidæ.* Sub-order *Heteroptera.* Order *Hemiptera.* Plate xvi, Figs. 6, *imago, dorsal view ;* 6 *a*, *imago, lateral view,* by 1½.

In July, 1900, Mr. W. Gollan, of the Government Botanical Gardens, North-Western Provinces, Saharanpur, forwarded some bugs, regarding which he wrote, "These insects have lately been damaging a small experimental plot of indigo I am growing in the garden. The insect congregates in clusters of three to four near the tops of the plants, and cuts the young growing points, feeding on these when they fall over to the point where the insects are clinging to the thicker portions of the stems. They drop to the ground when disturbed, so I get rid of them by shaking them on to cloths spread on the ground below the plants."

Mr. W. L. Distant has kindly identified the insect as *Anoplocnemis phasianus*, Fabricius, *vide* Lethierry and Siverin's Cat. Gen. Hémiptères, vol. ii, p. 12 (1894). The figure shows one of the specimens, dorsal and lateral views, × 1½.

2. *Bagrada picta,* Fabricius. Sub-family *Pentatominæ.* Family *Pentatomidæ.* Order *Hemiptera.*

At the end of April Mr. E. A. Hancock and I found a small plot of Natal indigo plants grown for experimental purposes at Pemberandah near Dalsingh Serai, Behar, attacked by a small bug. The insect had spread on to the plot of indigo from an adjoining threshing floor on which a crop of "Sursea" (Mustard), *Brassica* sp., Natural Order *Cruciferæ,* had been threshed. The bugs had evidently been feeding on the Sursea, but when that was cut and had dried had migrated to the indigo, on which it was feeding. It might become a severe pest if its ordinary pabulum failed. Mr. W. L. Distant has kindly identified it as *Bagrada picta,* Fabricius, Sub-family *Pentatominæ,* Family *Pentatomidæ,* Order *Hemiptera.* At a later date Mr. Hancock informs me that this bug did very great damage to his indigo plants.

3. *Chilomenes sexmaculata,* Fabricius, Family *Coccinellidæ.* Order *Coleoptera*

This lady-bird beetle was found to entirely eat up and eradicate a swarm of black aphids which had attacked a small plot of indigo grown in the compound of the Indian Museum, Calcutta. The beetle has a wide range, being found in South Africa, throughout India, the Malay Peninsula, Sumatra and Java.

4. *Agrotis segetis*, Schiff. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xii., Figs. 2, *imago* × 2; 2 *a*, *larva* × 2; 2*b*, *pupa* × 2.

In March, 1897, Messrs. Finlay, Muir & Co. sent some live larvæ to the Indian Museum, Calcutta, reporting that they were attacking the indigo in one of their estates. This appears to be the first report received by the Indian Museum, Calcutta, regarding the damage done by any lepidopterous pest to indigo. The specimens were reared in the Museum, and proved to be *A. segetis*, Schiff., and *A. biconica*, Kollar. The first of these appears to be "The Indigo Caterpillar" *par excellence*. Reference to these insects will be found in "Indian Museum Notes," Vol. IV., n. 4, pp. 194, 195 (1899).

On 29th March, 1897, Mr. H. Thorp of the Luckimpur Indigo Concern, Segowlie, Behar, reported that caterpillars were then very rife and doing great damage to the indigo all over Behar. He wrote: "This year the caterpillars are worse and more persistent than I have ever known them. Having destroyed one crop in my "Zerats" or home cultivation, they have attacked the new crop which I re-sowed as soon as it appeared above ground." On 6th April, 1897, Mr. Thorp wrote: "As a preliminary symptom there appears a little cobweb on the young indigo plant, which binds the topmost shoots together, and on the leaves appears minute black specks, whether the excrement or eggs [certainly the former—*Ed.*] of the caterpillars I cannot say. On opening the web I have mentioned a tiny caterpillar is seen. They spread with amazing rapidity. One evening a field, or "chukla" as it is called, of many acres in extent, may be fresh and healthy-looking, and the next morning the whole of it will be blighted. The effect of this is more or less fatal to the plant according to circumstances. In strong lands, and if the plant attacked is fairly advanced, though the leaves may be entirely withered and eaten up, the stem will shoot again, and provided that the plant is not again attacked will survive with only a small percentage of loss. But in a year like the present one, with the moisture deficient to start with and in light lands (which is the general character of indigo lands) the attack is generally fatal to the plant. East winds seem to be favourable, and west winds unfavourable to caterpillars. When the wind blows persistently from the east for days together, caterpillars will appear almost to a certainty. They generally appear when the plant is young, say, a fortnight to a month old. I have known them, however, to attack the plant in all stages of its growth, and at all seasons of the year. The caterpillar, however, which appears on the matured plant during the manufacturing season is, according to my experience, the green variety. Though these do not kill the plant, they strip it of its leaves, and render it practically unfit for manufacture." This report is published in "Indian Museum Notes," vol. iv, n. 4, pp. 195, 196 (1899). One specimen of the moth appears to have been reared, and drawings of the caterpillar, pupa, and moth were made which are reproduced on Plate xii., Figs. 5, *imago ;* 5 *a*, *larva ;* 5 *b*, *pupa*, all × 2. It is noted in "Indian Museum Notes" that the material was insufficient for identification, but the moth appears to me to be a stunted specimen of a species of *Caradrina*, Subfamily *Trifinæ*, Family *Noctuidæ*.

From March 19th to 27th, 1901, I made Mozufferpur, Behar, my head-quarters, visiting the surrounding Indigo Concerns in search of "The Indigo Caterpillar." During these eight days I met with but slight success, as I was able to find only three newly-hatched caterpillars at the Ottur Concern, which I was not able to rear. The season was unusually backward owing to the cold and late spring; moreover, all the indigo had to be resown, as rain fell early in March and destroyed all the crop. Searching the indigo fields at night with a lantern in the expectation of finding the moth ovipositing was also unsuccessful, no noctuids whatever being seen; four species of *Pyralidæ* only were captured. The season was altogether unfavourable for the indigo caterpillar, the wind being always from the west and therefore a dry wind, there being no easterly moist winds, which are said to be favourable for the insect.

On 5th April, 1901, Mr. E. Macnaghten, Secretary, Behar Planters' Association, Mozufferpur, sent a few indigo caterpillars from the Pipra Concern, Tirhut, to the Indian Museum, Calcutta, two of which produced moths, and from this material the larva, Plate XII, Fig. 5a, the pupa, Fig. 5b, and the imago Fig. 5 were drawn. The caterpillars pupated on May 1st, and emerged as moths on May 20th.

From April 17th to April 24th, 1901, I again visited Mozufferpur. At this period the indigo caterpillar had nearly disappeared, but I succeeded after much searching in finding a few at the Bhichanpur Indigo Concern, which I reared to the pupa stage, when they all unfortunately died, producing no moths. Whether or no they were *Agrotis segetis* I cannot say, but most probably they were. I was informed that these caterpillars were more numerous about ten days or a fortnight before my arrival, but that they have not been at all common anywhere in Behar this season. My specimens varied considerably in size, some being twice as large as others; they vary greatly in colour also, some being pale green, others yellowish green, and others again dark green. A nearly full-fed larva when extended in walking measures between a half and three-quarters of an inch in length. In colour it is green of various shades; the segments appear to be considerably retractible, as the larva when disturbed curls up into a ring, when all the segments are shortened and thickened. The larva is nearly cylindrical, the head is smaller than the second segment, the segments increase in width to the fourth, from thence to the anal segment they are of nearly equal width, though the anal segment is slightly larger than the others. The head is pale greenish-ochreous with a few scattered black bristles. There is a broad dorsal area of a paler green than the lateral areas, bearing numerous fine green lines, two of which close together in the middle line of the back are darker than the others; the broad dorsal area is bounded by a rather broad yellow line on each side; the lateral areas are darker than the dorsal area, and bear similar fine darker green lines; the lateral area on each side is posteriorly bounded by a broad yellow line irregularly marked with reddish-orange; just anterior to this line are the pure white spiracles; the ventral surface is pale green, as are all the legs; the claws of the true or thoracic legs and the bristles on the pro or abdominal legs are reddish-brown. The larva is exceedingly active, walking fast, and, as noted above, curls itself up into a ring when touched and drops to the ground without spinning a suspensory thread. It is probable that the hotter climate of Calcutta was the cause of the death of all the pupæ I brought down from Behar. On examining them I found they had all shrivelled up in the earth at the bottom of the breeding-cages in which they had been kept.

Agrotis segetis has received many synonymic names. Sir George Hampson in "The Fauna of British India: Moths," vol. ii, p. 181, n. 1620 (1894), gives nine names, given it by Walker and one by Swinhoe. He thus describes it:—"Whitish-brown, pale-brown, or fuscous; palpi darker at the sides; collar with a dark line; abdomen whitish. Fore wing with double waved subbasal, ante and post-medial lines; an obscure waved submarginal line, and marginal series of specks; the orbicular and reniform with dark centres and edges; the claviform small and black; all these markings being much obscured in the dark specimens. Hind wing iridescent white with a dark marginal line, and in some specimens with dark suffusion on the margin.

Habitat: Europe and throughout India and Ceylon. Expanse 42—48 millim." [1·5 to 1·9 inches, but often the moths hardly reach half this size.] The larva is known to be destructive to a great variety of plants, especially to turnips and corn in Europe; in South India and Ceylon it has been reported to eat the leaves of coffee, *vide* "Indian Museum Notes," vol. iv, n. 2, p. 42, n. 9 (1897).

Much has to be discovered as regards the lifehistory of this destructive moth in India, especially as to its relation to the indigo plant. For instance, when are the eggs laid that produce the young larvæ which eat off the young indigo when at its most vulnerable stage, *i.e.*, in the two, four, and seven leaf stages? Probably the eggs are laid immediately the young leaves of the plant show themselves above the ground, and hatch in a very few days, three or four perhaps. Again, why should the caterpillars do such great damage in some years, and be comparatively innocuous in others? Why should the moist east winds be favourable and the dry west winds be unfavourable for their development? It might be suggested that with a moist atmosphere the plant is more succulent and therefore affords better pabulum for the minute caterpillar when first hatched than the plants would be under a dry and burning west wind, which would render the leaves tough and leathery. Again, what becomes of the insects when the indigo is safe, *i.e.*, past the seven-leaf stage, till the next season comes round? I may note here that later on in the year when I collected thousands of caterpillars embracing many species in the mature indigo, I did not meet with a single larva of *A. segetis*, though 1901 being a bad year for the insect they may have been present in the indigo, but in few numbers, and so escaped observation. Or the insect may, and probably does, feed on many other plants besides indigo, and so is enabled to carry on the species from one season to the next by this means. It is found in August, however, as I obtained two very small specimens at Seeraha at night. Another question that puzzles indigo planters greatly with regard to this insect is a reason for its being so much more prevalent on seeted lands (*i.e.*, lands highly manured with the refuse plants from the indigo fermenting vats after the indigo has been extracted) than on lands not so manured. The only reason I can suggest is that plants from manured land are naturally the most vigorous, and consequently can bear a larger "crop" of caterpillars than poor indigo from worn-out, unmanured lands. The eggs are certainly not laid in the seet as has been suggested.

On May 28th, 1901, a letter headed "The Caterpillar Pest" appeared in *The Englishman*, from which the following extracts have been made:—"One of the most determined and persevering enemies the planter has to fight is the little green caterpillar; it will turn up suddenly in a year when the crop is excellent, and sweep off sheets of strong young indigo, not leaving a trace behind of the once green crop. The caterpillar appears about March, when it will steadily eat its way through the four or seven-leaf indigo; and then its movements are shrouded in mystery, but the supposition is it changes from a stout bloated caterpillar into a chrysalis, which is thought to be buried in the ground; but how long it remains in that state is not known. It then turns into a moth and lays its eggs on the indigo leaves, presumably at night, they taking about eight days to hatch." A bad "caterpillar year" is thus described:—"After there has been a cold weather rain some time before the sowings, and the indigo has already arrived a four leaves, a few days of east wind is sufficient to produce caterpillars. They will then creep, crawl, and eat until a west wind suddenly springs up and kills them and the half-dead thread-like stalks of the indigo remaining. If the planter is lucky enough to have moisture he resows his lands when the crop is dead, but with an east wind again the caterpillars appear and destroy the new crop; the only chance the indigo has of being saved is their eating the whole of the leaves up, leaving the lines where the indigo was—a faint thin streak of wire-like stumps; the caterpillars will then disappear, and if there are light west winds half the day and east winds the other half the crop will revive, and will soon spring into life again; warmth and moisture helping it to grow out of all danger of the caterpillars doing it any further harm. But the planter is generally left with a badly crippled crop, it having been badly thinned out. The pests are always worse on "seeted" lands ("seet" is the refuse of the indigo from the vats, which is spread or ploughed into the land as manure), and as a rule they first appear on these lands. Towards the latter end of the "khoonti mehai" (manufactre of indigo dye from the second cutting of the plant), milliards of caterpillars pass through the steeping vats with the indigo, and are thrown out with the seet in which they mix (a large number also falling with the indigo leaves to the ground on fields and mixing with the soil). These eggs remain in the seet throughout the cold months, and mix with the soil when the lands are seeted, and a cold weather rain, in conjunction with the mild east winds in March, is sufficient to stir them up and hatch them. The conclusion one must come to is that the grub is always more or less present in the indigo, and it appears under certain favourable conditions from the soil; and that the seet, however good as a manure, is always infested with the pest. I should be inclined to think, however, contrary to all principles, that if the seet was spread on the lands, and the spread seet afterwards burned on the fields carefully, that the lands would be benefited, and there would be no chance of the pest appearing on these lands.* The year 1897 was a terrible one for caterpillars throughout the whole of Behar, and a large number of concerns made as many as two or three resowings, and in the end the produce of indigo was only a little over half of that of other years. Take a factory in a bad "caterpillar year" like 1897 with, say, 5,000 bighas of cultivation (a bigha varies in size, but is usually about an acre), the cost for extra seed alone (the price of seed rising as the crops failed) would come to from Rs. 25,000 to Rs. 30,000 rough all-round figures, and in the end a bad crop."

In *The Englishman* of June 5th, 1901, "Old Planter" wrote about "The Indigo Caterpillar," and suggested that a circular be sent to each planter in Behar inviting him to give any information he may have regarding the life-history of the pest. On the following day was published in the same newspaper a series of nineteen questions that suggested themselves to me as requiring solution; these questions were embodied by the Secretary of the Behar Indigo Planters' Association and circulated by him to the planters in Behar.

Mr. J. M. Wilson notes that 1843 was a very bad caterpillar year as he is informed by a friend; the caterpillars in that year made a clean sweep of the crop in about twenty-four hours and at about the same date all over Behar. Mr. Wilson says that "There are three kinds of caterpillars that do more or less harm to the indigo. The small green one, as far as my experience goes, does not do much

* In the above remarks there appear to me to be several fallacious statements. Seeted or otherwise richly manured lands would more probably produce a larger "crop" of caterpillars than poor plant grown on poor lands. Again, as far as my experience goes, "The indigo caterpillar" does not show itself at all during khoontie mehai, though many other caterpillars of several species of moths are rampant at that period. But none of them survive the steeping process in the vats, all being killed, nor are any eggs that may have been laid by moths likely to survive. As for the eggs remaining unhatched in the seet throughout the cold months, this is I think also higly improbable. Nor do I think that the grub is always more or less present in the indigo. As far as my observations go, the caterpillar is only found in the first crop in the spring, never when the plants have grown to a considerable size. Burning the seet would certainly destroy any insects and eggs there might be in it (probably there are none of either), but the burning would certainly destroy the chief manurial qualities of the seet, the ashes being but of comparatively little value.

harm, and any change of weather seems to clear them off. The large green one sometimes attacks the khoontie indigo, and eats away the lower leaves, and does some damage. But the small reddish-brown caterpillar is the one that does most harm. My first experience of these was in 1853. We had succeeded in getting a splendid crop of young indigo, and I went into the head factory to report a sixteen annas jummah (full crop) and invited my manager to come and see it. He had to put off his visit for a day. However, the next morning we visited the fields, when to my horror and dismay the whole of my fine crop had disappeared, and the ground swarmed with these reddish-brown creatures. We had had a late cold weather rain and had plenty of moisture in the ground. So we sowed again, and the young indigo came up thickly only to be again destroyed by these caterpillars. However, we persevered and eventually the pests disappeared, and we got a very good crop and made a very fair season. Again in the years 1864 and 1865 we had very bad caterpillar years. The question was whether to resow or to give the caterpillars a chance to disappear. We feared that our moisture would be insufficient, so we resowed. This we had to do once or twice, but eventually got a grand crop and a good manufacturing season followed. In a later year I witnessed a bad attack of these same reddish-brown caterpillars. This time the crop did not disappear, but where the insects had attacked the plant, the plant seemed to dry up and became brown, drying up into stuff like snuff when touched. Resowings had to be made, but we made a good season in the end. My experience is that this particular kind of caterpillar only appears after a late cold weather rain. The land being full of moisture becomes heated with a damp heat, and this brings these voracious little animals into life. I have watched them during the middle of the day when the west winds are blowing as from a furnace. They then hide under small clods of earth, coming out in the cool of the evening to feed on the indigo. I did not notice how long they lasted, but certainly over a week. I do not consider, except for the extra seed which has to be bought and the cost of labour in ploughing and resowing, that caterpillars are especially dangerous to the indigo industry. I may further note that during bad caterpillar years new lands will be quite free from them. They are generally worst in old factory zerats" [fields].

In all, five planters replied to my series of questions, Messrs. M. J. Wilson (who sent in the general report quoted above), F. Murray, of Kurnoul Concern, Tirhut; T. R. Filgate, of Burhoulee Concern, Saran; Kenneth Mackenzie, of Gokulnagar Concern, Purneah; and R. N. Sealy, of Kinderpati Concern, Gorakhpur. It will be convenient to give the questions and the several replies received from each of these gentlemen in the order of the questions—

1. How many generations of the moth are there in the year?—Two in indigo.—(*Sealy.*)

2. The length of each generation, *i.e.*, from egg to moth?—About five months.—(*Sealy.*)

3. The length of each stage in a generation, the egg, the caterpillar, the chrysalis, and the moth?—The egg about two or three days, caterpillar about thirty days.—(*Sealy.*)

4. When are the eggs laid?—From 5th March to 15th April.—(*Sealy.*)

5. Where are they laid, *i.e.*, on the leaves of the indigo plant, in the ground, or on any other plants besides indigo?—On the leaves of the indigo plant. Two leaves are stuck together with a web and the eggs are laid between (*Sealy*). [The web is probably made by the young caterpillar, not by the mother-moth who laid the eggs.—*Ed.*]

6. What becomes of the insect during the period that there are no indigo plants on the zerats (fields). Does it carry on generation after generation during that period on other plants than indigo, or has it a quiescent stage; if so, what stage (egg, caterpillar, chrysalis, or moth) is it in?—I think the insect has a quiescent stage during the cold weather, in the chrysalis stage.—(*Sealy.*)

7. Does the caterpillar show any preference for early sown or late sown plants?—The reddish-brown caterpillar prefers early sown indigo (*Wilson*). My experience is that early sown plant (*i.e.*, plant sown in February) is not so liable to be attacked as late sown plant.—(*Murray.*) Prefers late sowings.—(*Filgate.*) Undoubtedly for late sown plant.—(*Sealy.*)

8. What parasites affect the caterpillar? I have bred a tachinid fly (very similar to a house-fly in general appearance) from caterpillars obtained at Muzaffarpur. This fly has been identified by Mr. Coquillett as *Tachina subnigera* van der wulp. There are doubtless other parasites.—(No answer.)

9. What is the cause of a "bad caterpillar year"? Has cold weather rain anything to do with it, and why?—My experience is that in a season when there are late cold weather rains followed in March by easterly winds with rather warm weather caterpillars are worst, especially the reddish-brown kind. The little green caterpillar is with us every year more or less, and does less harm. The large green caterpillars found some years in our khoonties only appear during some years, and then often when we are getting extra produce.—(*Wilson*). In my experience always preceded by rain in January, the reason why this should be so I do not know.—(*Murray*

If cold weather rains fall and the lands are ploughed and turned over, caterpillars are not bad. (*Filgate.*) Caterpillars are always worse after a cold weather rain. I cannot give any reason for this except that late ploughing releases the chrysalises from the grounds.—(*Sealy.*)

10. Why should seeted lands be more badly damaged by caterpillars than lands not so manured?—I cannot say, but caterpillars often appear in seeted lands, when they do not appear elsewhere.—(*Wilson.*) Do not know the reason why, but seeted lands are certainly more particularly affected by caterpillars.—(*Murray.*) Although a fact, I cannot say why it should be so (*Filgate*). I take it that the leaves of seeted plant are more tender than those of other plants.—(*Sealy.*)

11. Are the eggs of the moth present in the seet when it is spread over the fields? Not in my opinion.—(*Sealy.*)

12. A Tirhut planter suggests burning the seet and so killing any moth eggs there may be in it. But would not this procedure destroy most of the manurial value of the seet?—Burning seet on the land only fertilizes the soil for the one year. (*Wilson.*) Would partially destroy manurial value.—(*Murray.*)

13. What is the best sprayer or strawsonizer to use to destroy the caterpillars?—The best I have heard of is Strawson's.—(*Murray.*)

14. What is the best chemical to use in the sprayer or strawsonizer?—Parafine is cheap, and, I believe, effectual.—(*Murray.*)

15. Why is an east wind favourable, and a west wind unfavourable to the caterpillars?—An east wind is a damp warm wind, while the west wind is the opposite. An east wind brings what the natives call "Jhulka," a kind of cobweb in which small green caterpillars are generated; while the west wind brings "Jharka," a kind of blight that does away with the Jhulka.—(*Wilson.*) East winds are favourable to caterpillars, but I do not know why.—(*Murray.*) Damp suits the caterpillars.—(*Filgate.*) A west wind dries up the young caterpillars when they have just been hatched out.—(*Sealy.*)

16. Give the years when caterpillars were really bad. Do bad caterpillar years occur in regular cycles?—In my experience since 1847 one of the worst years was 1852 or 1853, and again in 1865. These were really bad years, but in the end we managed to secure fair crops. There have been other years when caterpillars have done harm, but not the damage they did in those above-mentioned. I think the pest depends a great deal on the weather, as noted in my reply to question 9.—(*Wilson.*) 1864 or 1865, 1888, 1889, 1893 and 1900.—(*Murray.*) During the last ten years, there has been only one

bad year.—(*Filgate.*) 1900 and 1901 were very bad years for caterpillars.—(*Sealy.*)

17. Why should new lands in villages usually escape being attacked by the caterpillar when sown with indigo? Why should they prefer (as stated by "Old Planter") worn-out zerats?—I cannot say, but in a bad caterpillar year the zerats undoubtedly suffer more than the zillah.—(*Murray.*) The plant being stronger in new lands is more affected by the caterpillar.—(*Filgate.*) The caterpillars have attacked the indigo in both new and old lands both years (1900 and 1901), but are worse in worn-out zerats.—(*Sealy.*)

18. Would it pay to manure indigo fields, which are known to be particularly badly affected by the indigo caterpillar so as to strengthen the young plants? The latter would perhaps then be able to recover from the ravages of the caterpillar instead of dying outright.—The young plant this year [1901] in lands manured with superphosphate did not get away any quicker than in ordinary lands. (*Murray.*) An answer to this question depends on the cost of manure per bigah.—(*Filgate.*)

19. Any other information should be given of a general nature.—My experience is that bad caterpillar years added considerably to the indigo seed bill. The crops eventually secured gave a good return, the produce being better than in ordinary years.—(*Wilson.*) The caterpillar appears in most years in this district (Purneah). The indigo lands are but very roughly prepared and never weeded, the sowing being done by hand on the plough. The rougher and more weedy the land the less is the damage done by the caterpillar. Indeed it is only in fairly clean lands that any damage at all is done. Provided one has a normal rainfall to bring on the plant, the weeds do not interfere with the indigo in any way, but rather the opposite.—(*Mackenzie.*) Caterpillars are worse here [Kindarpati Concern, Gorakhpur] than at any other factory I have been at, and I attribute this to the factory being near the jungle. During the period between the 5th March and 15th May north winds blow every night, and I think these north winds bring down the moths from the foot-hills which are covered with jungle. Caterpillars again appear towards the end of mahai. The eggs must be laid on the tender leaves of the second cuttings (khoonties) about the end of July and early in August, but the plants being stronger they do not do much harm. The eggs and young caterpillars on the plant appear to poison the leaves which dry up, and west winds at this stage cause the young plant to dry up before the leaves are thrown out. I think the only way to distribute a chemical would be to draw a cloth over the young plant kept wet with some chemica solution. This would prevent

the moths from laying their eggs on the young plant. How would steeping indigo seed in a solution of carbolic acid stop the moths from laying their eggs in the young plant? Steeping sugarcane before planting in the above-named solution certainly keeps the borer moth from attacking the young plant.—(*Sealy.*)

The answer given by the planters to my questions do not shed much light on the question. While many planters hold that "The Indigo Caterpillar" is the greatest enemy they have to contend against, Mr. Wilson appears to think that the damage done is inconsiderable, except, of course, the direct loss in the cost of fresh cultivation and resowing. Practically the planters have no remedy for the caterpillar to suggest. Some of them have had a heavy log of wood called a "hanger" dragged over the young indigo when badly attacked by caterpillars in the hope that they would be crushed, but as the soil is light and friable the result is that but few caterpillars are crushed, the bulk of them being simply forced into the soft earth and receive no injury. The only effectual remedy appears to me to be to poison them. To do this efficient sprayers must be provided and in considerable numbers in large concerns where a large area is under indigo. As the caterpillars appear to show themselves almost simultaneously and do all the damage in two or three days, many and large sprayers will be required to get over all the ground in time to save the indigo. Constant watchfulness is absolutely necessary, as directly caterpillars show themselves they must be dealt with. In a very few days it will be too late to apply the remedy. The best poisons to be used will probably prove to be Paris Green or London Purple, which are both arsenical poisons. The strength of these compounds must be determined by experiment. There is not the smallest doubt in my mind that if either of these poisons be applied properly at the right time that the crop will be saved. "The spraying of plants" by E. G. Lodeman (Macmillan & Co., Limited, London, 1899) is the latest work I have seen on the subject, and should be carefully studied by those who wish to carry out experiments in exterminating "The Indigo Caterpillar."

5. *Agrotis biconica*, Kollar. Sub-family *Trifinæ*. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

This moth was bred in March 1897, from a batch of caterpillars found on indigo and sent to the Indian Museum, Calcutta, by Messrs. Finlay, Muir & Co. It has not made its appearance since that date. It is thus described by Sir George F. Hampson: "Differs from *A. segetis*, Schiff. [see page 147] in having the subbasal, ante and postmedial lines of the fore wing almost or quite obsolete; the sub-marginal line strongly dentate, with black streaks on it; the orbicular elongate, with a dark streak from it to the reniform; the claviform very elongate, and filled in with black. *Habitat:* South Africa; North-Western Himalayas; the Punjab; Sikkim; throughout the Bombay and Madras Presidencies; Ceylon. *Expanse:* 38 millim. [1·45 inches.] In the Indian Museum, Calcutta, are specimens from Karachi, and Kulu and Solon in the Western Himalayas. Hampson gives three synonyms, *Agrotis exigua*, Kollar, *A. spiculifera* and *A. aristifera*, Guenée.

The one species of butterfly and ten species of moths which follow were all bred by me at Seeraha, Champaran, Behar, during the months of August and September, 1901. They were all found on indigo plants of considerable height, which were being cut for manufacture of the dye at the end of the mohran and beginning of the kunti mahai. Though many of these species were brought in in large numbers in the caterpillar stage, none of them can be said (at any rate at Seeraha and in the present season) to be doing any considerable damage. They all eat the leaves of the indigo and thus reduce the produce, but as the plants grow very thickly the damage done is hardly apparent. Nevertheless they must reduce the quantity of dye produced to a certain extent, and it is quite possible that in years favourable to them they may do very considerable damage.

6. *Chilades trochilus*, Freyer. Family *Lycænidæ*. Sub-order *Rhopalocera*. Order *Lepidoptera*.

This little butterfly has a very wide range, being found in South-Eastern Europe, almost throughout Africa, Syria, Arabia, Persia. Trans-Caucasia, the Pamirs, throughout India, Ceylon, Java, Bali, Sumba, Sambawa, and in Australia. In India the larva has been bred previously on *Zornia diphylla*, Pers., Natural Order *Leguminosæ*, and *Heliotropium strigonum*, Willd, Natural Order *Boragineæ*; it has not previously been found to eat indigo. It has several synonyms, *Lycæna putli*, Kollar, *Lycæna isophthalma*, Herrich-Schaffer *Lycæna parva*, Murray, *Lycæna gnoma*, Snellen. The following description is taken from specimens found on indigo:—*Larva:* Length when walking ·4 of an inch; onisciform, of equal breadth throughout, both ends rounded; pale green in colour, of the exact shade of the young indigo leaves on which it feeds; a slightly darker dorsal line edged with lighter green, also some similarly-coloured very faint diagonal lateral lines each crossing two or three segments; a prominent lateral continuous whitish line; the whole surface shagreened and sparsely covered with fine black hairs; the head very small, black, usually entirely retracted beneath the second segment; the constrictions between the segments shallow; apparently no mouth-like organ in the dorsal line on the eleventh segment, or excertible organs on the twelfth segment; all the legs pale green. *Pupa* ·2 to ·3 of an inch in length attached to the surface of a leaf by the anal end only, no median girth, colour pale green entirely without markings; the surface of the body covered with rather long white hairs or bristles; the pupa is rounded throughout, the thorax is slightly humped; the head broadly rounded; the anal end narrowly rounded.

The tiny caterpillar of this very small butterfly was found in considerable numbers in the indigo fields, but being so minute it can do only very slight damage to the plants.

7. *Creatonotus emittens*, Walker. Family *Arctiidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

This moth is recorded by Sir George F. Hampson from the North-Western Himalayas, Nepal, Manipur, and throughout South India and Ceylon. He gives five synonyms, *Aloa candidula*, Walker, *Aloa diminuta*, Walker, *Spilosoma punctistriga*, Walker, *Creatonotus rubricasta*, Moore, and *Aloa flora*, Swinhoe. He thus describes it:—"Head and thorax pinkish-whitish; abdomen crimson above, with series of dorsal and lateral black spots. Forewing pinkish-ochreous; a black fascia below the median nervure from before the middle of the discoidal cell to some way beyond its lower angle, the veins crossing it pale; a black submarginal streak above vein 5. Hind wing whitish, some specimens with a black spot at the end of the discoidal cell. The South India and Ceylon forms *emittens* and *flora* are much more suffused with pink than the northern forms; in the former the markings of the forewing are prominent, in the latter obsolete or only developed at the end of the discoidal cell. Of the northern forms, *diminutus* has the markings prominent; *candidulus* narrow or almost obsolete; and *punctistriga* with a speck at the end of the discoidal cell and a streak above vein 5 only. *Expanse:* ♂ 30, ♀ 38 millims" [1·2 and 1·4 inches].

I only bred five specimens, though the caterpillars were fairly common in the indigo; I found them difficult to breed in my breeding cages. The black markings on the upper side of the fore wing are extremely variable, in some the streak posterior to the median nervure is present, in others it is absent, and when present it varies in intensity and may be broken and continuous. The spot on the hind wing may be present or absent. Two pairs have the abdomen above crimson, one male has it luteous as described for *Spilosoma punctistrigata*, Walker.

The *larva* is extremely active, running with great rapidity, curling up into a ball when disturbed. The usual number of legs, three pairs of thoracic, four pairs of abdominal on 7th—10th segments and one anal pair. Head ochreous, the face with a reversed V-shaped, marking, white, enclosing a black triangular marking, the body extremely hairy, general coloration blackish or dark grey dorsally, greyish-white laterally; a dorsal interrupted whitish line, each segment furnished with numerous tubercles bearing long grey-black hairs; the under-surface pale. *Pupa* formed in a slight silken cocoon mixed with the hairs from the body of the larva, the cocoon spun up in the leaves of the food-plant; stumpy, *i.e.*, short and stout, shining brown in colour, smooth, without markings, the head blunt and rounded, the thorax slightly humped, the anal segment bluntly pointed.

I do not think this insect is ever likely to become a serious pest.

8. *Heliothis armigera*, Hübner. Sub-family *Trifinæ.* Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

This common and widely distributed pest was found in considerable numbers feeding in the larval state on the leaves of indigo. Further references to it will be found under *Pisum sativum*, Linn., at page 132. It might prove to be a very formidable pest to indigo under favourable conditions.

9. *Prodenia littoralis*, Boisduval. Sub-family *Trifinæ.* Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

Further notes on this common pest will be found on page 131 under *Brassica* (*Eubrassica*) *oleacea botrytis*, the cauliflower. It has been given six synonymic names, *Prodenia ciligira* and *testaceoides* by Guenée, *P. glaucistriga*, *subterminalis* and *declinata* by Walker and *Neuria retina* by Freyer. The *larva* when full grown is 1·6 inches in length. With three pairs of thoracic legs, four pairs of pro- or abdominal legs on the 7th—10th segments and a pair of anal claspers. Cylindrical, stout, smooth, without protuberances, and hairless; general coloration exceedingly variable, of several shades, of green from very pale to very dark, and of various shades of brown there is in the dark examples a pale reddish dorsal line, and in all a subdorsal or supra-lateral pale line, anterior to the latter and almost touching it is a series of linear black spots, one on each segment on each side; the spiracles prominent, surrounded by black, white, and ferruginous markings; posterior to the spiracles is a pale band, very prominent in the dark coloured specimens; the lower surface and legs always pale; head dark, with a prominent reversed V-shaped white marking, with its apex in front. *Pupa* shining, smooth, broad, broadest in front, tapering gradually to the sharp anal segment, the head rounded; the thorax very slightly humped; no markings whatever.

In actual point of numbers this is the second worst of the many lepidopterous pests found by me in the indigo at Seeraha during August and September, *Raparna nebulosa,* Moore, being the most numerous. But perhaps of the two *P. littoralis* does the more damage, as it is the much larger caterpillar, probably four times as large and will therefore eat four times as many leaves as its smaller rival. This is almost certainly the fat green caterpillar frequently referred to by the planters as being found in thousands in their steeping vats during kunti mahai. The larva turns to a pupa in the ground as does *Heliothis armigera,* Hübner. A small black fly about half the size of a common house fly has been bred in small numbers from the larva of *P. littoralis.* It has been identified by Mr. D. Coquillett as *Plectops orbata* Wiedemann.

9 *a.* *Tatrorhynchus vinctalis,* Walker, Sub-family *Trifinæ,* Family *Noctuidæ,* Sub-order *Phalænæ,* Order *Lepidoptera.* Plate xii, Fig. 6, ♂.

Scopula vinctalis, Walker, List Lep. Ins. B. M., Vol. xxxiv, page 1476 (1865); Butler, Proc. Zool. Soc. Lond., 1866, page 384; Swinhoe, Proc. Zool. Soc. Lond., 1886, page. 460; Warren, Proc. Zool. Soc. Lond., 1888, page 335; *Udea vinctalis,* Cotes and Swinhoe, Cat. Moths, India, page 610, n. 4160 (1887); *Tatrorhynchus vinctale,* Hampson, Fauna British Ind., Moths, vol. ii, page 268, n. 1890 woodcut n. 148, *male* (1894).

I only bred a single specimen of this very distinct little moth from indigo at Seeraha. It has been recorded from Aden, Karachi, Subathu, Campbellpur, Mhow, Coimbatore, and from Australia. Its general appearance is that of a pyrale rather than a noctuid.

10. *Remigia archesia* Cramer. Sub-family *Quadrifinæ.* Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.* Plate xiii, Fig. 3, *imago.*

This moth has not before been reported in India as a pest to agriculture, though it occurs in large numbers in the indigo in August and September, and is the third most commonly met with according to my experience. As the larva is of considerable size it must destroy a large quantity of the leaves of its food-plant. Sir George F. Hampson gives ten synomyms for this species, which goes to show how variable it is. This is also evidenced by the specimens bred by me in one place from one food-plant and at the same time of year. A particularly noticeable variation is the presence in some specimens only, of a prominent round black spot behind the submedian nervure towards the base of the wing on the upperside of the fore wing. All the markings, however, vary in intensity; some specimens also are much lighter than others. The larva is even more variable than the

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moth. Hampson's descriptions are as follows:—"Imago pale red-brown; abdomen pale fuscous, the anal tuft ochreous. Fore wing with a short subbasal red-brown line; an oblique antemedial pale or ochreous line, with diffused red-brown band on its outer edge; a sinuous medial line angled on the median nervure; the reniform large and indistinct; a red-brown diffused postmedial band, on which is a dark line slightly excurved beyond the cell, and at vein 2 very irregularly recurved to the lower angle of the discoidal cell, then descending to the inner margin; an indistinct pale waved submarginal line with a series of black specks on it; a dark waved marginal line. Hind wing ochreous fuscous, with a narrow fuscous medial band and a diffused submarginal band. Legs rufous. Some specimens have a black spot on the fore wing above the inner margin before the middle; the variety *gregalis*, Guenée, is duller in colour, with the markings of the fore wing obsolescent. *Larva* purplish brown speckled with black; the lateral area yellowish with red lines, a sublateral row of small black dots; head with a brown and red lateral streak. Food-plant *Desmodium*, Natural Order *Leguminosæ*. *Pupa* efflorescent. *Habitat*: Ethiopian and Oriental regions, North China. *Expanse*: 42—54 millim. [1·5 to 2·2 inches.]

Dr. F. Moore in Lep. Cey. vol. iii, p. 191, under *Canninda archesia*, gives the following description of the larva:—"Semi-looped; with twelve legs; the dorsal and under surface purplish brown, minutely black dotted, the sides yellowish and longitudinally lined with red and a sublateral row of minute black dots: head with a brown and red lateral streak; front legs red, middle and hind legs brown. *Pupa* reddish; efflorescent."

I made the following description:—*Larva*: When full grown at least two inches in length. The usual three pairs of thoracic legs, two pairs of pro or abdominal legs on the ninth and tenth segments, and the usual anal claspers; these three pairs of legs are furnished with very powerful and effective hooks so that the larva can adhere very closely to any surface on which it places itself. The larva is a semi-looper and can progress very rapidly. It is long in proportion to its girth, cylindrical. It presents a bewildering variety of coloration, so that it is impossible to describe all the variations in full. A few of the more striking ones may be mentioned:—The posterior surface very dark, almost black, strongly contrasted with a pale French-grey anterior surface, which is palest (almost white) where it meets the dark abdominal surface, and is divided longitudinally into four broad stripes of various shades, besides a dorsal stripe; each of these stripes is again made up of very fine lines, which under a magnifying glass are seen to be composed of small round closely-set darker spots on a paler ground; on the fifth segment there is always a prominent ocelloid spot on each side in the subdorsal area; the linear markings are continued across the head; the constrictions between all the segments obsolete, so that it is difficult to locate the divisions between the segments. Other general colours that may be mentioned are pale gamboge-yellow, sap-green of several shades, ochreous mixed with greenish, many shades of brown, etc. None are pure green. The larva feeds chiefly at night, and rests on the stems of the indigo during the day, to which its various shades of colour closely assimilate, so that the insect is difficult to see. The larva when about to pupate (at least this is always so in captivity) spins a number of leaves together with silk, and forms a slight cocoon in which it turns to a pupa. The *pupa* is covered with a slight white bloom like that seen on a plum; it is brown in colour, rather stout, cylindrical, ·8 of an inch in length, the head rounded, the posterior segment bluntly pointed, the wing cases prominent.

The insect is certainly a bad pest to indigo when in an advanced stage. As the pupa does not probably bury in the ground, it would be interesting to know in what stage the insect is when there is no indigo on the ground. Doubtless it feeds on other leguminous plants, of which one has been recorded, so is able to keep up successive generations till the indigo is large enough to support one or more broods of caterpillars during the rainy season.

11. *Trigonodes hyppasia*, Cramer. Sub-family *Quadrifinæ.* Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.* Plate xiii, Fig. 5 *imago.*

Sir George Hampson gives eight synonyms for this moth, which he thus describes: "Pale ochreous brown, slightly suffused with fuscous or dark grey-brown. Fore wing with a large black white edged triangular patch below the cell from near the base to towards the outer angle; a similar smaller patch beyond the discoidal cell on vein 5, with some pale fulvous beyond it; a slightly sinuous submarginal pale line, with patches of black suffusion inside it and a series of black specks beyond it; a dark marginal line. *Hind wing* with an indistinct medial line; the outer area suffused with fuscous. *Habitat*: Africa, Mauritius, Madagascar, Aden, throughout India and Burma, Ceylon, China, Formosa, Java, Australasia. *Expanse:* 46 millim." (1·7 inches.)

This does not appear to be a formidable pest to full-grown indigo, as only a few specimens were obtained by me. The moth is a very pretty one, and the two black triangles on the upper side of the fore wing make it easily identifiable.

12. *Plusia limbirena*, Guenée. Sub-family *Quadrifinæ*. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

Sir George Hampson gives only two synonyms for this moth, *Plusia confusa*, Moore, and *Plusia gamma*, Kollar (*nec* Linnæus). He thus describes it :—Head and thorax clothed with grey and black scales; abdomen pale with the dorsal tufts dark. Fore wing fuscous, with a cupreous tinge ; ill-defined darker medial and submarginal patches; the minutely waved double subbasal and antemedial lines with silvery specks on them ; the orbicular and reniform small, indistinct, and with pinkish edges ; a prominent silver Y-mark below the discoidal cell; the minutely waved double postmedial line angled inwards above vein 1 ; traces of an irregularly sinuous sub-marginal line; a small pinkish patch in the centre of the outer margin ; a marginal series of black specks. Hind wing pale at the base ; the outer area suffused with fuscous ; cilia pale ; under side with an indistinct lunule at the end of the discoidal cell and a waved post-medial line. *Habitat*; St. Helena, South Africa, Madagascar, Aden, the North-Western Himalayas, Sikkim, the Nilgiri Hills, and Ceylon. *Expanse*; 42 millim." [1·5 inches.] *Larva*: Total length when full-grown one inch. Three pairs of thoracic legs, two pairs only of pro or abdominal legs on the ninth and tenth segments, and the usual pair of anal claspers. The larva is a semi-looper. Cylindrical narrowest at the head, gradually increasing in width to the anal segment. Head of medium size, a little smaller than the second segment, pale yellowish green in colour, with two round black spots on each side on the top of the head (vertex), the anterior spot the larger, a lateral black streak on each cheek. Body pale emerald green, longitudinally striped with white, these stripes are three in number on each side of the dorsal line, the middle stripe is developed on each segment anteriorly into a ring which bears a central white spot; similarly the third or outer of the three lines bears posteriorly a similar spot; there is a prominent lateral white line with a round black spot on each segment almost touching it anteriorly; the spiracles are inconspicuous ; the abdominal region or under surface and legs are green and unmarked, the constrictions between the segments are shallow and would be difficult to detect were they not faintly defined with white.

This is not a serious pest to indigo as far as my experience goes, as I bred but a few specimens The two outwardly obliquely-placed prominent metallic-golden rounded spots on the upper side of the fore wing in the middle make this insect easy of recognition.

13. *Raparna nebulosa*, Moore. Sub-family *Focillinæ*. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xiii.

Figs. 8 *a, larva, drawn from a spirit specimen* ; 8 *b, pupa* ; 8 *imago, all life-size.*

Mr. Moore's original description of this moth as *Acosmetia nebulosa* is as follows :—" Upper side pale ochreous-brown. Fore wing darkest, with several transverse indistinctly darker waved narrow fasciæ, some pale spots on the costal edge near the apex. Under side paler. *Expanse* : 1 inch. *Habitat* : Darjiling." The figure given is of but small help in making the identification of this insect possible. The description quoted above is republished *verbatim* in "Desc. Lep. Ins., Coll. Atkinson." Sir George F. Hampson thus describes the moth :—"Male : Uniform pale brown ; fore wing with slightly darker, evenly disposed mottling. *Habitat* : Sikkim. *Expanse* : 24 millim." In freshly bred specimens the forewing on the upper side shows three perpendicular equidistant and parallel almost straight black bands in both sexes, which are alike. *Larva*, a semi-looper. With the usual three pairs of thoracic legs, four pairs of pro or abdominal legs on the 7th-10th segments, and anal pair of claspers ; cylindrical, of equal breadth throughout ; the head rather large, a little smaller only than the second segment ; the constrictions between the segments slight but distinct ; coloration pale emerald green, with a narrow lateral white line on each side ; all the legs and the abdominal area pale emerald green. Head with about twenty rather long black bristles, each bristle springing from a small black spot ; the second segment with two rows of similar bristles, six in each, the anterior row further apart than the posterior row, owing to the place of the posterior bristle on each side in the anterior row being occupied in the posterior row by the spiracle of that segment, thus crowding up the bristles anterior to the spiracle ; the third to twelfth segments bear on each side two bristles placed close together just anterior to the lateral white line, and four posterior to the line arranged in the form of a reversed Y ; on the anal segment are numerous black bristles of various lengths. Length, when full-grown, 1 inch.

Of all the caterpillars found by me in the kunties in August and September at Seeraha this was by far the commonest. Though it is small it must by force of numbers reduce the produce considerably. It is remarkable that this insect which occurs in myriads in Behar, should only have hitherto been recorded from one locality, and that in the hills of the Eastern Himalayas.

14. *Hypena* sp., prox. *mistacalis*, Guenée. Sub-family *Deltoidinæ*. Family *Noctuidæ*. Plate xiii, Fig. 9, *imago* × 2.

Mr. G. C. Dudgeon, to whom I sent specimens of this pretty little moth, is unable to identify it, and says that it is probably undescribed. It is rather common ; I bred about a dozen specimens of it. It pupates on the stems of the indigo, making a hammock-shaped cocoon of sooty-coloured rough silk, mixed with fragments of dead leaves. The larva being very small it does but little damage as far as my experience goes.

15. *Crocidophora pallida*, Moore. Family *Pyralidæ*.

I bred a single specimen only of this pyralid moth from indigo. It is remarkable in having the apex of the fore wing greatly produced and subfalcuta.

VII.—INSECT PESTS OF THE SUGARCANE.

On ***Saccharum officinarum***, Linn, Natural Order ***Andropogoneæ***. The Sugarcane.

1. *Dictyophara pallida*, Donovan. Sub-family *Eurybrachydinæ*. Family *Fulgoridæ*. Order *Rhynchota*.

Fulgora pallida, Donovan's Nat. Hist. Ins. India, Ed. 1, pl. viii, fig. 2 (1800); *Pseudophana pallida*, Westwood in Donovan's Nat. Hist. Ins. Ind. Ed. 2, pl. viii, fig. 2 (1838); Trans. Linn. Soc. Lond. vol. xviii, p. 150, n. 3 (1841); *Dictyophara pallida*, Walker, List Hom. Ins. B. M, part II, p. 310, n. 18 (1851), [nec, *D. pallida*, Walker, l.c., p. 320, n. 35]; Atkinson, Journ. A. S. B. vol. LV, pt. 2, p. 27, n. 26 (1886); Ind. Mus. Notes, vol. v, No. 2, p. 43, pl. v, fig. 1, *ova, larvæ nymphæ* and *imago* (1900).

In "Indian Museum Notes" (l. c.) the fulgorid bug, *Dictyophara pallida*, Donovan, is reported as damaging the sugarcane crop in the North Arcot district and at Coimbatore in South India. It is said that the canes when infested become stunted and damaged. The life history of this pest does not seem to have been studied. In April, 1901, I visited Cawnpore in the North-Western Provinces, and Muzaffarpur in Behar, Bengal, and in both places found this insect in abundance in the sugarcane fields. The perfect insects rest on the leaves of the sugarcane with their heads pointed upwards and fly short distances when disturbed. Many specimens, one behind the other, rest on a single sugarcane leaf. On an old field of sugarcane at the Cawnpore Experimental Station I first found the eggs; subsequently they were discovered in considerable quantities, though not to quite so great an extent on newly planted sugarcane. In the case of the old sugarcane the eggs were laid on the fresh shoots, the longer leaves of which were from two to three feet in length. The eggs are rather large for the size of the insect, being $\frac{1}{25}$ of an inch in length (1 millim.), a perfect oval in shape, the surface apparently slightly rough under a lens but exhibiting no surface sculpturing under a microscope, the surface a little shining, the egg very pale green in colour, but becoming slightly tinged with yellow before the young larva emerges. The eggs are invariably (except in the rare instance when a leaf has become reversed) laid on the under surface alongside the midrib of the leaf, in the natural longitudinal hollow of the leaf. They are generally to be found on the posterior half of the leaf, *i.e.*, that adjoining the main stem of the plant, and are placed in a long string or mass, generally about half-an-inch in length, but sometimes extending to a full inch or even more. They are laid very irregularly, though close together. At either end there is usually a single egg, then two or three more or less abreast till the end of the string of eggs is reached. Very rarely are there four eggs abreast. The eggs nearly always touch one another, but do not overlap in the way that one tile overlaps another on a roof. In the more than fifty clsuters of eggs I collected in an area of a few square yards in a few minutes, the number of eggs in a string or cluster ranged from three to thirty, but from fifteen to twenty was the usual number. Each egg-mass is thickly covered with the long pure white thread-like hairs which clothe the anal segment of the mother-bug, so that the white egg-mass on the green sugarcane leaves is extremely conspicuous. There is no mistaking these eggs if examined at all carefully, though the web egg-shelter of a small spider which is common in the cane-fields superficially resembles the eggs of the bug. Not improbably these spiders feed largely on the young bugs. The pale green eggs of the bug can often be seen beneath their cottony covering. The eggs are attached extremely slightly to the surface of the leaf; the least touch dislodges them. This perhaps is not an important matter in the economy of the insect, as if the eggs should fall to the ground they would most likely be uninjured, being quite hard; the actual fall would not hurt them, and the active young larvæ on emergence would quickly regain their food plant. I noted that if a single egg-cluster was found on a plant there would be usually several others, generally two or three, sometimes as many as six. In four days after I first found the eggs the young larvæ commenced to emerge. They do not eat the empty egg shells as so many lepidopterous insects do They are colourless (whitish), of grotesque appearance, being furnished with a pair of long tail-like tufted filaments from the posterior end of the body, which they can bring close together into a single "tail" or separate widely apart. They are very active and hop vigorously. Owing to my visit to Cawnpore being of a few days duration only, I was unable to follow up the life history of this pest. It probably takes some weeks to reach the perfect state, or possibly some months. The perfect insect is about half-an-inch in total length, the head produced into a long snout upturned at the tip, the eyes black and prominent, coloration pale wainscoat-brown, the fore wing with some small scattered black dots hardly to be seen except under a lens, the hind wing transparent, white, immaculate. The female has a large mass of white flocculent material at the end of the body, with which she covers the eggs when laying them.

This insect, if it attacks the sugarcane in large numbers, must be a serious pest, as it must greatly reduce the vitality of the plant by sucking up the sap through its proboscis or beak, piercing the cuticle of the leaf for that purpose. The remedy for it is simple if taken in time. The egg-masses being so very conspicuous, it would be extremely easy to collect and destroy them. Children could do it. They should each be provided with an empty kerosine oil tin, and made to go over the lines of young sugarcanes, examining the underside of each leaf carefully. Any leaf with an egg-mass attached to it should be cut off and put into the tin to be subsequently burnt. As the eggs drop off at the slightest touch, the collecting receptacle should not be a basket or other porous article through which the loose eggs can fall. If the children went over the fields once a week until no more eggs were found, the pest would be eradicated for that season, and with a little care and attention in subsequent years it could be practically exterminated. Should it be found advisable to attack the insect after it has become a hopper or larva, kerosine emulsion (made from two-thirds kerosine oil and one-third soap, added to ten times its bulk of water) should be sprayed over the plants on which the insects are at work.

At Muzaffarpur I found eggs commonly at Mr. Roland Hudson's estate at Ottur. The insect is probably widely spread, and doubtless is found on other plants besides the sugarcane.

Mr. J. M. Hayman, Deputy Director of Agriculture, Experimental Station, Cawnpore, has found freshly-laid eggs of this insect up to the end of May, so that it appears probable that there are no well-defined broods, but that the egg-laying goes on for a considerable period.

2. *Dinoderus minutus*, Fabricius. Family *Bostrychidæ ; Læmotmetus ferrugineus*, Gerst., Family *Cucujidæ*, and *Sitophilus oryzæ* Linnæus, Family *Curculionidæ ;* all Order *Coleoptera*.

In June, 1900, Captain A. T. Gage, of the Royal Botanic Gardens, Sibpur, near Calcutta, sent to the Museum for identification three species of beetles which were found to destroy the tissues of sugarcane. They bore small tunnels through the tissue of the cane, and reduce it to powder, leaving the vascular system practically untouched.

One beetle was pronounced by M. P. Lesne, of the Natural History Museum, Paris, to be the cosmopolitan warm region species *Dinoærus minutus,* Fabricius, Family *Bostrychidæ;* the second beetle was pronounced by Mr. M. A. Grenville to be *Læmotmetus ferrugineus,* Gerst., Family *Cucujidæ;* and the third beetle was identified by M. J. Desbrochers des Loges to be *Sitophilus oryzæ,* Linnæus, Family *Curculionidæ,* which he says is found all over the world.

The first species, *Dinoderus minutus,* Fabricius, has been referred to in "Indian Museum Notes," vol. i, n. 1, p. 43 (1889); in vol. ii, n. 6, p. 150, n. 21 (1893); in vol. iii, n. 3, p. 123, process block of imago dorsal and lateral views, antenna, fore, mid, and hind legs (1896); in vol. iv, n. 1, p. 37 (1896); and n. 3, p. 135 (1899) as in all cases being destructive to bamboo in various parts of India. It is figured in Bulletin No. 7, 1900, Agricultural Series, No. 6, Department of Land Records and Agriculture, Bengal, on "Saccharum, sugar, diseases, pests, etc., to which the sugarcane is subject," by Lieutenant A. T. Gage, M.A., M.B., B.Sc. This paper deals with sugarcane diseases in Bengal. Dr. Gage records the following varieties of sugarcane as affected by the shot-borer, *Dinoderus minutus,* Fabricius:—"Chinia" or "Tikh" or "Ketari" variety at the Soupoul sub-division of Bhagalpur; "Mango, Bhoorli, and Bansahi" varieties of cane at Beheea, East Indian Railway; "Belati, Bheula, Mukhi and Nori" varieties at Bogra; "Kunri, Shamsara, Puri, Kajooli and Basta" varieties at Burdwan; "Auck, Ganna or Gandari, Kooshur," etc., varieties at Dacca; "Reora" and "Bhuli" varieties from Saran and Darbhanga districts respectively, where the disease is known as "Pilna;" "Mugi, Saheban, Kheri, Kajla and Banisha" varieties at Dinajpur; sugarcane from Faridpur; a variety known as "Nola" from the Jhenida sub-division, and "Dhulsundur and Wajli" varieties from the Narail sub-division, both in Jessore; "Shamsara, Bombai, Bhoori and Kajli" varieties from Midnapore; "Shamsara" variety in the Tamluk sub-division of Midnapore; "Bhooli" variety from the Begusarai sub-division, and "Mango, Maneria and Rounda" varieties in the Jamni sub-division, both in Monghyr; "Chinia, Ketar and Mango" varieties from the Barbigha police station in the Jamni sub-division; "Sakor Chinia, Maneria, Mango and Rounda" varieties from the Sikandra police station, also in the Jamni sub-division;

"Chinia, Maneria, and Rounda" varieties from the Saikpora police station, also in the Jamni sub-division; "Maneria and Rounda" varieties from the Chakai outpost, Nawadih, "Shiti" variety in Murshidabad; sugarcane from Mymensingh; "Shamsara, Dhali and Kajli" varieties at Kushtea in Nadia, where the disease is called "Bonga" and "Berupoka;" "Khagra" variety at Noakhali; "Kazla and Dhalsundur" varieties in Pabna; "Bhanda Mugi" variety at Rangpur; "Bhurli" variety (disease called "Lohi, Murari and Ukhra"), "Chinia" variety disease called "Murari and Ukhra") at Saran; sugarcane in the Gopalgunge sub-division, and "Bhooli" variety at the Sadar sub-division, both of Saran.

The third species is the well-known beetle regarding which Mr. E. C. Cotes, the First Assistant to the Superintendent, Indian Museum, in 1888, wrote the report entitled "The Indian Wheat and Rice Weevil, *Calendra* (*Sitophilus*) *oryzæ*, Linn.," illustrated by a plate of the insect in all its stages. References to it under its better-known generic name *Calendra* will be found scattered over all the volumes of "Indian Museum Notes." It is figured on plate viii, figs. 5, *dorsal view*, and 5 *a*, *lateral view* × 8.

3. Prox. *Ligyrus rugiceps*, Lec. Family *Scarabæidæ*. Order *Coleoptera*. Plate vii, Figs. 7 and 7 *a*, *dorsal and lateral views of beetle.*

On 7th June, 1901, the Officiating Collector of Rangpur, Bengal, forwarded to the Indian Museum, Calcutta, thirteen beetles of the Family *Scarabæidæ* which are new to the Museum collection, and are apparently allied to *Ligyrus rugiceps*, Leconte, together with a copy of a report by the District Engineer, Rangpur, dated the 1st June, 1901, in which it is stated that "The sugarcane crop in the district is being fearfully devastated by an insect which eats the new and tender shoots at the root of the cane underground two or three inches below the surface just above the point from which the shoots sprout up from the seed cane. They are not observed to attack the older shoots which have become hard and formed into stems. They are found to attack principally the plant canes, *i.e.*, the sprouts of newly planted seed canes, but not the ratoon sprouts, or a very few of these. They abound largely in newly broken up virgin soil several hundred acres of land where the canes sprouted up splendidly have been entirely destroyed and rendered barren. They have been killed by digging up the earth round the roots of the plants in immense numbers, but to no effect. The vernacular name for this insect is "gozra." The cultivators believe that the gozras will leave the fields on heavy rain setting in, and that their abundance this year is simply owing to the scantiness of the rainfall last year, and the total lack of rain during the last six or seven months. The cultivators report that these gozras are damaging the "aus" paddy crops in places.

The allied American species has been reported to do great damage to sugarcane, and corn (probably Indian corn or maize), and has been found at the roots of grasses, in carrot roots and in dahlia tubers. The life history is very imperfectly known. No remedy is suggested for this pest except the use of trap-lanterns to be lighted in the fields at night where the beetle is abundant, the light attracting the insect, which falls into a tray below containing water with a thin film of kerosine oil on the top. As this insect in the imago or perfect state feeds on the young cane just below the surface of the ground, it is not probable that many of them would come to light, except perhaps at the pairing season. The larvæ or grubs also feed underground. Except the laborious and expensive method of digging out the beetles wherever their presence is shown by the dead or dying canes, it is difficult to devise a remedy for its ravages. Fortunately this is the first recorded instance of its being a pest in India, so that the damage it does appears to be quite local at present.

4. *Chilo simplex*, Butler. Family *Crambidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

Jarthera simplex, Butler, Proc. Zool. Soc. Lond., 1880, p. 690, n. 150.

Chilo simplex, Barber, Ind. Mus. Notes, vol. iv, n. 4, p. 217, n. 7 (1899); vol. v, n. 1, p. 21 (1900); n. 2, pp. 41, 42, 43, 44 (1900).

Crambus zonellus, Swinhoe, Proc. Zool. Soc. Lond., 1884, p. 528, n. 119. pl., xlviii, fig. 16; Cotes and Swinhoe, Cat. Moths, India, p. 690, n. 4703 (1889).

Crambus partellus, Swinhoe, Proc. Zool. Soc. Lond., 1885, p, 879, n. 192; Cotes and Swinhoe, Cat. Moths, Ind., p. 690, n. 4700 (1889).

Diatræa saccharalis, Cotes (*nec* Fabricius), Ind. Mus. Notes, vol. i, n. 1, pp. 22,—27, pl. ii, fig. 2; *a, upper surface of moth natural size; b, dorsal view of caterpillar enlarged; c, lateral view of caterpillar natural size; d, lateral view of caterpillar enlarged; e, chrysalis natural size; f, chrysalis enlarged; g, piece of sugarcane shewing tunnels and chrysalis natural size;* vol. i, n. 1, p. 67 (1889); vol. i, n. 4, p. 212 (1889); vol. ii, n. 1, p. 2 (1891); vol. ii, n. 6, p. 162, n. 137 (1893); vol. iii, n. 1, p. 26; vol. iii, n. 1, pp. 50—52 (1896); vol. iv, n. 1 pp. 34, 35 (1896); vol. iv, n. 2, p. 43, n. 9 (1897); vol. iv, n. 4, pp. 199, 200, n. 6 p. 219, n. 17 (1889); vol. v, n. 1, p. 22 (1900); vol. v, n. 2, p. 41 (1900).

The Sorghum Borer, Cotes, Ind. Mus. Notes, vol. i, n. 1, pp. 28—29, n. 3 (1889); vol. iii, n. 5 p. 63 (1896).

The Sugar-cane Borer, Cotes, Ind, Mus. Notes, vol. iii, n. 5, pp. 63, 64 (1896).

Before dealing in detail with *Chilo simplex*, Butler, the most fully known of the Indian sugarcane lepidopterous borers, I will reprint the original description of it by Dr. A. G. Butler, and Sir

George F. Hampson, Bart., as well as the two synonymic names given to it by Colonel C. Swinhoe.

Jarthera simplex, Butler. *Habitat:* Formosa. *Description:* "Form of preceding species [*Jarthera chrysographella*, Kollar], but the primaries [the front wings] of the male uniformly greyish brown, minutely speckled with darker scales, a marginal series of black dots, fringe blackish; of the female testaceous with black marginal dots and pale testaceous fringe; secondaries [the hind wings] silvery white, slightly greyish in the male: body corresponding in colour with the wings. Under surface white, the wings suffused with brown in the male and with testaceous in the female towards the costal margin. Expanse of wings: ♂ 11 lines, ♀ 13 lines. A pair."—(*Butler*, l.c.)

Chilo simplex, Butler. *Habitat:* Japan; Formosa; Chusan; Punjab; Karachi. *Description:* "Male: yellowish brown suffused with fuscous. Fore wing with costal area rather darkest; traces of dark specks below middle of cell and at lower angle; the veins of outer area slightly streaked with fuscous: a marginal series of black specks. Hind wing whitish with slight fuscous tinge. Female: paler, the hind wing white. The form *partellus* [Swinhoe], has on the fore wing of male a highly curved antemedial series of short fuscous streaks, a slight yellowish patch in end of cell, an oblique series of diffused fuscous streaks, from apex to middle of inner margin, and a sub-marginal series of specks; female with same diffused fuscous from apex round lower angle of cell, or sometimes nearly evenly suffused with fuscous, with a dark fuscous patch beyond cell."—(*Hampson*, Ind. Mus. Notes, vol. v, n. 1, p. 22 (1900).)

Crambus zonellus, Swinhoe. *Habitat:* Karachi, May. *Description:* "Allied to *C. decoloreilus*.* Yellowish fawn-colour; abdomen whitish; last joint of the labial palpi very long, $\frac{1}{10}$ inch; abdomen extending somewhat beyond the wings. Fore wings acute outer border nearly straight, slightly oblique, marginal points black; fore wings darker towards the costa and outer border, a faint brown streak along the sub-costal nervure, a black dot at the end of the cell, two brown spots below, on the submedian nervure, and a brown shadowy band running in from the apex, towards the centre of the hinder margin, but stopping half way; hind wings whitish. Expanse of wings $\frac{8}{10}$ inch."—(*Swinhoe*, l. c.)

* ? *Gelechia decolorella*, Herrich-Schaffer in Walker's Lep. B. M. pt. xxvii, p. 585, n. 181 (1863).

Crambus partellus, Swinhoe. *Habitat:* Poona, October and November; Bombay, September and November. In great quantities at Poona. *Description:* "Allied to *C. desistalis*, Walker. Pinkish white, irrorated with grey and black atoms. Fore wings with the irrorations (which are always darker and denser in the male than in the female) making the costal portion dark, and forming two irregular, diffuse, very oblique bands across the wing, one before the middle and the other beyond it, and running up to the apex; there is sometimes also a black dot at the end of the cell. Hind wings pure white. Under side pure white, with some diffuse grey colour in the interior of the fore wings of the male; pure white and unmarked in the female. Expanse of wings, ♂ $\frac{8}{10}$—1 inch, ♀ $1\frac{2}{10}$—$1\frac{5}{10}$ inch."—(*Swinhoe*, l.c.)

In Cotes and Swinhoe's Cat. of the Moths of India, Mhow and Khandalla are given as additional localities for this species.

As the damage to sugarcane caused by borers appeared to me to be one of the most important I could investigate, I wrote in February, 1901, to the Director of Land Records and Agriculture North-Western Provinces and Oudh, owing to the reports made by him in 1899 of the serious ravages caused by these insects in those provinces during that year, on the subject. He arranged that I should visit the Experimental Station near Cawnpore in April. My object in this visit was, if possible, to obtain the eggs of *Chilo simplex*, Butler, which is the most notorious of the lepidopterous borers. Unfortunately for my purpose this insect appears to have entirely disappeared from the cane grown at the Experimental Station, so my search for this insect at all stages failed.

In June I visited Sikta, Bettiah, on the borders of Nepal, where considerable quantities of cane is grown, but the only borer I found there was *Scirpophaga auriflua*, Zeller, *Chilo simplex* being wholly absent. A little later in the same month, however, I found the larvæ and pupæ abundant at Seeraha Indigo Concern in Champaran. Here five distinct varieties of sugarcane are grown, known by the vernacular names of Kalagera (also as the Bourbon cane), Chinia, Nagori, Samsara and Burali. In all of these the larvæ of *C. simplex* were found, ranging from half-grown to full-grown examples. One pupa only was found in a tunnel in the cane.

LARVA when full grown ·9 of an inch in length, cylindrical, tapering slightly towards the head and anal segment; head small, oval, shining, blackish or pale ochreous in colour, the mouth-parts black, the first segment with a large dorsal horny plate coloured like the head; segments three to ten bearing a subdorsal series of spots, two on each side, each spot smooth, shining, raised, oval and blackish; below this are two lateral series of similar spots, one below the other, placed obliquely, the upper spot nearer the head the larger; the eleventh, twelfth and thirteenth segments with one spot only in each series; below these again are the similarly formed and coloured spiracles; true legs, abdominal legs and oval claspers concolorous with the body, the abdominal legs and claspers with black hooks; the body bears a few scattered hairs.

PUPA reddish-brown, smooth, shining, length ·75 of an inch, head rather pointed, spiracles prominent, black.

At Seeraha I did not succeed in finding any eggs of this moth, nor any young larvæ. Mr. Cotes in Ind. Mus. Notes, vol. i, n. 1, p. 24, says that the eggs of the Amercian sugarcane borer are laid upon the young cane near the axils. In the West Indian cane borer, *Diatræa saccharalis*, Fabricius, the eggs are at first light yellow in colour, within thirty-six hours a tinge of orange appears, which deepens gradually becoming orange-brown; the eggs are laid in clusters of from four to fifty-seven, usually between ten and thirty, on the green leaves (*H. Maxwell-Lefroy*). In Java the allied *Chilo infuscatellus*, Snellen, lays its eggs in clusters on the under surface and near the base of the leaves, although sometimes they are laid on the upper side and then almost always just on the midrib (*Dr. L. Zehntner*). It is probable that our species also lays its eggs on the leaves, where they would be very conspicuous.

On emergence the young larva probably at once tunnels into the heart of a shoot of cane, and gradually eats its way downwards, killing the shoot in doing so. At intervals it drives holes to the outside of the cane, presumably for air. The central growing shoot of the cane dies and grows no more; it turns yellow, and it is by this dead, yellow central leaf (called a "dead heart") that the presence of a borer in a shoot or stem of cane is at once demonstrated. If this "dead-heart" is gently pulled it comes out at once, its base being rotten and turned black. The entire tunnel or burrow made by the larva also turns black; it is full of moisture, smells badly, is in a generally very insanitary state, and is the home of many small insects that live on the putrescent matter, especially a small grub of some fly. When full-grown the larva turns to a pupa as stated above and emerges in about ten days as a dingy grey or drab-coloured moth.

As regards remedies for this pest, the following notes may be of use. When the cane is very young children in gangs in charge of some intelligent man should go over the canes row by row, and pick off the eggs which are probably conspicuous and laid in rows or clusters on the leaves. The eggs of *Chilo simplex* not having as yet been discovered, it is not certain what their appearance is, but they are probably white, and laid as described above. The eggs with the leaves on which they are laid should be placed in kerosine oil tins or some other unperforated vessel (a basket is not a good thing to use, as the eggs may get rubbed off the leaves, fall through the holes in the basket and ultimately hatch in the cane field, quickly finding their way on to the canes), the leaves being burnt or fed to cattle. The rows of canes should be carefully searched for eggs once a week, until no more eggs are found. Later on all diseased canes should be cut out close to the bottom of each near the ground, such canes being destroyed and not allowed to remain on the field. If left where cut, the caterpillars will crawl out and attack a neighbouring growing cane. If the canes are not cut low down, the larvæ may be in the piece of the cane remaining uncut and so escape. A few affected canes can be at once detected if the borer is of sufficient age by the presence of the "dead heart." If the larva is very young the cane will not show a "dead heart" at this early stage of its existence. If the "dead hearts" are carefully removed week by week so long as any are to be found, together with the eggs, the borer will be entirely eradicated. When the canes grow large it is almost hopeless owing to the size of the canes, their numerous and large leaves, and the density of the fields, to search for either eggs or caterpillars, but if care be taken when the cane is young to eradicate the insect, there should be no borers left when the cane grows large. In one field of "Burali" cane, which is a small variety, at Seeraha, I found many bored canes, but on cutting these out I found no borers whatever at any stage. The reason appears to be this. The cane is planted (sown) in trenches, the earth from the trenches being heaped up on each side. When the trenches are filled up after the cane has grown to a foot or so in height, the earth covers the stems of the cane above the hole in the cane made by the borer for breathing purposes, and the borer is killed in the cane. It might be advantageous to level off the fields by filling up the trenches at as early a date as possible, so killing any borers there may be in the canes; but this would be unnecessary if all the eggs have been previously collected and destroyed and all "dead hearts" cut out. In old and large cane if "dead hearts" are searched for and found, it is not necessary to cut out the stems close to the ground, thereby wasting several feet of sound cane, but the cane should be cut within eight inches or a foot of its growing point. The cane being at this stage very large and thick, the borer will be found to have penetrated down the stalk but a short distance. There is no loss to the cultivator in cutting out diseased canes, as in the case of young cane the bored shoot invariably dies, and only throws out thin, straggling, lateral shoots which, when full grown, will give but little or no produce in the mill.

It has often been recommended to burn the trash (outside leaves of the cane in the field after the cane is cut for milling. This appears to me to be a wasteful process, as the trash if allowed to rot is of great value for manure. I would rather advocate the trash being at once ploughed into the ground and allowed to rot there, by this means killing any eggs there may be in the leaves, or collecting and burying it till thoroughly rotted, subsequently spreading it over the fields.

It might be found advantageous to catch the perfect moths. The following apparatus should be used. Stout stakes should be driven into the fields at intervals to be settled by experience, a few traps being experimented with at first. On the top of the stake a shallow wooden tray, tarred inside to make it water-tight, should be fixed, and the tray filled to a depth of about half an inch with thin treacle or molasses. The moths will probably be found to come in numbers to feed on the molasses, to which they will stick. A kerosine-oil lamp might be experimented with to attract the moths. It should be suspended close to the tray of sweets, or placed on a stand in the middle of the tray. It remains to be seen whether the molasses alone would attract the moths, or whether a lamp in addition to the sweets proves to be more efficacious. A common tin lamp such as natives commonly use, with a piece of cotton twisted up for a wick, would probably give sufficient light. These lamps, however, would be useless on windy nights, and a hurricane or other wind-proof lantern would have to be substituted.

Plate xiv, Fig. 1, *male imago life-size, shows both surfaces of the wings, the left-hand side the upper side, the right-hand side the under side ;* Fig. 1 *a, the upper side of a female imago life-size in natural position when at rest ;* Fig. 1 *d, larva full size seen from the side ;* Figs. 1 *b* and 1 *c, young larva, dorsal and lateral views found breeding in maize stalks in Calcutta,** Fig. 1 *e, pupa seen from the side.*

5. *Scirpophaga auriflua*, Zeller. Family *Crambidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.*

Scirpophaga auriflua, Zeller, Monograph *Chilo et Crambus*, p. 2 (1863); Walker, List Lep. Ins. British Museum, vol. xxx, p. 968 (1864); Moore, Proc. Zool. Soc. Lond, 1867, p. 666 ; Lep. Cey., vol. iii, p. 387 (1884-7) ; Cotes and

* These larvæ died young, so were not bred up to the imago stage, but as there is only one maize borer known, they are probably *Chilo simplex.*

Swinhoe, Cat. Moths, India, p. 684, n. 4655 (1889); Alcock, Ind. Mus. Notes, vol. v, p. 43, pl. vi, figs. 1, *female twice enlarged; 2, section of sugarcane showing cocoon* (1900).

This insect has only once been reported to damage sugarcane, the caterpillar having been sent down to the Indian Museum, Calcutta, from Kushtea, the moths bred, and the species figured in "Indian Museum Notes," vol. v. In May, 1901, Mr. H. Thorp of Sikta, Betteah, on the Nepal frontier, sent some caterpillars to the Museum, which proved to be this species.

In June, 1901, I visited Sikta, and found that quite fifty per cent. of the shoots of the "khari" variety of cane grown by Mr. Thorp was bored by this insect; the "reonda" variety of cane was also badly affected. The "khari" cane was obtained from the Burdwan Experimental Farm. The symptoms of an affected cane are very similar to those attacked by *Chilo simplex*, Butler, a "dead heart" is always present if the larva has been in the cane some while, but the presence of *S. auriflua* can always be told by the base of the leaves from the growing point of the cane having a series of holes across each leaf at right-angles to the length of the leaf bored with a parallel row, which were made by the young larva when it first penetrated into the cane after hatching; these holes seem never to be present in a shoot attacked by *C. simplex*. As a rule the leaves are bent backward and fall over at the point of perforation, so an affected cane can at once be detected by this feature as well as by the "dead heart." The line of holes arise from the fact that the larva penetrates into the heart of the cane when the leaves are tightly rolled up before they unfold, so that each leaf is penetrated in several places. The falling over of the leaves is due to the wind acting on a weakened spot. In all other respects the injury done by this insect is similar to that of *C. simplex*; the larva bores right down the centre of the shoot, the inside turns black and rotten, and harbours many insects which feed on the decayed mass Each attacked shoot stops growing, the growing point being killed. When full-grown the larva has nearly reached the root of the cane; it bores a hole at right-angles to the tunnel in which it has hitherto lived to the outside of the cane, lines this hole with silk, and fits a neat lid or operculum across the hole of exit, through which the moth on emergence from the chrysalis leaves the cane. The larva then retreats about an inch up its tunnel, spins a flimsy silk cocoon of white silk, and turns to a pupa, its head downwards and towards the hole of exit. A light placed out in the fields over a tray of molasses only produced one moth, so this trap does not appear to be very effective, probably the moths fly but little, especially in windy weather. In the "Sewari" variety of cane which is a very hard and tough variety, no borers were found at Sikta.

Larva when full-grown about an inch in length (the males a third smaller), pale yellow in colour, without any markings, the dorsal pulsating "heart" often dark and prominent. The caterpillar is extremely soft and flaccid, with a very thin integument; the constrictions between the segments deep; the head is very small (smaller than in any of the other sugarcane borers), very pale ochreous in colour, with a similarly coloured plate on the dorsal area of the first segment; the spiracles inconspicuous, concolorous with the body; the true legs small; the abdominal legs and anal claspers not furnished with hooks; the body hairless. The larva when removed from its tunnel is very inactive and lethargic.

Pupa of the male ·50 of an inch, of the female ·75 of an inch in length. In both sexes it is extremely soft and flaccid, and is very easily injured. Colour cream or very pale yellow, without markings, but when reaching maturity and just before the emergence of the moth, the wing-covers and the legs are very prominent, the hinder pair reaching beyond the outer edge of the wing-covers; the head is narrow, square in front, the black eyes and the cases of the antennæ prominent; the abdomen of the male tapers to a sharp point, in the female the anal segment is very large, thicker than the segment in front of it, ferruginous in colour.

The larva turns to a chrysalis within the tunnel in which it has lived as a caterpillar. Before doing so it bores to the extreme outside of the shoot, forming a short tunnel at right angles to its original bore. This tunnel it closes on the outside by a neat circular operculum or cover made from a piece of the thin bark of the sheath of the cane fastened at the edges with silk. It then retires back into its tunnel, as it goes spinning "bulk-heads" or partitions of silk across the tunnel as it retreats, one behind the other at short distances (about 1 or 2 mm.) apart. I have counted as many as twelve of these bulkheads, but five or six is a common number. Lastly it spins a flimsy cocoon of white silk within the tunnel, and turns to a pupa, head downwards towards the opening. The operculum and bulk-heads are doubtless constructed to keep out ants and other predaceous insects which would otherwise enter and eat up the defenceless pupa.

By shutting up both sexes of the moth I obtained the eggs of *S. auriflua* at Sikta. They are laid in groups of three or four, each group being covered with the long red hairs with which the anal segment of the female moth is furnished. The eggs are large for the size of the moth, oval in shape, pale green in colour, smooth and without structure. The eggs are laid close to the base of the penultimate whorl of leaves at the growing point of the shoot. The female probably climbs down between the two outermost leaves, posterior end foremost, and lays the eggs as low down as possible where they are entirely hidden from view, the eggs being coated with the "fur" from the mother's body to protect them from the ants which pervade the canes. As soon as the young larva hatches, it penetrates into the central shoot, which dies.

Later on at Seeraha I found larvæ, pupæ and moths of *S. auriflua* in all the five varieties of cane grown there.

Dr. F. Moore in Lep. Cey. describes the moths thus :—

"Silky-white. Wings without markings. Body white; abdomen with broad cinereous-grey bands above and beneath, anal tuft luteous [in the female only]; palpi and fore-legs with cinereous-grey bands. Expanse: 1·4 inch."

Zeller's description I have not seen. Dr. Moore records it from Calcutta as well as from Ceylon; there are specimens from Kushtea, in Bengal, in the Museum, and I have found it in two places in the Champaran District of Behar. In my specimens the male measures 1·0 inch in expanse across the open wings, the female 1·3 to 1·6 inches. Both sexes have the wings long and very narrow, and are exactly like white satin, the cilia or fringes to the wings long, especially those on the hind wing. The male is much smaller than the female, especially the abdomen, which in the male has no large, luteous or pale ferruginous tuft of hairs at the end; the broad ashy-grey bands on the abdomen are often wanting. As regards remedies for this pest, it seems hopeless to search for the eggs, as they are hidden away out of sight and are not at all conspicuous when found. Cutting out affected canes and possibly catching the perfect moths in trays of molasses, as recommended for *C. simplex*, seem to be the only possible remedies to exterminate the pest.

In July, 1901, the Collector of Rangpur, Bengal, forwarded some insects reported to be destructive to Sugarcane, together with a copy of letter No. 356, dated 16th idem, from the District Engineer, Rangpur. On examining them they proved to be larvæ of *S. auriflua*. The District Engineer writes :—

"I have the honour to state that another kind of insect called "Banga" is destroying the sugarcane in the district. These insects attack the canes from the top and go downwards, eating up the pith and then the flesh. It is said that when drizzling rains continue for a few days these insects cease to attack the canes in large numbers."

A considerable number of large hymenopterous parasites were bred in Calcutta from the larvæ of *S. auriflua* sent to me in July by Mr. Thorp of Sikta. One *Bracon nicevillii*, Bingh. has black antennæ, longer than the body ; the head black in the middle yellow in front and behind ; the thorax yellow ; abdomen yellow tipped with black above ; the legs yellow ; both the wings hyaline, pale yellow, margined irregularly with fuscous ; the fore wing with a large medial black spot stretching across the wing, a smaller spot beyond it from the costa to the middle of the wing, with a smaller one behind it on the inner margin. It is figured on plate vii, fig. 2, *female.* The other *Pimpla predator* Fabr. var. has the wings entirely hyaline, the body yellow, with lateral black spots on the abdomen. It is figured on plate vii, fig. 3, *male.* This borer is also attacked by 2 species of Hymenopterous parasites belonging to the family BETHYLIDÆ.

They have been pronounced by Mr. William H. Ashmead to be new species and have been named by him *Goniozus indicus* and *Apanteles scirpophagæ.*

Plate xiv, fig. 2, *shows a male imago ; 2 a, a female imago, upper and under sides ; 2 b, a female imago in its natural position when at rest ; 2 d, the larva, side view, life size ; 2 e, male pupa ; 2 f, female pupa ; 2 g, a bored cane stem with tunnel made by larva, with a pupa* in situ, *and thirteen partitions separating the pupa from the hole of exit ; 2 c, a batch of eggs laid on a sugarcane leaf.*

6. *Nonagria inferens,* Walker. Family *Noctuidæ.* Sub-order *Phalænæ.* Order *Lepidoptera.* Plate xii, Figs. 9, ♀ *imago ; 9 a, larva, lateral view ; 9 b, larva, dorsal view ; 9 c, pupa, ventral view.*

Leucania inferens, Walker, List Lep. Ins. British Museum, vol, ix, p. 105, n. 65 (1856) ; *Seramia inferens,* Moore, Lep. Cey., vol. iii, p. 8, pl. cxlv, fig. 3 (1884). Swinhoe, Proc. Zool. Soc. Lond., 1885, p. 447, n. 6 ; 1886, p. 441, n. 68 ; Butler, Proc. Zool. Soc. Lond. 1883, p. 158, n. 55 ; Cotes and Swinhoe, Cat. Moths, India, p. 261, n. 1654 (1887) ; *Nonagria inferens,* Hampson Fauna Brit. India, Moths. vol. i ; p. 284, n. 1943, woodcut, n. 153, *male,* also *head of female,* (1894).

Leucania proscripta, Walker, List Lep. Ins. British Museum, vol. ix, p. 106 n. 67 (1856) ; Butler, Ann. and Mag. of Nat. Hist., fifth series. vol. xviii, p. 190, n. 55 (1886) ; Cotes and Swinhoe, Cat. Moths India, p. 261, n. 1655 (1887).

Seramia fraterna, Moore, Desc. Lep. Coll. Atkinson, p. 103 (1879) ; Cotes and Swinhoe, Cat. Moths, India, p. 261, n. 1653 (1887).

I reprint the original descriptions of this species by Mr. Francis Walker, Dr. F. Moore and Sir George Hampson, and those of the two synonymic names it has received from Mr. Walker and Dr. Frederic Moore.

Leucania inferens, Walker. *Habitat* : Ceylon. *Description* : "Pale bright fawn-colour ; abdomen whitish-testaceous, much paler than the thorax, fore wings with three black discal dots and with an intermediate brownish stripe, which accompanies the median veins and its branches; a hardly interrupted blackish line along the exterior border. Hind wings white. Length of the body $4\frac{1}{2}$ lines; of the wings 10 lines." (*Walker*, l. c.).

Seramia inferens, Moore. *Habitat*: Ceylon. *Description*: "Fore wing dull yellowish-ochreous, with a longitudinal ochreous-brown fascia extending from the base along the median vein to the exterior margin; a brown exterior marginal line: hind wing white. Thorax dull yellowish-ochreous; abdomen paler; legs dull brownish-ochreous. Expanse: $1\frac{2}{10}$ inch." (*Moore, l. c.*)

Nonagria inferens, Hampson. *Habitat*: Sind, Bombay, Mhow Ceylon, Burma, Flores. *Description*: "Hind wing with veins 3 and 4 from the cell. Antennæ of male ciliated; of female simple. Ochreous. Fore wing with a red-brown suffusion along median nervure and veins 2 to 5; a marginal dark-line; cilia paler. Hind wing white. Expanse: 28 millim." (*Hampson, l. c.*)

Leucania proscripta, Walker. *Habitat*: East Indies. *Description*: "Pale testaceous. Abdomen whitish. Fore wings fawn-coloured towards the exterior border, with the exterior dots indistinct; a pale brownish discal stripe, and a brown line along the exterior border, which has whitish-testaceous cilia. Hind wings, white. Length of the body, 5 lines; of the wings, 10 lines." (*Walker, l. c.*)

Seramia fraterna, Moore. *Habitat*: Dharmsala, Western Himalayas. *Description*: "Very similar to *S. proscripta* and *S. inferens* Fore wing with a slightly darker shade longitudinally through the median veins, and a small distinct black spot below the cell: hind wing white. *Expanse* ♂ $1\frac{1}{10}$. ♀ $1\frac{3}{10}$ inch" (*Moore, l. c.*).

LARVA when full-grown 1·3 inches in length when walking; cylindrical, tapering rather suddenly towards the head, less rapidly towards the anal segment, which is rounded; rather stout, smooth, shining, with a few colourless bristles about ·15 of an inch in length; the segments broadly and shallowly pitted; flesh-coloured, the pulsating dorsal vessel (heart) dark and rather prominent; spiracles small, black; head cordate, small, ferruginous, the mouth-parts black; legs concolorous with the body, short; the abdominal legs (claspers) on the seventh to tenth segments inclusive counting the head as the first; the fifth and sixth, eleventh and twelfth segments without true legs or claspers. The larva is very active when removed from its tunnel in a cane, walking briskly.

PUPA formed in a thin white cocoon* in the tunnel in the cane made by the larva, the head downwards, the cocoon placed close to the large hole bored right through the cane to the outside leaf made for the escape of the moth. Length ·75 of an inch, reddish-brown in colour, the segmental constrictions rather darker, cylindrical, ending in a sharp black point; the spiracles dark red, prominent; the head rounded; the wing-cases well marked.

The above descriptions are taken from the larger larvæ and pupæ which have produced female moths, the smaller ones producing male moths differ only in being altogether of a more slender build.

The eggs of this species have not been discovered. In canes attacked by this borer there are no (at any rate prominent) signs of the entrance of the young larva into the cane as there is in the case of *Scirpophaga auriflua*, Zeller, there is no row of holes across the larger growing leaves at their base, nor are these leaves turned over and drooping. The "dead-hearts", however, are always present, as they are in all the canes I have examined affected by lepidopterous borers if the boring has been of sufficient period to kill the growing point as invariably happens sooner or later. As usual, the young larva of *N. inferens* starts from the top of the shoot of cane and gradually eats its way downwards to close to the root in the young cane, on reaching the bottom it bores a hole at right angles to the length of the cane to the outside for the escape of the moth, and pupates inside the tunnel—at least this occasionally happens, as I have found at least two pupæ within the tunnel, but most probably the larger number of larvæ leave the cane when full-fed, and pupate in the ground as is usual with the *Noctuidæ*. I have not found any pupæ in the earth, but believe they usually pupate in the ground, as so very few pupæ are found in the canes.

At Seeraha in Champaran this is the commonest borer of the three I found there in June. The larvæ are found in the canes also throughout July, but many dead ones occur in the canes during the latter month, being doubtless drowned in their burrows by the heavy rain. The larva is the largest of the three Champaran borers, and differs greatly in appearance from either of the two others. Its pale flesh-colour is very distinctive, *S. auriflua* is creamy-white, while *C. simplex*, Butler, is colourless, but marked with rows of dark spots. In Champaran it is found in the chinia, nagori, samsara and burali

* In numerous specimens bred in captivity the larvæ have made a rough cocoon of debris of the leaves and stalks of the cane without any silk, between the bases of two leaves of a stalk of cane. They have never turned to pupæ in a tin of earth placed in the breeding cages for them to pupate in if they so desired.

varieties of cane, but not in the kalagera variety (Bowhan cane), probably owing to the fact that this last was at the time of my visit to Seeraha some eight feet high, and all borers were then very scarce and difficult to discover.

As regards remedies, the egg of *N. inferens* not having been discovered, it is not possible to say if the pest can be attacked at that stage. In the larva stage cutting out all diseased canes would appear to be the only effectual remedy. The cut out canes should be at once burnt or fed to cattle, never left on the fields. If allowed to remain on the fields the larva will when full-grown bore through the cane and probably pupate in the earth in the usual way, the moths emerging in due course and producing a second generation. As the *Noctuidæ* are especially fond of sweets, trays of molasses put out in the fields would doubtless attract large numbers, but it is doubtful if they would get drowned in the treacle, being strong fliers; probably they would rest just on the edges of the trays and sip their fill from thence, flying away again when satiated.

This borer is attacked by a hymenopterous parasite which has been described as a new species by Mr. William H. Ashmead. He has named it *Macrocentrus nicevillei*.

Plate xii, Fig. 9, *shows a female imago, upper and under sides;* 9 *a and* 9 *b, larva dorsal and lateral views;* 9 *c, pupa, all life size.*

7. *Agonoscalis nubila*, Fabricius. Division *Eysarcoriaria*. Subfamily *Pentatominæ*, Family *Pentatomidæ*, Order *Rhynchota*.

At Sikta, Betteah, Behar, I found this bug in large numbers on the sugarcane leaves, to which it did a certain amount of damage. Further notes on this species will be found on page 143 under Corn.

8. *Ripersia sacchari*, Green. Family *Coccidæ*. Order *Rhynchota*.

In June and again in August, 1901, I found considerable colonies of this "mealy bug" in all the five varieties of cane (chinia, nagsri, samsara, burali and kalagera) growing at Seeraha, Indigo Concern, Champaran, Behar. The colonies vary considerably in number; in some instances there were only a few coccids, in others as many as twenty, in a colony. They are found between the outer sheathing leaves and the stalks of the cane, always low down near the ground, never high up on the cane. The lower leaves of the cane (generally known as "trash") easily come off with the exercise of slight force; not so the younger leaves growing higher up the stalk. The insect appears to do but little damage, at any rate this is so at

Seeraha and in the months I visited that district. In the dry season it may prove to be a bad pest.

Some specimens were sent to Mr. E. Ernest Green, Entomologist, Royal Botanic Garden, Peradeniya, Ceylon, who identified them as *Ripersia sacchari*, Green. He notes in his letter of 3rd September, 1901, that he has recently received *Dactylopius sacchari*, Cockerell, another sugarcane pest, from India. The two insects are very much alike, and can only be distinguished by microscopic characters.

R. sacchari is described and figured in "Indian Museum Notes," vol. v, n. 2, p. 37, n. 3, pl. vi, figs. 5, *pygidium of female ;* 6, *antenna of female* (1900), collected from sugarcane in the Gorakhpur district, North-Western Provinces.

VIII.—INSECT PESTS OF COTTON.

On ***Gossypium*** sp., Natural order ***Malvaceæ.*** Tho cotton plant.

1. *Sylepta multilinealis*, Guenée. Family *Pyralidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xiv, figs. 4 *a*, *larva* ; 4 *b*, *pupa-case after the moth has emerged ;* 4, *imago*—all × 2.

The Director of Land Records and Agriculture, North-Western Provinces and Oudh, in October, 1900, forwarded a large number of caterpillars which he reported to be damaging the cotton plants in the Government Experimental Farm at Cawnpore. On rearing them they proved to be the pyralid moth *Sylepta multilinealis* Guenée, which has been referred to in "Indian Museum Notes, vol. iv, n. 2, pl. 63, n. 3, pl. v, fig. 4, *imago* (1897), under the generic name *Synclera*, as injuring cotton in Baroda. The genus *Synclera* ; Lederer, is a synonym of the genus *Pagyda*, Walker, and has nothing to do with the genus *Sylepta*, Hübner. *S. multilinealis* has a wide habitat, being found in West Africa, East Siberia, Japan, China, throughout India, Ceylon, and Burma, the Malayan sub-region, and the Australian region. This moth is referred to on page 132 as attacking the Bhindi or Lady's Fingers plant, *Hibiscus esculentus*, Linn., Natural Order *Malvaceæ*. The figures show the larva, pupa-case and moth all twice enlarged.

2. *Earias fabia*, Cramer, Pap. Ex., vol. iv, p. 126, pl. ccclv, fig. H (1781). Sub-family *Gonopterinæ*. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

On 21st September, 1893, the Assistant Director, Department of Agriculture and Commerce, North-Western Provinces and Oudh, forwarded some caterpillars which were said to be damaging a crop of Egyptian cotton in the experimental farm at Cawnpore. He noted that the insects attack the leaves of the cotton plant, which curl up and get dry. He also says that the crop has not yet flowered though the flowering season is approaching to a close. The matter is referred to in "Indian Museum Notes," vol. iii, n. 5, p. 68 (1896): "The specimens proved insufficient for precise determination, but are likely to have belonged to the group *Noctues*."

On 4th December, 1893, the Director of Land Records and Agriculture, Punjab, Lahore, sent some pods [bolls] of Egyptian cotton, containing green and white insects tunnelling into the pods. A single moth was bred from these caterpillars, but was unidentified. It differs only from *Earias fabia* in having the green stripe on the upper side of the fore wing continued to the costa instead of being restricted to the middle of the wings. Probably it is only a variety of that species.

In "Indian Museum Notes," vol. iv., n. 1, p. 36 (1896), mention is made of "a green caterpillar, three-quarters of an inch long, which twists up and destroys the leaf when pupating" of cotton from Baroda in the Bombay Presidency. All these references probably relate to *E. fabia*.

On 1st September, 1901, Mr. J. M. Hayman, Deputy Director of Agriculture, North-Western Provinces and Oudh, forwarded some caterpillars in spirit attacking cotton at the experimental station, Cawnpore. He also sent some stems of the plant in spirit, they being completely bored out leaving only the bark. On the 21st idem he sent two moths, which proved to be *E. fabia*; these were from the first generation. He found the second generation of the caterpillars in the young flower buds of the cotton before opening, and they eat the inside completely leaving only a shell. He noted that the pupal stage was about ten days.

Without knowing the complete life history of this new pest to cotton it is difficult to suggest a remedy. It is probable, however, that if the young plants were sprayed with a solution of Paris Green, the young larvæ would be killed before they bored into the young stems and shoots of the cotton plants in the first generation, and into the flower buds in the second generation. Further reference to this insect will be found on page 131, under *Hibiscus esculentus*, Linn., the Bhindi or Lady's Fingers

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IX.—INSECT PESTS OF OPIUM.

On ***Papaver somniferum***, Linn., Natural order ***Papa veraceæ***, the opium or white poppy.

1. *Agrotis ypsilon*, Rott. Family *Noctuidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*. Plate xii, Fig. 3, *imago natural size*.

In February, 1901, Mr. John Christian, Sub-Deputy Opium Agent, Shahabad, sent to the Indian Museum some nearly full-grown caterpillars of a moth said to be " Doing great damage to the poppy crop in particular localities in the Shahabad district." He noted that "these insects appear chiefly at night, and eat up the plant from the stem. But the peculiarity in this instance is that a field of fine poppy has been completely destroyed, while an adjacent field, lying next to it, has been almost untouched. This would seem to point to some peculiarity in the latter field which rendered it immune from the attacks of these pests. I need hardly say if you could kindly suggest some means of destroying these pests or preventing their destruction of the plants, even to a certain extent, you would be conferring an inestimable boon to the poor opium cultivators, and doing a real service to the Opium Department."

As regards "the peculiarity" mentioned above, it seems probable that the pest is a new one in the district, and that one or more female moths have laid their eggs in one field and not in another. If the pest becomes common, it is almost certain that every field in the district will become affected. An effort should be made to exterminate the insect on its first appearance. Hand-picking, especially at night when the larvæ are feeding, is the most obvious and certain remedy, and if the pest is purely local, could easily be done. The larvæ, like that of all "cut-worms", feeds mostly at night; by day it hides away amongst the roots of the plants on which it feeds, and even just below the surface of the ground. Thoroughly ploughing and breaking up the ground after the crop is gathered, would destroy any pupæ that may be in the ground, as all *noctues* larvæ pupate below the surface of the earth. Chemical insecticides might be applied to the growing crops with excellent effect where the damage done is great, but the cost of the materials (the chemicals and the necessary apparatus for thorough spraying), would probably be too costly for the cultivators.

The caterpillars sent were received on February 6th, pupated on the 9th, and emerged between the 25th and 27th. The moth is almost universally distributed, being found everywhere except in South America. On the upper side of the front wings it is umber-brown, with narrow black markings; the hind wings are white with dark veins and a suffused dark margin. The under side of all the wings are practically unmarked, the front wings are dark silvery, the hind wings pure silvery and very shining. The moth, under its synonymic name *Agrotis suffusa*, Fabricius, is referred to in every volume of "Indian Museum Notes," and in vol iii, n. 4, p. 25, the larva and imago is figured.

X.—INSECT PESTS OF TEA.

On ***Camellia theifera*** Griff., Natural order ***Ternstrœmiaceæ***.
The tea plant.

1. *Diapromorpha melanopus*, Lacord. Family *Chrysomelidæ*. Order *Coleoptera*. The Orange Beetle.

In June, 1900, the Manager of the Baraoora (Sylhet) Tea Co., Ltd., forwarded some specimens of the "Orange Beetle," *Diapromorpha melanopus*, Lacord, which was "Doing considerable damage to the young shoots of our tea bushes." Writing at a later date in the same month he stated that "As many as from 25,000 to 30,000 Orange Beetles have been daily destroyed. "This pest" he notes "does not appear to have shown itself to any noticeable extent before in South Sylhet, and it would be interesting to learn, if possible, why it should have appeared in myriads this year." It is figured in "Indian Museum Notes," vol. iii, n. 4, p. 7 (1896).

2. *Biston suppressaria*, Guenée. Family *Geometridæ*. Suborder *Phalænæ*. Order *Lepidoptera*. Plate xiii; Figs. 10 *b*, *pupa ventral view*; 10 *c*, *pupa lateral view*; 10, *imago male*; 10 *a larva, lateral view*.

On 31st January, 1901, Mr. K. D. Murray, Manager of the Lankapara Tea Co., Ltd., Duars, forwarded a large number of pupæ of a moth, which he says resulted from a hairless stick-like larva of a greyish-brown colour very similar in appearance to the bark of the branches of the tea bush, which did great damage in certain places to the tea on his estate during the rainy season—August to October 1900. During the month of January, 1901, deep hoeing was commenced, and large numbers of the chrysalises were found in the cultivation, especially in places where the caterpillars were previously most numerous, and he noted that these pupæ are probably those of the caterpillars mentioned above.

The pupæ were placed in a breeding cage on jute and damped every other day. At the end of February and early in March the moths emerged at irregular intervals and were found to be *Biston suppressaria*, Guenée. The moth has been recorded from the Kangra Valley, Sikkim, Assam, Calcutta, Ceylon and Japan. This insect has not previously been reported to do damage to tea, and is not likely to prove a serious pest. The only remedy for it would appear to be to employ children to hand-pick and kill all the larvæ they can find during the season they are feeding, and in the winter when cultivation is going on to thoroughly dig up the ground where the caterpillar was previously known to do much damage, and to thoroughly break up the soil, and crush all the pupæ that may be observed. One pupa killed in the winter would probably, if left to come to perfection, be the parent of hundreds of larvæ the next rainy season. The moth would appear to be single brooded laying its eggs in the spring, which emerge in the rains. The moth may, however, be double-brooded, but this can only be known by studying its life-history throughout the year. This may be the species referred to in "Indian Museum Notes," vol. v, p. 51 (1900), as doing much damage to tea during the rains, appearing in millions and denuding acres of tea bushes of all their leaves. The locality is not stated where the injury occurred.

On June 3rd, 1901, Mr. K. D. Murray sent a large number of full-grown caterpillars of what is probably this species to the Museum. Total length over two inches. Cylindrical, colour dark brown, exactly the colour of the weathered bark of a tree, sometimes with a greenish shade; the whole surface highly rugose, each segment deeply seamed; the head cleft covered with low shining tubercles reminding one much of those on a lizard; the first abdominal segment bears two obtuse tubercles anteriorly; the rest of the body is practically unmarked. The larva has a most offensive smell, so much so that it would probably be nauseous to birds. It spins a good deal of very strong silk, by which it drops at slight provocation to the ground

Mr. Murray writes that the caterpillar reappeared on a portion of the Lankapara tea garden early in May, the larva being then very small; he describes them as "mere threads," when they were very difficult to find, but they developed very rapidly, and by the first week in June were full-fed. They have affected the upper end of the garden only. Children were largely employed hand-picking the larvæ. It was at the lower end of the garden that such large numbers of the pupæ were destroyed in the spring, and Mr. Murray hopes that the caterpillars will not appear there later on. The moth is evidently double-brooded in the Duars, the caterpillars being found in May and June, and again in the autumn.

3. *Capua coffearia*, Nietner. Family *Tortricidæ*. Sub-order *Phalænæ*. Order *Lepidoptera*.

Mr. E. Ernest Green in a letter dated 10th June, 1901, writes:—

"I enclose some remarks on the synonymy of *Capua coffearia*, Nietner, of which you may be able to make some use. You will find references to the destructiveness of the insect in my Circular, Series I, No. 19, September 1900, 'Some Caterpillar Pests of the Tea Plant,' pp 239-265."

The remarks referred to above consist of some MS. Notes by Mr. J. H. Durrant, who writes:—

"In 1890 Mr. E. C. Cotes of the Indian Museum, Calcutta, submitted to me a dark female of *C. coffearia*, Nietner. I returned it to him as *Capua menciana*, Walker. I now consider this identification erroneous, and should regard it as a dark variety of *Homona fasciculana*, Walker. *Capua menciana* occurs in Japan, Shanghai, Sikkim, the Khasias, Assam, Borneo, Pulo Laut Island, Celebes, Portuguese Timor, and Batchian, *vide* Walsingham, Ann. and Mag. of Nat. Hist., seventh series, vol. v, pp. 482, 483 (1900); but I have not yet seen a specimen of this species from Ceylon. I named your [Green's] specimens referred to in your "Insect Pests of the Tea Plant," pp. 89-93, figs. 17 *a—e* (1890), *Homona fasciculana*, Walker. Lord Walsingham and I are agreed that *Tortrix coffearia*, Nietner=*Homona fasciculana*, Walker. The synonymy will therefore be as below:—

Group TINEINA.

Family TORTRICIDÆ.

Genus *Capua*, Stephens.

Capua, Stephens, Ill. Brit. Ent., Hanst., vol. iv, p. 171 (1834).
Homona, Walker, Cat. Lep. Ins. B. M. vol. xxviii, p. 424 (1863).
Godana, Walker, Cat. Lep. Ins. B. M., vol. xxxv, p. 1800 (1866).

751(4). *Capua coffearia*, Nietner (n. syn.=*fasciculana*, Walker; =*sp.*, Green; =*menciana*, Cotes (*nec* Walker).

Tortrix coffearia, Nietner, Obs. Enemies Coffee-tree, Ceylon, pp. 4, 24, n. 19 (1861)[1]; *Homona fasciculana*, Walker, Cat. Lep. Ins. British Museum, vol.

xxviii, p. 424, n. 1 (1863)[2]; *Tortrix coffearia*, Guenée, Rev. de Zool., second series, vol. xvi, p. 61, n. 20 (1864)[3]; Nietner, Obs. Enemies Coffee-tree, Ceylon (2nd edn.), pp. 4, 17, n. 19 (1872)[4]; idem, Green's 3rd edn., pp. 4, 16, n. 19 (1880)[5]; Moore, Lep. Cey., vol. iii, p. 494 (1887)[6]; *Homona fasciculana*, Moore, Lep. Cey., vol. iii, p. 496 (1887)[7]; *Tortrix coffearia*, Cotes and Swinhoe, Cat. Moths India, p. 696, n. 4747 (1889)[8]; *Homona fasciculana*, Cotes and Swinhoe, Cat. Moths India, p. 700, n. 4774 (1889)[9]; *Cacoecia* sp., Green, Ins. Pests Tea Plant, pp. 89-93, figs. 17*a*—*e* (1890)[10]; *Pandemis menciana*, Cotes, Ind. Mus. Notes, vol. ii, n. 6, p. 163, n. 146 (1893)[11]; *Tortrix coffearia*, Cotes, Ind. Mus. Notes, vol. ii, n. 6, p. 163, n. 147 (1893)[12]; *Capua fasciculana* Walsingham and Durrant, Cat. East. and Aus. Lep. Het. Oxford Un. Mus., vol. ii, p. 575, n. 3690 (1900)[13].

TYPES: ♂ ♀. *coffearia*, Nietner, ♀. Mus [—?—]; *fasciculana*, Walker, ♂. Mus. Br.

HABITAT: CEYLON [1-13]—Dickaya [10] II *(Green)*; Peradeniya *(Thwaites, Green)*; Pundalaya, II, XII (Green); Nawalapitiya (*Pole*); Kandy (*Green*).

LARVA: *Coffea arabica*[13], Coffee [1,4—6]; garden plants ([1,4—6]); *Camellia theifera*[11], Tea[10].

The above synonymy is abstracted by Mr. Durrant from his and Lord Walsingham's forthcoming index of the *Tineina*.

The only references to this insect in "Indian Museum Notes" are Nos. 10 and 11 of the synonymy given above. Both the species mentioned should be known as *Capua coffearia*, Nietner. A good description of this insect and the damage done by it to the tea-plant will be found in Mr. E. Ernest Green's Circular, Series I, No. 19, "Some Caterpillar Pests of the Tea Plant," pp. 244-274, nn. 1 and 2 (1900).

4. *Acanthopsyche* (*Pteroma*) *plagiophleps*, Hampson. Family *Psychidæ*. Suborder *Phalænæ*. Order *Lepidoptera*.

Pteroma plagiophleps, Hampson, Ill. Lep. Het. B. M. vol, ix, p. 6, n. 122, p. 65, pl. clix, fig. 19, *male; 19a, neuration of male*; pl. clxxvi, fig. 13 *puparium of male showing projecting pupa-case after the moth has emerged* (1893); *Acanthopsyche* (*Pteroma*) *plagiophleps*, Hampson, Fauna Brit. Ind., Moths vol. i, p. 296, n. 628 (1892).

This moth has hitherto only been known from Nawala-pittia, Ceylon. Hampson describes the male as "uniform pale brown; the under side of the hind wing bluish-white. Larva-case suspended by a long silken thread; both case and thread covered with comminuted fragments of leaves. Expanse: 16 millim." (·6 of an inch). Mr. G. C. Dudgeon, Manager of the Holta Tea Co., Kangra Valley, Punjab, furnishes the following notes on the insect:—

"This bag-worm occurs commonly on tea in the Kangra Valley, doing some damage to isolated bushes but not appearing to spread to any great extent. The larva feeds on the old leaves, seeming to eat the under surface only. The case is formed of minute particles of leaf attached to the outer surface of the silk cocoon. When about to pupate the case is suspended by a white thread from a half to one and-a-half times the length of the cocoon itself; this thread has a few particles of dried leaf usually attached along it. The moths emerge in August and September, and probably at other times during the year. The female is a whitish insect without any scale-covering, having the head-end produced to a slight hook, the scutellate segments being shiny dark brown. The male has the wings entirely sooty-black on the upper side, but with the under side of the hind wing milky-white, with the exception of a dark band along the costa: the abdomen is slight, and the wings rather rounded. The female lays her eggs in the cocoon, from which the young larvæ ultimately construct their first cases."

XI.—INSECT IN CALCUTTA MUNICIPAL WATER.

Chironomus cubiculorum, Doleschall. Family *Chironomidæ*. Order *Diptera*. Plate xv, Figs. 5 *b*, *larva*; 5 *c*, *pupa*; 5, *male imago*; 5 *a*, *female imago*.

In December, 1900, the health authorities of Calcutta forwarded large numbers of the larva of a dipterous insect, which they reported were causing them some uneasiness as the larvæ existed in countless swarms in the filtering beds of the Calcutta water-supply. They proved on examination to be the larvæ of a species of midge (Family *Chironomidæ*). They were reared, and as the Museum possessed no examples of this family, the insects were forwarded to Mr. D. W. Coquillett, who identified them as *Chironomus cubiculorum*, Doleschall.

As but little is known regarding this family in India, possibly due to their being usually taken for mosquitos, to which they are very similar, a short description of the larva and its habits may be of value.

The larvæ of the *Chironomidæ*, unlike those of the *Culicidæ*, are not always found in water, but when they are, they can be distinguished from the larvæ of mosquitos by their worm-like appearance, the thorax not being conspicuous as in mosquito larvæ; besides which they are not provided with the hairs with which the mosquito larvæ are somewhat plentifully clothed. The larvæ of many species, as in this instance, are red in colour, hence their popular name of "blood worms," this colour, it being of interest to note, being produced by the presence of hæmoglobin, which is present in those species which have their tracheal system rudimentary. The oxygen required for breathing being obtained in these species through the hæmoglobin, which possesses the power of assimilating oxygen. The adults are exceedingly mosquito-like in appearance, and in some species the similarity is carried still further by the blood-sucking proclivities of the females. Midges differ, however, from true mosquitos in having the veins of the wings unprovided with scales.

In the species *Chironomus cubiculorum,* Doleschall, the larvæ attach themselves by the extremity of the abdomen, apparently by means of the hooklets on their anal pair of legs to the débris in which they lie. Thus attached, the anterior portion of the body is moved sideways or up and down in a wavy snake-like motion. Others, though rarely, do not attach themselves to any foreign substance, but half creep, half swim about the bottom aided by their anterior appendages which apparently act as paddles. They also swim advancing sideways through the water by means of a rapid figure-of-eight motion. Before pupating the larvæ construct loose fluffy tubes of rubbish in which they lie.

LARVA: Length, full grown, 8 mm. Colour semi-transparent red, darkest along the back.

ADULT INSECT: Length, 4½ mm. In life the colour is light green On the back of the thorax there are three longitudinal brown bands; one central and extending from the anterior end to the middle of the thorax, broad, and under a lens, apparent as two bands divided by a suture; two bands extending from a little above the posterior end of the central band to the posterior end of the thorax; under surface of thorax light brown; last two segments of the abdomen blackish. Eyes black. Anterior pair of legs light fuscous, the posterior and middle pairs with tarsus and lower half of tibia fuscous, the rest green.

The following is the original description of the species by Doleschall:—

Eerste bildrage tot de Kennis der Dipterologische fauna van Nederlandesche Inde. Door C. L. Doleschall.

"*Chironomus cubiculorum*, n. sp."

"*Chiron.* lacte viridis; thorace antice gibbosissimo, dorso maculis 3 rufis metathoraceque rufis, femoribus tibiisque viridibus, tarsis pallide flavis, articulationibus nigris, oculis nigris, antennis pilosis simis. Longit. 1⅓ mm. Habit. Javan, in cubiculis, sat copiosus empore pluviarum (Ambarawa)." Published on page 405 of Naturkundig-Tijdschrift voor Nederlandsch Indie. Dul X. Batavia, 1856. Figured on Tab. v, fig. 2.

Although this description is rather meagre, the insect is easily identified by comparison with the excellent figure given. In our examples there are only traces of brown on the joints of the legs and not black; this, however, is no great difference. In our figure, plate XV fig. 5, the insect is shown at a slight angle and gives one a false idea as to the width of the head, it being all but as broad as the thorax.

Plate xv. Figs. 5, 5 *a*, 5 *b* and 5 *c* show the larvæ, pupa, male and female perfect insects all much enlarged.

In Colombo, Ceylon; a species of *Chironomus*, inhabiting the lake in the city, has in the perfect state constituted itself a nuisance. Its life history has been studied and remedies proposed for its destruction by Mr. E. Ernest Green, Government Entomologist, Ceylon, and Dr. Albert J. Chalmers, M.D., F.R.C.S., who has done excellent work on the mosquito malaria question in West Africa. Their reports on the subject were printed in the *Times of Ceylon* on August 16th and 28th, 1901, respectively. These reports being highly interesting are reproduced below.

THE COLOMBO LAKE FLY NUISANCE.

REPORT OF THE SPECIAL GOVERNMENT ENTOMOLOGIST.

My visit to Colombo extended from Tuesday, July 30th, to Friday, August 2nd, during which time I studied the life history of the "Lake Fly" and made the following observations:—

The insect proves to be a species of *Chironomus*, one of the aquatic flies, the early stages being passed in the water of the Colombo Lake.

The eggs of the insect are embedded in irregular masses of jelly, looking like miniature masses of frog-spawn. The ova are arranged in this gelatinous mass in transverse rows, or rather, in one continuous string which traverses the mass, looped transversely from side to side. An average-sized egg-mass may contain over 1,000 individual eggs, produced—presumably—by a single fly. I found these egg-masses, in large quantities, attached to floating sticks and rubbish and to the stems of herbage growing in the water at the edge of the lake and on the margins of the small islands. The most favourite situation appeared to be upon floating or partly submerged sticks and branches. This is probably due to the fact that such objects afford a firmer support to the fly when ovipositing. The eggs may also be attached to wooden piles or masonry rising out of the water.

The larvæ resulting from these eggs sink to the bottom of the lake and burrow into the oozy mud, forming therefrom rope-like tubes composed of particles of earth and vegetable matter. I found the whole surface of the mud, near the margins of the lake, completely covered with a tangled mass of these tubules each containing a small vermiform larva of *Chironomus*. It would be impossible to estimate the number of larvæ living at one time in the lake. But from about three cubic inches of the mud, I extracted more than 200 larvæ. The fully grown larva is about $\frac{5}{8}$ths of an inch long and of a bright red colour. It is worm-like in appearance, but has some short appendages at both the anterior and posterior extremities. Some of the latter act as gills, permitting oxygenation of the blood while the insect remains submerged. The larva feeds upon decaying organic matter and completes this stage of its existence in the mud.

The pupal stage is also passed in the same situation until immediately before the emergence of the fly, when air forms inside the pupa, causing it to rise to the surface. The pupa is elongate and narrow, about $\frac{3}{8}$ths of an inch in length, tapering behind and somewhat swollen in front. At the anterior extremity is a thick tuft of respiratory filaments performing the office of gills. Just before emergence the pupa rises to the surface of the water, the skin splits, and the fly is liberated.

The adult fly is a small gnat-like insect of about the size of a common mosquito but of a rather more slender build. It may be distinguished from the mosquito by the absence of prominent beak-like mouth-parts. The species in question is of a dull brownish colour, the thorax longitudinally and the abdomen transversely banded with grey. The wings are transparent and marked with a few brownish specks. The sexes may be distinguished by the presence in the male insect of a pair of densely plumose antennæ, while those of the female are small and inconspicuous. The body of the male is slender and measures a little less than $\frac{1}{4}$ inch. The female is stouter, but scarcely more than $\frac{1}{8}$th of an inch in length.

I was unable, during my short visit, to determine the exact time at which the emergence of the flies takes place. I watched the lake carefully from 4 P.M. till 7 P.M. but, though a few individual flies were seen leaving the water, no general ascent of pupæ and liberation of flies was observed. At about 6 P.M. I saw myriads of the flies resting in the grass and rank herbage on Dhobies' Island. It is possible that they may be hatched out during the night or in the early hour of the morning, and that they rest during the day, preparatory to their evening flight. The flies were also observed, comparatively early in the afternoon, resting on the whitewashed walls of buildings near the lake, and sheltering amongst the plants in the garden of the Royal College. These were the insects that had been attracted by the bungalow lights on the previous evening, a fact that indicates that the flies are not ephemeral but live for more than one day. Several small clouds of the flies were noticed outside the Pettah Station, but I was informed that they had not been so troublesome during the last few days. During the south west monsoon the flies are carried by the prevailing wind to the north and north-eastern shores of the lake, involving the Fort and the Pettah in the nuisance; while the Colpetty and Slave Island bungalows are affected during the prevalence of the north-east winds. All stages and ages of the insects were observed to be present at the same time. There is apparently a constant succession of broods throughout the year.

SUGGESTIONS FOR REMEDIAL MEASURES.

In dealing with this pest we are fortunate in having a nearly complete knowledge of the life history of the insect, and it will be possible to attack it at each of the principal stages of its existence.

The eggs, as noticed above, are laid in the water, anchored to some solid substances which will retain them at the surface, ensuring them the amount of light and air necessary for their development. As this part of the lake is kept free from floating weeds by a system of contracts, it follows that the deposition of the eggs must be confined to the margins of the water. The removal and destruction of all floating rubbish and herbage growing in the water at the margins of the lake will ensure the destruction of an enormous number of eggs. This will not prevent the subsequent deposition of fresh batches of eggs on the banks. But from my observation that floating sticks form a favourite point of attachment for the egg-masses, I think it would be possible to trap the bulk of the eggs by laying down, in the water along the margins, bamboos lightly covered with brushwood. The eggs would be deposited on these during the night. The following morning the bamboos should be lifted out and left on the bank to dry. The heat and drying action of the sun would kill any eggs deposited on these traps. The bamboos would be returned to the water each afternoon at about 5 o'clock. To reduce the available breeding places, the smaller unoccupied islets might be removed.

The larvæ, living on the surface of the mud and being independent of gaseous air, would be unaffected by any application of kerosene to the surface of the water. The restriction of the eggs to the margins of the lake fixes a limit to the feeding grounds of the larva.

It is improbable that they would wander very far from their native spot. A zone of some ten yards from the bank, all round the lake, would practically cover the sphere of action of the larva. The removal of the mud, to a depth of only six inches, along this marginal zone, will effectually destroy the myriads of larva now breeding there, A shallow dredging, repeated twice or thrice during the year, will be much more effective than deeper dredging at longer intervals. It will be necessary to remove the oozy surface mud only. The larvæ will not thrive in the firmer gravelly or sandy mud. The insects inhabiting, as they do, merely the surface layer of the mud, it may be necessary to contrive some modification of the ordinary method of dredging, to prevent the dispersal of this superficial layer during the operation. Possibly some form of hand dredging might be employed. I am confident that a judicious system of dredging, on the lines here suggested, will practically remove the nuisance or, at any rate, very greatly mitigate it.

The greater number of the pupæ would be destroyed by the same measures that have been suggested for the removal of the larvæ. But in this stage the insect is also vulnerable at a different point, namely, at the time when it rises to the surface of the water preparatory to the liberation of the fly. A film of kerosene on the water at this time would kill any of the pupæ with which it came in contact, and would certainly prevent the successful emergence of any flies. If it is decided to give this plan a trial, the application should be made in the evening, shortly before dusk. The simplest and most effective way of applying the oil would be by trailing a rope, covered with rags or tow soaked in kerosene, along the surface: the ends of the rope being attached to two boats which would be rowed along the margins of the lake at a suitable distance from each other. The rope should be periodically recharged with oil.

The adult flies are notoriously attracted by light, and might, perhaps, be trapped by bonfires or lighted chulahs placed along the edge of the lake. But I am of opinion that this measure would not really repay the cost. An enormous number of flies might, however, be slaughtered on Dhobies' Island and at other places where they are known to rest during the day, by spraying the grass with a mixture of kerosene and water.

I am most sanguine of profitable results from the employment of the system of dredging suggested above.

E. Ernest Green,
Government Entomologist.

Royal Botanic Gardens, Peradeniya,
ugust 10th, 1901.

THE LAKE FLIES OF COLOMBO.

DR. ALBERT J. CHALMERS'S REPORT.

The following report by Dr. Chalmers, forwarded to the Mayor by Dr. Perry, P.C.M.O., has been printed and circulated:—

1. INTRODUCTORY.

By the orders of Dr. Perry, the Principal Civil Medical Officer, his investigation has been undertaken.

I understand that Mr. Green, who is a most distinguished Entomologist, has been asked by the Municipal Council to give a report.

I therefore feel some diffidence in offering my report.

I, however, thought that perhaps the Municipal Council desired two quite separate and independent reports: one an expert report from an Entomologist, and the other an ordinary report from a person who is not an expert in such matters. Therefore in accordance to orders received I beg to submit this short account.

I would, however, beg that it might be considered merely in the light as a very secondary report, and that its imperfections, which are many, may be excused, as I have had very little time either to make a study of entomology or to write this report. As few scientific terms as possible are used in this report.

I have to express my thanks to Dr. Perry, Principal Civil Medical Officer, for his kindness in looking over my specimens and in giving me certain very valuable assistance, especially with regard to the methods to be adopted to diminish the numbers of these flies.

I have also to express my gratitude to Drs. Griffin and Fernando for many kind suggestions.

I have to thank Mr. De Silva, the Assistant in Pathology in the Ceylon Medical College, for several photographs taken from my specimens.

2. THE LIFE HISTORY OF THE LAKE FLY.

The lake fly belongs to a family of the *Diptera*, or two-winged insects, called *Chironomidæ*, and to the genus *Chironomus*, but I have no means at my disposal to determine the species.

The fly lays its eggs in jelly or mucous masses attached to water-weeds and brick walls just at the water line. The eggs may be found attached to almost anything which is stationary in the water. I have not found any on the slag or waste from the Engine Yards.

In Figure I is seen a typical arrangement, *viz.*, a little bolster-shaped mass of mucous in which the eggs appear to the naked eye like little brown specks arranged in rings. About 20 eggs form one ring, and as there are about 20 (estimated) of these rings, there will be quite 400 eggs in one bolster. The part of the bolster which is attached to the wall or weed is clear and contains no eggs.

In specimens taken from the Norris Canal near the Principal Civil Medical Officer's Office and, in fact, near any road, the mucous is quite brown from the dust of the road.

When a single egg is examined under a lower power of the microscope, it is seen to be enclosed in a transparent chitinous shell through which the development of the larva can be watched.

A late stage of embryonic development is seen in Figure II (a camera lucida drawing) where the eye spot and segments of the future larvæ can be distinctly seen.

About 36 hours or more after deposition the eggs hatch and produce larvæ.

This is brought about by the embryo making a rupture in the chitinous shell and then wriggling its way out. Eggs, differently magnified, showing the rupture, are to be seen in Figures III and IV, both of which are camera lucida drawings.

In Figure V a larva, half inside and half outside its shell, can be seen. This figure is a microphotograph, and shows the character of the burst shell, the larva, and the masses of *algæ*, dirt, etc., in the water in which the new-born larva is about to live.

In the embryonic and the early larval stage these flies seem to suffer much from the attacks of the larvæ of other insects.

The larvæ are free-swimming, very active, and very voracious. They rapidly grow in size, and in a few days appear much larger and of a distinct bright red colour.

On examining them under the microscope the red colour is found to exist in little vessels, and, when examined by means of the spectroscope, shows two absorption bands in exactly the same position as those produced by the red colouring matter of human arterial blood and which is called Oxyhæmoglobin.

By means of this Oxyhæmoglobin the larva is able to make use of the air dissolved in water, and is therefore not compelled to be constantly coming up to the surface of the water to breathe like the larvæ of Mosquitoes.

As a consequence of this it is able to live in the mud at the bottom of shallow parts of the lake or, if there is not natural mud present, to live in little mud cases which it makes out of any débris which may exist in the vessel in which it is being reared.

The larvæ now increase enormously in size, *vide* Figure VI. which is a photograph of a larva in this red stage.

Some days later the larvæ become pupæ. These pupæ are of a dark red colour, and breathe by means of white hair-like processes, which are to be seen in the head-area. Figure VII is a photograph of a pupa, but unfortunately does not show these white processes.

Inside the pupæ can be seen the insect more or less developed.

The insect now ruptures the skin of the pupa and escapes.

The empty pupal skins can be seen in the early evening floating on the surface of the lake.

Figure VIII shows a photograph of the male and female insects.

The male has a long slender abdomen and the female a shorter thicker one. The lowest figure is an insect in the act of escaping from a pupa.

During the day-time the adult insect appears to frequent shady posts such as under bridges, the shade of the grass, weeds, shrubs, etc.

At dusk, as is only too well-known, they fly about in the air.

Figure IX shows the cage in which the eggs and larvæ were reared, the drawer being the portion which contains the water with the larvæ, eggs, and plants. The can attached to the stick was used for collecting eggs and for obtaining larvæ from the mud, etc.

3. THE HAUNTS OF THE FLY.

I have spent several hours investigating the haunts of the fly, and find that it lays its eggs in jelly-like masses attached to the leaves or stems of plants growing out of the waters of the lake just at the water line. Also to the brick walls of bridges and to the brick facings of the banks of the lake just at the water line.

If attention be now turned to the map of the lake, this will be seen to be marked with red crosses, and these indicate where I have been able to find the eggs of the fly.

A list of the places is as follows :—

The banks of Rifle Green.

The mud island close by.

The margins of the Galle Face portion of the Lake.

The bank of the Military Hospital.

The Galle Face bridge (most marked).

The Hunupitiya beach opposite the Public Hall.

The stream by the Dhobie lines in Polwatta (most marked).

The bank near the Fort Station.
The bank near the Government Store, Beira.
Dhobies' Island.
Banks near the Station.
Banks near the Norris Canal.
The banks of Captains Garden.
The banks of St. Joseph's College.
The banks of the Police Quarters.

Figure X shows the appearance of the lake close to the Government Store, Beira, and which was not merely a home for the eggs but which smelt very badly indeed.

Figure XI shows Dhobies' island, the banks of which and of the neighbouring mud-banks produce weeds on which the eggs were easily found. Portions of the water of Dhobies' island, particularly near the large clump of trees just seen in the photograph, were bad smelling.

Figure XII shows the bridge and the wall of the bank in the neighbourhood of the Norris Canal, where eggs were found. The Canal itself contains a large quantity of weeds, but the boat was not able to proceed far enough up the entry of the Canal for me to make the necessary observations; but judging from the stream at Polwatte, I consider this a very likely place for eggs, larvæ, etc.

Figure XIII shows the bank near St. Joseph's College where eggs were found.

The above photographs depict typical spots, both clean and dirty, where the larvæ were found attached to weeds growing out of the water, and to the brick walls.

But the Lake proper is not the only place where the larvæ, etc., are to be found, for the little stream near the Polwatte lines had an abundance of larvæ, pupæ, and flies.

Nor are the flies merely to be found in the waters of streams close to the Lake, for I have found eggs in the uncemented part of Norris Canal, just by the Principal Civil Medical Officer's Office in Borella.

I have not found the eggs in the waters of Victoria park.

Neither did I find any eggs on the slag which is tipped from the Engine Yard into the lake near the Railway Station. This might, however, be because the slag was comparatively fresh.

4. THE PREVENTION.

Every animal when placed in advantageous circumstances grows and flourishes and increases in numbers. In order that a specie may cease to exist in a given place, something adverse must be introduced into some stage of its life history with which it is unable to cope.

These Lake Flies appear to me to be, at present, living under very advantageous circumstances. They have plenty of water in which to lay their eggs and plenty of weeds to attach them to, mud for their larvæ to develop in, and shade for themselves from the heat of the day. There is also plenty of *Algæ, Sperogera, Volvon,* and the like, for the voracious larvæ to live upon. It is true that they have enemies—other larvæ in the egg-stage and worms in the pupal-stage, etc. Nevertheless, these flies grow and increase in numbers, and will, I think, in due time spread to other pools in Colombo.

The question now asked is what can be introduced into their life history so disadvantageous as to diminish their numbers.

The life history of the Fly for practical purposes may be divided into three parts:—

I. The Perfect Insect—Capable of flying in the air and of much movement.

II. The Larvæ and Pupæ—Swimming in the water or living in the mud at the bottom of the stream.

III. The Eggs—Stationary and at the surface of the water.

I. The insect stage.

Many have been the attempts to kill adult mosquitoes on a large scale. They cannot be said to be very successful; and I do not think that any can be applied with success in this case.

II. The larval stage.

The young larvæ are most resistant, and the older larvæ protect themselves by burying in the mud. Kerosene, etc., is quite useless against such larvæ. Some of the younger larvæ lived for hours in kerosene.

I, personally, do not see any easily-applied method of dealing with these larvæ, except one method, which I shall mention below.

III. The egg stage.

This is sedentary and on the surface of the water, and this is the stage at which I propose to attack the insect.

Methods of attacking the eggs.

It appears to me to be necessary for the fly to lay its eggs attached to something which is washed by fresh water. It does not appear very particular as to what that something is, whether, for example it is a piece of weed or a brick wall, so long as it is stationary and will, so to speak, anchor the eggs.

My opinion is that that anchorage must be destroyed.

This can be effected by—

(1) Cleaning the borders of the lake, and removing all the weeds so as to leave clean earth banks.

(2) Dredging away all weeds and low mud banks growing above the surface of the lake.

(3) Scraping along the water line of all brick facings to the lake by means of such a scraper as seen in Figure IX. These scrapings would have to be placed in some metal receptacle and finally emptied upon the earth, preferably into a fire.

(4) The cleansing of stinking bays of the lake like that opposite the Government Store, Beira.

(5) The clearing of the Norris Canal and other such streams.

(6) The cementing of the little section of the Norris Canal just by the Principal Civil Medical Officer's Office. (The eggs were not found in the cemented portion, and it is my belief that these eggs originated by flies brought there by the Electric Tram.)

I would also suggest two experiments.

A.—That the Galle Face Lake bridge be scraped free of eggs along the water line, and then tar be applied just above and below that line, and the result watched.

(The flies might not deposit the eggs on tar.)

B.—That 50 yards of bank be cleaned and then faced with slag from the engine waste mixed with tar, and the result watched.

ESTIMATED COST OF CLEANING THE BANKS.

I estimated the banks of the lake to be 18,000 yards long.

I consider one cooly can cleanse 30 yards in one day. One cooly costs 50 cents per diem.

To cleanse the banks of the lake will require 600 coolies at 50 cents each, *i.e.*, R300, *i.e.*, £20 sterling.

I cannot give an estimate of cleaning the stream leading into the lake nor of lowering the mud banks. The expenses of cleaning the banks of the islands would be proportionate to that for the lake.

The expenses of the two experiments would be trifling.

OTHER METHODS.

A.—Another suggestion has to be considered, *viz.*:—

Whether, by gradually reclaiming the lake by opening the locks, the flies could be diminished.

Certainly, if the lake disappears the flies will disappear in that quarter, but the dhobies would have to be considered, and this alone renders the idea impracticable.

B.—Another suggestion would be to introduce salt water, but this appears to me to be—

1.—Expensive.

2.—Impracticable, because the dhobies' interest in the lake has to be considered.

5. SUMMARY.

My belief is:—

1.—Clean the lake, banks, swamps, etc.

2.—Try the two experiments.

If they are unsuccessful, there is not much lost and the banks must then be periodically cleaned and kept clean.

If they are successful—

(*a*) Tar the water-line of all walls, posts, etc., going into the lake, and let fresh tar be applied periodically.

(*b*) Face the banks of the lake with slag mixed with tar and let this be kept clean.

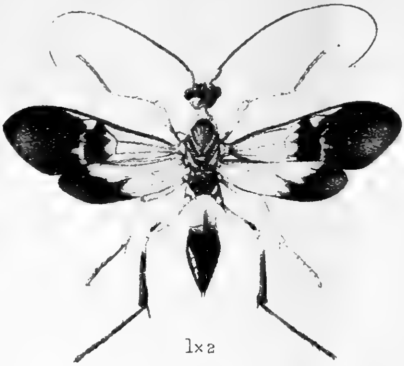
XII.—INSECTS IN FABRICS.

In Blankets.

Setomorpha rutella, Zeller. Family *Tineidæ*. Sub order *Phalænæ*. Order *Lepidoptera*.

In "Indian Museum Notes," vol. ii, n. 1, pp. 9, 10 (1891), the tineid moth *Setomorpha rutella*, Zeller, as identified by Lord Walsingham, was reported to be destructive to bales of country blanketing. Colonel Mackesy, Superintendent and Agent for Army Clothing, Alipore, near Calcutta, on 19th December, 1887, wrote, "I beg to forward a box containing *débris* taken from a bale of country blanketing which was baled up and dammered about two years ago. The blankets are destroyed completely by these insects. It would be impossible to open such bales periodically for brushing and beating." Some of the pupæ sent emerged between December 20th. and 29th, 1887. The moth is referred to again, *l.c.*, p. 164, n. 152 On 25th March, 1901, Mr. J. H. Durrant returned the specimens to the Museum, saying that it was thought that they might=*tineoides*, Walshingham, but they are distinct, and that the identification is confirmed.

G. I. C. P. O.—No. 1574 R. & A.—10-3-1903.—1000.—C. W. M.



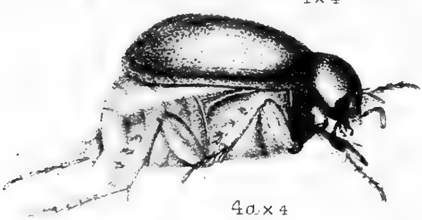
1×2

2 ♀

3 ♂

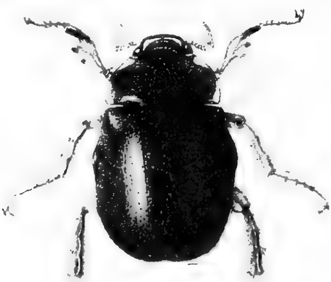
4×4

5×2



4a×4

5a×2



6×2

7

6a×2

7a

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,, 2. BRACON NICEVILLII Bingham Hymenopterous parasite on *Scirpophaga auriflua*, Zeller. 177
,, 3. PIMPLA PREDATOR Fabr., *var.* Do. do. do. 178
,, 4. SERICA (AUTOSERICA) CALCUTTÆ, Brenske, dorsal view × 4 130
,, 4 *a*. Do, do. do. do. lateral do × 4
,, 5. ANOMALA DORSALIS, Fabricius, dorsal view . . . 130
,, 5 *a*. Do. do. do. lateral do. . . .
,, 6. Do. do. do. var. FUSCA, Brenske, dorsal view 130
,, 6 *a*, Do. do. do. var. FUSCA, Brenske, lateral view . . . .
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7 *a*. Do. do. lateral do. . . .

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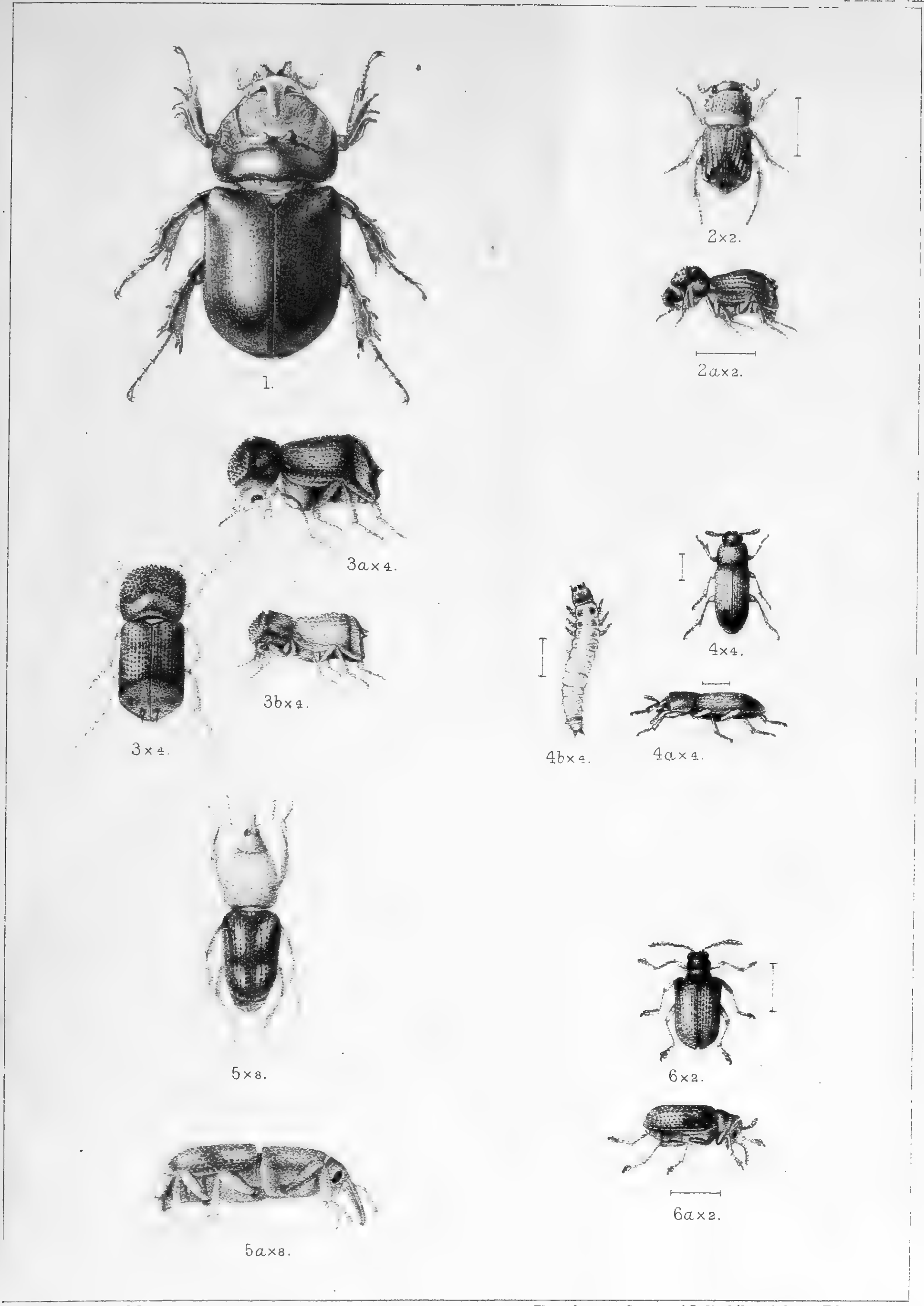
„ 3.	Do prox. basilare, Say., dorsal do. . . .	113
„ 3 *a*. } „ 3 *b*. }	Do do. lateral views . . .	
„ 4.	Tribolium confusum, Jacq. Duv., dorsal view . .	139
„ 4 *a*.	Do. do. do. lateral do. . .	
„ 4 *b*.	Do. do. do. larva . .	
„ 5.	Calandra (Sitophilus) oryzæ, Linnæus, dorsal view × 8	168
„ 5 *a*.	Do. do. do. do. do. lateral view × 8	
„ 6.	Crioceris impressa, Fabricius, dorsal view . . .	134
„ 6 *a*.	Do. do. do. lateral do. . . .	



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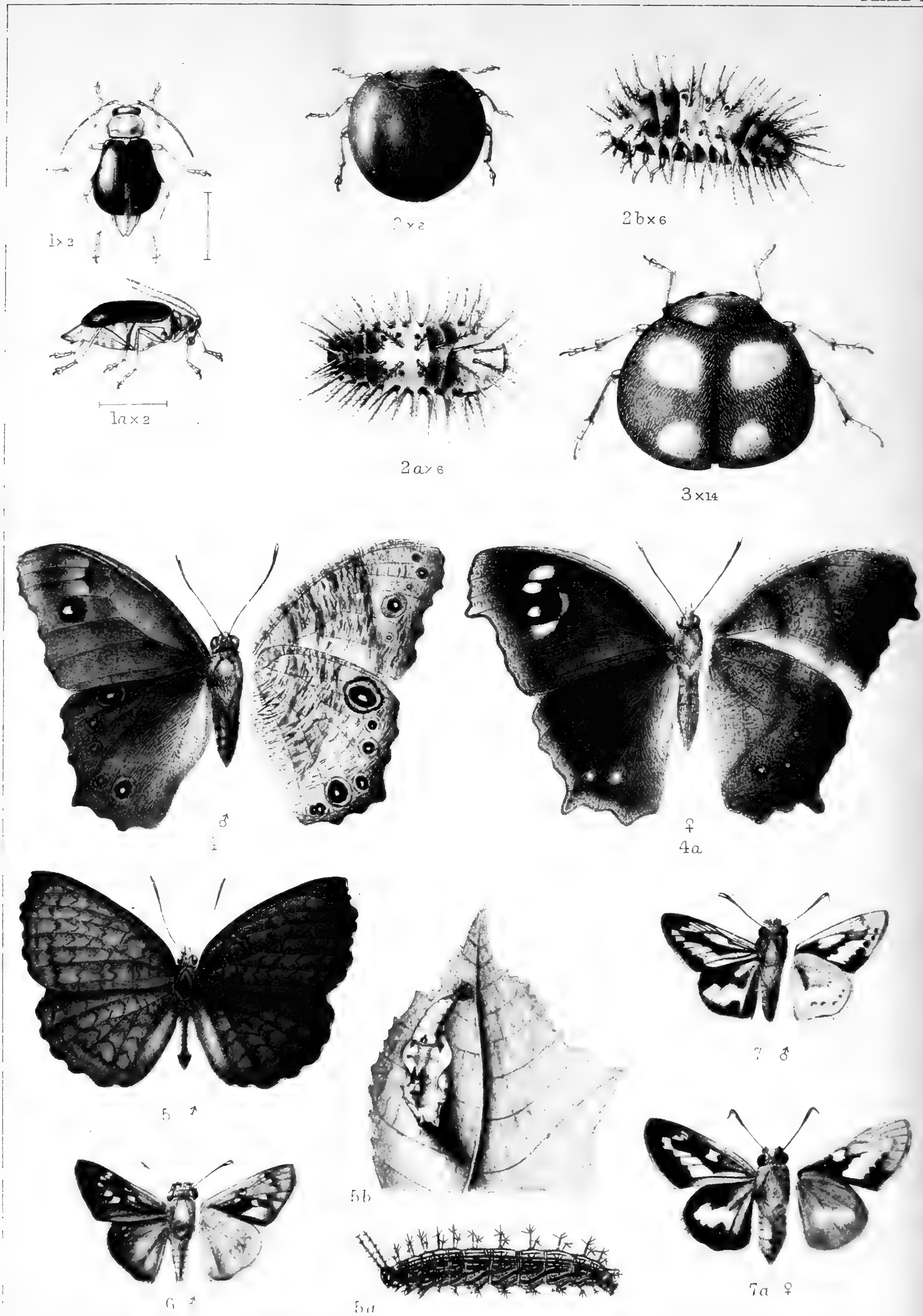

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„ 2.	Chilocorus nigrita, Fabricius, imago	129
„ 2 *a*.	Do. do. do. larva, dorsal view	
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„ 3.	Platynaspis villosa, Mulsant, imago × 14	63
„ 4.	Melanitis ismene, Cramer, ♂	137
„ 4 *a*.	Do. do. do. ♀	
„ 5.	Ergolis merione, Cramer, ♂ imago	135
„ 5 *a*.	Do. do. do. larva, lateral view	
„ 5 *b*.	Do. do. do. pupa, dorsal do.	
„ 6.	Baoris (Chapra) mathias, Fabricius. ♂	137
„ 7.	Padraona palmarum, Moore. ♂	126
„ 7 *a*.	Do. do. do. ♀	

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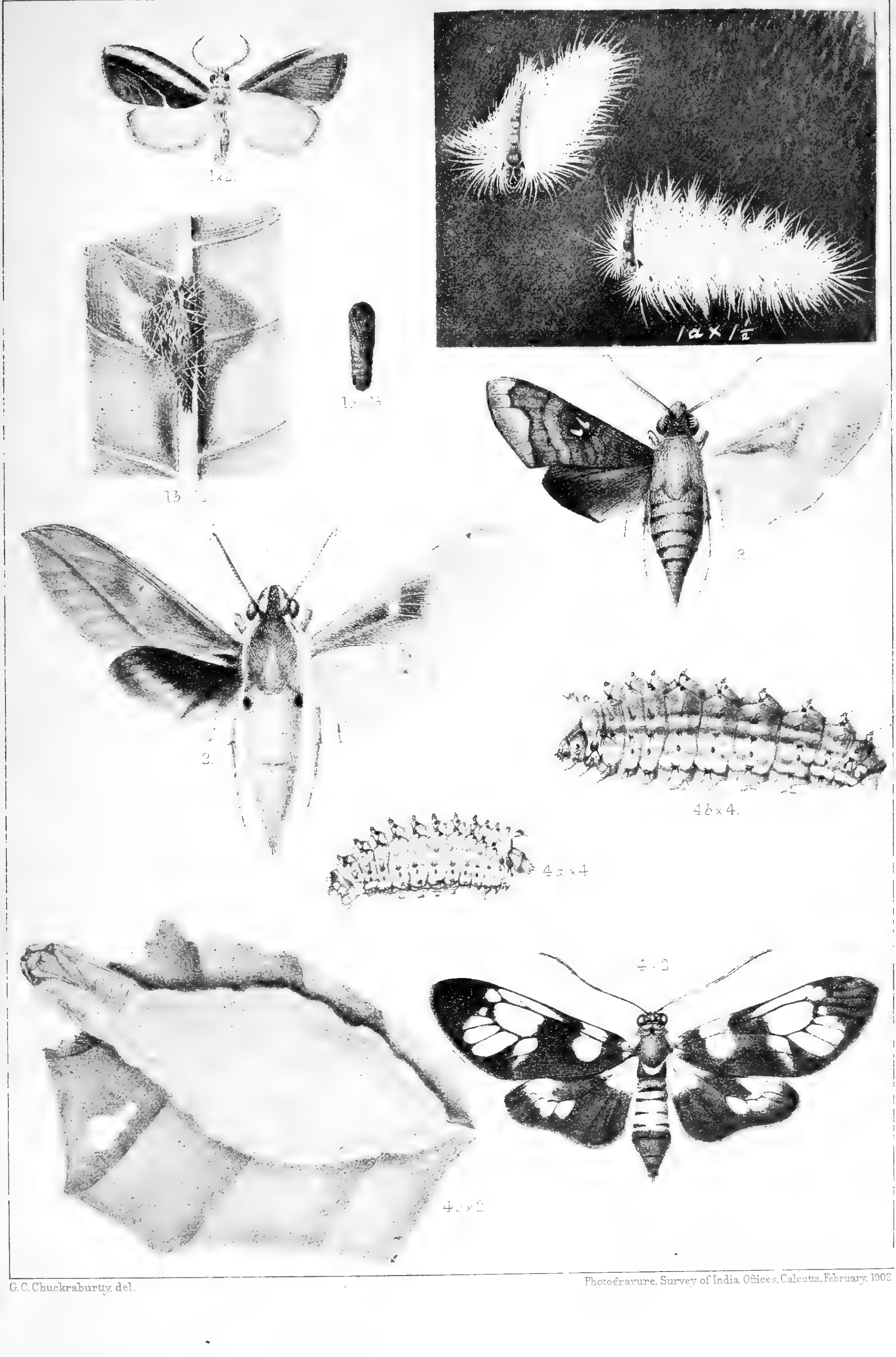
PLATE X—

FIG. 1.	RŒSELIA FOLA, Swinhoe,			♂ imago × 2	109
,, 1 *a*.	Do.	do.	do.	larva front and lateral views × $1\frac{1}{2}$ . . .	
,, 1 *b*.	Do.	do.	do.	cocoon × $1\frac{1}{2}$	
,, 1 *c*.	Do.	do.	do.	pupa × $1\frac{1}{2}$ . . .	
,, 2.	CHÆROCAMPA BUTUS, Cramer			. . . . . .	119
,, 3.	NEPHELE HESPERA, Fabricius			. . . . . .	126
,, 4.	TRYPANOPHORA SEMIHYALINA, Kollar,			♀ imago × 2 .	107
,, 4 *a*.	Do.	do.	do.	young larva × 4	
,, 4 *b*.	Do.	do.	do.	adult larva, × 4	
,, 4 *c*.	Do.	do.	do.	cocoon showing empty pupa-case projecting therefrom . . .	



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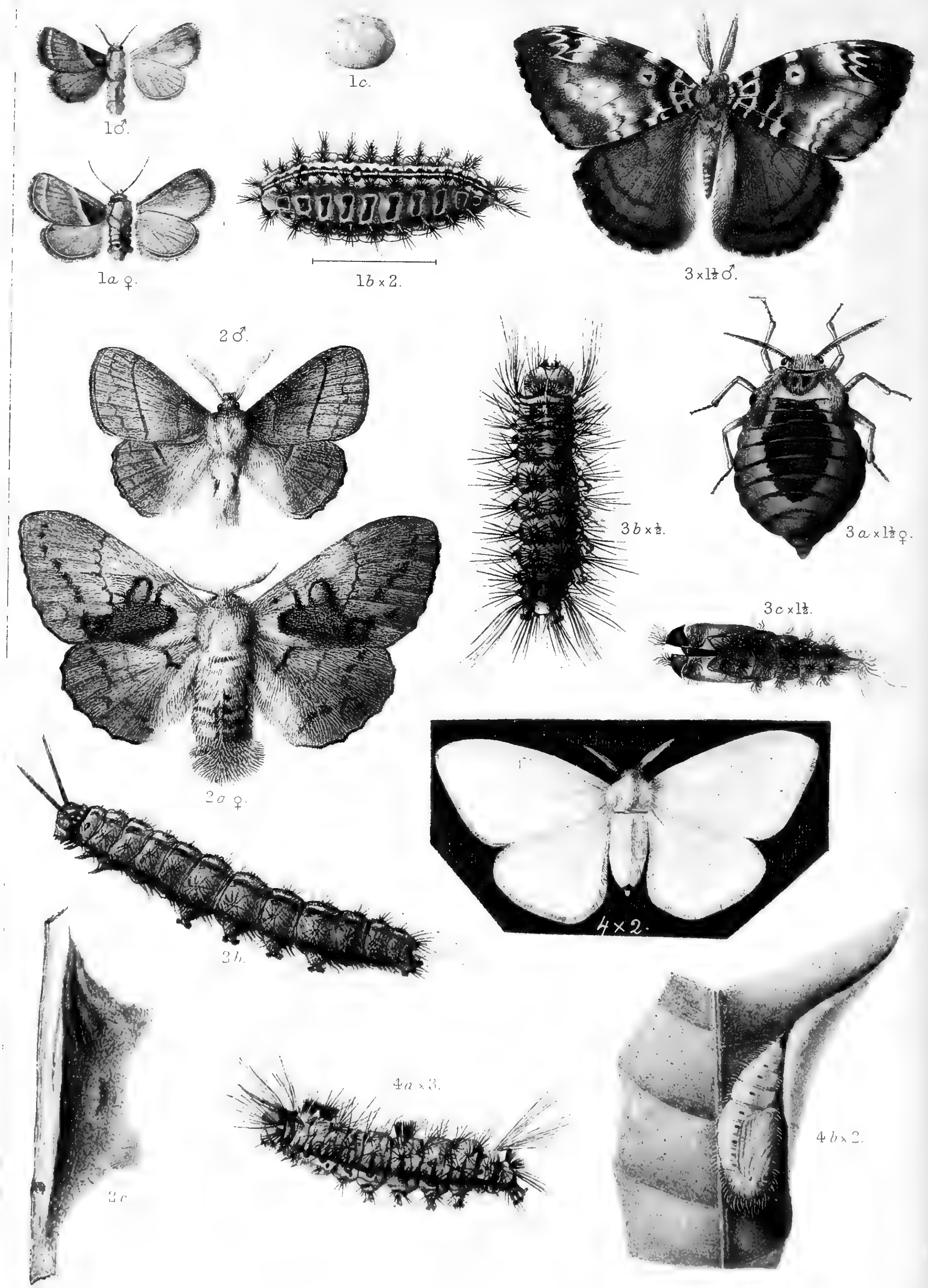

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PLATE XI—

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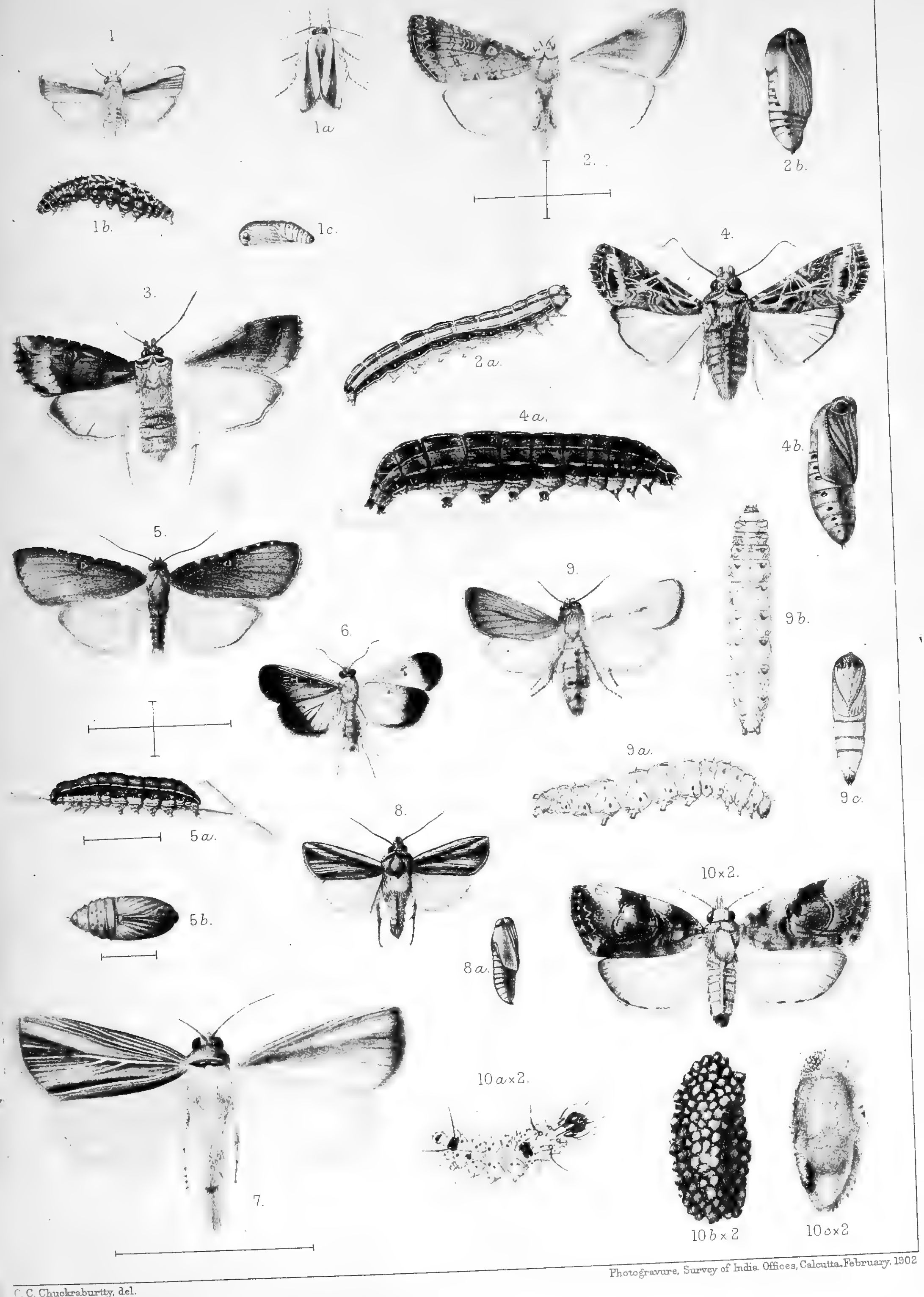
Fig. 1.	THOSEA CANA, Walker, ♂ imago					136
„ 1 *a*.	Do.	do.	do.	♀	do.	
„ 1 *b*.	Do.	do.	do.		larva, lateral view	
„ 1 *c*.	Do.	do.	do.		cocoon	
„ 2.	TRABALA VISHNU, Lefebre ♂ imago					107
„ 2 *a*.	Do.	do.	do.	♀	„	
„ 2 *b*.	Do.	do.	do.		larva	
„ 2 *c*.	Do.	do.	do.		cocoon	
„ 3.	LYMANTRIA AMPLA, Walker, ♂ imago					108
„ 3 *a*.	Do.	do.	do	♀	do.	
„ 3 *b*.	Do.	do.	do.		larva, dorsal view	
„ 3 *c*.	Do.	do.	do.		empty pupa-case	
„ 4.	LEUCOMA (KANCHIA) SUBVITREA, Walker, ♀ imago × 2					108
„ 4*a*.	Do.	do.	do.	do.	larva × 3	
„ 4*b*.	Do.	do.	do.	do.	pupa × 2	

EXPLANATION OF PLATE.

PLATE XII— PAGE.

FIG. 1.	EARIAS FABIA, Stoll, imago	131
" 1 *a*.	Do. do. do. do. at rest	
" 1 *b*.	Do. do. do. larva, lateral view . . .	
" 1 *c*.	Do. do. do. pupa " " . . .	
" 2.	AGROTIS SEGETIS, Schiff, imago × 2	145
" 2 *a*.	Do. do. do. larva × 2	
" 2 *b*.	Do. do, do. pupa, × 2	
" 3.	AGROTIS YPSILON, Rott., imago	184
" 4.	PRODENIA LITTORALIS, Boisduval, imago . . .	131
" 4 *a*.	Do. do. do. larva, lateral view .	
" 4 *b*.	Do. do. do. pupa " .	
" 5.	CARADRINA sp., imago × 2	146
" 5 *a*.	Do. do. larva, lateral view × 2	
" 5 *b*.	Do. do. pupa, ventral view × 2	
" 6.	TATRORHYNCHUS VINCTALIS, Walker, ♂ . . .	159
" 7.	LEUCANIA sp., prox. HOMOPTERANA, Swinhoe, imago × 2	138
" 8.	LEUCANIA sp., imago	138
" 8 *a*.	Do. do. do. pupa, lateral view . . .	
" 9.	NONAGRIA INFERENS, Walker, imago	178
" 9 *a*.	Do.. do. do larva, lateral view . .	
" 9 *b*.	Do. do. do. larva, dorsal view . .	
" 9 *c*.	Do. do. do. pupa, ventral view . . .	
" 10.	PLOTHEIA CELTIS, Moore, imago × 2	108
" 10 *a*.	Do. do. do. larva × 2	
" 10 *b*.	Do. do. do. cocoon, upper half, showing the outside thickly studded with pellets of the frass of the larva × 2	
" 10 *c*.	Do. do. do. cocoon, larva half showing inside, and the ventral side of the pupa × 2	

PLATE XII.



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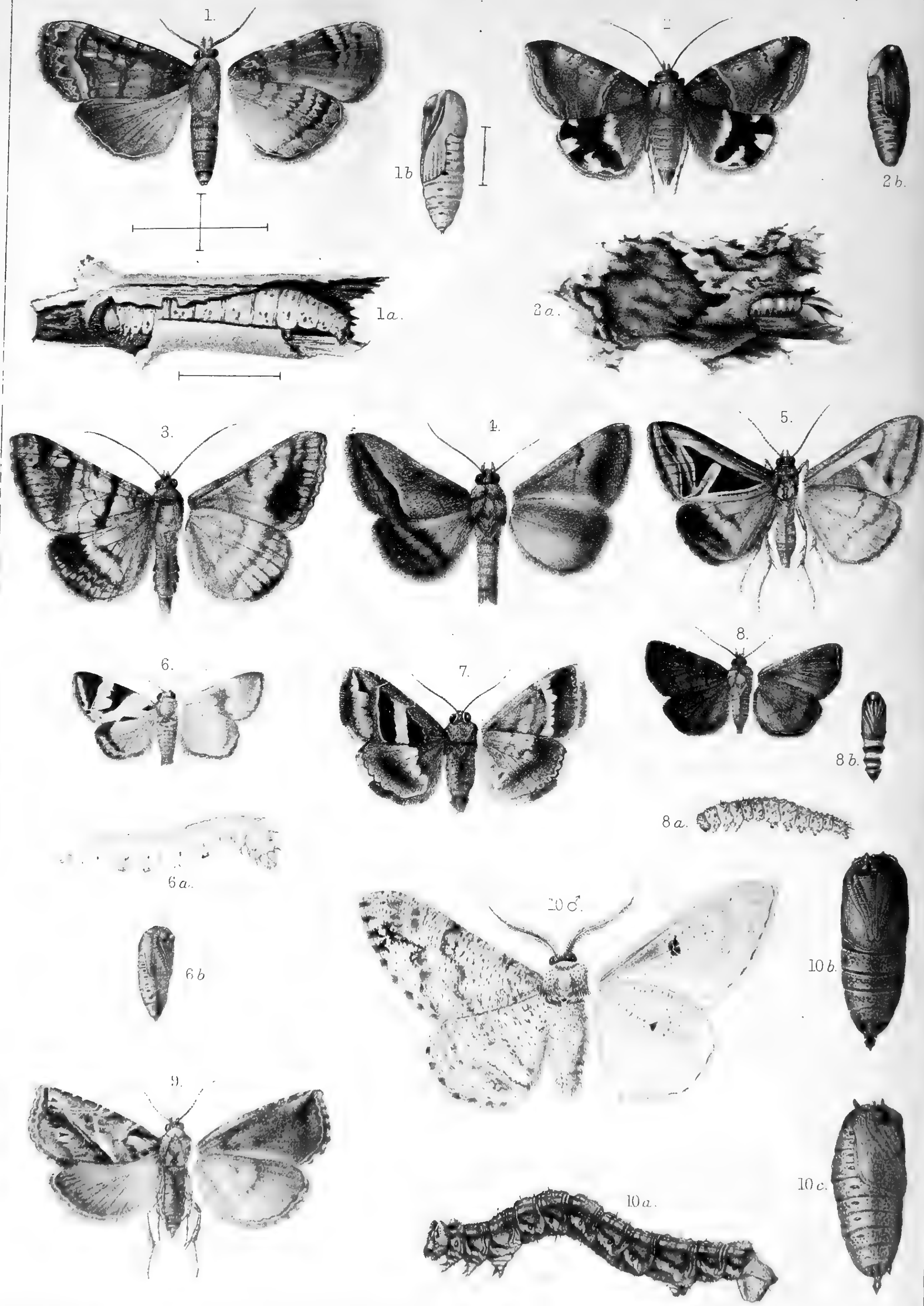

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PLATE XIII—

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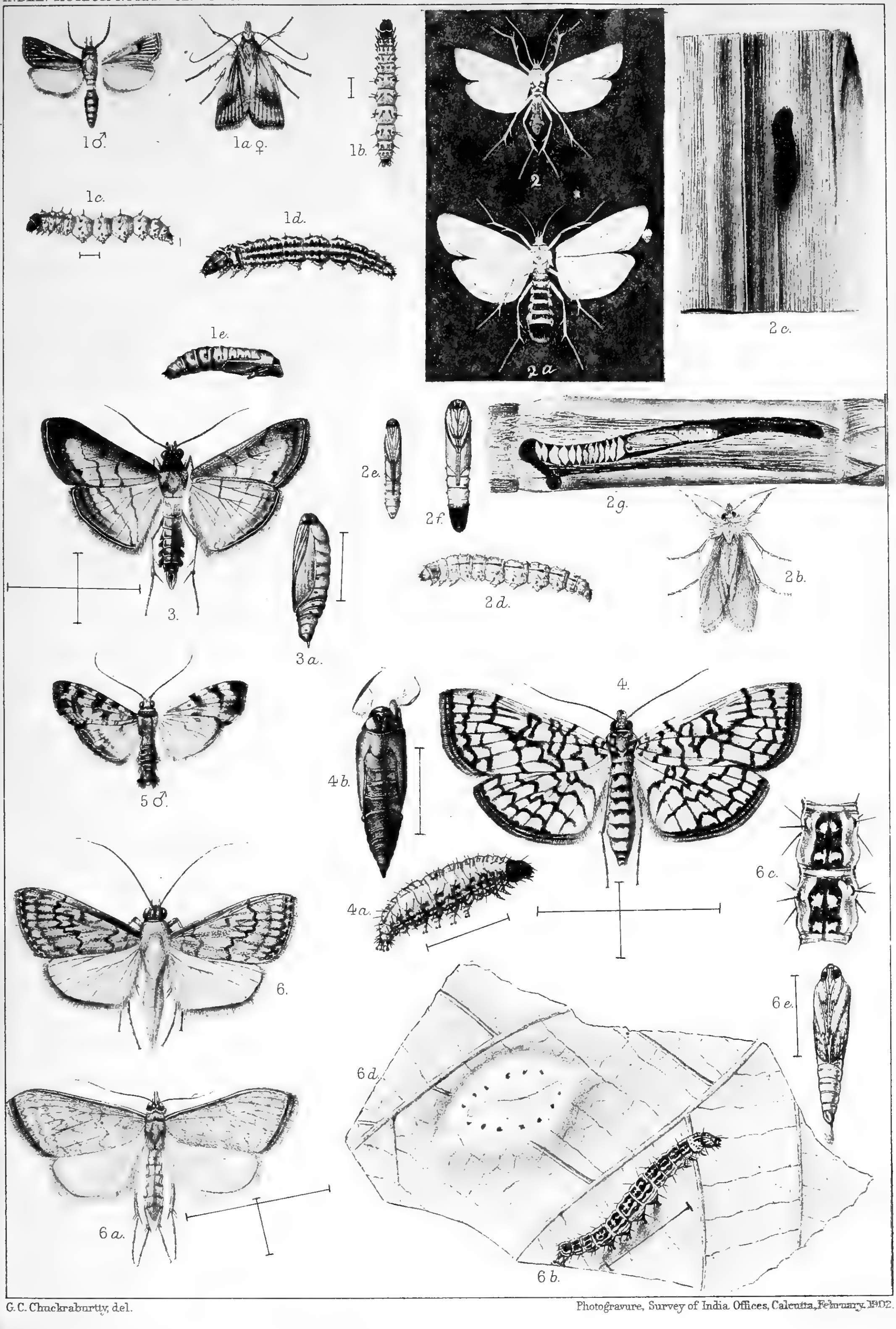
Fig. 1.	Chlumetra transversa,	Walker,		imago enlarged .	125
,, 1 *a*.	Do.	do.	do.	larva enlarged in a mango shoot .	
,, 1 *b*.	Do.	do.	do.	pupa enlarged .	
,, 2.	Ophiusa melicerta,	Drury,		imago	135
,, 2 *a*.	Do.	do.	do.	cocoon, with empty pupa-case projecting therefrom	
,, 2 *b*.	Do.	do.	do.	pupa . . .	
,, 3.	Remigia archesia,	Cramer,		imago	159
,, 4.	Do.	frugalis, Fabricius		. . . .	137
,, 5.	Trigonodes hyppasia,	Cramer		. . . . . .	161
,, 6.	Do.	do.	ino, Drury,	imago . . .	114
,, 6 *a*.	Do.	do.	do. do,	larva, lateral view .	
,, 6 *b*.	Do.	do.	do. do.	pupa, do. .	
,, 7.	Grammodes geometrica,	Fabricius,		imago . . .	139
,, 8.	Raparna nebulosa,	Moore,		imago	162
,, 8 *a*.	Do.	do.		larva, lateral view . .	
,, 8 *b*.	Do.	do.		pupa, ventral view . .	
,, 9.	Hypena sp., prox. mistacalis,	Guenée,		imago × 2 .	163
,, 10.	Biston suppressaria,	Guenée, ♂		. . . . .	185
,, 10 *a*.	Do.	do.		larva, lateral view . .	
,, 10 *b*.	Do.	do.		pupa, ventral view . .	
,, 10 *c*.	Do.	do.	do.	lateral view . .	

EXPLANATION OF PLATE.

PLATE XIV—

				PAGE.
FIG. 1.	CHILO SIMPLEX, Butler,		♂ imago	174
,, 1 *a*.	Do.	do.	♀ do.	
,, 1 *b*.	Do.	do.	young larva dorsal view, much enlarged	
,, 1 *c*.	Do.	do.	young larva lateral view, much enlarged	
,, 1 *d*.	Do.	do.	larva, full fed, lateral view .	
,, 1 *e*.	Do.	do.	pupa, lateral view . .	
,, 2.	SCIRPOPHAGA AURIFLUA, Zeller,		♂	178
,, 2 *a*.	Do.	do.	♀	
,, 2 *b*.	Do.	do.	♀, natural position when at rest . . .	
,, 2 *c*.	Do.	do.	egg mass . . .	
,, 2 *d*.	Do.	do.	larva, lateral view . .	
,, 2 *e*.	Do.	do.	pupa ♂	
,, 2 *f*.	Do.	do.	,, ♀	
,, 2 *g*.	Do.	do.	bored sugarcane with pupa *in situ*	
,, 3.	MARASMA TRAPEZALIS, Guenée,		imago × 2 . . .	143
,, 3.	Do.	do.	pupa, lateral view × 2 .	
,, 4.	SYLEPTA MULTINEALIS, Guenée,		imago × 2 . . .	182
,, 4 *a*.	Do.	do.	larva lateral view × 2	
,, 4 *b*.	Do.	do.	pupa-case, dorsal view × 2	
,, 5.	GLYPHODES NEGATALIS, Walker,		♂ imago . . .	114
,, 6.	PYRAUSTA MACHÆRALIS, Walker,		imago × 2 . .	112
,, 6 *a*.	Do.	do.	do. do	
,, 6 *b*.	Do.	do.	do. larva × 2 . . .	
,, 6 *c*.	Do.	do.	do. larva, dorsal view of two segments, greatly enlarged	
,, 6 *d*.	Do,	do.	do. larva full fed in cocoon before turning to pupa .	
,, 6 *e*.	Do.	do.	pupa, ventral view × 2 .	



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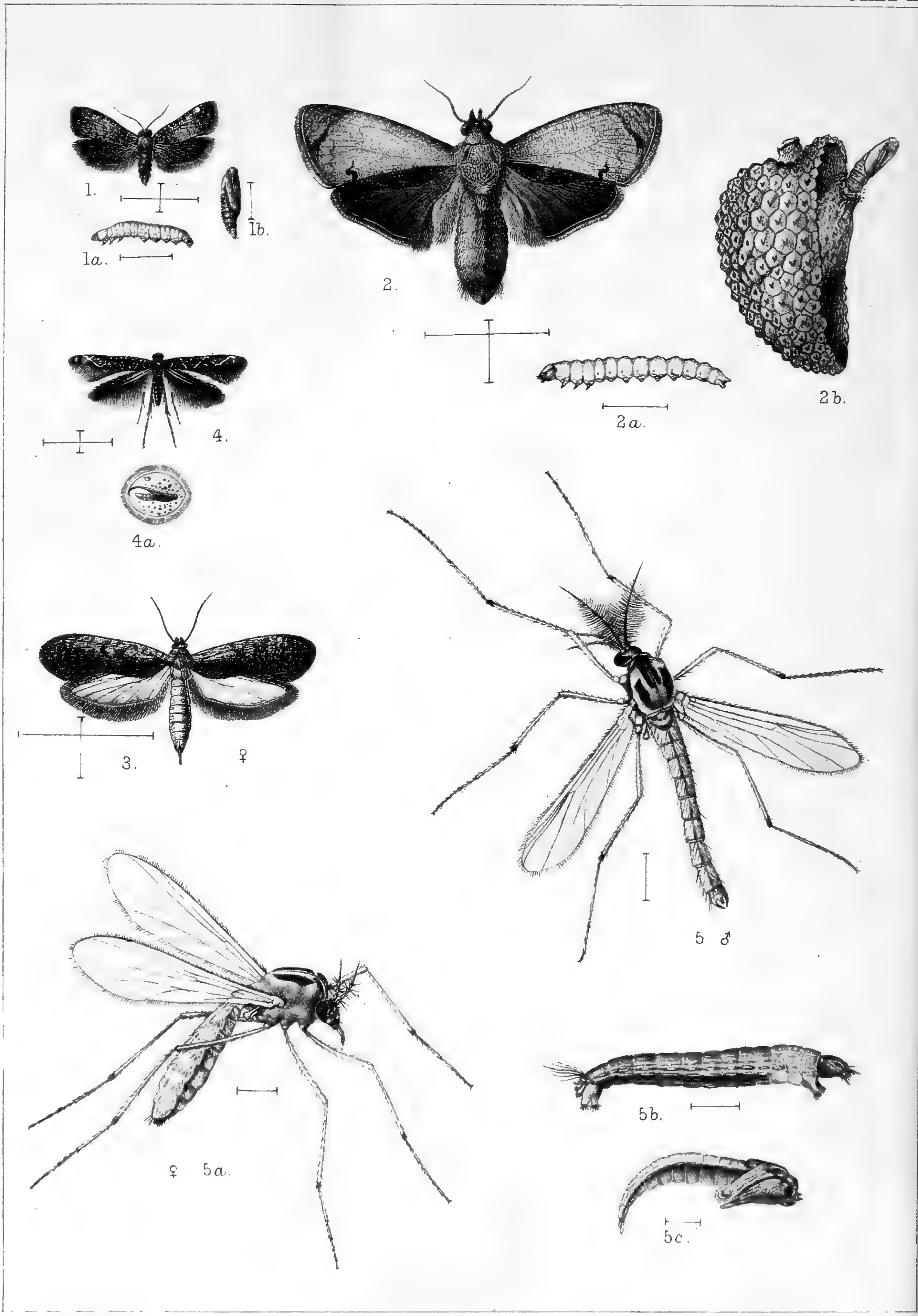

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PLATE XVI—

			Page
FIG. 1.	*Oligotrophus saligneus* n. sp.	♀ imago, dorsal view, much enlarged	115
„ 1 *a*.	ditto ditto	♀ imago, lateral view, much enlarged	
„ 1 *b*.	ditto ditto	front view of head of ♀, much enlarged	
„ 1 *c*.	ditto ditto	antenna of ♂, much enlarged	
„ 1 *d*.	ditto ditto	antenna of ♀, much enlarged	
„ 1 *e*.	ditto ditto	genitalia of ♂, much enlarged	
„ 1 *f*.	ditto ditto	ovipositor of ♀, much enlarged	
„ 1 *g*. „ 1 *h*.	ditto ditto	pupa at different stages, much enlarged	
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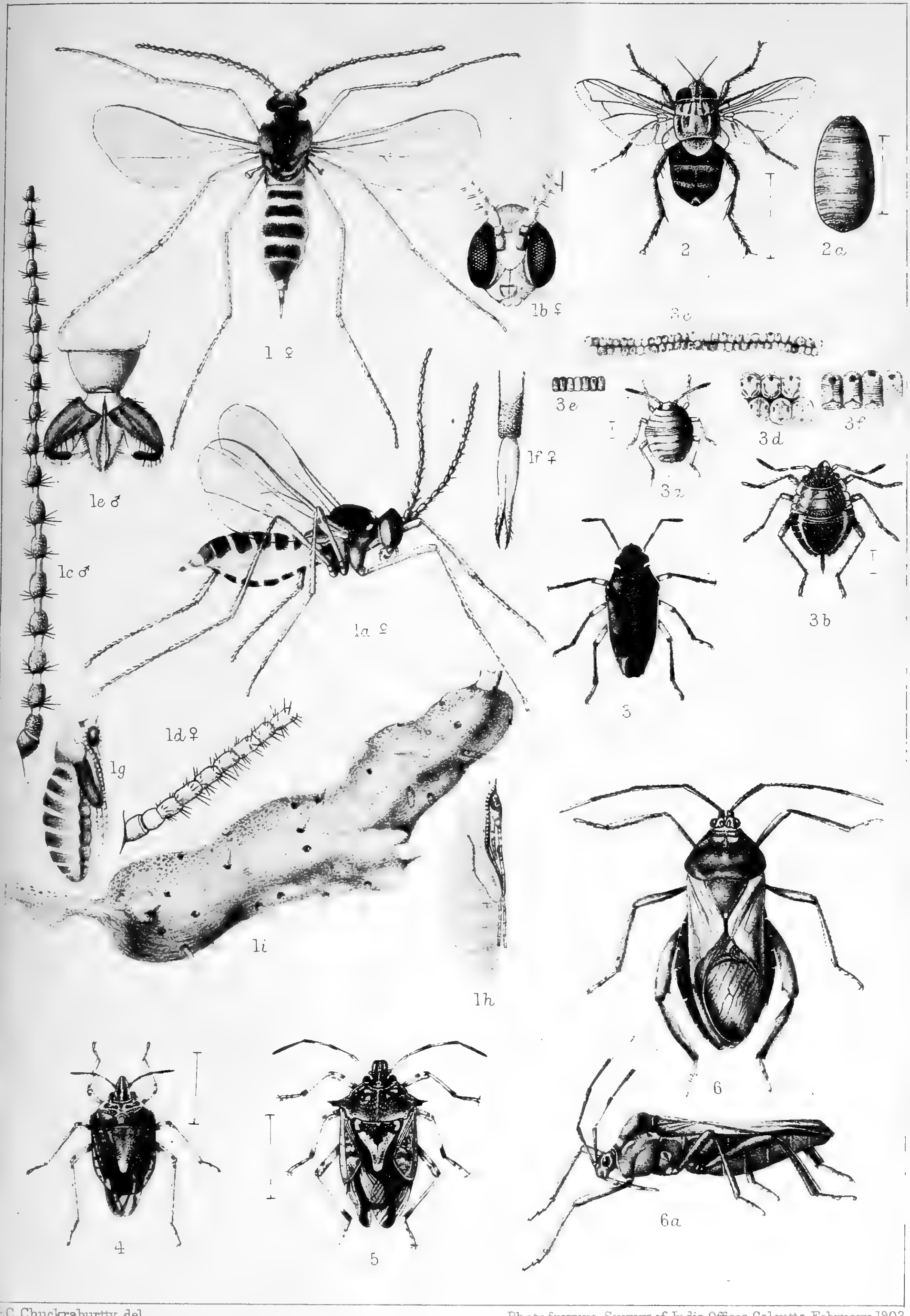

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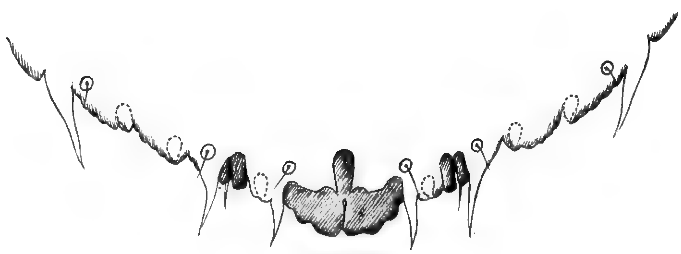

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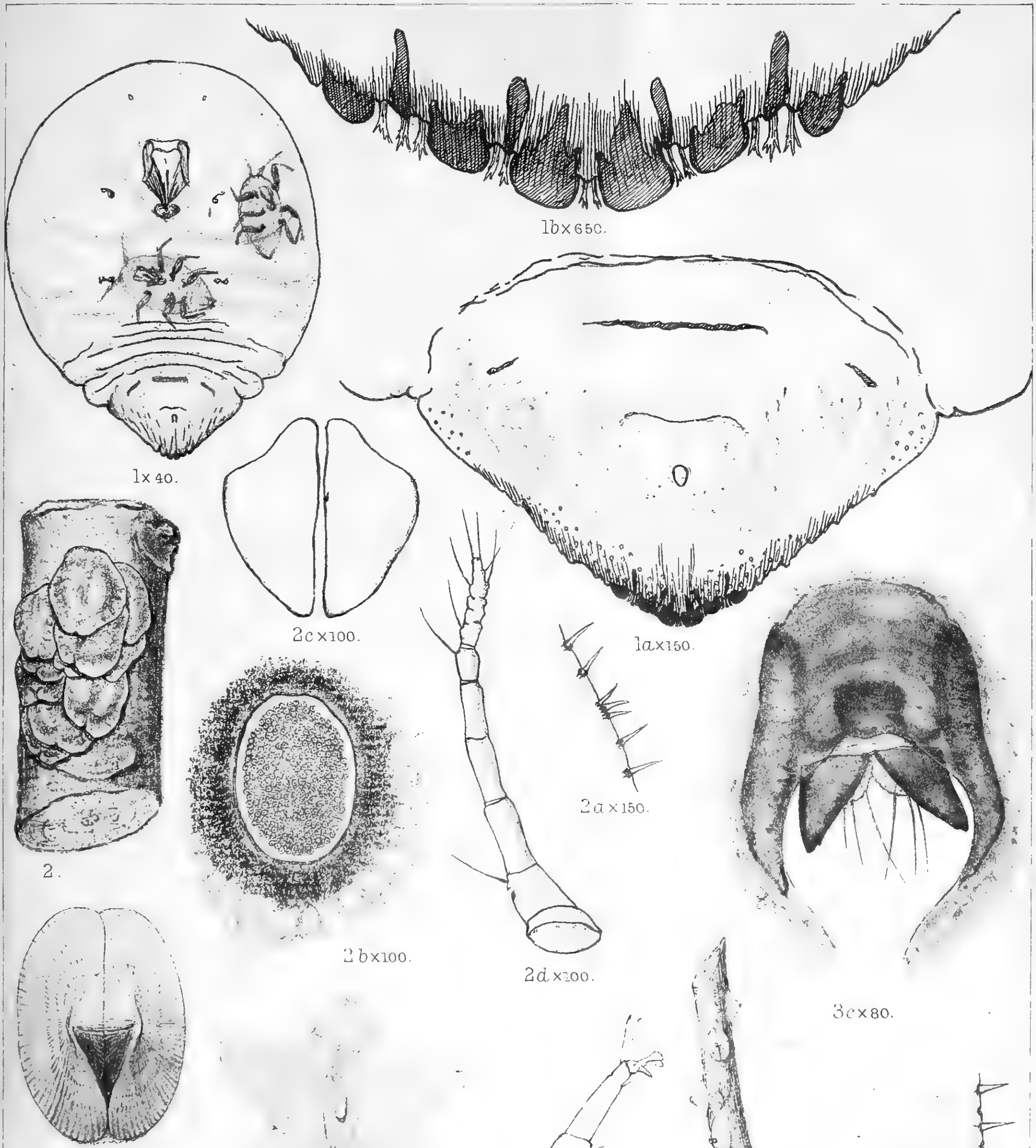
EXPLANATION OF PLATE.

EXPLANATION OF PLATE.



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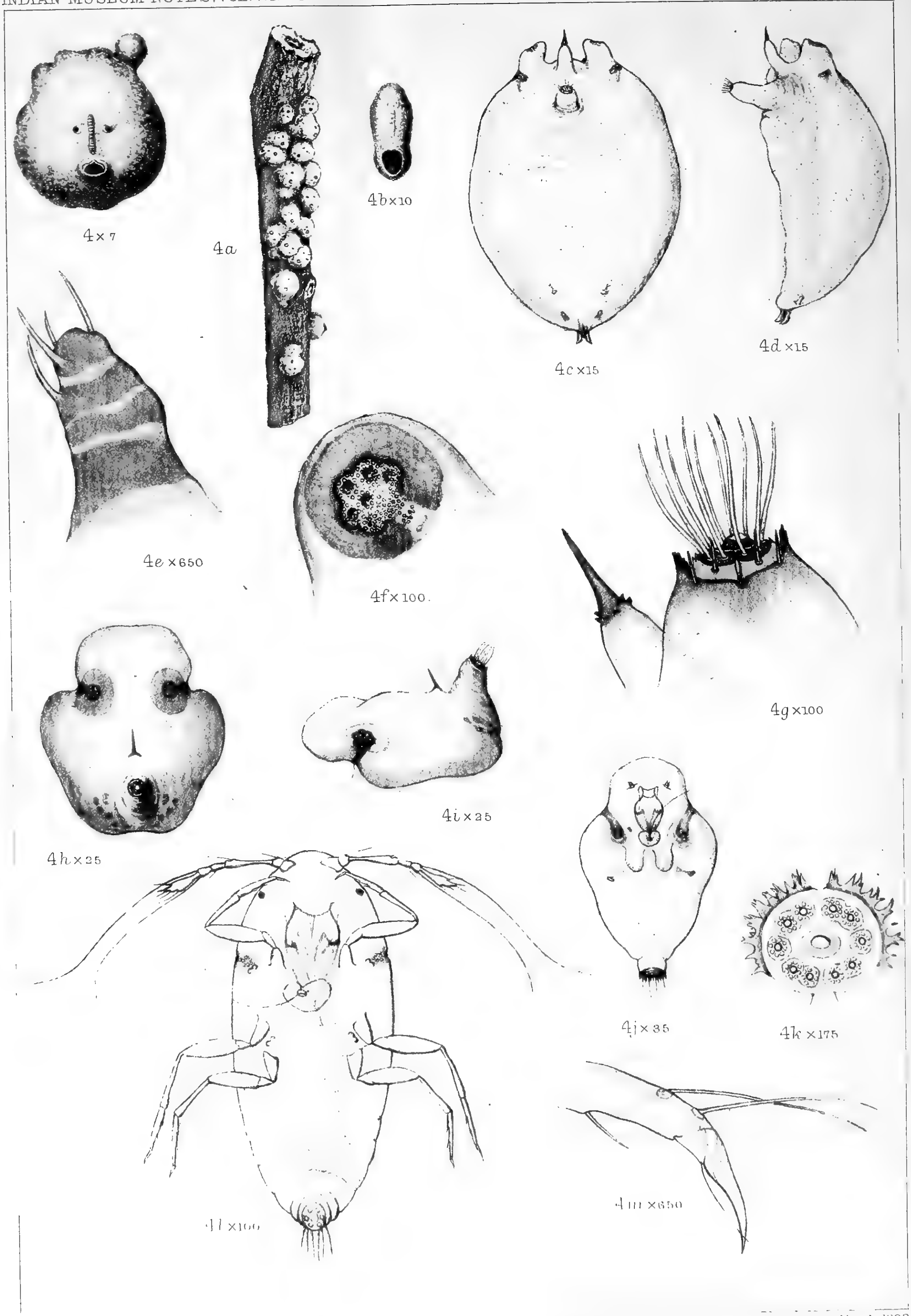

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EXPLANATION OF PLATE.

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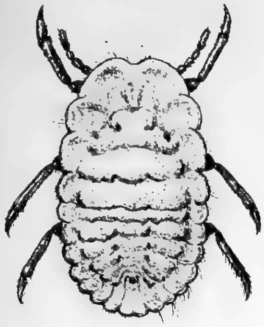

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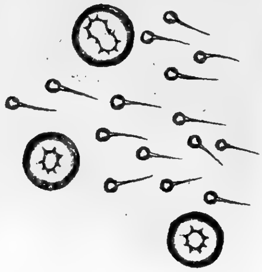
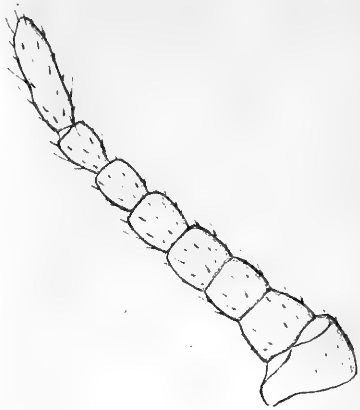
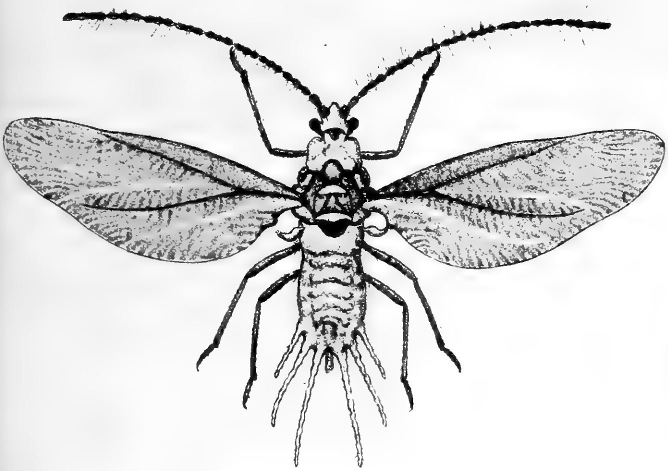


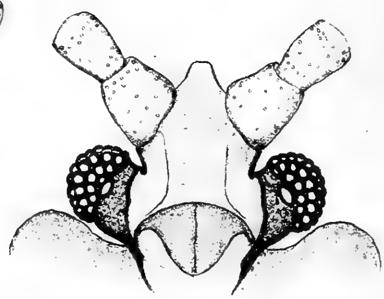
5*a* × 150.



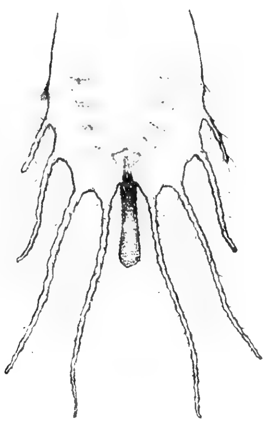
5*b* × 25.



5*c* × 7.



5*d* × 40.



6 × 8.

6*a* × 35.

E. Ernest Green, del.

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INDIAN MUSEUM NOTES.

ISSUED BY THE TRUSTEES.

EDITED BY THE SUPERINTENDENT.

VOLUME V.—NO. 4.

CONTAINING THE TITLE PAGE, PREFACE, TABLE OF CONTENTS, AND INDEX TO THE VOLUME.

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1903.

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,, ,, ,, ,,	V, 1900 to 1903	.	4	4

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PREFACE TO VOLUME V.

THIS number (No. 3) of "Indian Museum Notes" is the first to be issued under the editorship of Mr. Lionel de Nicéville, who has occupied the position of Entomologist since the 19th January 1901, and who takes the entire responsibility for its contents and their manner of arrangement.

The first three volumes of "Indian Museum Notes" were planned and executed by Mr. E. C. Cotes, who was able to devote most of his official hours to the new undertaking. When Mr. Cotes left the Museum the duties of Editor devolved upon the Superintendent, who could, of course, spare only a small portion of his time to work which, though in itself of high importance, must always take a secondary place in the economy of a museum intended for the general public; so that the fourth volume, which was edited by the Superintendent, may quite frankly be confessed to be inferior to its predecessors in compass and ambition.

However, now that an acknowledged specialist, such as Mr. de Nicéville, * holding a position which corresponds with that of State Entomologist, has succeeded to the editorship of "Indian Museum Notes," it is hoped that this publication will take its proper place as a Journal of Economic Entomology, wherein shall be found not only illustrated records of the life-histories of all the insects that affect, whether for ill or good, the various agricultural industries of the country, but also a compendium of the means by which the hurtful species may be brought under some control and their ravages restricted.

Such a consummation, however, is beyond the powers of a single man however experienced and however energetic: it can only be attained by the sustained co-operation of planters and district officials throughout the country. But this co-operation must be intelligent and real. For instance, desultory consignments of dead caterpillars and grubs are, at present, of no help to us. If living caterpillars cannot be sent, then some of them should be kept in confinement at the place where they are giving trouble and the resulting chrysalids should be sent: or, if there be any doubt about the vital powers of the chrysalids, these should be kept until the

* Since this note was printed, we have had to lament the death of Mr. de Nicéville. He died on the 3rd December 1901, of fever contracted in the Darjeeling Terai, where he had gone to study the life-history of the mosquito-blight. Dying practically in harness, with much enduring good work accomplished, it may be said of him, as of Tellus the Athenian,

"τελευτὴ του βίου λαμπροτάτη ἐπεγένετο."

perfect insects emerge from them. Again, when the Entomologist suggests a remedy against the ravages of any insect, the correspondent should endeavour to return, for record, some account of its effects, whether they are successful or not.

A. ALCOCK, MAJOR, I.M.S.,
Superintendent,
Indian Museum.

The above preface was written by Major Alcock and appeared with No. 3 of this volume, the first number, as it was regrettably the last, to be drawn up and edited by the late Mr. L. de Nicéville. It will be seen that the note was intended to be a preface both to No. 3 and Volume V.

The original papers in the volume include two by Mr. G. B. Buckton, F.R.S., describing a new species of *Psylla* and a new species of *Aleurodes;* five by Mr. E. Ernest Green, F.E.S., Government Entomologist, Ceylon, three of which are important papers on Indian Scale Insects (Coccidæ); one by Herr E. Brenske describing two new Melolonthids; a paper by Mr. W. H. Ashmead describing a new species of *Pireninæ;* and finally one by Mr. J. Hartley Durrant describing a new genus of Tineid Moths. To all these well-known authorities our sincerest thanks are due as they are also to Sir George Hampson, *Bart.*, Mons. Desbroches de Loges, Mr. Distant, Mons. P. Lesné, Mr. C. O. Waterhouse, F.E.S., Mr. R. S. Newstead, and others for their kind help in identification work.

The miscellaneous Notes on Insect Pests in No. 1 were drawn up by the late Mr. Barlow and those in No. 2 by Mr. Peal, who replaced Mr. Barlow as Entomological Assistant, both under the immediate supervision of the Superintendent.

E. P. STEBBING, I.F.S.,
Officiating Superintendent,
Indian Museum.

31st March 1903.

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